Awel y Môr Offshore Wind Farm

Category 6: Environmental Statement

Volume 4, Annex 9.1: Navigation Risk Assessment

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Awel y Môr

Navigational Risk Assessment

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Revision Number	Date	Summary of Change
0.1	31/05/2021	First draft of full PEIR NRA.
0.2	17/06/2021	Updates following GoBe review.
1.1	12/07/2021	Updates following RWE review.
1.2	05/08/2021	Final Version for PEIR.
1.3	28/01/2022	ES stage first draft.
1.4	03/03/2022	Additional ES updates.
2.1	17/03/2022	Additional internal updates.
2.2	04/04/2022	Final ES version.

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Abbreviations Table

Abbreviation	Definition
µPa	Micropascals
AC	Alternating Current
AIS	Automatic Identification System
ALARP	As Low as Reasonably Practical
ALB	All-Weather Lifeboat
ARPA	Automatic Radar Plotting Aid
AtoN	Aid to Navigation
AyM	Awel y Môr
BEIS	Department for Business, Energy and Industrial Strategy
BMAPA	British Marine Aggregate Producers Association
BSU	Federal Bureau of Maritime Casualty Investigation
CA	Cruising Association
CAA	Civil Aviation Authority
CBA	Cost Benefit Analysis
CBRA	Cable Burial Risk Assessment
CCTV	Closed Circuit Television
CHIRP	Confidential Human Factors Incident Reporting Programme
COLREGs	Convention on International Regulations for Preventing Collisions at Sea
CoS	Chamber of Shipping
CRO	Coastguard Rescue Officers
CRT	Coastguard Rescue Teams
CTV	Crew Transfer Vessel
dB	Decibels
DC	Direct Current
DCO	Development Consent Order
DDDMM	Degree Decimal Minutes
DF	Direction Finding
DfT	Department for Transport

Abbreviation	Definition
DSC	Digital Selective Calling
ECC	Export Cable Corridor
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EMF	Electromagnetic Field
ERCoP	Emergency Response Co-operation Plans
ES	Environmental Statement
FSA	Formal Safety Assessment
GLA	General Lighthouse Authority
GPS	Global Positioning System
GRP	Glass Reinforced Plastic
GT	Gross Tonnage
GyM	Gwynt y Môr
HAT	Highest Astronomical Tide
HDD	Horizontal Directional Drilling
HMCG	Her Majesty's Coastguard
IA	Inter-Array
IALA	International Association of Marine Aids to Navigation and Lighthouse Authorities
IHO	International Hydrographic Organization
ILB	Inshore Lifeboats
IMCA	International Marine Contractors Association
IMO	International Maritime Organization
kHz	Kilohertz
Km	Kilometres
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

Abbreviation	Definition
MHWS	Mean High Water Springs
MMSI	Mobile Maritime Service Identity
MoD	Ministry of Defence
MRCC	Maritime Rescue Coordination Centre
MSI	Maritime Safety Information
MW	Megawatts
NAVTEX	Navigational Telex
NM	Nautical Mile
NRA	Navigational Risk Assessment
NSIP	Nationally Significant Infrastructure Projects
O&G	Oil and Gas
O&M	Operations and Maintenance
OOW	Officer of the Watch
OREI	Offshore Renewable Energy Installation
OSP	Offshore Substation Platform
OWF	Offshore Wind Farm
PEIR	Preliminary Environmental Information Report
QHSE	Quality, Health, Safety and Environment
RNLI	Royal National Lifeboat Institution
RYA	Royal Yachting Association
SAR	Search and Rescue
SLoO	Single Line of Orientation
SMS	Safety Management System
SONAR	Sound Navigation Ranging
SoS	Secretary of State
SOV	Service Operations Vessel
SWH	Significant Wave Height
TSC	Territorial Seas Committee
TSS	Traffic Separation Scheme
UK	United Kingdom

Abbreviation	Definition
UK JRCC	UK Joint Rescue Coordination Centre
UKHO	United Kingdom Hydrographic Office
VHF	Very High Frequency
VTS	Vessel Traffic Service
WGS84	World Geodetic System 1984
WTG	Wind Turbine Generator

Glossary of Terms

Term	Definition
AyM	The Project.
Array	The area where the wind turbines will be located.
Development Consent Order	An order made under the Planning Act 2008 granting development consent for a Nationally Significant Infrastructure Project (NSIP) from the Secretary of State (SoS) for Business, Energy and Industrial Strategy (BEIS).
Environmental Statement (ES)	The documents that collate the processes and results of the Environmental Impact Assessment (EIA).
Impact	An impact to the receiving environment is defined as any change to its baseline condition, either adverse or beneficial, resulting from the activities associated with the construction, operation and maintenance, or decommissioning of the project.
Maximum Design Scenario (MDS)	The maximum design parameters of the combined project assets that result in the greatest potential for change in relation to each impact assessed.
Mitigation	Mitigation measures, or commitments, are commitments made by the project to reduce and/or eliminate the potential for significant effects to arise as a result of the project. Mitigation measures can be embedded (part of the project design) or secondarily added to reduce impacts in the case of potentially significant effects.
PEIR	Preliminary Environmental Information Report. The PEIR is written in the style of a draft Environmental Statement (ES) and forms the basis of statutory consultation. Following that consultation, the PEIR documentation will be updated into the final ES that will accompany the applications for the Development Consent Order (DCO) and Marine Licence.

1 Introduction

1.1 Background

1. Anatec was commissioned by Awel y Môr Offshore Wind Farm Limited (hereafter referred to as the Applicant) to undertake a Navigational Risk Assessment (NRA) for the proposed Awel y Môr Offshore Wind Farm (AyM). The NRA presents information on AyM relative to the existing and estimated future navigational activity and forms the technical appendix to Volume 2, Chapter 9: Shipping and Navigation of the Environmental Statement (ES) (application ref: 6.2.9).

1.2 Navigational Risk Assessment

2. An Environmental Impact Assessment (EIA) is a process which identifies the environmental effects of a proposed development, both negative and positive. An important element / requirement of the EIA for offshore projects is the NRA. Following the relevant Maritime and Coastguard Agency (MCA) guidance (see Section 2) the NRA will include:

- 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 AyM description relevant to shipping and navigation;
- Baseline characterisation of the existing environment including:
    - Key navigational features;
    - Meteorological and oceanographic conditions;
    - Vessel traffic movements;
    - Emergency response resources; and
    - Historical maritime incidents.
- Discussions of potential hazardss on navigation, communication and position fixing equipment;
- Cumulative and transboundary overview;
- Future case vessel traffic characterisation;
- Collision and allision risk modelling;
- Hazard identification;
- Outline of embedded environmental measures; and
- Outline of through life safety management features.

3. The NRA aims to screen the potential hazards and determine which should be taken forward to the impact assessment undertaken in Volume 2, Chapter 9: Shipping and Navigation (application ref: 6.2.9). Potential hazards are considered for the construction, operations and maintenance (O&M), and decommissioning phases.

2 Guidance and Legislation

2.1 Legislation and Policy

4. 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, Department for Environment and Climate Change (DECC), 2011), which is summarised in Volume 2, Chapter 9: Shipping and Navigation (application ref: 6.2.9). This includes consideration of the draft EN-3 updates which are currently being consulted on.

2.2 Primary Guidance

5. As of April 2021, the primary guidance required to be considered for an NRA undertaken for a United Kingdom (UK) Offshore Renewable Energy Installation (OREI) is the MCA 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 (MCA, 2021).

6. 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).

7. The MCA require that their methodology be used as a template for preparing NRAs, which is set out within Annex 1 of MGN 654. 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). Both Volume 2, Chapter 9: Shipping and Navigation (application ref: 6.2.9) and the NRA identify base case and future case levels of risk, and assess what measures are required to ensure the future case remains broadly acceptable or at most tolerable with mitigation.

8. This NRA is fully compliant with MGN 654 and its annexes including the required MCA Methodology for Assessing the Marine Navigational Safety & Emergency Response Risks of OREI. This is demonstrated by the completed MGN 654 checklist presented in Appendix A.

9. In line with industry standard approach for marine risk assessment and as required under MGN 654, the International Maritime Organization (IMO) Formal Safety Assessment (FSA) approach has been used for risk assessment. Further detail on the use of the IMO FSA process is included within Section 3.1 and 3.2.

10. On this basis the primary guidance documents used to inform the NRA are the following:

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

2.3 Other Guidance

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

- MGN 372 (Merchant and Fishing) OREIs: Guidance to Mariners Operating in the Vicinity of UK OREIs (MCA, 2008);
- International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) Recommendations R139 on The Marking of Man-Made Offshore Structures (IALA, 2021) and Guidance G1162 on The Marking of Man-Made Offshore Structures (IALA, 2021);
- The Royal Yachting Association's (RYA's) Position on Offshore Renewable Energy Developments: Paper 1 (of 4) – Wind Energy (RYA, 2019); and
- Standard Marking Schedule for Offshore Installations (DECC, 2011).

3 Navigation Risk Assessment Methodology

3.1 Formal Safety Assessment Methodology

12. A shipping and navigation user can only be affected by a hazard if there is a pathway through which a hazard can be transmitted between the source activity and the user. In cases where a user is exposed to a hazard, the overall severity of consequence to the user is determined. This process incorporates a degree of subjectivity, and therefore multiple assessment criteria are considered for shipping and navigation users including:

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

13. 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 (i.e., where gear is not deployed). A separate methodology and assessment have been applied in Volume 2, Chapter 8: Commercial Fisheries (application ref: 6.2.8) to consider hazards which are directly related to commercial fishing activity (as opposed to commercial fishing vessels in transit) including impacts of a commercial nature.

3.2 Formal Safety Assessment Process

14. In line with standard approach to marine risk assessment, the IMO FSA process (IMO, 2018) as approved by the IMO in 2018 under Maritime Safety Committee – Marine Environment Protection Committee (MEPC).2/circ.12/Rev.2 will be applied to the risk assessment within this NRA and Volume 9, Chapter 2: Shipping and Navigation (application ref: 6.2.9).

15. The FSA process is a structured and systematic methodology based upon risk analysis and Cost Benefit Analysis (CBA) (if applicable) to reduce hazards 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 analysis (investigation of the causes and initiating events and consequences of the more important hazards identified in Step 1);
- Step 3 – Risk control options (identification of measures to control and reduce the identified hazards);

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

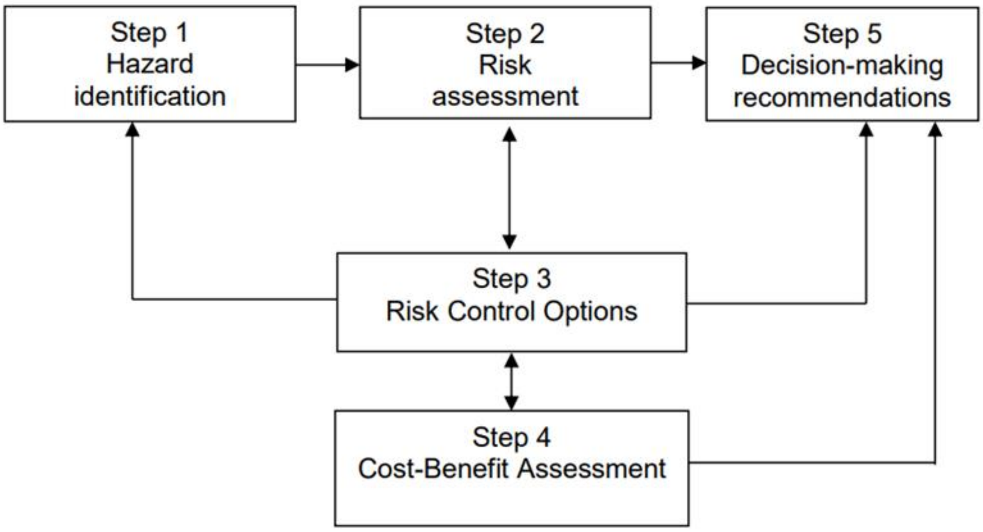


Figure 3.1: Flow Chart of the FSA Methodology (IMO, 2018)

16. It is noted that impacts of a commercial nature are considered outside the remit of the NRA (which is focussed primarily on hazards associated with navigational safety) but have been considered in the FSA where appropriate.

3.3 Hazard Workshop Methodology

17. A standard and key tool used in the NRA process is the Hazard Workshop which ensures that all risks are identified and 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 hazards within the Hazard Log (see Appendix E), which has been completed based upon the outputs of the Hazard Workshop.

Table 3.1: Severity of Consequence

Rank	Description	Definition			
		People	Property	Environment	Business
1	Negligible	No perceptible risk.	No perceptible risk.	No perceptible risk.	No perceptible risk.
2	Minor	Slight injury(s).	Minor damage to property i.e., superficial damage.	Tier 1 local assistance required.	Minor reputation risks – limited to users.

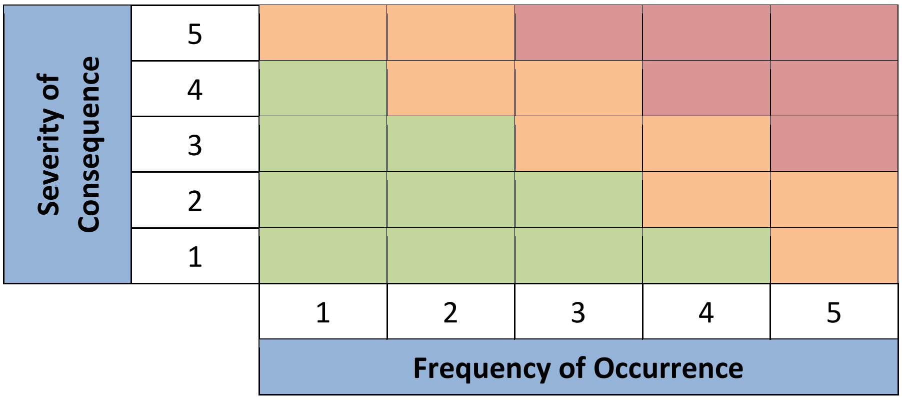
Rank	Description	Definition			
		People	**Property**	**Environment**	**Business**
3	Moderate	Multiple minor or single serious injury.	Damage not critical to operations.	Tier 2 limited external assistance required.	Local reputation risks.
4	Serious	Multiple serious injury or single fatality.	Damage resulting in critical risk to operations.	Tier 2 regional assistance required.	National reputation risks.
5	Major	More than one fatality.	Total loss of property.	Tier 3 national assistance required.	International reputation risks.

Table 3.2: Frequency of Occurrence

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

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

Table 3.3: Tolerability Matrix and Risk Rankings



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

19. Once identified, the tolerability of a hazard will be assessed to ensure it is ALARP. Further risk control measures may be required to further mitigate a hazard in accordance with the ALARP principles, noting that unacceptable risks are not considered to be ALARP.

3.4 Methodology for Assessing Cumulative Effects

20. All hazards identified and assessed within the FSA process are also assessed for potential cumulative effects taking into account other cumulative developments. Given the varying status and location of developments, and noting the unique nature of shipping and navigation, a tiered approach specific to shipping and navigation has been utilised (overarching methodology is discussed in Volume 1, Annex 3.1: Cumulative Effects Assessment (application ref: 6.1.3.1)).

21. The tiered approach for shipping and navigation considers the following criteria:

- Project status;
- Proximity to AyM (a maximum extent of 100 nautical miles (NM) has been considered);
- Likely level of cumulative effect; and
- Data confidence.

22. The tiers utilised are summarised in Table 3.4, which includes the precise criteria required for a development to be placed within each tier. Projects within tiers 1-3 have then been assessed as part of the cumulative routeing scenario (see Section 15). Tier 4 projects have not been considered given the uncertainty in the project progression and / or distance from the array.

23. It is noted that any operational[1] developments (including Oil and Gas (O&G) assets) are considered baseline (see Section 9.3).

[1] Operational as of time of writing – 11/06/2021

Table 3.4: Cumulative Tier Summary

Tier	Minimum Project Status	Definition	Minimum Data Confidence	Assessment Approach
1	Operational, under construction, consented or under determination	▪ May impact a main route identified as passing within the array or within 1NM of the array. ▪ OREI within 50NM of the array.	Medium	Quantitative cumulative re-routeing of main routes
2	Operational, under construction, consented or under determination	▪ May impact a main route identified as passing within the array or within 1NM of the array. ▪ OREI between 50NM and 100NM from the array.	Medium	Quantitative cumulative re-routeing of main routes
3	Pre Scoping	▪ May impact a main route identified as passing within the array or within 1NM of the array. ▪ OREI Within 100NM of the array.	Low	Qualitative assumptions of routeing only
4	Pre Scoping	▪ Further than 100NM from the array.	Low	Not considered (screened out)

3.5 Assumptions

24. The shipping and navigation baseline and hazard identification within the NRA and subsequent assessment in Volume 2, Chapter 9: Shipping and Navigation (application ref: 6.2.9) has been undertaken based upon the information available and responses received at the time of preparation. It was assessed based upon a conservative scenario, in particular noting that the locations of structures will not be finalised until post consent.

25. Limitations of the data sources considered are discussed in detail in Section 7.4.

4 Consultation

26. This section sets out the consultation undertaken to date of relevance to shipping and navigation for AyM as part of the NRA process. This process has considered consultation requirements and recommendations within the MCA Methodology under MGN 654 (MCA, 2021), and includes:

- Outputs of Scoping Opinion;
- Responses received to the PEIR under Section 42;
- Dedicated stakeholder meetings and correspondence;
- Regular operator outreach; and
- Hazard Workshop.

4.1 Scoping Opinion

27. The Applicant submitted a Scoping Report in June 2020, with the Planning Inspectorate releasing a subsequent Scoping Opinion in August 2020. Outputs of relevance to the NRA are summarised in Table 4.1, including reference to where each point is addressed within the NRA or ES.

Table 4.1: Scoping Opinion Summary

Consultee(s)	Key Points Raised	Where Addressed
The Planning Inspectorate	The Inspectorate notes the intention to assess marine traffic within the refined offshore ECR search area using Automatic Identification Survey (AIS) only. Noting the statement in paragraph 639 about the use of AIS data and the likely under-representation of some types of vessel, the Inspectorate advises that the Applicant makes efforts to agree the approach to the NRA with relevant consultation bodies. The outcomes of the NRA and other relevant technical documents relied upon in the ES should be readily accessible with appropriate cross reference to supporting information/appendices.	▪ Data sources assessed have been discussed with relevant stakeholders including the MCA and Trinity House (see Section 4.2) and include means by which non AIS traffic is accounted for (see Section 7).

Consultee(s)	Key Points Raised	Where Addressed
The Planning Inspectorate	The guidance and the methodology used in the ES should be clearly explained to support understanding as to how predictions have been made in the assessment. The Applicant should make use of information sources to establish future traffic baselines the assessment.	▪ Guidance considered is provided in Section 2; ▪ NRA Methodology is provided in Section 3; ▪ Data sources assessed are provided in Section 7 and have been discussed with relevant stakeholders including the MCA and Trinity House (see Section 4.2).
The Planning Inspectorate	The Applicant's attention is drawn to the advice from Trinity House to ensure that any structures such as met masts which would be placed outside the array are included in the assessment of effects. If cable protection is likely to be required then the assessment should use a worst-case scenario based on the maximum extent of cable protection expected to be used.	▪ The potential for an isolated Met Mast has been included within the quantitative risk modelling in Section 17, and associated hazards assessed in Volume 2, Chapter 9: Shipping and Navigation (application ref: 6.2.9). ▪ Cable protection height assumed is detailed in Sections 6.3.1 and 6.3.2.
The Planning Inspectorate	The advice from Trinity House identifies a potential need for additional measures such as buoys. The ES should provide full details of the mitigation measures relied on in the assessment of effects and identify if/how these have been agreed with the relevant stakeholders.	▪ Mitigation measures are discussed in Section 19, noting that this includes lighting and marking in agreement with Trinity House.

Consultee(s)	Key Points Raised	Where Addressed
Isle of Man Government	Any significant risk of interference with navigation is of concern to the Territorial Seas Committee (TSC) as the island is heavily reliant on a high quality marine transport system for goods, services and passengers. The proposed extension is in close proximity to the bad weather route used by the Isle of Man Steam Packet which operates a fast craft on this route from Douglas to Liverpool and at the height of the season, it operates a twice daily return service. This may not have been picked up as part of your data collection in July unless bad weather forced the use of this route, and again in December, the fast craft does not operate. It is acknowledged that it is difficult to accurately plot such routes and given the requirements to alter course given bad weather conditions, it would be appreciated if such requirements could be considered as to the placement of the turbines to allow sufficient distance between to safely permit ships in bad weather conditions.	▪ Adverse weather routeing is considered in Section 13.4.3, with associated impact assessment undertaken in Volume 2, Chapter 9: Shipping and Navigation (application ref: 6.2.9). ▪ Long term data spanning 2019 has been assessed to ensure seasonal variation is captured (see Appendix B).
Isle of Man Government	The TSC seeks confirmation that the Isle of Man Steam Packet Company has been engaged and identified as a commercial ferry operator.	▪ Isle of Man Steam Packet were consulted as part of the regular operators consultation, the outputs of which are presented in Section 4.4. Noted that Isle of Man Steam Packet have confirmed they are content with the array boundary as per Section 4.2.

Consultee(s)	Key Points Raised	Where Addressed
MCA	The EIA Report should supply detail on the possible impact on navigational issues for both commercial and recreational craft, specifically: ▪ Collision Risk ▪ Navigational Safety ▪ Visual intrusion and noise ▪ Risk Management and Emergency response ▪ Marking and lighting of site and information to mariners ▪ Effect on small craft navigational and communication equipment ▪ The risk to drifting recreational craft in adverse weather or tidal conditions ▪ The likely squeeze of small craft into the routes of larger commercial vessels.	▪ Collision risk is considered quantitatively within Section 17; ▪ Hazards associated with Navigational Safety are considered within this NRA and in Volume 2, Chapter 9: Shipping and Navigation (application ref: 6.2.9); ▪ Visual intrusion and noise are considered within Section 14; ▪ Lighting and marking and promulgation of information are considered embedded mitigation (see Section 19); ▪ Effects on navigation and communication equipment is considered in Section 14; ▪ Risk of drifting recreational vessels is assessed within Volume 2, Chapter 9: Shipping and Navigation (application ref: 6.2.9); and ▪ Displacement of small craft including potential for interaction with larger vessels has been assessed within Volume 2, Chapter 9: Shipping and Navigation (application ref: 6.2.9).

Consultee(s)	Key Points Raised	Where Addressed
MCA	An NRA will need to be submitted in accordance with MGN 543 and the MCA's Methodology for Assessing the Marine Navigation Safety & Emergency Response Risks of OREI. Both documents are currently being reviewed and have already been through a consultation period with stakeholders. It is intended to carry out a second consultation within the next month and whilst the main themes of the guidance remain the same, we would advise the applicant to make themselves aware of the amendments. It is intended to publish new versions later this year and all advice provided to the applicant will be consistent with the new guidance documents. The NRA should be accompanied by a detailed MGN Checklist	▪ This NRA is compliant with MGN 654 (active relevant MCA guidance at the time of writing) as per Section 2; and ▪ An MGN checklist is provided in Appendix A.
MCA	The development area is located adjacent to a significant amount of traffic to major ports, with a Traffic Separation Scheme (TSS) in close proximity, and attention needs to be paid to routing, particularly for pilotage operations where there is a pilot boarding station to the west of the site. The likely cumulative and in combination effects on shipping routes should also be considered, the impact on navigable sea room and include an appropriate assessment of the distances between wind farm boundaries and shipping routes as per MGN 543.	▪ Route deviations are considered within Section 16; and ▪ Baseline pilotage operations are considered within Section 9.9. and assessed within Volume 2, Chapter 9: Shipping and Navigation (application ref: 6.2.9).

Consultee(s)	Key Points Raised	Where Addressed
MCA	The turbine layout design will require MCA approval prior to construction to minimise the risks to surface vessels, including rescue boats, and Search and Rescue (SAR) aircraft operating within the site. Any additional navigation safety and/or SAR requirements, as per MGN 543 Annex 5, will be agreed at the approval stage. MCA would also welcome early discussion on the lighting and marking arrangements.	▪ Full consideration will be given to MGN 654 Search and Rescue (SAR) Annex 5 requirements around layout access, and the final layout will be agreed with the MCA; and ▪ As per Section 19, precise lighting and marking will be agreed with Trinity House post consent and will be compliant with the general principles outlined within IALA R139 / G1162.
MCA	Attention should be paid to cabling routes and where appropriate burial depth for which a Burial Protection Index study should be completed and, subject to the traffic volumes, an anchor penetration study may be necessary. If cable protection measures are required e.g. rock bags or concrete mattresses, the MCA would be willing to accept a 5% reduction in surrounding depths referenced to Chart Datum. This will be particularly relevant where depths are decreasing towards shore and potential impacts on navigable water increase, such as at the Horizontal Directional Drilling (HDD) location.	▪ A Cable Burial Risk Assessment (CBRA) will be completed as per Section 19.

Consultee(s)	Key Points Raised	Where Addressed
MCA	Consideration will need to be given to the implications of the site size and location on SAR resources and Emergency Response Co-operation Plans (ERCoP). Attention should be paid to the level of radar surveillance, AIS and shore-based Very High Frequency (VHF) radio coverage and give due consideration for appropriate mitigation such as radar, AIS receivers and in-field, Marine Band VHF radio communications aerial(s) (VHF voice with Digital Selective Calling (DSC)) that can cover the entire wind farm sites and their surrounding areas. A SAR checklist will also need to be completed in consultation with MCA.	▪ Baseline SAR resources are considered within Section 11, and associated hazards are assessed within Volume 2, Chapter 9: Shipping and Navigation (application ref: 6.2.9); and ▪ A SAR checklist will be complete as required under MGN 654.
MCA	MGN 543 Annex 2 requires that hydrographic surveys should fulfil the requirements of the International Hydrographic Organisation (IHO) Order 1a standard, with the final data supplied as a digital full density data set, and survey report to the MCA Hydrography Manager. Failure to report the survey or conduct it to Order 1a might invalidate the NRA if it was deemed not fit for purpose.	▪ Hydrographic surveys will be undertaken as per Section 20.8.

Consultee(s)	Key Points Raised	Where Addressed
Trinity House	Trinity House would expect the following to form part of the ES: ▪ NRA ▪ Comprehensive vessel traffic analysis in accordance with MGN 543. ▪ The possible cumulative and in-combination effects on shipping routes and patterns should be adequately assessed. ▪ Proposed layouts should conform to MGN 543 and consideration should be given to the layout of the current Gwynt y Môr (GyM) OWF in this regard. The Awel y Mor project layout should align with the current operational site. ▪ If any structures, such as met masts, offshore platforms, accommodation platforms or other transmission assets, lie outwith the actual wind farm turbine layout, then additional risk assessment should be undertaken.	▪ Vessel traffic analysis is presented in Section 13; ▪ Assessment of shipping routes are presented in Section 16; ▪ The final layout will conform with MGN 654 and be agreed with the MCA; and ▪ The potential for an isolated Met Mast has been included within the quantitative risk modelling in Section 17, and associated hazards assessed in Volume 2, Chapter 9: Shipping and Navigation (application ref: 6.2.9).

Consultee(s)	Key Points Raised	Where Addressed
Trinity House	We consider that this development will need to be marked with marine aids to navigation by the developer/operator in accordance with the general principles outlined in IALA Recommendation O-139 on the Marking of Man-Made Offshore Structures as a risk mitigation measure. In addition to the marking of the structures themselves, it should be borne in mind that additional aids to navigation such as buoys may be necessary to mitigate the risk posed to the mariner, particularly during the construction phase. All marine navigational marking, which will be required to be provided and thereafter maintained by the developer, will need to be addressed and agreed with Trinity House. This will include the necessity for the aids to navigation to meet the internationally recognised standards of availability and the reporting thereof.	▪ As per Section 19, precise lighting and marking will be agreed with Trinity House post consent and will be compliant with the general principles outlined within IALA R139 / G1162.
Trinity House	Any monitoring equipment, including met masts and LIDAR or wave buoys must also be marked as required by Trinity House.	▪ As per Section 19, precise lighting and marking will be agreed with Trinity House post consent and will be compliant with the general principles outlined within IALA R139 / G1162.

Consultee(s)	Key Points Raised	Where Addressed
Trinity House	A decommissioning plan, which includes a scenario where on decommissioning and on completion of removal operations an obstruction is left on site (attributable to the wind farm) which is considered to be a danger to navigation and which it has not proved possible to remove, should be considered. Such an obstruction may require to be marked until such time as it is either removed or no longer considered a danger to navigation, the continuing cost of which would need to be met by the developer/operator.	▪ A decommissioning plan will be undertaken as per Section 20.9.
Trinity House	The possible requirement for navigational marking of the export cables and the vessels laying them. If it is necessary for the cables to be protected by rock armour, concrete mattresses or similar protection which lies clear of the surrounding seabed, the impact on navigation and the requirement for appropriate risk mitigation measures needs to be assessed.	▪ A CBRA will be completed as per Section 19.

4.2 Section 42

28. The relevant responses received as part of the statutory consultation on the PEIR under Sections 42 and 47 of the Planning Act 2008 which occurred between 31st August and 11th October 2021 are summarised in Table 4.2.

Table 4.2: Section 42 Responses

Consultee	Key Points Raised	Where Addressed
Cruising Association	The Cruising Association stated no comment and that they were “content.”	Noted.

Consultee	Key Points Raised	Where Addressed
Trinity House	Early layout consultation should be undertaken with Trinity House noting AyM should not adversely affect the current lines of orientation at the operational GyM.	The final layout will be agreed with Trinity House and MCA noting preliminary consultation has already been undertaken with both. Hazards to surface navigation and SAR are assessed within Volume 2, Chapter 9: Shipping and Navigation (application ref: 6.2.9).
Isle of Man Government	Noted that the Isle of Man Steam Packet Company has indicated they are content with the current project coordinates.	Noted.
CoS	The CoS recommended that the layout design should give due consideration to shipping and navigation, citing specifically the traffic associated with the anchorage in Dulas Bay/Point Lynas.	As per Section 6.1, the western extent of the array has been removed post PEIR, thus reducing potential for interaction with the referenced traffic. The final layout will be agreed with the MCA and Trinity House and these discussions will include due consideration of surface navigation.
	The CoS stated strong preference for two lines of orientation across the development, unless sufficient safety justification be made to the MCA. Further, consideration should be given to GyM in terms of space between the projects and consistent lines of orientation through both sites.	The final layout will be agreed with the MCA and Trinity House, noting that framework Layout Commitments have been agreed (see Section 19.1) that include provision for limiting impact on the GyM lines of orientation.

Consultee	Key Points Raised	Where Addressed
	CoS stated concern over the modelled position of the isolated Met Mast structure within the Other Infrastructure Zone, noting specifically the deviated traffic associated with Point Lynas. CoS recommended: Alternative locations be sought and the structure be contained within the array for safety of navigation.	As per Section 6.2.4 the Other Infrastructure Zone has been refined post PEIR to shift the potential Met Mast locations further from the Point Lynas traffic. The final position will be agreed with MCA and Trinity House.
	The CoS stated it should be considered that a drifting allision may result in higher consequences than a "low impact" contact, particularly in adverse weather conditions. The CoS stated consideration should also be given to potential for an unpowered drifting vessel, whilst taking into consideration charted cabling, to drop anchor for safety concerns and the potential for anchor snag or anchor drag leading to allision.	Consequences from potential allisions (including drifting) in terms of PLL and pollution are assessed in Appendix D. Qualitative assessment is made in Volume 2, Chapter 9: Shipping and Navigation (application ref: 6.2.9). Emergency anchoring is assessed within Volume 2, Chapter 9: Shipping and Navigation (application ref: 6.2.9).
	The CoS stated that near miss incidents have occurred around the UK between wind farm structures and commercial vessels which have experienced loss of power, leading to emergency anchoring, subsequent anchor drag, and rescue tug use to keep the vessel from alliding with the structure.	Drifting risk including consideration of emergency anchoring is assessed within Volume 2, Chapter 9: Shipping and Navigation (application ref: 6.2.9). Incidents occurring at constructing or operational UK wind farms are discussed in Section 12.4.

Consultee	Key Points Raised	Where Addressed
	The CoS stated implications for SAR capabilities in the area need careful consideration, and the Applicant should consider what organisational or financial assistance will be provided to MCA in provision of SAR.	Hazards to SAR are assessed within Volume 2, Chapter 9: Shipping and Navigation (application ref: 6.2.9). As per Section 19, the Applicant will comply with MGN 654 which includes a requirement to agree a SAR checklist with the MCA which sets out the relevant mitigations that will be in place. It is noted that AyM will also increase resources including self help capability in the event of a SAR incident. Associated cooperation procedures with the MCA will be agreed via the ERCoP (Section 19). General consideration of aviation obstacles to fixed wing and rotary aircraft (including SAR aircraft) is also considered in Volume 2, Chapter 13: Military and Civil Aviation (application ref: 6.2.13).
	The CoS stated view that the assessed frequency of certain impacts should be raised including powered and drifting allision risk and impacts on SAR responders.	The rankings assigned are based on various input including the baseline assessment, quantitative modelling, and level of stakeholder concern, and give due consideration to frequency of both realistic and worst case consequences. The CoS view and input has been captured within the NRA process.

Consultee	Key Points Raised	Where Addressed
	The CoS stated supports for burial of interconnector and inter-array cabling wherever possible to minimise reduction of water depth and snagging risk. The CoS queried what monitoring of the seabed and cable burial will be present post cable-laying, noting that for some developments around the UK, inter array cables in particular have become exposed within a short period.	Necessary cable protection measures will be assessed and agreed as part of the CBRA. This will include conditions in relation to monitoring procedures and interim mitigations in the event that cables become exposed.
	The CoS supports the application and use of safety zones during construction, decommissioning and periods of major maintenance for the safety of life. However, the application or use of safety zones for protection of property or assets is not supported.	The application for any safety zones applied for will include a safety case for their implementation that demonstrates how they will reduce risks to project vessels, personnel and third party vessels and crews. It is noted that the Applicant does not intend to apply for permanent operational safety zones.

4.3 Key Stakeholder Meetings / Correspondence

29. Details of meetings and / or correspondence with key stakeholders are summarised in Table 4.3. This includes reference to where the points raised have been incorporated or addressed within the NRA.

Table 4.3: Consultee Meetings

Consultee	Key Points Raised	Where Addressed
UK Chamber of Shipping (CoS) Meeting, 28/09/2020	Queried how it is being ensured that all relevant parties are invited to participate in consultation.	▪ Comprehensive consultation has been undertaken based on requirements of the MCA NRA Methodology (MCA, 2021).

Consultee	Key Points Raised	Where Addressed
	The 10NM buffer around the array area is an acceptable study area and there is agreement with the navigational features shown (as per the Scoping Report) including the Point Lynas pilot boarding station which lies outside of the 10NM study area.	▪ Navigational features are considered within Section 9, and this includes relevant features outside of the study area including the Point Lynas boarding area.
	Queried the cargo vessel traffic shown near Colwyn Bay.	▪ Cargo vessels are considered within Section 13.2.1.
	Satisfied with the approach of using AIS data for the summer period alongside the winter survey data for the PEIR submission, with both survey datasets to be used in the Environmental Statement (ES).	▪ The agreed approach has been utilised as per Section 8.
	Queried whether 20 years of Marine Accident Investigation Branch (MAIB) data could be used.	▪ A total of 20 years of MAIB data has been considered as per Section 12.1.
	The proposed datasets to be used in the NRA are acceptable.	▪ Agreed data sets have been utilised as per Section 7.
	When undertaking regular operator analysis Peel Ports would be useful to contact. Seatruck Ferries should also be considered.	▪ Peel Ports have been consulted with (key points given in Section 4.2). ▪ Regular operator consultation is presented in Section 4.4, including response from Seatruck.
	The site seems largely amenable to pre existing routes.	▪ Post wind farm routeing is assessed in Section 16.4.2 and aligns with this input.

Consultee	Key Points Raised	Where Addressed
	The only consideration is the anchoring and sheltering to the west of the site.	▪ Anchored vessels are considered within Section 13.2.9.
	Routeing in the area is now close to normal following the effects of COVID-19 but with limited passengers. Tankers are slightly reduced in numbers but the routeing is the same.	▪ Noted, Appendix B considers a long term vessel data set to identify any COVID-19 related effects.
Port of Mostyn Meeting, 29/09/2020	The 10NM buffer around the array area is an acceptable study area.	▪ See Section 7.1.
	Content with the data presented and note that there is potential for P&O Ferries to start operating a ferry route out of Mostyn (headed for Dublin) in 2021. If this route does proceed it will consist of three ferries per day and will pass through the Outer Channel and between the GyM and North Hoyle OWFs.	▪ As per Section 16.1, this route is not active at the time of the NRA. It has been considered within the discussion of future case commercial traffic in Section 16.1.
	The tidal lagoon project being developed by the Port of Mostyn is in its infancy, but could be under construction within the next five years.	▪ Cumulative projects under consideration are stated in Section 15.
	Content that the impacts covered (as per the Scoping Report) and consultee list is comprehensive.	▪ See Section 18.
	The Port of Mostyn would be interested in attending the Hazard Workshop.	▪ The Port of Mostyn were invited to the Hazard Workshop, see Section 4.5.
Cruising Association (CA) Meeting, 01/10/2020	Queried the minimum spacing between wind farm structures under consideration.	▪ See Section 6.2.2.

Consultee	Key Points Raised	Where Addressed
	The 10NM buffer around the array area is an acceptable study area and there is agreement with the navigational features shown (as per the Scoping Report).	▪ See Section 7.1 (study area) and Section 9 (navigational features).
	The area off Point Lynas is primarily used for anchoring rather than shelter.	▪ See Section 13.2.9.
	The area is not heavily cruised with routes which are present such as between Fleetwood/Glasson and the Menai Strait used infrequently.	▪ Baseline recreational activity is considered in Section 13.2.4.
	It is expected that there will be little recreational activity in the winter period.	▪ This aligns with the findings of the winter survey (Section 13.2.4.).
	Content that the impacts covered (as per the Scoping Report) are comprehensive.	▪ See Section 18.
	There are several local cruising clubs which may be interested in the project and contact details can be provided.	▪ Promulgation of information will be a mitigation, see Section 19.
	The CA would be interested in attending the Hazard Workshop.	▪ CA were invited to the Hazard Workshop, see Section 4.5.
Dee Conservancy Meeting, 01/10/2020	The 10NM buffer around the array area is an acceptable study area although it may be worth ensuring the area around the Mostyn port access channel is covered.	▪ As per Section 7.1, the study area has been defined to capture the Mostyn channel traffic.
	Mostyn Port have authority for pilotage in the area but it is noted that the outer pilotage area is rarely used.	▪ Pilotage is considered within Section 9.9.

Consultee	Key Points Raised	Where Addressed
	The anchorage area at the western extent of the study area is mostly used for sheltering in winter and often used by vessels leaving Liverpool and awaiting orders.	▪ Anchored vessels are considered within Section 13.2.9.
	Traffic within the Dee estuary is mostly non-Automatic Identification System (AIS) with three or four fishing vessels on AIS known to often be out at the GyM site. In summer there are typically non AIS long liners in the area.	▪ Consideration has been given to the findings of Volume 2, Chapter 8: Commercial Fisheries (application ref: 6.2.8) which aligns with this input.
	Recommend liaising closely with the RYA and noted that there are two or three local clubs within the Dee estuary itself.	▪ The RYA Coastal Atlas has been used to identify recreational areas, see Section 13.2.4.
	Commercial traffic has appeared to be fairly steady despite the effects of COVID-19 but the cessation of building A380 aircraft wings within the Dee (Broughton) means that vessels carrying those wings will no longer visit the area with no expectation for them to return. The Mersey Guardian operates in the area (Dee) carrying out water quality testing.	▪ A variety of pre and post COVID data has been considered as per Section 7.
	Content that the impacts covered (as per the Scoping Report) are comprehensive, noting that impacts on the port were of most interest to the Dee Conservancy.	▪ As per Section 18, port access is assessed within Volume 2, Chapter 9: Shipping and Navigation (application ref: 6.2.9).

Consultee	Key Points Raised	Where Addressed
	The Dee Conservancy would be interested in attending the Hazard Workshop.	▪ Dee Conservancy were invited to the Hazard Workshop, see Section 4.5.
MCA and Trinity House Meeting 02/10/2020	The 10NM buffer around the array area is an acceptable study area.	▪ See Section 7.1.
	Queried how temporary traffic working on the pipeline going into the Dee estuary would be accounted for, although agreed that the study area was unlikely to require an extension.	▪ Long term data has been considered in Appendix B. ▪ Cumulative assessment has been undertaken in Volume 2, Chapter 9: Shipping and Navigation (application ref: 6.2.9).
	If an extension to the Liverpool Bay TSS was deemed necessary a safety case would be required.	▪ Based on consultation to date a TSS extension is not anticipated to be necessary.
	No issues raised with the proposed data sources for use in the NRA.	▪ Agreed data sources have been considered (see Section 7.).
	The obstruction of the Point Lynas Light (and any other Aid to Navigation (AtoN)) by the wind farm should be considered. It is suggested that it should first be considered what the impact may be, i.e. which angles may be obscured and if there is deemed to be a navigational safety concern to speak to Trinity House.	▪ Existing AtoN are considered within Section 14.10.
	Queried whether the operator of the Raynes Jetty (Llanddulas) had been identified.	▪ Cargo vessels are assessed within Section 13.2.1.

Consultee	Key Points Raised	Where Addressed
	Confirmed that a second round of consultation on the updates to MGN 372, MGN 543 and the Methodology is due at the end of October/November.	▪ This NRA is compliant with MGN 654 (active relevant MCA guidance at the time of writing) as per Section 2.
P&O Maritime Meeting, 08/10/2020	Queried whether consultation is being undertaken with Bangor University.	▪ Bangor University was contacted for comment in 2020 however as the vessel is operated by P&O Maritime direct consultation was considered more appropriate.
	The 10NM buffer around the array area is an acceptable study area.	▪ See Section 7.1.
	There is potential for some interaction with the Endeavour vessel and further information will be provided. Otherwise, the impacts presented (as per the Scoping Report) are considered sensible.	▪ Associated hazards assessed in Volume 2, Chapter 9: Shipping and Navigation (application ref: 6.2.9).
	Vessels operated by P&O Maritime do not navigate internally within existing wind farm arrays.	▪ Associated hazards assessed in Volume 2, Chapter 9: Shipping and Navigation (application ref: 6.2.9).
	P&O Maritime would be interested in attending the Hazard Workshop and will provide feedback prior to this after viewing the Scoping Report.	▪ P&O were invited to the Hazard Workshop, see Section 4.5.
Peel Ports Meeting, 24/11/2020	Stated that although the Port of Liverpool has Vessel Traffic Services (VTS) coverage, this will not be in use at the extent of the development.	▪ This has been included within the baseline assessment (see Section 9.8).

Consultee	Key Points Raised	Where Addressed
	Queried the potential for the Liverpool Bay TSS to be extended noting the benefit this would have for pilotage and anchoring activities off Point Lynas	▪ Based on consultation to date it is not anticipated that an extension to the TSS will necessary, noting that in order for the IMO to approve such an extension a traffic management issue in general would need to be demonstrated.
RYA Email correspondence, 01/10/2020	The RYA are not aware of any significant water based recreation issues within the area. However, it is recommended that vessel traffic surveys are undertaken at peak recreational times with information indicating that this likely to be between mid-July and mid-August.	▪ The NRA includes assessment of summer survey data as per Section 7.2.
	The RYA Coastal Atlas will provide an indication of general use of the area by larger recreational craft but it should be noted that recreational intensity is based on AIS. Areas identified as "Boating Areas" within the atlas are based on consultation with local clubs and as such take account of all activity.	▪ Boating areas are considered in Section 13.2.4.
Royal National Lifeboat Institution (RNLI) Email correspondence, 01/10/2020	Recommend that the two 14 day periods of AIS data gathering both take place in the summer.	▪ The survey periods are selected to ensure compliance with MGN 654, see Section 8.

Consultee	Key Points Raised	Where Addressed
	Coxswains at our Moelfre, Llandudno, Rhyl and Hoylake lifeboat stations would be happy to advise on smaller traffic density, i.e. those vessels not carrying AIS.	▪ RNLI were in attendance at the Hazard Workshop and provided baseline input.
	From past experience, the process of a lifeboat passing through a restricted area when on a service call has not been as smooth as it could have been and early consideration of how to mitigate this would be welcome.	▪ Communication procedures with regards to SAR resources will be agreed with the MCA.
	The 10NM buffer around the array area is an acceptable study area.	▪ See Section 7.1.
P&O Ferries Email correspondence, 17/10/2020	Given that the proposed site is on latitude in line with the existing GyM and south of the Douglas TSS there is not any effect on the Liverpool-Dublin route.	▪ Post wind farm routeing is assessed in Section 16.4.2 and aligns with this input.
MCA and Trinity House Meeting, 06/12/2021	Trinity House indicated the refined Other Infrastructure Zone was an improvement in terms of risk than at PEIR stage. It was suggested qualitative consideration should be given to Met Mast locations in the south of the Other Infrastructure Zone, noting the worst case position (north west corner) should be modelled.	▪ Allision risk to the Met Mast is assessed in Section 17.3.2.

4.4 Regular Operators

30. Marine traffic data (see Section 13) was used to identify regular users of the area around the array. A request for consultation was sent these operators (see Appendix C). The substantive responses received are summarised in Table 4.4.

Table 4.4: Regular Operators Consultation Summary

Consultee(s)	Key Points Raised	Where Addressed
Stena Line	No comments with regards to safe navigation but would like to be kept informed of the progress of the project and specifically the location of the construction ('home base') port.	▪ The construction port has not been determined at NRA stage, however hazards associated with wind farm vessels and port access are assessed within Volume 2, Chapter 9: Shipping and Navigation (application ref: 6.2.9).
James Fisher	▪ Small deviation required to avoid array area on inward approach to Mersey. ▪ Concern over outward passage from Mersey, particularly during adverse weather, (S/SW Gales) when pilot carried. ▪ Unclear whether passage south of AyM / GyM would be affected - if so concerns over being forced to use the TSS Western (outbound) Lane as such passage would be open to the elements and would increase passage time.	▪ Route deviations are considered within Section 16; and ▪ Adverse weather routeing is considered within Section 13.4.3.
Isle of Man Steam Packet Co	▪ No impact on routeing ▪ No safety concerns anticipated ▪ Vessels would not choose to make internal passage ▪ No planned routeing changes currently of relevance to AyM	▪ Findings of the NRA and Volume 2, Chapter 9: Shipping and Navigation (application ref: 6.2.9) aligns with this input.

Consultee(s)	Key Points Raised	Where Addressed
P&O	No concerns raised, project is positioned well south of current routes.	▪ Findings of the NRA and Volume 2, Chapter 9: Shipping and Navigation (application ref: 6.2.9) aligns with this input.
Seatruck	▪ Vessels will have to be more vigilant on their passages. ▪ May impact upon weather routeing - specifically Liv-Dub-Liv during Southerly gales, but any effects not expected to be significant. ▪ Minor deviations to small parts of present weather routes may be needed.	▪ Route deviations are considered within Section 16; and ▪ Adverse weather routeing is considered within Section 13.4.3.
Whitaker Tankers Ltd	▪ Proposed position of the windfarm would not affect routes ▪ When proceeding to the pilot station from Point Lynas, but may need to consider that more time will be required as a deviation will be required. ▪ Consideration will be required for vessels during northerly winds but this can be accounted for in passage plans and considered by Masters during the transits.	▪ Route deviations are considered within Section 16; and ▪ Adverse weather routeing is considered within Section 13.4.3.

4.5 Hazard Workshop

31. A virtual Hazard Workshop was held on the 6th May 2021 to provide stakeholders including at a local level the opportunity to input into the NRA process. Participant organisations were as follows:

- Boskalis Westminster;
- CA;
- CoS;
- Dee Conservancy;
- Hanson Aggregates;

- James Fisher;
- Jenson Angling Boats;
- Liverpool Pilots;
- North Wales Cruising Club;
- North West Venturers Yacht Club;
- Port of Mostyn;
- RNLI;
- Tarmac Marine;
- Trinity House; and
- Whitaker Tankers.

32. The key output of the Hazard Workshop is the Hazard Log, which is provided in Appendix E, however a summary of the key point raised is provided in Table 4.5.

Table 4.5: Hazard Workshop Summary

Key Points Raised	Where Addressed
There was general consensus that the navigational features and marine traffic baselines were sufficient and comprehensive.	▪ Data sources informing the NRA baseline are shown in Section 7.
Queries around how non AIS vessels have been captured were raised.	▪ As required under MGN 654, the vessel traffic survey undertaken in 2020 and 2021 (see Section 8.1) includes Radar and visual observation data; ▪ The RYA Coastal Atlas (RYA, 2018) includes indication of likely areas of non AIS activity via the general boating area element (see Section 13.2.4.2); ▪ Consultation has been undertaken with the CA, RYA, and via the Fishing Liaison Officer, and any additional input received by the local representation at the Hazard Workshop has also been considered.
The Pilot representation stated that an extension of the TSS would be of benefit to certain vessels, however it was also noted that other vessels may be adversely affected. The general consensus was that the current TSS was suitable from a navigational safety perspective in relation to AyM.	▪ Hazards associated with the TSS are assessed in Volume 2, Chapter 9: Shipping and Navigation (application ref: 6.2.9).

Key Points Raised	Where Addressed
No concerns associated with adverse weather routeing were raised.	▪ Adverse weather routeing is assessed in Section 13.4.3.
Trinity House noted concerns over the met mast being an isolated structure (i.e., if it is not sited within or in alignment with the array). Specifically, there would be concerns over AtoN failure meaning the structure was not clearly visible, leading to increased allision risk.	▪ Allision risk including for the Met Mast is assessed in Section 17.3.2, noting associated hazards are assessed in Volume 2, Chapter 9: Shipping and Navigation (application ref: 6.2.9).
The general consensus was that the largest area of concern was the NW corner in terms of allision risk, but that standard lighting and marking was sufficient to minimise the risk.	▪ Allision risk is assessed in Section 17.3.2, noting associated hazards are assessed in Volume 2, Chapter 9: Shipping and Navigation (application ref: 6.2.9).
Trinity House noted the existing lighthouse at Point Lynas has a range of 19NM which may be affected by the array area, however consider the AtoN on AyM will likely be sufficient to compensate for this.	▪ Effects on existing AtoN are considered in Section 14.10.
Participants had not experienced notable Radar effects from the existing (operational) GyM. In terms of ability to detect smaller vessels within operational arrays, general consensus was that COLREGS would apply, with vessels entering the TSS from the array doing so with caution.	▪ Effects on Navigation, Communication and Position Fixing Equipment are assessed in Section 14.
It was suggested that communication procedures between AyM and RNLI should be in place, noting that there have been communication issues in relation GyM	▪ Communication procedures during SAR operations are required to go through Her Majesty’s Coastguard (HMCG). Appropriate communication procedures will be agreed with the MCA as part of the ERCoP process (see Section 19).

5 Lessons Learnt

33. There is considerable benefit for the Applicant in the sharing of lessons learnt within the offshore industry. The NRA, and subsequent risk assessment undertaken in Volume 2, Chapter 9: Shipping and Navigation (application ref: 6.2.9) 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.

34. Data sources for lessons learnt include the following:

- GyM Environmental Statement (NPower Renewables, 2005);
- Sharing the Wind – Recreational Boating in the Offshore Wind Strategic Areas (RYA and Cruising Association (CA), 2004);
- Results of the Electromagnetic Investigations (MCA and QinetiQ, 2004);
- Offshore Wind and Marine Energy Health and Safety Guidelines (RenewableUK, 2014);
- Offshore Wind Farm Helicopter Search and Rescue Trials Undertaken at the North Hoyle Wind Farm (MCA, 2005);
- Interference to Radar Imagery from Offshore Wind Farms (Port of London Authority (PLA), 2005); and
- Strategic Assessment of Impacts on Navigation of Shipping and Related Effects on Other Marine Activities Arising from the Development of Offshore Wind Farms in the UK Renewable Energy Zone (REZ) (Anatec & The Crown Estate (TCE), 2012).

6 Project Description

35. This section sets out the Project Description in terms of a Maximum Design Scenario (MDS) from a shipping and navigation perspective.

36. An overview of AyM is provided in Figure 6.1. This includes the array within which surface structures (Wind Turbine Generators (WTGs) and Offshore Substation Platforms (OSPs)) will be installed, the offshore Export Cable Corridor (ECC) within which the export cables will be laid, the GyM Interlink Zone, and the Other Infrastructure Zone within which a Meteorological Mast (Met Mast) may be installed.

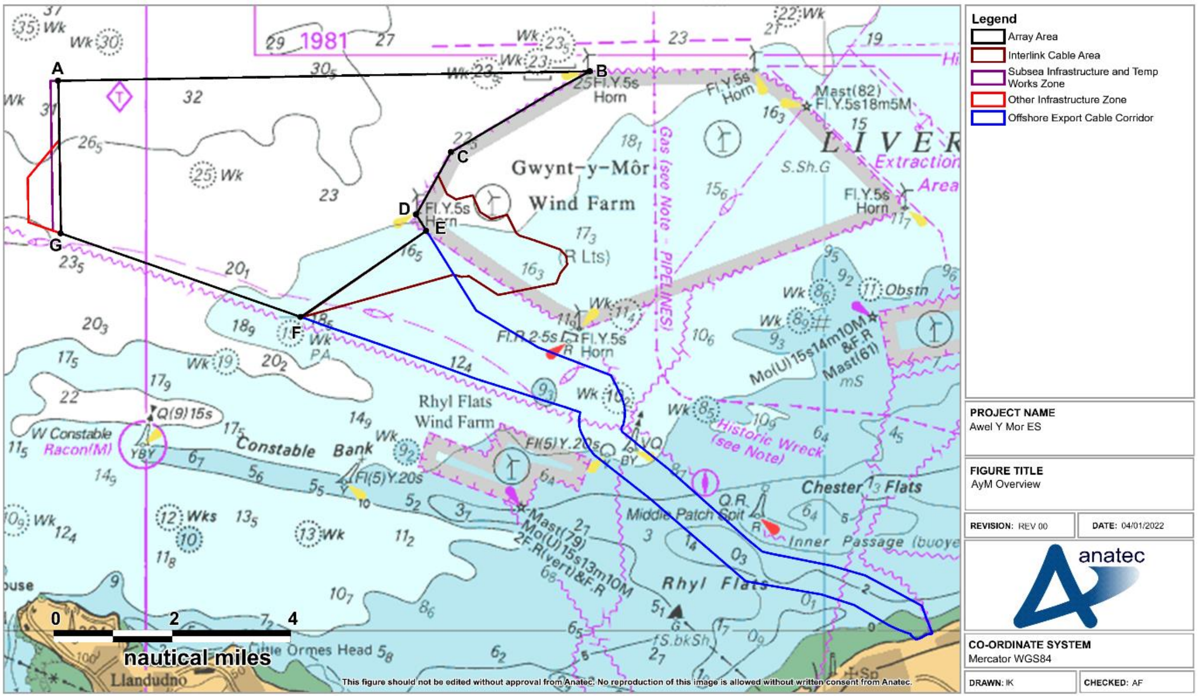


Figure 6.1: AyM Overview

6.1 Array Area

37. The array is located approximately 6NM off the Welsh coast in the Irish Sea, as shown in Figure 6.1. The array covers an area of approximately 22.7NM^2 and is adjacent to the existing Gwynt y Môr (GyM) OWF, which has been operational since 2015 (noting that AyM and GyM are considered “sister” projects).

38. Key corner points of the array are shown in Figure 6.1, with coordinates of each given in Table 6.1.

39. It is noted that the western extent of the array considered at the PEIR stage has been removed, meaning a smaller area is being considered for the purposes of the ES.

Table 6.1: Array Coordinates (World Geodetic System 1984 (WGS84))

Point	Latitude	Longitude
A	53° 29’ 16.90" N	03° 51’ 37.38" W
B	53° 29’ 26.67" N	03° 36’ 37.69" W
C	53° 28’ 05.01" N	03° 40’ 32.27" W
D	53° 27’ 01.87" N	03° 41’ 31.64" W
E	53° 26’ 45.45" N	03° 41’ 14.51" W
F	53° 25’ 18.41" N	03° 44’ 47.18" W
G	53° 26’ 42.82" N	03° 51’ 33.28" W

6.2 Surface Infrastructure

6.2.1 Layout

40. A final layout for AyM will not be determined until after the application has been submitted and determined, at which stage the layout will be approved in consultation with MCA and Trinity House (noting that preliminary consultation has been undertaken with MCA and Trinity House as part of the overarching NRA process).

41. As such, a worst case from the current potential layout options has been defined for the purposes of the collision and allision modelling undertaken within NRA. This worst case is shown in Figure 6.2, and has been determined as such based on the following:

- Maximum site build out;
- Maximum number of structures (including on the periphery); and
- Met Mast sited outside of the array within the Other Infrastructure Zone (see Section 6.2.4).

42. A worst case position for the Met Mast (see Section 6.2.4) has been chosen within the Other Infrastructure Zone. It is emphasised that this is the worst case position chosen for the purposes of the NRA, as opposed to a “proposed” Met Mast location under consideration.

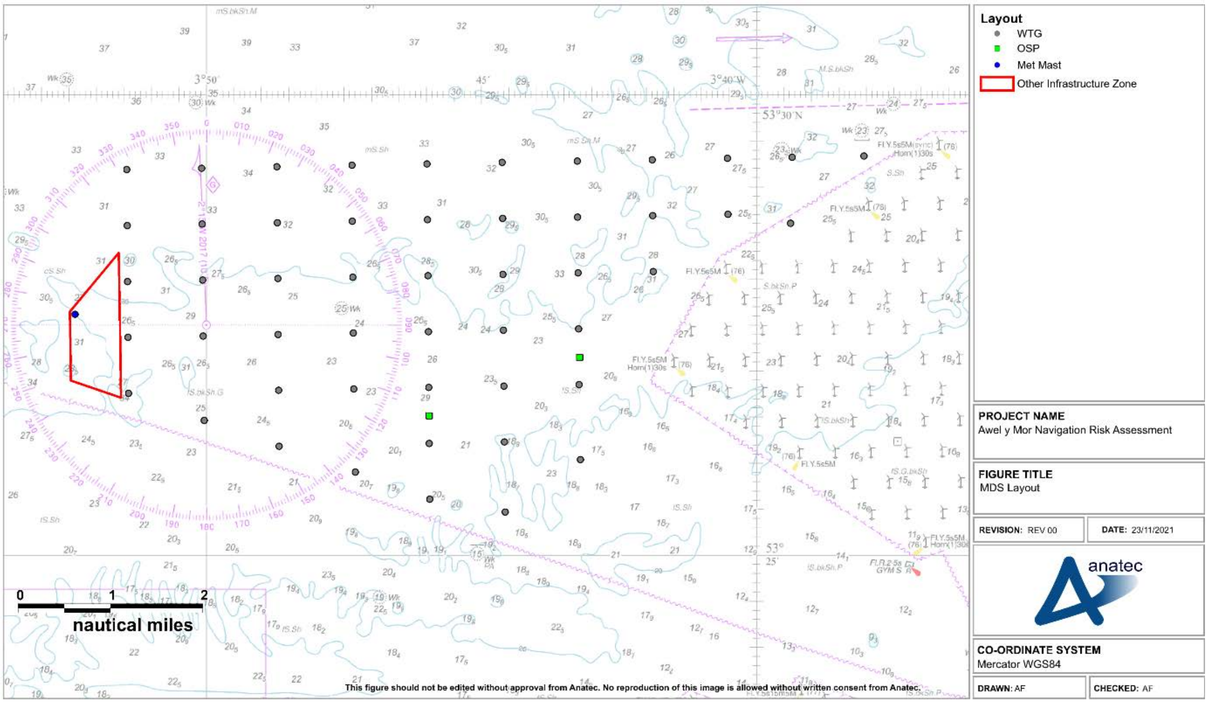


Figure 6.2: Worst Case NRA Layout

43. It is noted that Search and Rescue (SAR) access in line with MGN 654 SAR Annex 5 (i.e., SAR lanes) is not being defined at this stage given that associated discussions are ongoing with the MCA. The worst case from a SAR perspective is considered to be a Single Line of Orientation (SLoO), and this will therefore be assessed within the NRA and Volume 2, Chapter 9: Shipping and Navigation (application ref: 6.2.9).

6.2.2 WTGs

44. There will be a maximum of 50 WTGs installed within the array, with each installed on either monopile or jacket multileg foundations (fixed to the seabed via either piles, suction buckets, or Gravity Bases). The worst case from a shipping and navigation perspective has been identified as the multileg option, as this will exceed the dimensions of the monopile at sea level.

45. On this basis, the MDS WTG measurements assuming use of the multileg jacket foundations are provided in Table 6.2.

Table 6.2: MDS for Shipping and Navigation – WTGs

Parameter	MDS for Shipping and Navigation
Number of WTGs	50
Foundation type	Multileg Jacket
Dimensions at sea surface	28.5 x 28.5 metre (m)

Parameter	MDS for Shipping and Navigation
Maximum blade tip height (above Mean High Water Springs (MHWS))	282m
Minimum air gap (above MHWS)	22m
Maximum rotor diameter	250m
Minimum Spacing	830m

6.2.3 OSPs

46. There will be a maximum of two OSPs installed within the array. Worst case dimensions at sea level for the OSPs have been based on the topside size, given these exceed the foundation dimensions. On this basis, the OSP dimensions assumed for the purposes of the MDS for shipping and navigation are 80x50m. These dimensions are assumed regardless of foundation type, which for reference are as follows:

- Monopile;
- Gravity base;
- Multileg with suction buckets;
- Multileg with piles; and
- Multileg with gravity base.

6.2.4 Met Mast

47. The MDS for shipping and navigation includes one Met Mast, which will be installed either within the array or the Other Infrastructure Zone (see Figure 6.1). The Met Mast will be installed on a monopile foundation, and as worst case will be of diameter 5m at sea level.

48. It is noted that the Other Infrastructure Zone has been refined post PEIR based on feedback received under Section 42 (see Section 4.2) to move the potential Met Mast locations further from the traffic associated with Point Lynas.

6.3 Subsea Cables

6.3.1 Export Cables

49. There will be up to two export cable circuits installed within the offshore ECC shown in Figure 6.1. The maximum length of export cables will not exceed 79.34 kilometres (km), noting that this accounts for two export cables. The indicative length of the route of the export cables within the offshore ECC is 27.4km. This assumes a route along the centreline of the offshore ECC, then two separate straight routes to the indicative OSP locations.

50. There may also be an interlink cable to GyM placed within the GyM Interlink Zone (see Figure 6.1). The interlink cable could be up to 10km in length.

51. Indicatively, the offshore export cable will be buried to between 0.5 and 4m. Burial depths may be less than this in areas of rock or at cable crossing (close to 0m as a worst case), noting that the Cable Burial Risk Assessment (CBRA) will identify the necessary locations and extent of any external protection. Indicative maximum height of external rock berm protection is 1.4m.

6.3.2 Inter Array Cables

52. A network of inter array cables will connect the WTGs to the OSPs, noting potential for branches or loops. There may also be inter array cables connecting to the Met Mast (see Section 6.2.4).

53. The maximum length of inter array cables (inclusive of any to the Met Mast) will be 160km.

54. As with the offshore export cable, indicatively, inter array cables will be buried to between 0.5 and 4m. Burial depths may be less than this in areas of rock or at cable crossing (close to 0m as a worst case), noting that the CBRA will identify the necessary locations and extent of any external protection. Indicative maximum height of external rock berm protection is 1.4m.

6.4 Vessel Numbers

6.4.1 Construction Phase

55. Indicative “peak” project vessel numbers during the construction phase are presented in Table 6.3. Note this represents the "Maximum / peak" number of vessels at any time, not the average, indicative or total amount. Following this, Table 6.4 presents the indicative maximum number of round trips per key vessel type.

56. Indicatively, a maximum of 530 annual helicopter return trips to shore by two helicopters are estimated during the construction phase. This does not account for emergency situations and / or emergency drills.

Table 6.3: Construction Vessel Numbers

Parameters	Peak Vessel Numbers
Filter layer installation/seabed prep vessels	4
Gravity base ballast installation vessels	2
WTG Foundation Installation Vessels	16
Transition Piece Installation Vessels	6
Scour Vessel	2
WTG Installation Spread	15
Commissioning Vessels	3

Parameters	Peak Vessel Numbers
Accommodation Vessels	2
IA Cable Vessels	12
Export Cable Vessels	12
Substation Topside Installation Vessels	4
Substation Foundation Vessels	8
Other Vessels	15
Total	**101**
Indicative Maximum Total On site Concurrently	**35**

Table 6.4: Round Trips during Construction Phase

Vessel	Number of Round Trips
Scour Layers Vessel	170
Gravity Base Foundation Ballast Vessel	315
Foundation Installation Spread	133
Transition Piece Installation	24
WTG Installation Spread	45
Commissioning Vessels	78
Accommodation Vessels	52
IA Cable Vessels	23
IA Rock Berm Vessels	84
Export Cable Vessels	23
Export Cable Rock Berm Vessels	164
Substation Installation Vessels Topside	8
Substation Installation Vessels Foundation	16
Other Vessels	2300
Total	**3,436**

6.5 Operational Phase

57. Indicative "peak" project vessel numbers during the O&M phase are presented in Table 6.5. Note this represents the "Maximum / peak" number of vessels at any time,

not the average, indicative or total amount. The indicative maximum number of round trips per key vessel type is also included.

58. A maximum of 200 annual helicopter return trips to site per year is assumed during the O&M phase.

Table 6.5: Vessel Numbers and Round Trips during O&M Phase

Parameters	Peak Vessel Numbers	Maximum Round Trips
Peak numbers of Jack-Up vessels	2	6
Peak Service Operations Vessels (SOVs)	2	52
Peak numbers of small O&M vessel (Crew Transfer Vessels (CTVs))	6	1095
Peak numbers of lift vessels	2	6
Peak numbers of cable maintenance vessels	2	1
Peak auxiliary vessels	8	48
Total	22	1,208

7 Data Sources

59. This section summarises the main data sources used to characterise the shipping and navigation baseline deemed of relevance to AyM, including consideration of any data limitations associated with the sources considered.

7.1 Study Area

60. The study area within which assessment has been undertaken is defined as a minimum 10NM buffer of the array, and 5NM buffer of the offshore ECC, noting that this also captures the GyM Interlink Zone. It should be considered that the 10NM buffer is based on previous iterations of the array (see Section 6.1), and as such extend beyond 10NM from certain boundaries of the current iteration.

61. The study area is considered as capturing relevant passing traffic while still remaining site specific to AyM, and has been agreed with key stakeholders (see Section 4.2), noting that it captures key traffic in the area including that associated with Mostyn and anchoring activity off Point Lynas.

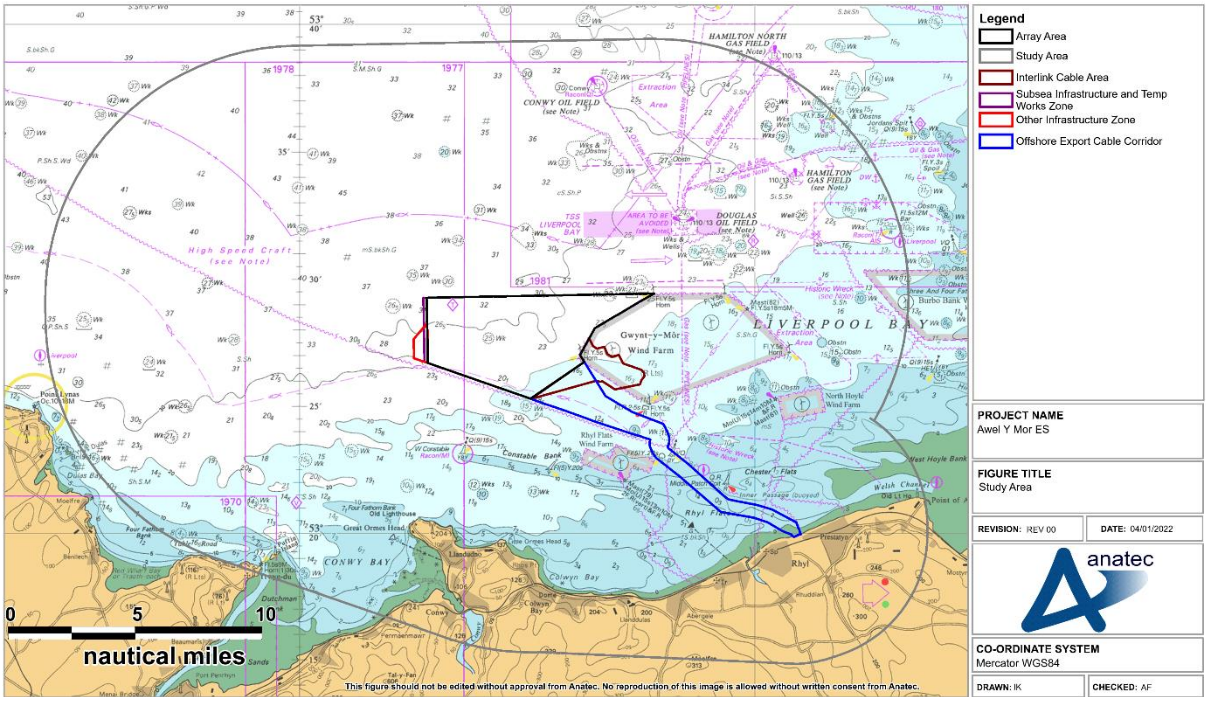


Figure 7.1: Study Area

7.2 Marine Traffic Data

62. As per Section 8, the NRA considers 28 days of survey data (Automatic Identification System (AIS), radar, and visual observation data) collected on site via a site dedicated

vessel survey and 12 months of additional AIS data recorded during the entirety of 2019.

63. The 12 months of data are assessed in full within Appendix B, and utilised within the NRA itself where appropriate. Full details of the approach to marine traffic data collection are provided in Section 13.

7.3 Summary of Data Sources

64. The main data sources used to characterise the shipping and navigation baseline relative to AyM are outlined in Table 7.1.

Table 7.1: Data Sources

Data	Source	Purpose
Vessel Traffic	12 months of AIS data covering the entirety of 2019	To establish the marine traffic baseline
	28 days of AIS, radar, and visual observation data collected during November/ December 2020 and July /August 2021.	
Marine Aggregate Dredger Routes	All passage plans from British Marine Aggregate Producers Association (BMAPA) (2021)	To establish the routes of marine aggregate dredgers
Recreational Traffic	RYA Coastal Atlas (RYA, 2018)	To establish the recreational baseline.
Maritime Incidents	MAIB marine accidents database (2010 to 2019)	To define the baseline incident rates within the study area relative to AyM
	RNLI incident data (2010 to 2019)	
	Department for Transport (DfT) UK civilian SAR helicopter taskings (2015 to 2020)	
Other Navigational Features	United Kingdom Hydrographic Office (UKHO) Admiralty Sailing Directions West Coasts of England and Wales Pilot NP37 (UKHO, 2017).	To establish the baseline in terms of navigational features
	UKHO Admiralty Charts (UKHO, 2021)	

Data	Source	Purpose
Weather	Volume 4, Annex 2.1: Physical Processes Technical Baseline (application ref: 6.4.2.1).	Wind and wave data
	UKHO Admiralty Sailing Directions West Coasts of England and Wales Pilot NP37 (UKHO, 2017).	Visibility data
	Admiralty Chart 1978 and 1826 (UKHO, 2021)	Tidal stream data

7.4 Data Limitations

7.4.1 Marine Traffic Data

65. The long-term AIS vessel traffic data used to validate the vessel traffic survey data assumes that vessels which are 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 the vessel type and dimensions) unless there is clear evidence to the contrary.

66. Given the date of the marine traffic surveys (2020/2021), traffic levels and behaviours may have been affected by the ongoing COVID-19 pandemic. This has been considered within the assessment of long term AIS data collected during the entirety of 2019 for the purposes of validation. Quantitative and qualitative consideration of potential COVID-19 effects on particular NRA elements (e.g., routeing) is considered and summarised within Appendix B.

7.4.2 RYA Coastal Atlas

67. The RYA Coastal Atlas data used to assess the relative densities of recreational vessels only contains data from recreational vessels broadcasting via AIS, and precedes the presence of GyM. The RYA state the general boating area element of the Coastal Atlas provides a good indication of non-AIS use of the area.

68. The relative densities of these areas are based on predictions of the locations of recreational vessels based upon information from local clubs, the location of harbours / mariners, and 2015[2] RYA club survey data. Therefore, in addition to the survey data and consultation, the RYA Coastal Atlas is considered to provide good overall indication of both AIS and non-AIS recreational activity within the study area.

[2] Noting, this is prior to the installation of GyM therefore some changes may have occurred due to the presence of GyM.

7.4.3 Historical Incident Data

69. Although all UK commercial vessels are required to report accidents to the Marine Accident Investigation Branch (MAIB), non-UK vessels do not have to report unless they are in a UK port or within 12NM territorial waters or carrying passengers to a UK port. There are also no requirements for non-commercial recreational craft to report accidents to the MAIB.

70. The Royal National Lifeboat Institution (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.

7.4.4 United Kingdom Hydrographic Office (UKHO) Admiralty Charts

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

8 Vessel Traffic Survey Methodology

72. In agreement with the MCA and Trinity House, the NRA will be informed by the following marine traffic data sources:

- 14 days of AIS, Radar, and visual observation data collected during November and December 2020;
- 14 days of AIS, Radar and visual observation data collected during July and August 2021; and
- 12 months of AIS data collected over the entirety of 2019.

73. This section summarises the methodology of the Winter 2020 survey, Summer 2021 survey, and 2019 AIS data collection processes.

8.1 Winter 2020 Survey Methodology

74. A marine traffic survey of AyM was undertaken by the guard vessel Karima during November and December 2020. An archive photograph of the vessel is provided in Figure 8.1, with key vessel details then provided in Table 8.1.

75. The survey commenced on the 18th November 2020 at 11:00 and concluded on the 2nd December 2020 at 11:00, thus providing 14 days of full coverage with no downtime.

Figure 8.1: Guard Vessel Karima (Copyright Marine Traffic)

Table 8.1: Karima Details

Parameter	Specification
Name	*Karima*
Mobile Maritime Service Identity (MMSI)	232006310
IMO Number	7427403
Callsign	MPKV5
Length	26m
Flag State	UK

76. Any tracks recorded during the survey period classified as temporary (i.e., non-routine), such as the tracks of the survey vessel, have been excluded from the analysis. O&G support vessels operating at permanent installations were retained in the analysis, as were wind farm support vessels operating at the operational wind farms within the study area.

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

78. Therefore, larger vessels were recorded on AIS, while smaller vessels without AIS installed (i.e., certain fishing vessels under 15m length and certain recreational craft) were recorded, on the Automatic Radar Plotting Aid (ARPA) Radar on board the Karima, with visual observation data collected where possible. It is noted that a proportion of smaller vessels also carry AIS voluntarily.

8.2 Summer 2021 Survey Methodology

79. As for the winter survey, the summer marine traffic survey of AyM was undertaken by the guard vessel Karima. The survey commenced on the 24th July 2021 at 08:30 and concluded on the 7th August 2021 at 08:30, thus providing 14 days of full coverage with no downtime.

80. Survey methodology is as per Section 8.1.

8.3 2019 Long Term AIS Data

81. The year of 2019 data was collected from multiple coastal receivers to ensure coverage of the study area was as comprehensive as practicable. The assessment of a year of data allowed seasonal variations to be captured and considered throughout the NRA where appropriate. The full analysis is provided in Appendix B.

9 Navigational Features

82. The navigational features in proximity to AyM and the offshore ECC have been identified using the relevant UKHO Admiralty Sailing Directions (UKHO, 2017) and the UKHO Admiralty Charts (UKHO, 2021) and these are presented in Figure 9.1. The following subsections discuss each of the navigational features presented.

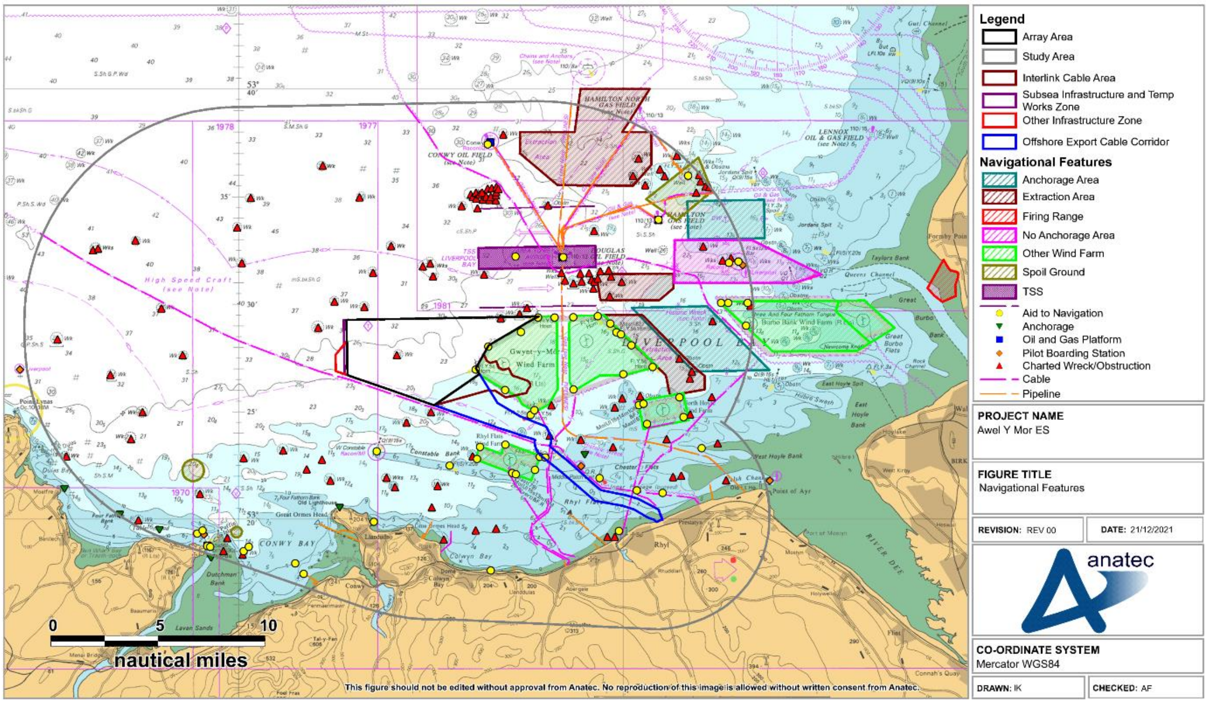


Figure 9.1: Navigational Features

9.1 International Maritime Organization Routeing Measures

83. The Liverpool Bay Traffic Separation Scheme (TSS) IMO adopted routeing measure is situated within the study area and runs adjacent to the northern boundary of the array as shown in Figure 9.2, noting that it also runs adjacent to the GyM array area. The separation distance between the array and the TSS is approximately 0.5NM, as illustrated within Figure 9.2.

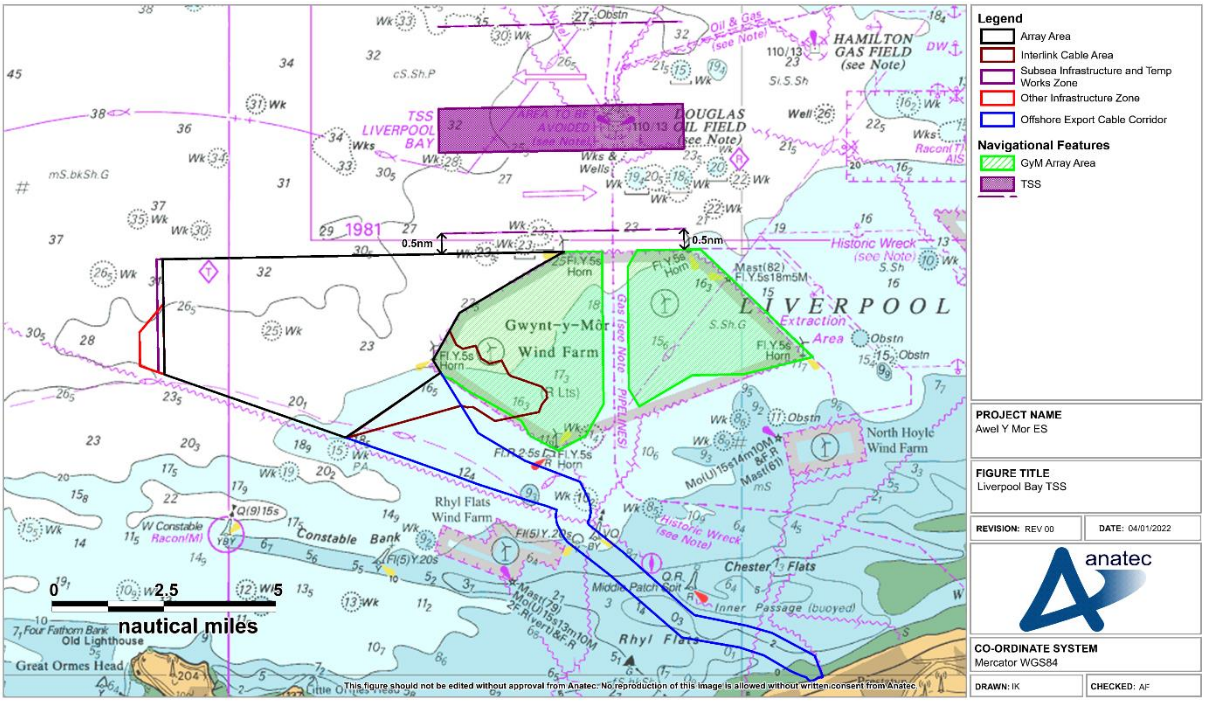


Figure 9.2: Liverpool Bay TSS

9.2 Other Offshore Wind Farms Developments

84. There are four operational OWFs located within the study area as shown in Figure 9.3, with Table 9.1 providing additional details of relevance. It is noted that the Burbo Bank project is located outside the study area (14NM from the array), however its extension site is within the study area.

85. Planned wind farm projects of relevance will be considered on a cumulative basis, and are considered in Section 15.

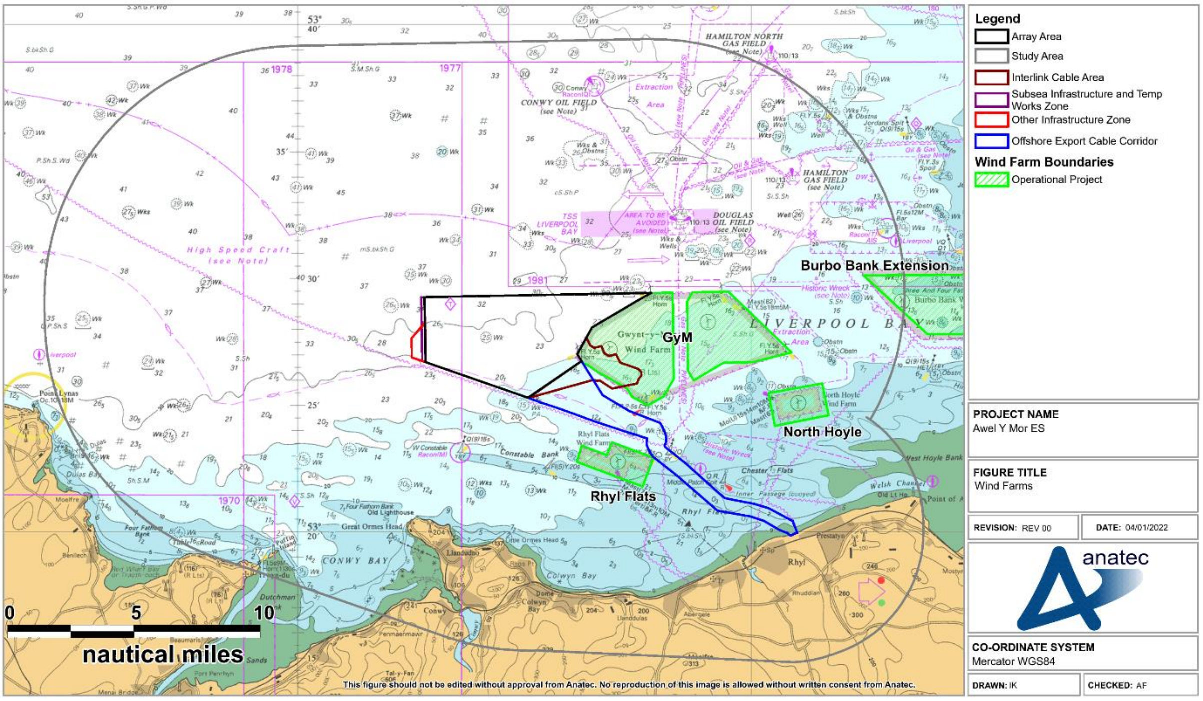


Figure 9.3: Wind Farms

Table 9.1: Wind Farm Details

Name	Minimum Distance from AyM (NM)	Year Operational
GyM	Adjacent	2015
Rhyl Flats	3NM south east	2009
North Hoyle	8NM south east	2004
Burbo Bank Extension	9NM east	2017

9.3 Oil and Gas Features

86. Figure 9.4 presents the O&G platforms and pipelines within the study area, with Table 9.2 then presenting a summary of details of relevance. Details of subsea cables associated with the platforms are included within Section 9.5.

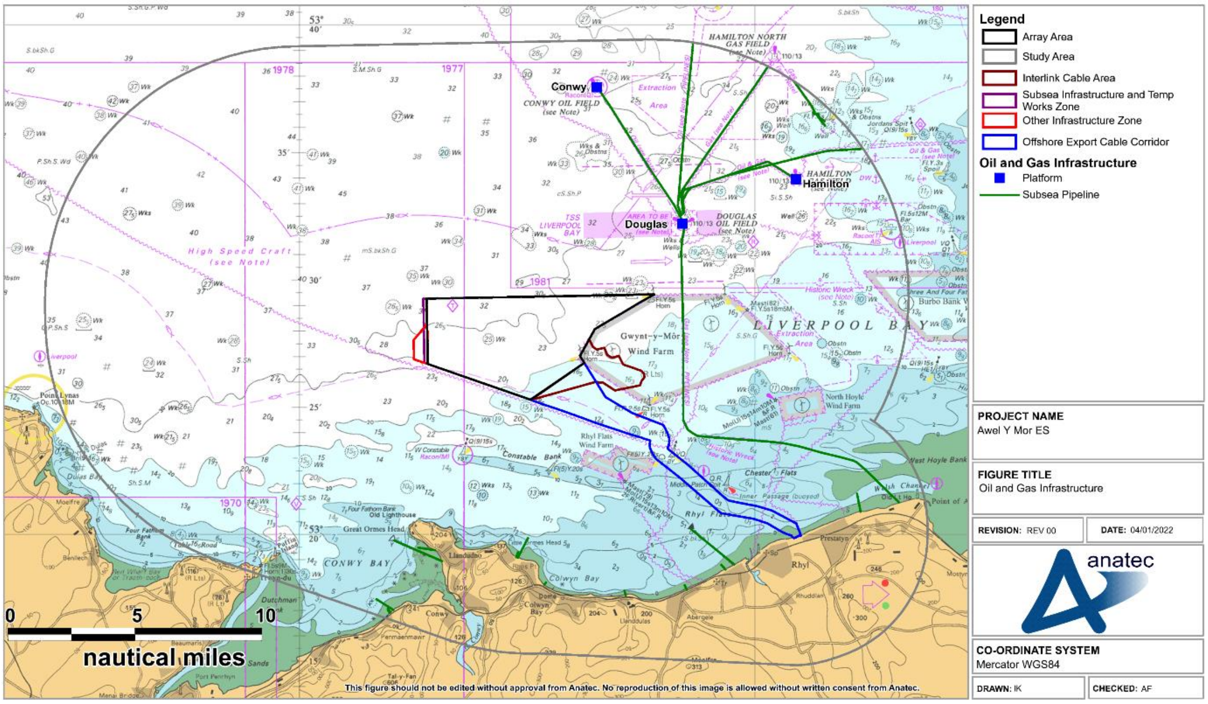


Figure 9.4: Oil and Gas Infrastructure

Table 9.2: Oil and Gas Platforms Summary

Name	Type	Distance from AyM (NM)	Status
Douglas Complex	Manned	3NM north east	Producing
Hamilton Platform	Normally Unmanned	7.5NM north east	Producing
Conwy Platform	Manned	8.5NM north	Producing

9.4 Aids to Navigation

87. The Aids to Navigation (AtoN) located within the study area are presented in Figure 9.5, colour coded by AtoN type. Lights fitted to operational wind farms and lights / navigational systems marking O&G installations in the area have been included for reference.

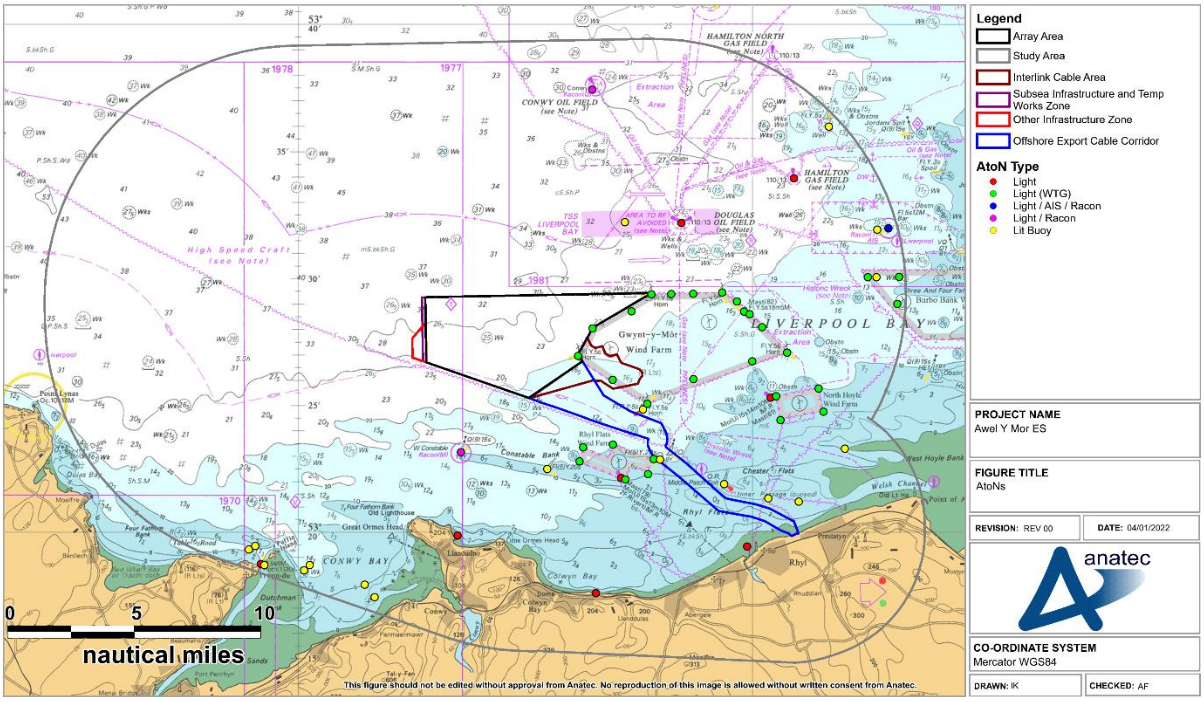


Figure 9.5: AtoNs

9.5 Submarine Cables

88. A total of 13 submarine cables are located within the study area. As shown in Figure 9.6, this includes interconnector cables, wind farm export cables, and cables associated with O&G infrastructure within the study area. The following cables are observed to intersect the offshore ECC:

- GyM export cables making landfall at Pensam;
- North Hoyle export cables making landfall north of Pensam;
- Burbo Bank Extension export cables making landfall north of Rhyl; and
- East West Interconnector running between the UK and Ireland.

89. It is noted that subsea inter array cables are also present within the OWFs within the study area. These are not shown in Figure 9.6, however none intersect the offshore ECC given they are laid within the relevant OWF boundaries.

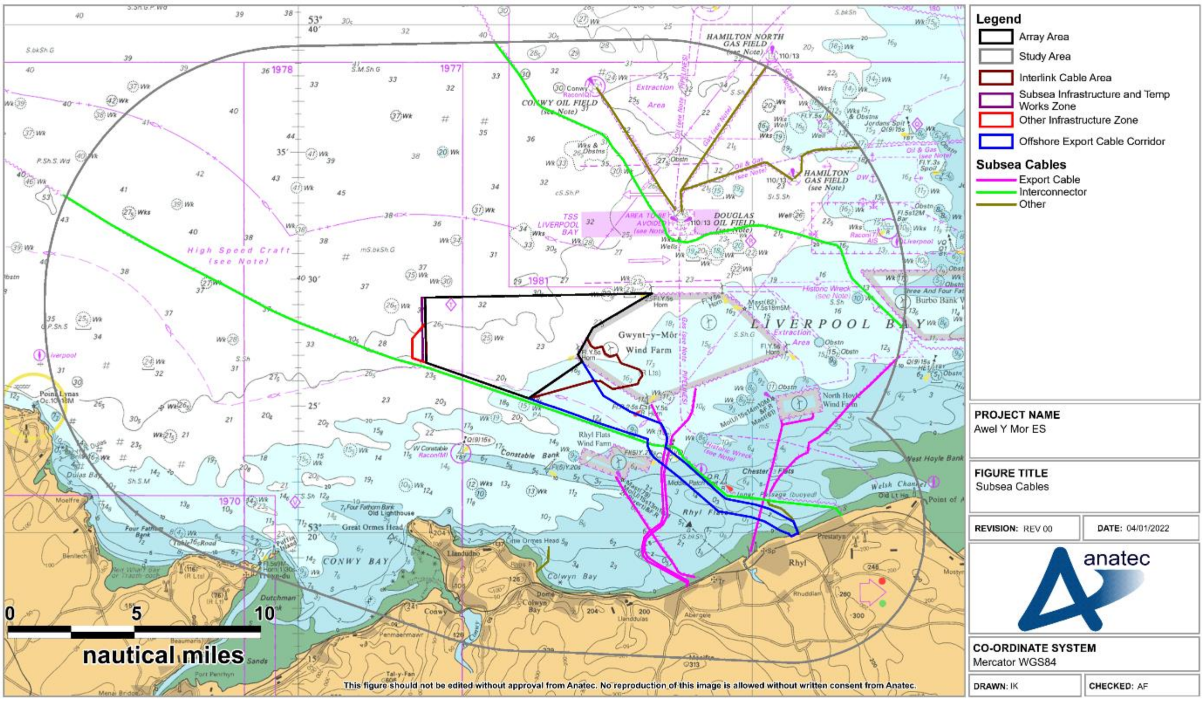


Figure 9.6: Subsea Cables

9.6 Marine Aggregate Dredging

90. There are three marine aggregate dredging areas present within the study area, as shown in Figure 9.7, comprising two Production Agreement areas and one Exploration and Option area. Relevant details of the three areas are provided in Table 9.3.

91. British Marine Aggregate Producers Association (BMAPA) transit routes are also present within the study area and are presented in Section 13.2.6.

Table 9.3: Marine Aggregate Dredging Areas

Area Number	Area Name	Status	Minimum Distance from AyM (NM)
393	Hilbre Swash	Production Agreement	3.0
457	Liverpool Bay	Production Agreement	6.1
1808	Liverpool Bay	Exploration and Option	3.0

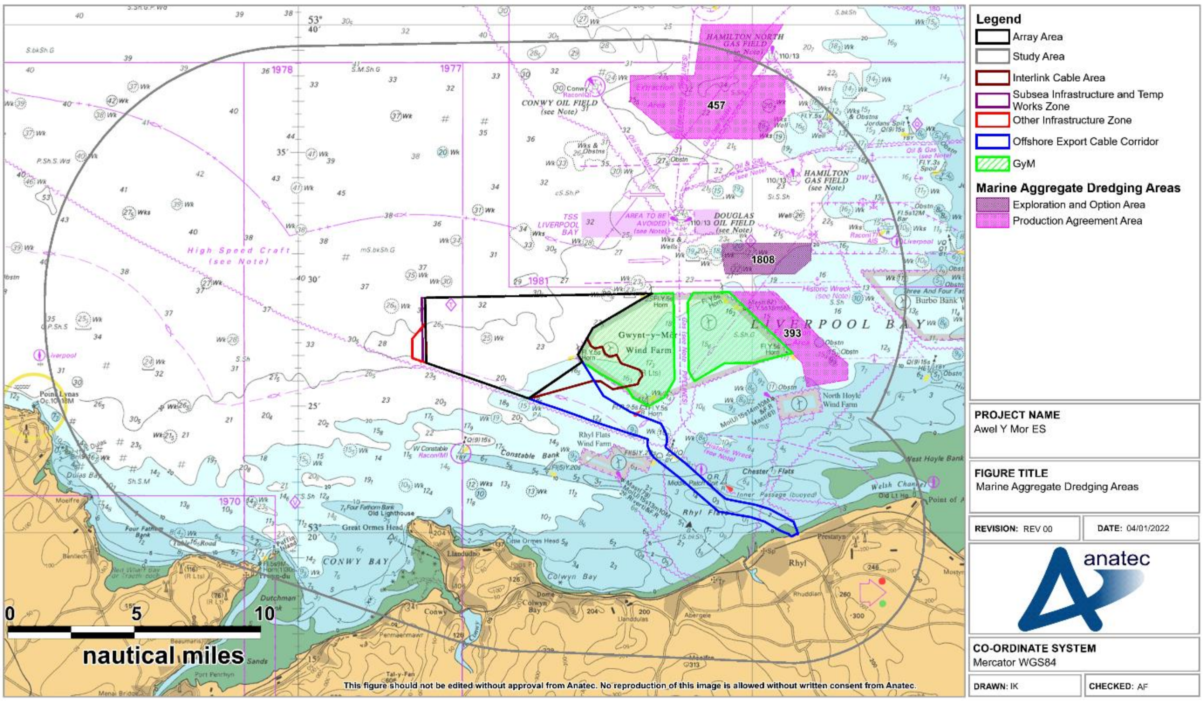


Figure 9.7: Marine Aggregate Dredging Areas

9.7 Wrecks

92. A total of 120 charted wrecks and obstructions are located within the study area with a high concentration of charted wrecks and obstructions located within or near the Liverpool Bay TSS. Two charted wrecks are located within the array.

93. Further details of wrecks including non-charted wrecks are provided in Volume 2, Chapter 11: Offshore Archaeology and Cultural Heritage (application ref: 6.2.11).

9.8 Ports

94. Nearby ports are presented in Figure 9.8. The closest port to the array is Rhos-on-sea, located approximately 7.4NM to the south and is used by recreational and fishing vessels. Llandulas is the closest commercial port to the array and is located approximately 9.0NM to the south.

95. The Liverpool Vessel Traffic Service (VTS) operates in the area, however does not extend to the array.

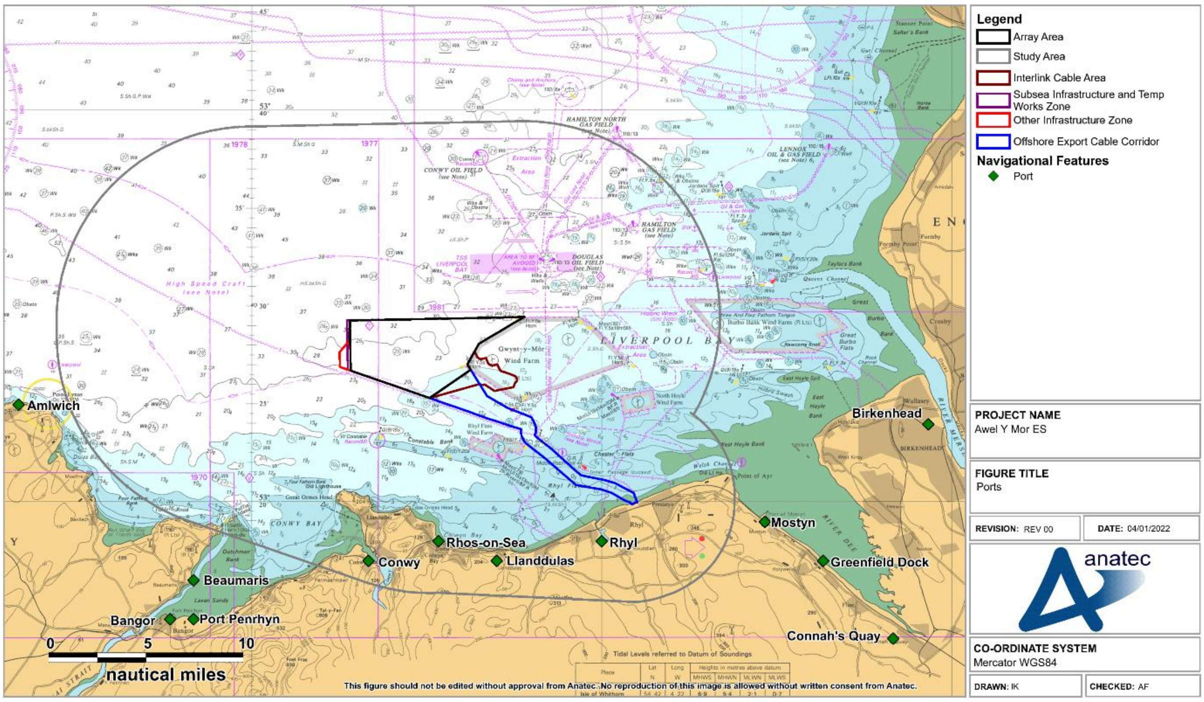


Figure 9.8: Ports

96. The number of arrivals to the busiest ports in the vicinity of AyM is presented in Figure 9.9, based on Department for Transport (DfT) port arrival data. These statistics exclude some vessel movements which occur within port or harbour limits, however are still considered to give an indication of the relative traffic levels and trends. The significant majority of the vessel arrivals to the ports within the area are associated with the Port of Liverpool.

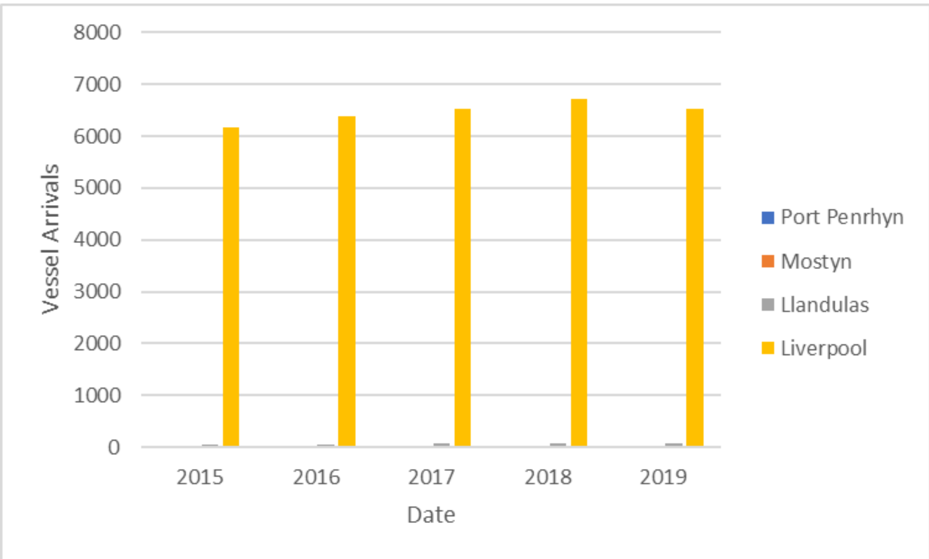


Figure 9.9: Vessel Arrivals to Ports in Proximity to AyM (DfT, 2015-2019)

9.9 Pilot Boarding Stations

97. Nearby pilot boarding stations are presented in Figure 9.10, following this Table 9.4 presents details of the pilot boarding stations including their minimum respective distances from the array and offshore ECC.

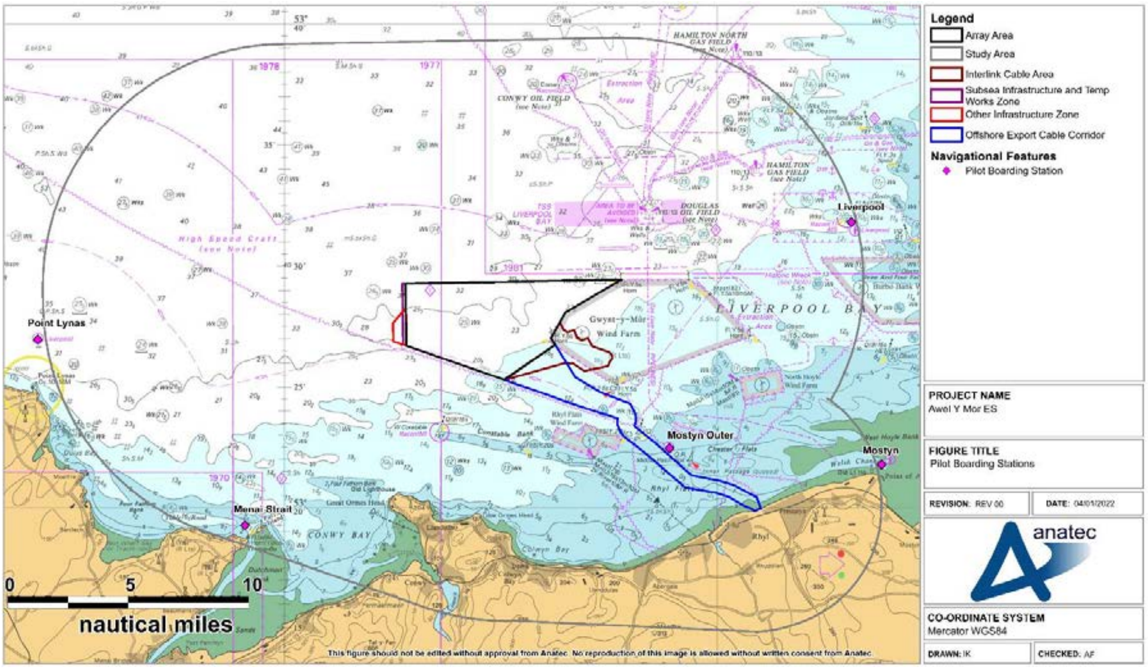


Figure 9.10: Pilot Boarding Stations

Table 9.4: Pilot Boarding Stations

Pilot Boarding Station	Minimum Distance from Array (NM)	Minimum Distance from Offshore ECC (NM)
Mostyn Outer	6.4	0.2
Menai Strait	9.6	12.3
Liverpool	9.8	13.2
Liverpool (Point Lynas)	13.9	19.3
Mostyn	14.3	5.5

9.10 Anchorages

98. Charted and preferred / known anchorages within the study area are shown in Figure 9.11. There are two anchorage areas associated with the Port of Liverpool, the northernmost of which is noted as being for deep draughted vessels via a note on the relevant charts. Anchoring is prohibited in the area between these two anchorages to allow access to local ports, noting this area includes the charted location of the Liverpool pilot boarding area (see Section 9.9).

99. The charts indicate anchorage can also be obtained within an area labelled as "North Rhyl", in an area located approximately 0.7NM from the offshore ECC.

100. It is noted that commercial vessels are known to anchor off Point Lynas at Moelfre Road which affords good shelter in westerly winds. Further details are provided in Section 13.2.9 which provides analysis of vessels observed to be at anchor within the marine traffic data studied for the purposes of this NRA, noting that these findings align with consultation output (see Section 4).

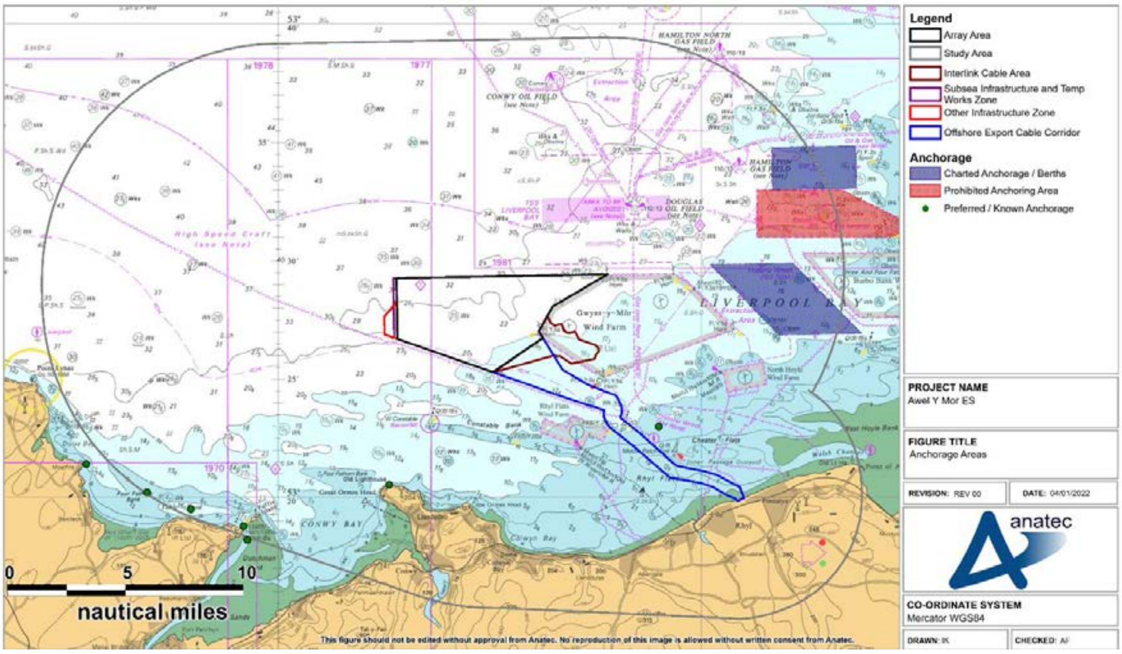


Figure 9.11: Anchorage Areas

9.11 Military Practice Areas

101. A Ministry of Defence (MoD) Altcar Rifle firing range (MoD area X5306) is located 18NM to the east of the array. No restrictions are placed on the right to transit the firing practice area at any time and operates a clear range procedure (i.e., firing only takes place when the area is considered to be clear of all shipping).

9.12 Marine Environmental High Risk Areas

102. Marine Environmental High Risk Areas (MEHRA) (DfT, 2001) are areas along the UK coast designed to "*inform [ships'] Masters of areas where there is a real prospect of a problem arising. This prime purpose stands alone and regardless of any consequential defensive measures*" (Lord Donaldson, 1994).

103. There are no MEHRAs located in proximity to AyM, with the closest being in excess of 90NM from the array.

10 Meteorological Ocean Data

104. This section presents meteorological and oceanographic statistics of relevance in the vicinity of AyM, defined based on the available data sources as detailed in Section 7. It is noted that the data presented within this section is used as input to the collision and allision risk modelling within Section 14.

10.1 Wind

105. Wind direction probabilities within the area of relevance to AyM have been based on data assessed within Volume 4, Annex 2.1: Physical Processes Technical Baseline (application ref: 6.4.2.1). The probabilities are shown in Figure 10.1. As can be seen, the predominant wind direction is from the south west.

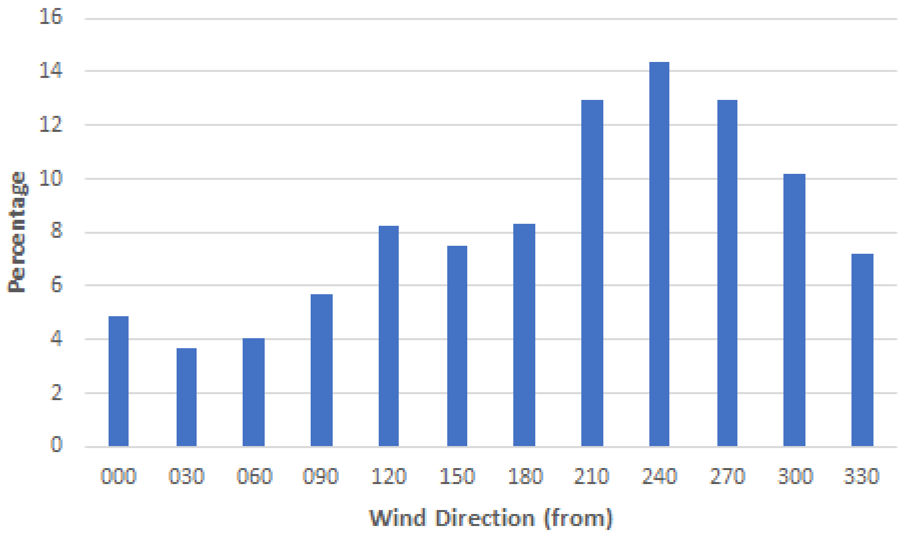


Figure 10.1: Wind Direction Probabilities

10.2 Wave

106. Table 10.1 presents the proportion of the sea state within each of three defined ranges based upon Significant Wave Height (SWH) data collected for the area as per Volume 4, Annex 2.1: Physical Processes Technical Baseline (application ref: 6.4.2.1).

Table 10.1: Sea State Probabilities

Sea State (based on SWH)	Proportion
Calm (<1m)	0.7509
Moderate (1–5m)	0.2489
Severe (≥5m)	0.0002

10.3 Visibility

107. It is assumed that the annual proportion of poor visibility is 2%. This is based upon information from UKHO Admiralty Sailing Directions West Coasts of England and Wales Pilot NP37 (UKHO, 2017).

10.4 Tidal

108. Tidal data to be used as an input to the collision and allision modelling is based upon the information available from Admiralty Chart 1978 and 1826. Table 10.2 presents the peak flood and ebb direction and speed values for the Chart 1978 B, C, D, E, G, K, L, M and Chart 1826 P, and S charted tidal diamonds in proximity to the site.

Table 10.2: Tidal Data

Tidal Diamond (Chart 1978)	Flood		Ebb	
	Direction (°)	Speed (knots)	Direction (°)	Speed (knots)
B	098	1.4	276	1.5
C	104	1.6	279	1.4
D	100	1.8	289	1.7
E	100	1.7	281	1.3
G	105	1.7	280	1.4
J	102	1.8	282	1.7
K	104	1.4	270	1.4
L	100	1.4	295	1.3
M	133	1.2	316	1.2
Tidal Diamond (Chart 1826)	**Flood**		**Ebb**	
	Direction (°)	**Speed (knots)**	**Direction (°)**	**Speed (knots)**
P	083	2.5	269	2.0
S	098	3.3	276	2.9

11 Emergency Response Overview

11.1 Search and Rescue Helicopters

109. Since April 2015, the Bristow Group have provided helicopter SAR operation service in the UK and is contracted to do so until March 2026. The SAR helicopter service is operated out of 10 base locations around the UK, with the closest to AyM being located at Caernarfon, approximately 26NM south west of the array as shown in Figure 11.1. This base is the most likely to respond to any incident requiring SAR helicopter services, based upon the SAR helicopter data for the region (99% of incidents as per Section 12.3).

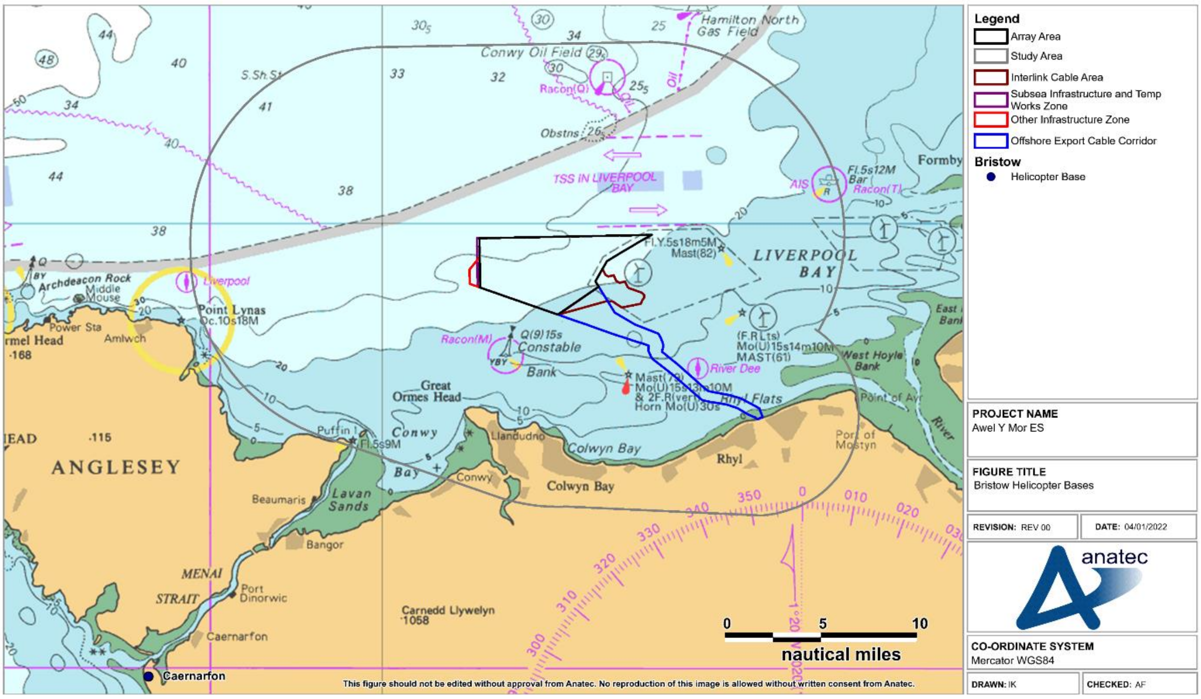


Figure 11.1: Bristow Helicopter Bases

11.2 Royal National Lifeboat Institution

110. The RNLI is organised into divisions, with the relevant region for AyM being "Wales and West". Based out of more than 230 stations around the UK, there are around 350 lifeboats across the RNLI fleet, including both All-Weather Lifeboats (ALBs) and Inshore Lifeboats (ILBs). Figure 11.2 presents the locations of RNLI stations in proximity to AyM, and Table 11.1 summarises the types of lifeboat operated by the RNLI out of the three stations located within the study area.

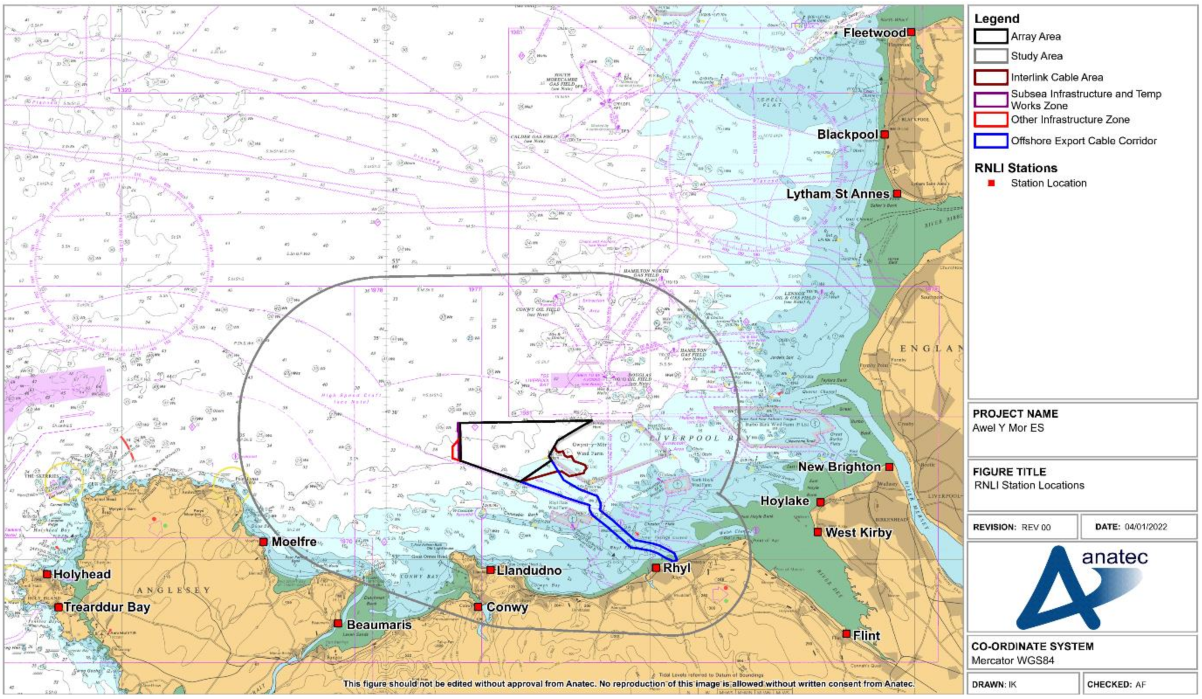


Figure 11.2: RNLI Station Locations

Table 11.1: RNLI Station Details

Station	Lifeboat(s)	ALB Class	Inshore Lifeboat (ILB) Class	Minimum Distance to Array (NM)
Llandudno	ALB and ILB	Shannon	D Class	6.5
Conwy	ILB	n/a	D Class	8.8
Rhyl	ALB and ILB	Shannon	D Class	10.3

111. RNLI lifeboats are available on a 24-hour basis throughout the year. Given that the RNLI have a 100NM operational limit, and noting the locations of the nearest stations, a RNLI lifeboat could respond to an incident within the array. This is reflected within the RNLI incident data for the region (see Section 12.2).

11.3 Her Majesty's Coastguard

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

113. The HMCG coordinates SAR operations through a network of nine Maritime Rescue Coordination Centres (MRCC), a Maritime Rescue Sub Centre (MRSC) in London and the Joint Rescue Coordination Centre (JRCC) based in Hampshire. A corps of up to

3,500 volunteer Coastguard Rescue Officers (CRO) around the UK from around 350 Coastguard Rescue Teams (CRT) are involved in coastal rescue, searches and surveillance.

114. All of the MCA's operations, including SAR, are divided into three geographical regions. The Wales and West of England region covers the area encompassing AyM. Each region is divided into six districts with its own MRCC, which coordinates the SAR response for maritime and coastal emergencies within its district boundaries. The closet MRCC to AyM is located in Holyhead, approximately 27NM west of the array.

12 Historical Maritime Incidents

12.1 Marine Accident Investigation Branch

12.1.1 2010-2019

115. The incidents recorded within the MAIB data between 2010 and 2019 occurring within the study area are presented in Figure 12.1, colour coded by incident type. Following this, Figure 12.2 shows the same data colour coded by the type of vessel involved in the incident.

116. A total of 45 incidents were recorded by the MAIB within the shipping and navigation study area between 2010 and 2019, which corresponds to an average of five incidents per year. Of these, one occurred within the array. No incidents were recorded within the offshore ECC, however one incident occurred in the GyM Interlink Zone.

117. The most common incident types were “Accident to Person”, which accounted for 29% of the total, followed by “Machinery Failure” which accounted for 27%. The incident within the array was a case of “Machinery Failure” of a vessel associated with the O&G industry in 2012.

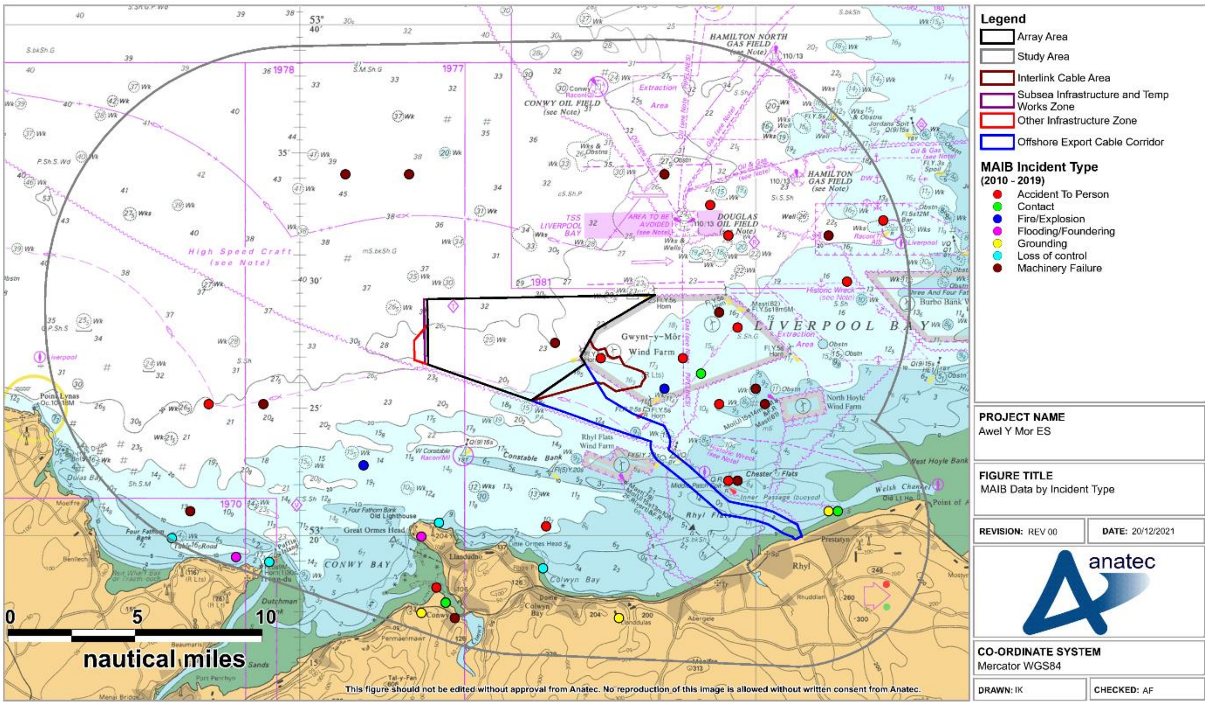


Figure 12.1: MAIB Data by Incident Type

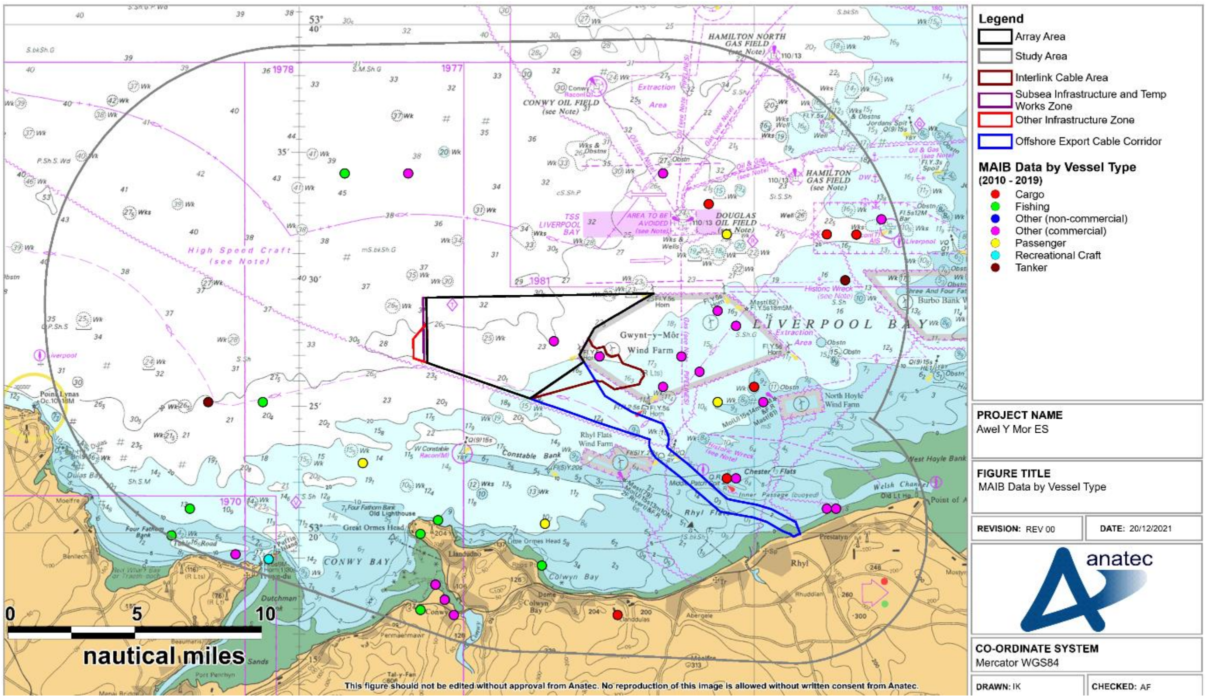


Figure 12.2: MAIB Data by Vessel Type

12.1.2 2000-2009

118. At UK Chamber of Shipping (CoS) request (see Section 4.2) an additional ten years of MAIB incident data covering 2000-2009 has also been considered to bring the total up to 20 years. It should be considered that the 2000-2009 data precedes key features of the area (notably the operational wind farms and the Liverpool Bay TSS), and therefore the most recent ten years available (Section 12.1.1) has remained the focus of the analysis.

119. A total of 44 incidents were recorded by the MAIB within the study area during the ten-year period between 2000-2009, which corresponds to an average of four per year. No incidents occurred within the array (however one occurred in close proximity, within 200m), and one incident occurred within the offshore ECC. The most common incident types were "Accident to Person" and "Machinery Failure".

120. These findings are considered as correlating well with the 2010-2019 data.

12.2 Royal National Lifeboat Institution

121. The incidents recorded within the RNLI data between 2010 and 2019 occurring within the study area are presented in Figure 12.3, colour coded by incident type. Following this, Figure 12.4 shows the same data colour coded by the type of vessel involved in the incident.

122. A total of 1,150 incidents were recorded by the RNLI within the study area between 2010 and 2019, which corresponds to an average of 115 incidents per year, noting that

the majority of these incidents occurred within coastal regions. Of these, five occurred within the array and 22 incidents occurred within the offshore ECC.

123. The most common incident types were "person in danger", which accounted for 30% of the total, followed by "machinery failure" which accounted for 27%. The most common vessel types / people involved in incidents were recreational vessels (41%), and person in danger (31%).

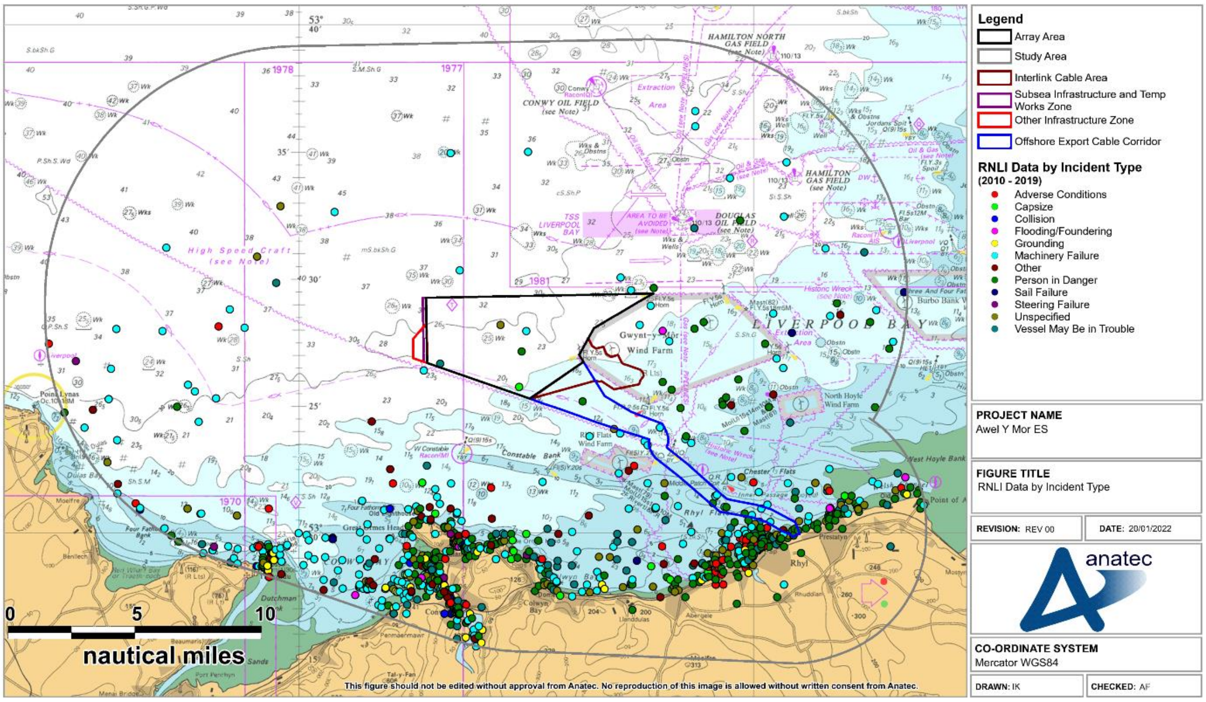


Figure 12.3: RNLI Data by Incident Type

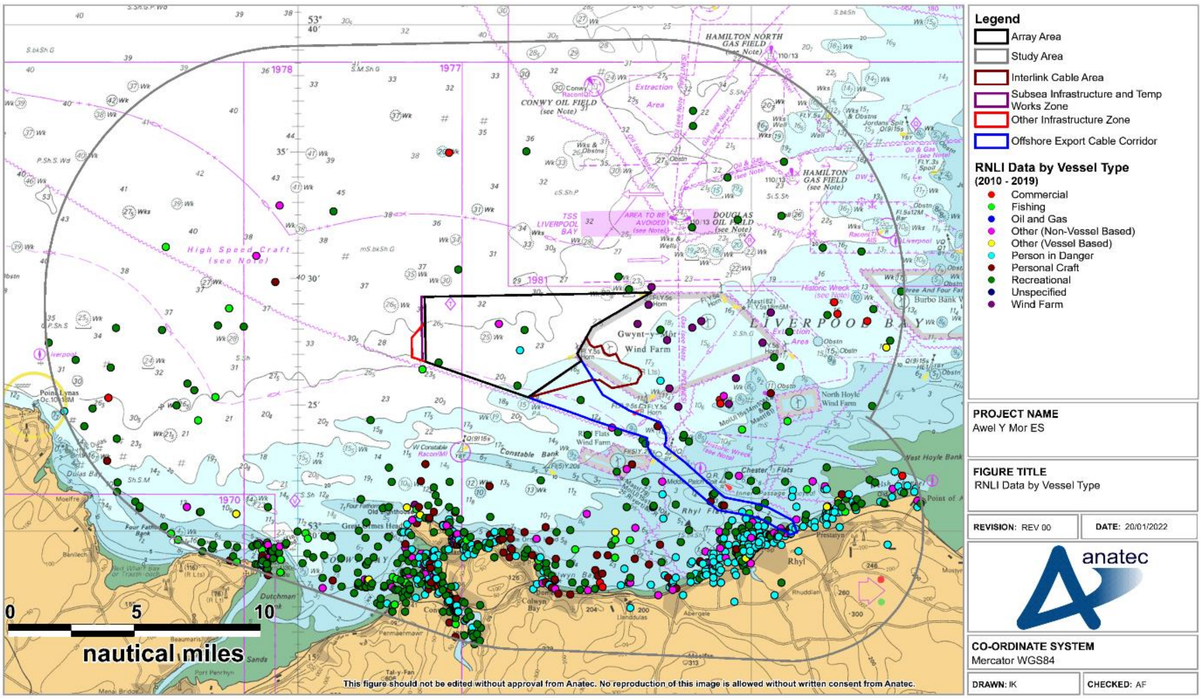


Figure 12.4: RNLI Data by Vessel Type

12.3 Search and Rescue Helicopter Taskings

124. A total of 96 SAR helicopter taskings were undertaken for incidents within the shipping and navigation study area, corresponding to an average of 19 taskings per year. No SAR helicopter taskings were undertaken within the array or offshore ECC. Figure 12.5 presents the SAR helicopter taskings undertaken within the study area colour coded by tasking type.

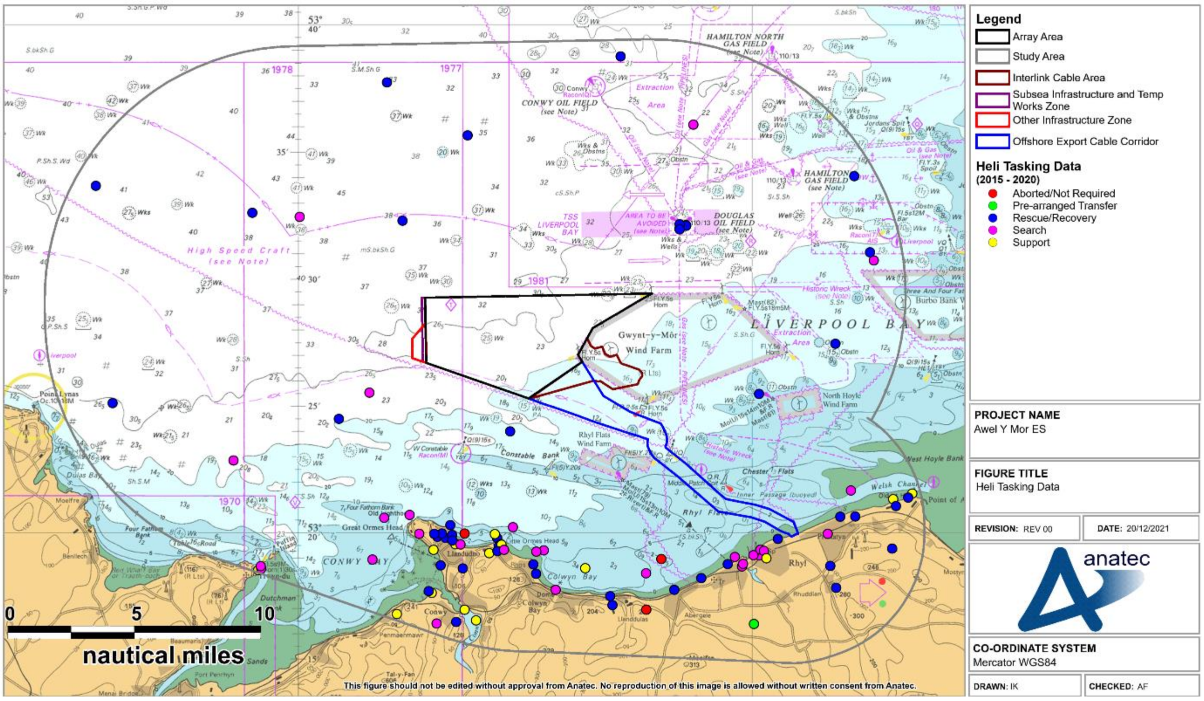


Figure 12.5: Heli Tasking Data

12.4 Historical Offshore Wind Farm Incidents

125. At the time of writing[3] there are 39 fully commissioned and operational OWFs in the UK, ranging from the North Hoyle OWF (fully commissioned in 2003) to Hornsea Project One (fully commissioned in 2020). To date[3], these developments consist of approximately 17,415 fully operational wind turbine years.

126. MAIB incident data has been used to collate a list of historical collision and allision incidents involving UK OWF developments, which is summarised in Table 12.1. 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. This list is limited to collision and allision incidents given their specific relevance to shipping and navigation. Only incidents that have been formally reported are captured.

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

128. As of January 2020, there have been no collisions 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.

[3] 24th January 2022

129. As of January 2022 there have been ten reported[4] 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 approximately 1,742 years per WTG allision incident in the UK, noting that this is a conservative calculation given that only operational WTG hours have been included (whereas allision incidents counted include non-operational WTG). Table 12.1 includes details of these nine WTG allision incidents, any other allision incidents, and collision incidents involving UK OWF developments.

130. It is noted that there have also been a number of collision and allision incidents involving non-UK OWF developments, including the following notable incidents:

- An allision incident involving an offshore service and supply vessel which experienced a loss of control whilst undertaking an emergency control system test shortly after casting off from a WTG in a German OWF (Federal Bureau of Maritime Casualty Investigation (BSU), 2019); and
- An anchored bulk carrier breaking its anchor chain during a storm, resulting in the vessel drifting and colliding with another anchored vessel. All 18 crew members were evacuated by helicopter, and the vessel then drifted into a WTG and subsequently into a platform foundation, both associated with a wind farm development under construction. With the vessel around 3nm from the Dutch coast, it was taken under tow and brought north until the storm had passed, upon which it was towed into Rotterdam (gCaptain, 2022).

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

Table 12.1: 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 – project vessel with WTG	7th August 2005	A vessel involved with the installation of WTGs underestimated the effect of the current and allided with the base of a WTG whilst manoeuvring alongside it. Minor damage was sustained to a gangway on the vessel, the WTG tower, and a WTG blade.	Minor damage to gangway on the vessel	None	MAIB
Project	Allision – project vessel with WTG	29th September 2006	When approaching a WTG, an offshore services vessel was struck by the tip of a WTG blade which was rotating rather than secured in a fixed position.	None	None	MAIB
Project	Allision – project vessel with disused pile	8th February 2010	The Skipper on-board a work boat slipped their hand on the throttle controls whilst in proximity to a disused pile. There was insufficient time to correct the error and the vessel struck the pile. A passenger	Minor	Injury	MAIB

Incident Vessel	Incident Type	Date	Description of Incident	Vessel Damage	Harm to Persons	Source
			moving around the interior of the vessel was thrown off his feet. Although not known at the time, the passenger was later diagnosed with back injuries. No serious damage was caused to the vessel.			
Project	Collision – third party vessel with project vessel	23rd April 2011	A third-party catamaran was hit by a project guard vessel within a harbour.	Moderate	None	MAIB
Project	Allision – project vessel with WTG	18th November 2011	The Officer of the Watch (OOW) on-board a cable-laying vessel fell asleep and woke to find the vessel inside a wind farm. He attempted to manoeuvre the vessel out of the wind farm on autopilot, but the settings did not allow a quick turn and the vessel struck the foundations of a partially completed WTG. The vessel suffered two hull breaches.	Major	None	MAIB

Incident Vessel	Incident Type	Date	Description of Incident	Vessel Damage	Harm to Persons	Source
Project	Collision – project vessel with service vessel	2nd June 2012	A CTV became lodged under the boat landing equipment of a flotel. Nine persons were safely evacuated and transferred to a nearby vessel before being brought back into port.	Moderate	None	UK CHIRP
Project	Allision – project vessel with WTG	20th October 2012	The OOW misjudged the distance from a WTG monopile and made contact with the vessel's stern resulting in minor damage.	Minor	None	MAIB
Project	Allision – project vessel with buoy	21st November 2012	A wind farm passenger transfer catamaran struck a buoy at high speed whilst supporting operation for an OWF. The vessel was abandoned by the crew of 12 with the vessel having been holed, causing extensive flooding. There were however no injuries. It was found that the Master had unknowingly altered the	Major	None	MAIB

Incident Vessel	Incident Type	Date	Description of Incident	Vessel Damage	Harm to Persons	Source
			vessel's course and had not been formally assessed to determine his suitability for the role.			
Project	Allision – project vessel with WTG	21st November 2012	A work boat allided with the unlit transition piece of a WTG at moderate speed. The impact caused all five persons on-board to be forced out of their seats. The vessel was able to proceed to port unassisted with no water ingress incurred, although there was some structural damage. It was found that the vessel's Master had relied too heavily on visual cues and there had been insufficient training with navigation equipment. The WTG transition piece had been reported as unlit although the defect reporting system had failed to	Moderate	None	MAIB

Incident Vessel	Incident Type	Date	Description of Incident	Vessel Damage	Harm to Persons	Source
			promulgate a navigation warning.			
Project	Allision – project vessel with WTG	1st July 2013	After disembarking passengers at an offshore substation a service vessel's jets were disengaged, but the vessel jet drive suffered a failure which resulted in an allision with a WTG foundation. The vessel suffered some damage whereas the WTG foundation was not damaged.	Minor	None	IMCA Safety Flash
Project	Allision – project vessel with WTG	14th August 2014	A standby safety vessel allided with a WTG pile and consequently leaked marine gas oil and a surface sheen trailed from the vessel. Under its own power the vessel moved away from environmentally sensitive areas until the leak was stopped.	Minor with pollution	None	UK CHIRP

Incident Vessel	Incident Type	Date	Description of Incident	Vessel Damage	Harm to Persons	Source
Third party	Allision – fishing vessel with WTG	26th May 2016	A crew member on-board a fishing vessel left the autopilot on, resulting in an allision with a WTG. A lifeboat attended the incident.	Moderate	Injury	Web search (RNLI, 2016)
Project	Allision – project vessel with WTG	16th January 2020	A project vessel servicing WTGs allided with a WTG whilst transiting back to port resulting in a member of the crew coming into contact with the railings. The vessel proceeded unaided back to port where the man was subsequently taken to hospital to obtain doctors' advice.	None	Injury	Web search (Vessel Tracker, 2020)

13 Vessel Traffic

131. This section presents the results of two 14-day survey periods of marine traffic survey data (28 days in total), collected by an on-site vessel during 2020 and 2021 as per Section 8.

132. A number of tracks recorded during the survey periods were classified as temporary (non-routine), such as tracks associated with survey vessels. These have therefore been excluded from the analysis. O&G support vessels and wind farm vessels at operational platforms and wind farms have been retained in the analysis.

133. The vessels recorded during the winter 2020 survey period within the study area are colour-coded by vessel type and presented in Figure 13.1. Following this, the vessels recorded during the summer 2021 survey period within the study area are colour-coded by vessel type and presented in Figure 13.2.

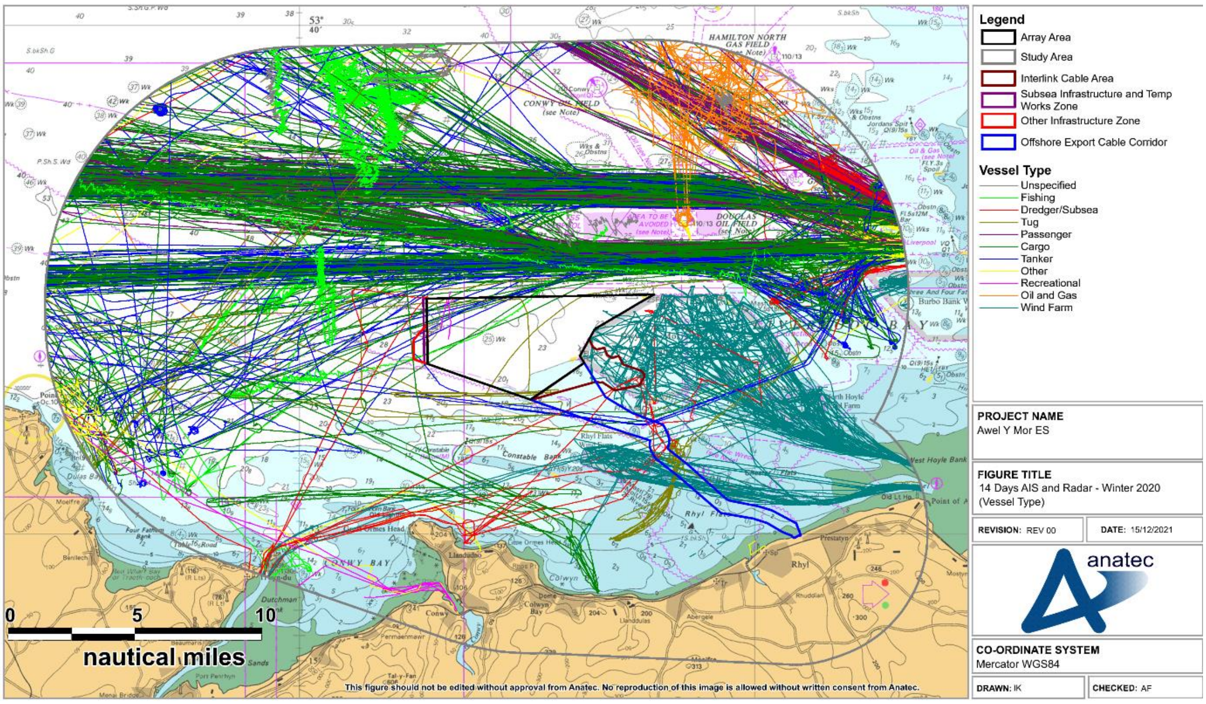


Figure 13.1: Vessel Types – Winter 2020 Survey Period

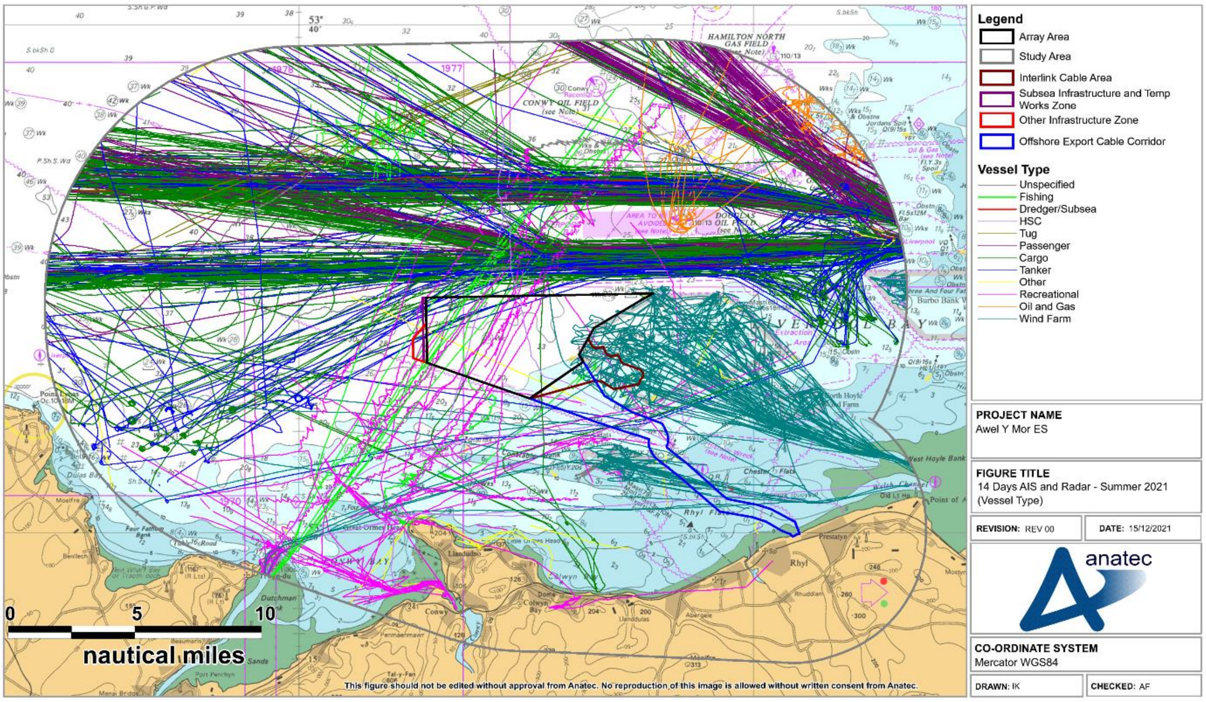


Figure 13.2: Vessel Types – Summer 2021 Survey Period

134. During the winter survey period, 5% of vessels were recorded on Radar with the majority (52%) of these vessels identified as fishing vessels. During the summer survey period, 3% of vessels were recorded on Radar with the majority (56%) of these vessels identified as recreational vessels. It is noted that for a number of vessels detected on Radar during the surveys it was not possible to identify the vessel type, generally due to adverse weather conditions.

135. The heat map of the density of vessels recorded during both survey periods within the study area is presented in Figure 13.3.

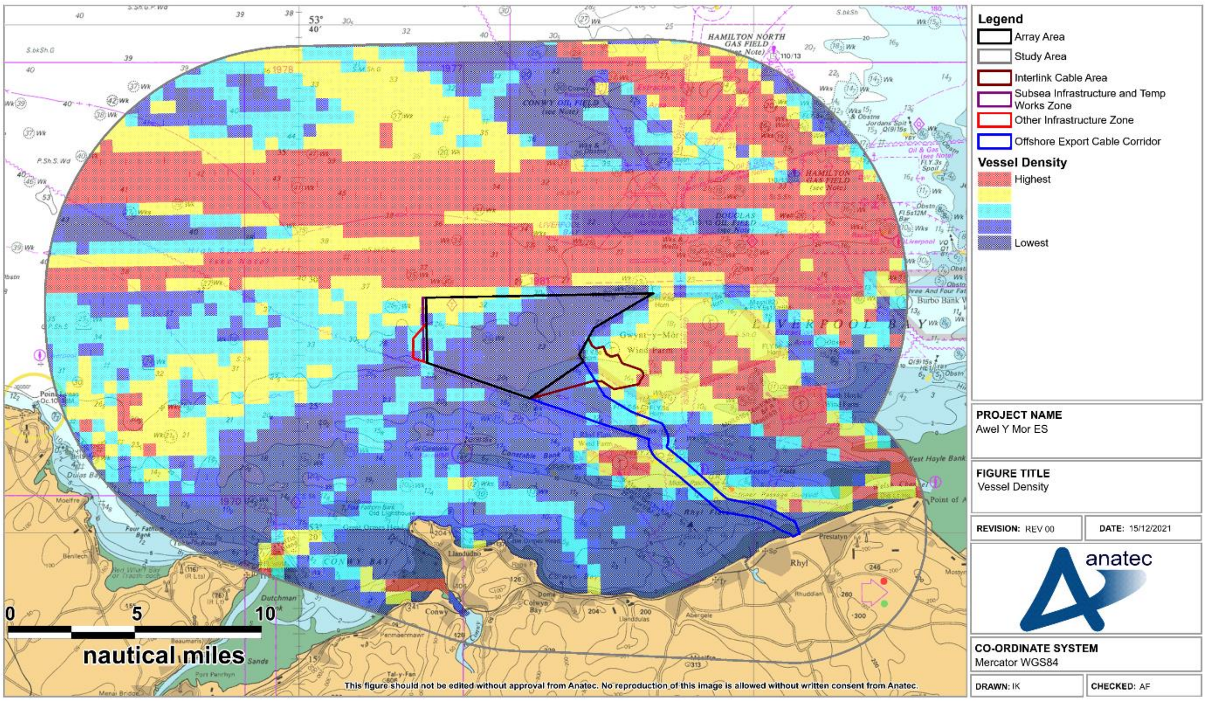
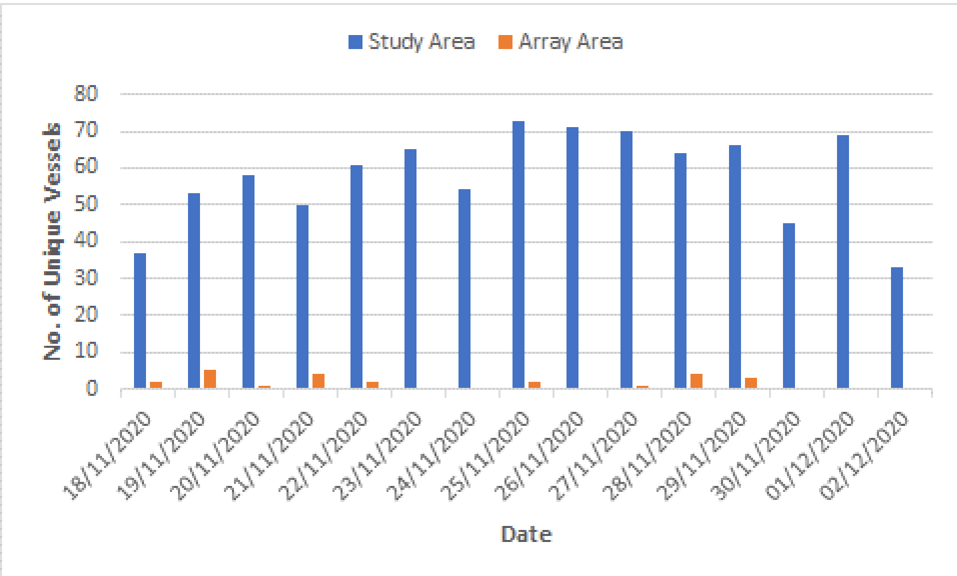


Figure 13.3: Vessel Density – 28 days 2020/2021

13.1 Vessel Counts

136. The number of unique vessels recorded per day within the study area and intersecting the array during both survey periods are presented in Figure 13.4. Throughout the winter survey period approximately 3% of vessels recorded within the study area intersected the array. For the summer survey period this was 6%. Following Figure 13.4, Table 13.1 and Table 13.2 present summaries of the unique number of vessels recorded during the busiest full day, quietest full day, and on average both survey periods, within the study area and the array area respectively.



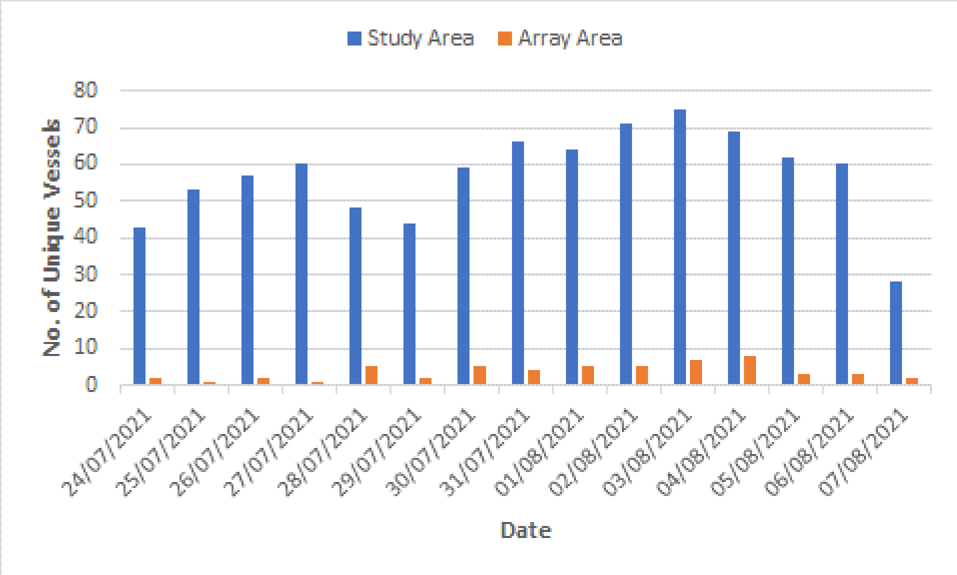


Figure 13.4: Unique Vessels Per Day

Table 13.1: Summary of Unique Vessels Recorded within the Study Area

		Quietest Day/s	Busiest Day/s	Average
Winter	Count	45	73	58
	Date	30/11/2020	25/11/2020	N/A
Summer	Count	44	71	57
	Date	29/07/2021	02/08/2021	N/A

Table 13.2: Summary of Unique Vessels Recorded within the Array

		Quietest Day/s	Busiest Day/s	Average
Winter	Count	0	5	2
	Date	24/11/2020, 26/11/2020, 30/11/2020, 01/12/2020, and 02/12/2020	19/11/2020	N/A
Summer	Count	0	8	4
	Date	25/07/2021 and 27/07/2021	04/08/2021	N/A

13.2 Vessel Types

137. The relative proportions of vessel types recorded within the study area and the array during both survey periods are presented in Figure 13.5.

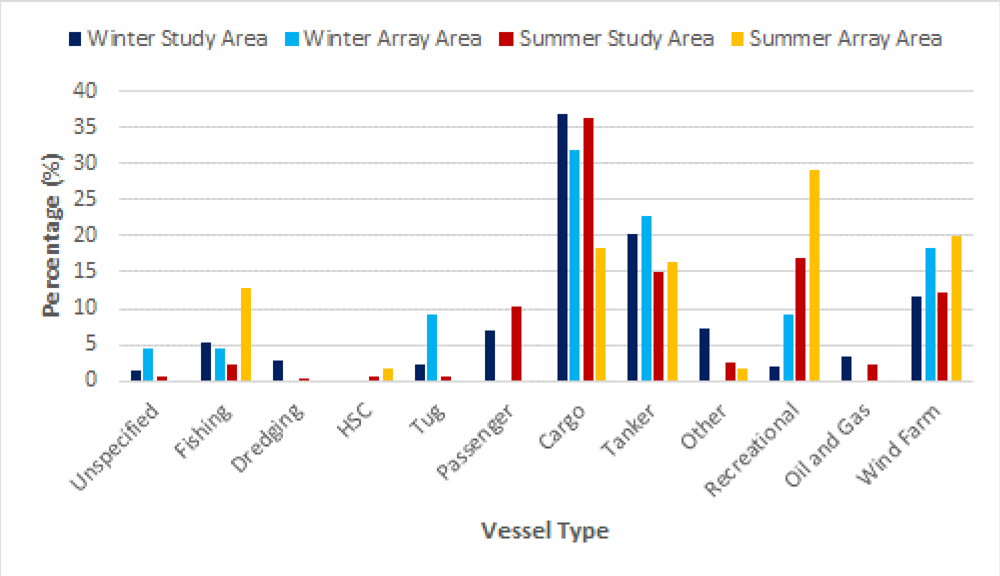


Figure 13.5: Vessel Type Distribution

138. The main vessel types recorded throughout the winter survey period within the study area were cargo vessels (37%), tankers (20%), and wind farm vessels (12%). The main vessel types recorded throughout the winter survey period within the array area were cargo vessels (32%), tankers (23%), and wind farm vessels (18%).

139. The main vessel types recorded throughout the summer survey period within the study area were cargo vessels (36%), recreational vessels (17%), and tankers (15%). The main vessel types recorded throughout the summer survey period within the array area were recreational vessels (29%), wind farm vessels (20%), and cargo vessels (18%). The key difference between the surveys was observed to be an increase in recreational activity during the summer period, noting this is as would be expected.

13.2.1 Cargo Vessels

140. Figure 13.6 presents a plot of cargo vessels recorded throughout both survey periods within the study area, colour coded by cargo vessel sub-type.

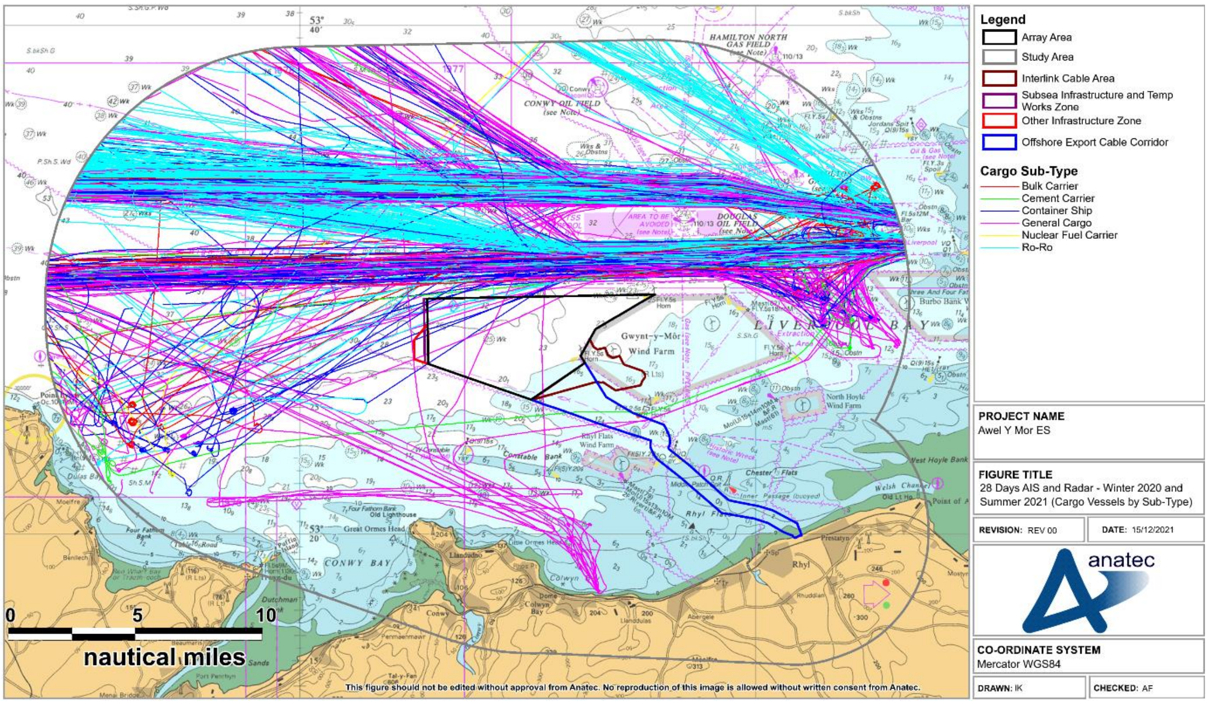


Figure 13.6: Cargo Vessels within the Study Area

141. An average of 21 unique cargo vessels per day were recorded during the survey periods within the study area, with the most common types being Ro-Ro (32%) and general cargo vessels (31%). The majority of the cargo vessels within the study area were observed to utilise the Liverpool TSS.

142. Cargo vessels were observed at anchor within both the Liverpool anchorages and off Point Lynas. Further details are provided in Section 13.2.9.

143. Table 13.3 presents the key commercial ferry routes identified as being utilised by the commercial freight ferries recorded.

Table 13.3: Commercial Freight Ferries

Operator	Route	Vessels
Seatruck	Dublin / Liverpool	▪ Clipper Pennant ▪ Clipper Point ▪ Seatruck Pace ▪ Seatruck Panorama ▪ Seatruck Power ▪ Seatruck Progress ▪ Seatruck Progression
Stena	Dublin / Birkenhead	▪ Stena Forecaster

Operator	Route	Vessels
Atlantic Container Line	Dublin / Liverpool	▪ Atlantic Sky ▪ Atlantic Star ▪ Atlantic Sun
Cobelfret	Dublin/Liverpool	▪ Clementine ▪ Valentine ▪ Victorine

13.2.2 Tankers

144. Figure 13.7 presents a plot of the tankers recorded throughout both survey periods within the study area, colour coded by tanker type.

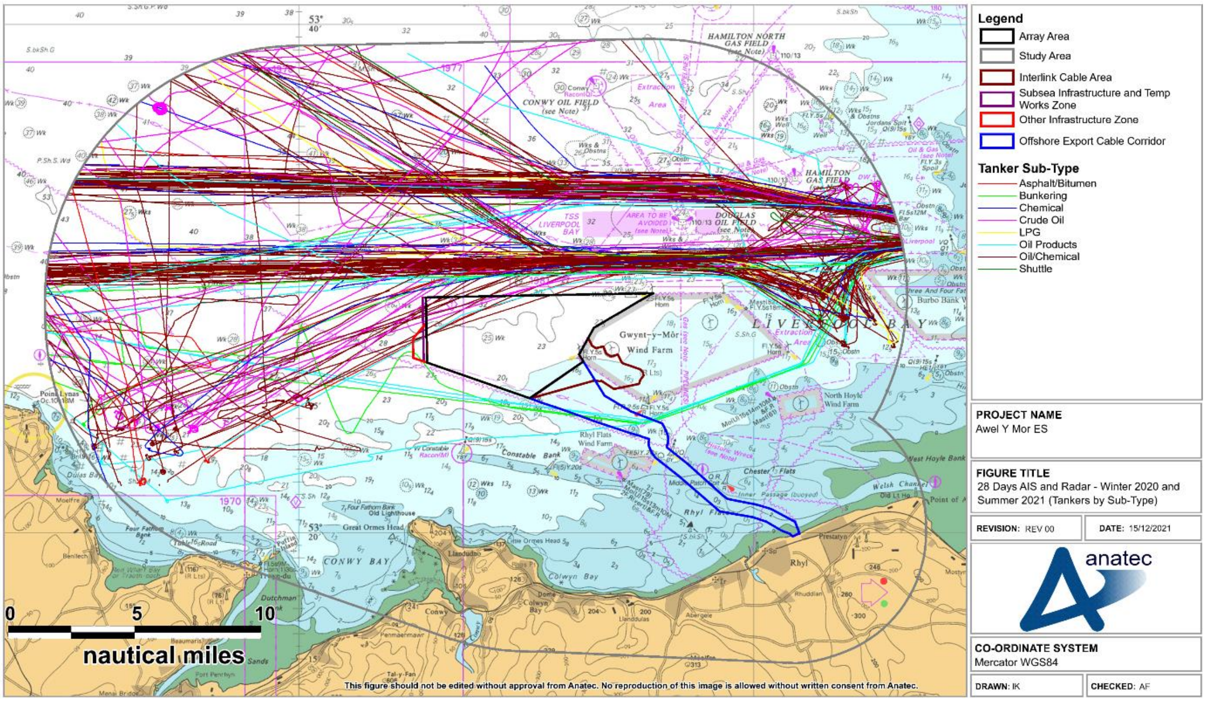


Figure 13.7: Tankers within the Study Area

145. An average of 11 unique tankers per day were recorded during the survey periods within the study area, with the most common type being combined oil and chemical tankers (59%).

146. Tankers were observed at anchor within both the Liverpool anchorages and off Point Lynas. Further details are provided in Section 13.2.9.

13.2.3 Passenger Vessels

147. Figure 13.8 presents a plot of passenger vessels, recorded throughout both survey periods within the study area.

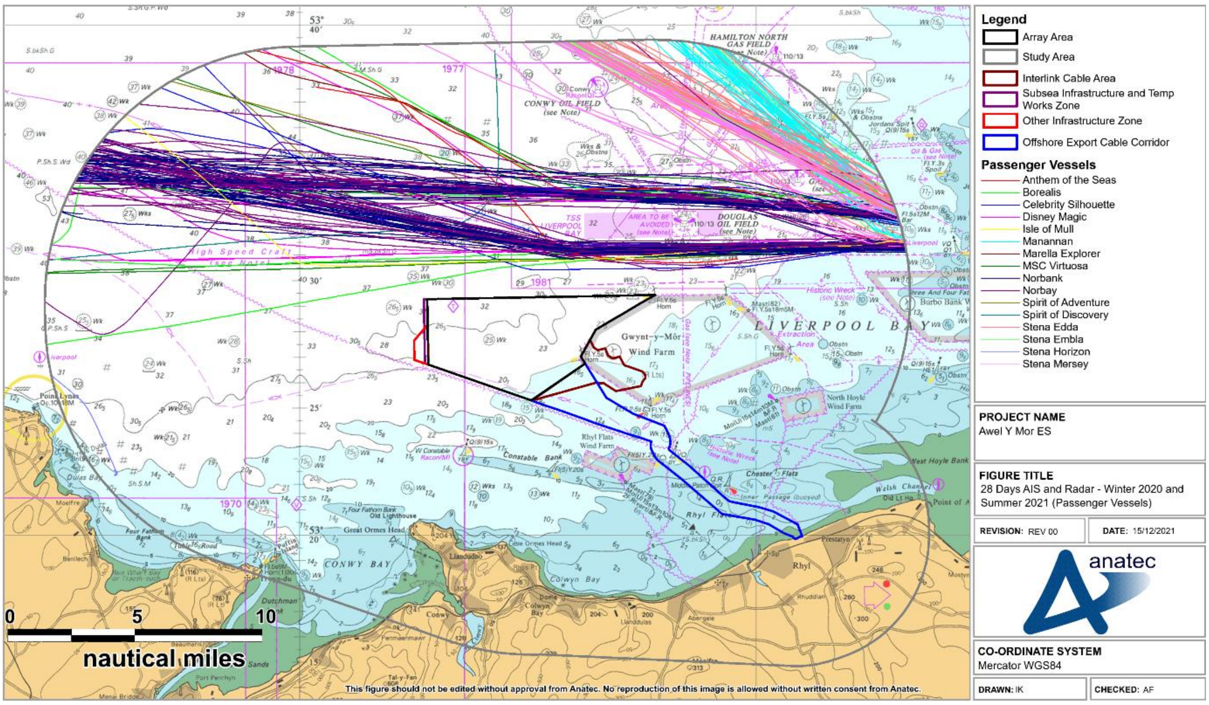


Figure 13.8: Passenger Vessels within the Study Area

148. An average of approximately five unique passenger vessels per day were recorded during the survey periods within the study area. Table 13.4 presents the known commercial passenger ferry routes within the study area. It is noted that the Ben My Chree route was not running during the winter survey, however was present during the summer survey and within the long term 2019 data.

Table 13.4: Commercial Passenger Ferries

Operator	Route	Vessels
P&O	Liverpool to Dublin	▪ Norbank ▪ Norbay ▪ Clipper Pennant
Stena Lines	Liverpool / Belfast	▪ Stena Mersey ▪ Stena Horizon ▪ Stena Edna
Steam Packet Company	Liverpool / Douglas	▪ Ben My Chree

13.2.4 Recreational Vessels

149. Baseline recreational activity has been assessed via the available marine traffic data and the RYA Coastal Atlas (RYA, 2018) in line with RYA preference.

13.2.4.1 Marine Traffic Data

150. Figure 13.9 presents a plot of recreational vessels recorded throughout both survey periods within the study area, colour-coded by survey period (i.e., summer / winter).

151. It is noted that charter anglers operating recreational fishing trips are considered in further detail within Volume 4, Annex 12.1: Recreational Fishing Technical Baseline (application ref: 6.4.12.1). Consultation with local users undertaken as part of that baseline indicates such vessels of less than 15m in length do utilise the area including the array.

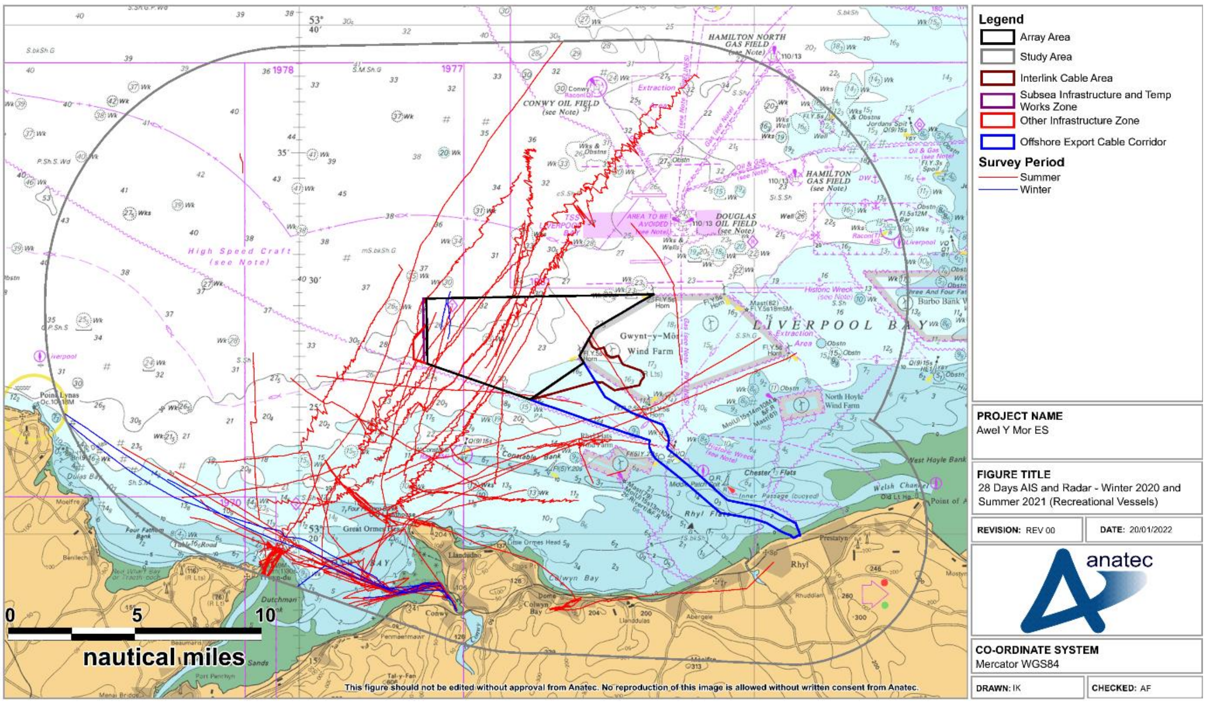


Figure 13.9: Recreational Vessels within the Study Area by Survey Period

152. An average of five unique recreational vessels were recorded per day during the 28 days of data in the study area. It is noted that high seasonal variation was observed, with an average of just one unique recreational vessel recorded per day during the winter survey period within the study area. Recreational vessels were generally recorded within coastal regions to the south of the study area particularly near Conwy, Port Penrhyn, and Point Lynas during the winter period, however transits further offshore including through the array were recorded during summer.

13.2.4.2 RYA Coastal Atlas

153. The RYA Coastal Atlas data (RYA, 2018) is shown relative to AyM in Figure 13.10 (AIS vessel density) and Figure 13.11 (general boating areas).

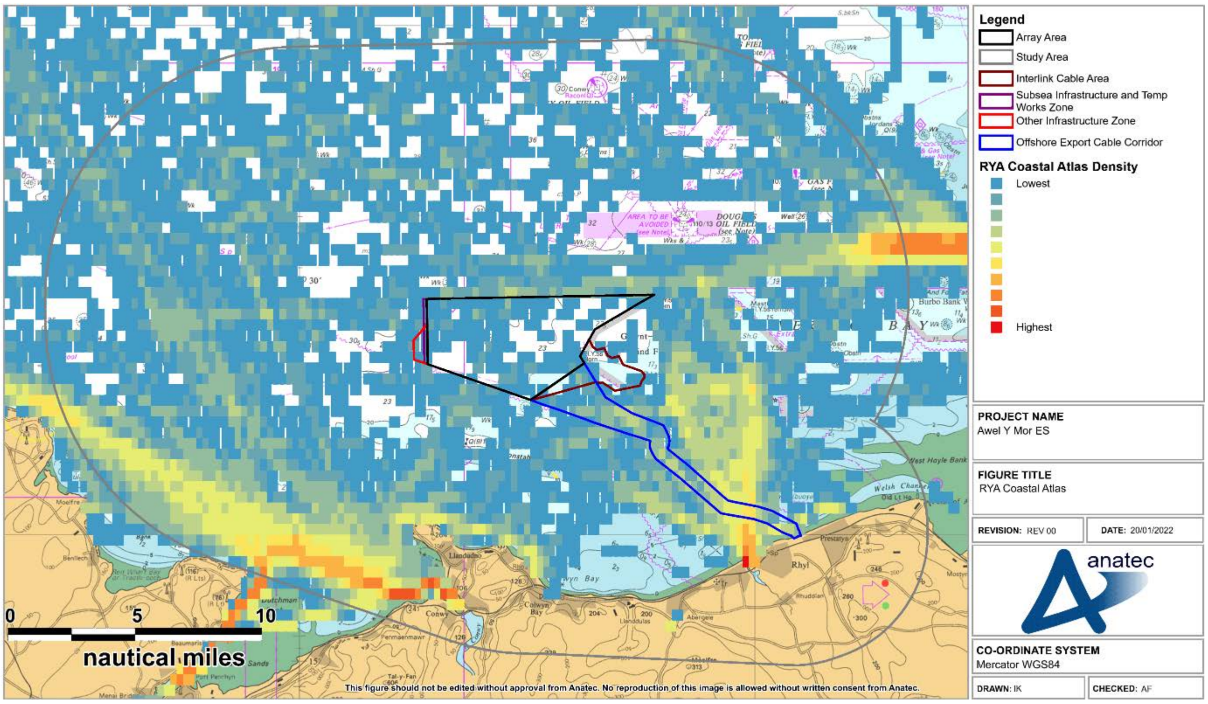


Figure 13.10: RYA Coastal Atlas – Vessel Density

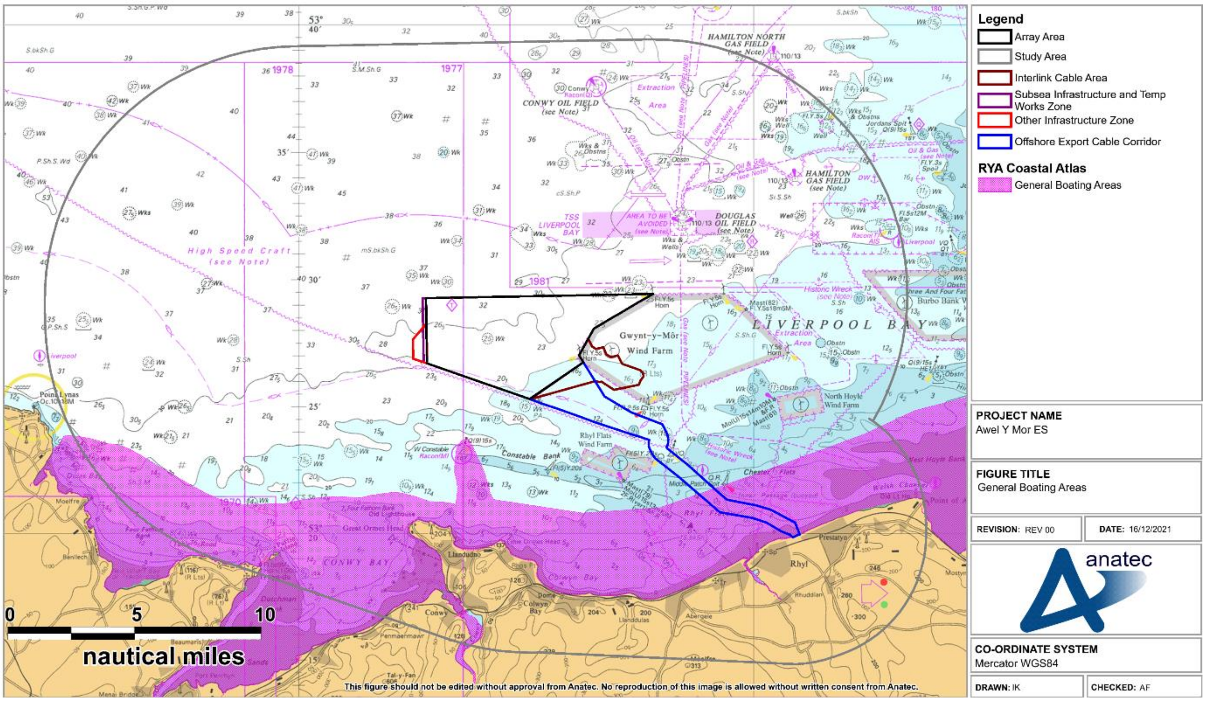


Figure 13.11: RYA Coastal Atlas - General Boating Areas

154. There was considered to be good correlation overall between RYA Coastal Atlas data and the long term 2019 data in that the majority of recreational activity was observed to be coastal, with density within the array itself being generally low. However, it is noted that both the vessel density and general boating area elements of the RYA

Coastal Atlas showed a notable level of activity off Rhyl in the vicinity of the offshore ECC landfall. This activity was not reflected in the long term 2019 data or the 2020 / 2021 survey data. It is considered likely that this change is associated with the operational wind farms in the area, in particular GyM (see Section 9.2). Regardless, the potential for recreational craft (including those not on AIS) to be present in the vicinity of the offshore ECC and landfall is considered in Volume 2, Chapter 9: Shipping and Navigation (application ref: 6.2.9).

13.2.5 Fishing Vessels

155. Figure 13.12 presents a plot of the fishing vessels recorded during both survey periods within the study area, colour-coded by survey period (i.e., summer / winter). It is noted that further detail on commercial fishing vessels including consultation outputs are available in Volume 4, Annex 8.1: Commercial Fisheries Technical Baseline (application ref: 6.4.8.1). The associated consultation with local users indicated that non AIS vessels do utilise the area.

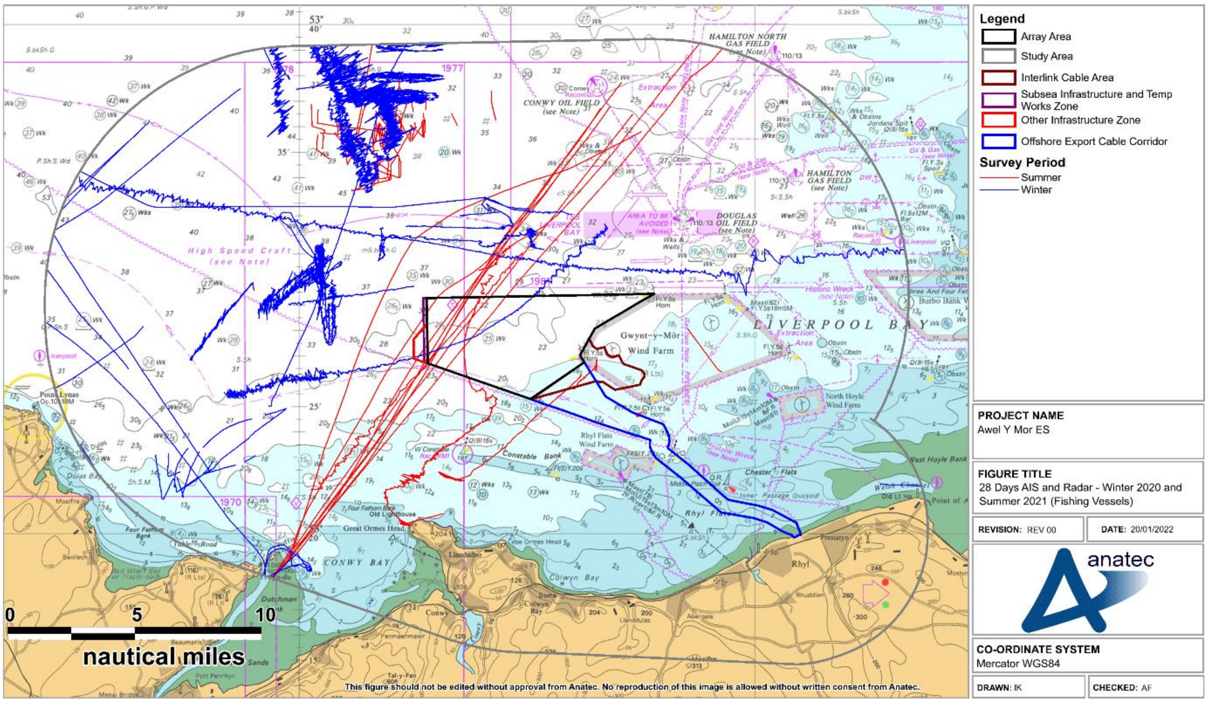


Figure 13.12: Fishing Vessels within the Study Area, by Survey Period

156. An average of two unique fishing vessels were recorded per day during the 28-day survey period within the study area. This included both vessels in transit and actively engaged in fishing (i.e., gear deployed). It is noted that behaviour indicating active fishing (i.e., gear deployed) was recorded, primarily to the west of the array.

157. Eight instances of vessel activity were recorded within the array itself, with the speed and behaviour of these suggested they were transiting at the time as opposed to actively fishing.

13.2.6 Marine Aggregate Dredgers

158. Figure 13.13 presents a plot of the marine aggregate dredger vessels, recorded during both survey periods within the study area. Following this Figure 13.14 presents the BMAPA routes (BMAPA, 2021) within the study area.

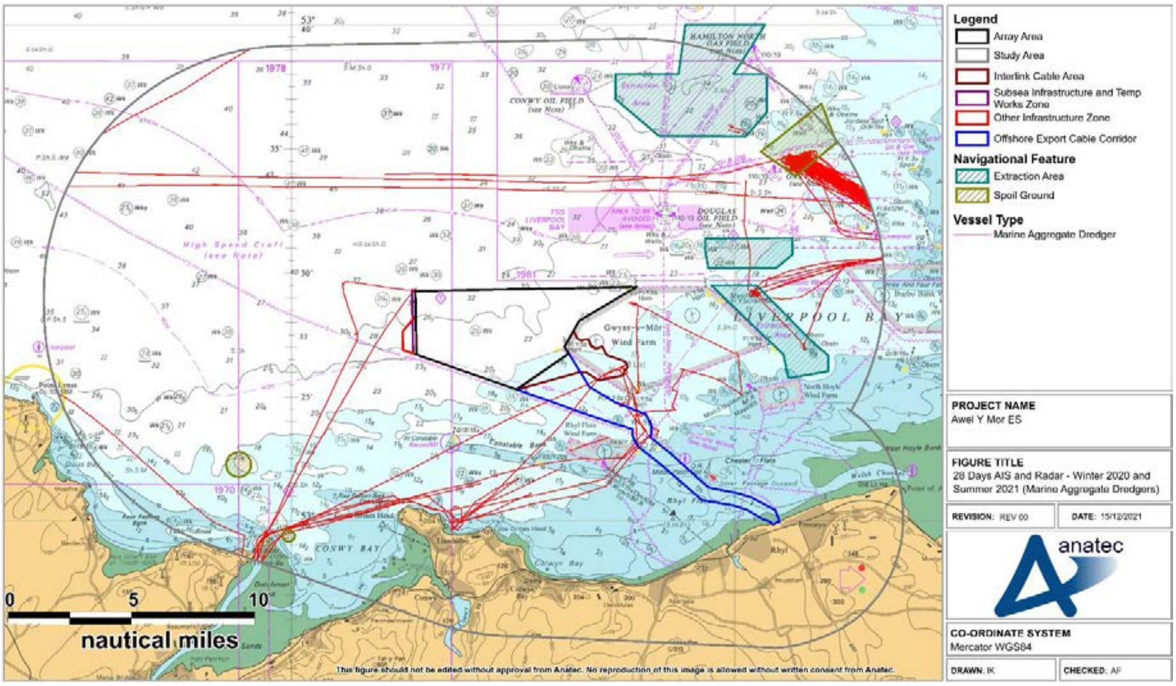


Figure 13.13: Marine Aggregate Dredger Vessels within the Study Area

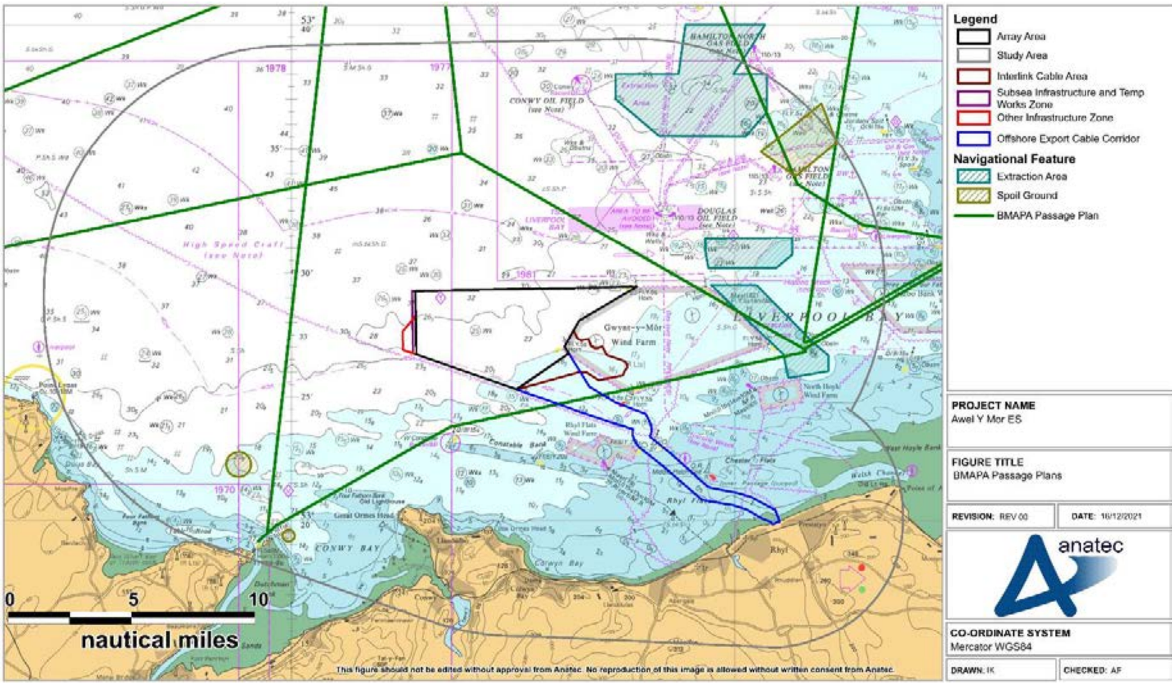


Figure 13.14: BMAPA Routes (2021)

159. An average of one unique marine aggregate dredger vessel was recorded per day during the survey periods within the study area, with these vessels generally transiting to nearby extraction areas. No BMAPA passage plan route passes intersect the array, however one intersects the offshore ECC.

13.2.7 Oil and Gas Vessels

160. Figure 13.15 presents a plot of O&G vessels, recorded during both survey periods within the study area. The relevant platforms are included for context.

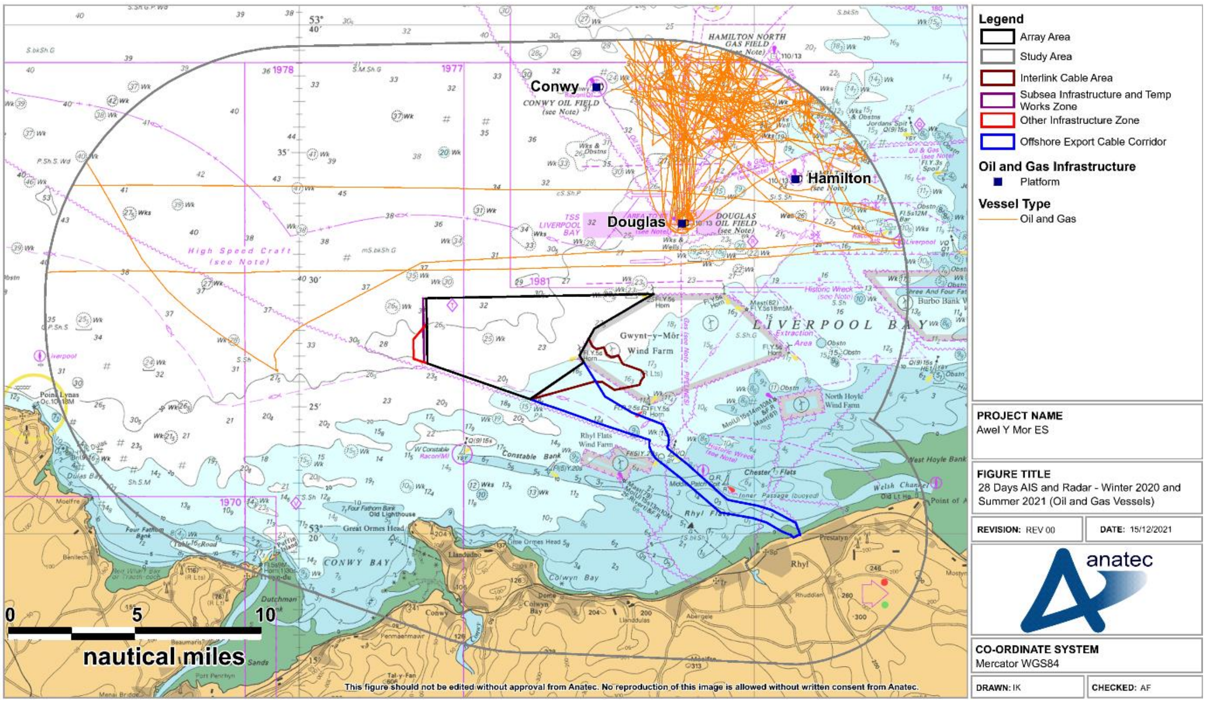


Figure 13.15: Oil and Gas Vessels within the Study Area

161. An average of between one and two unique O&G vessels per day were recorded throughout the survey periods within the study area. The significant majority of this activity was associated with the Douglas platform (see Section 9.3).

162. O&G vessels were generally recorded within the north eastern section of the study area, visiting the platforms within or in close proximity to the study area (see Figure 9.1).

13.2.8 Wind Farm Vessels

163. Figure 13.16 presents a plot of wind farm vessels, recorded throughout both survey periods within the study area.

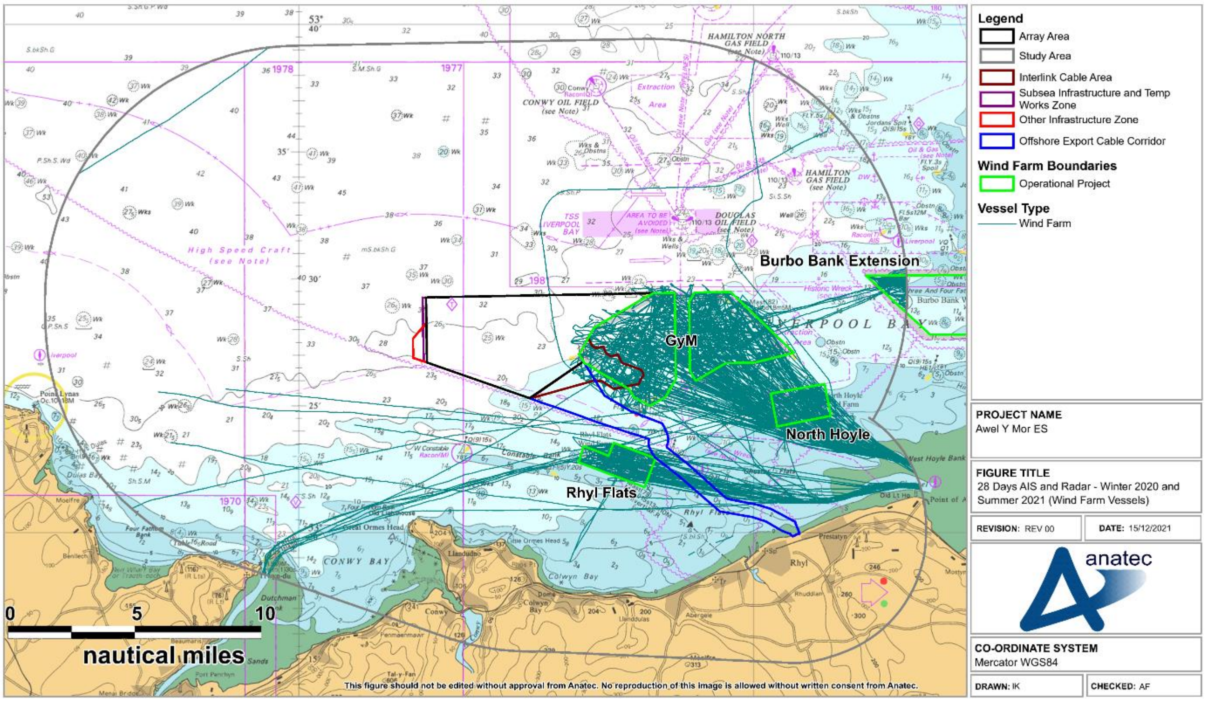


Figure 13.16: Wind Farm Vessels within the Study Area

164. An average of seven unique wind farm vessels were recorded throughout the survey periods within the study area. The significant majority of this traffic was associated with the operational GyM, Rhyl Flats, and North Hoyle projects. Of this traffic, the majority was observed to mobilise from the port of Mostyn to the south.

13.2.9 Anchored Vessels

165. Figure 13.17 presents a plot of anchored vessels, recorded throughout both survey periods within the study area. The charted anchorages associated with Liverpool are included for reference (see Section 9.10).

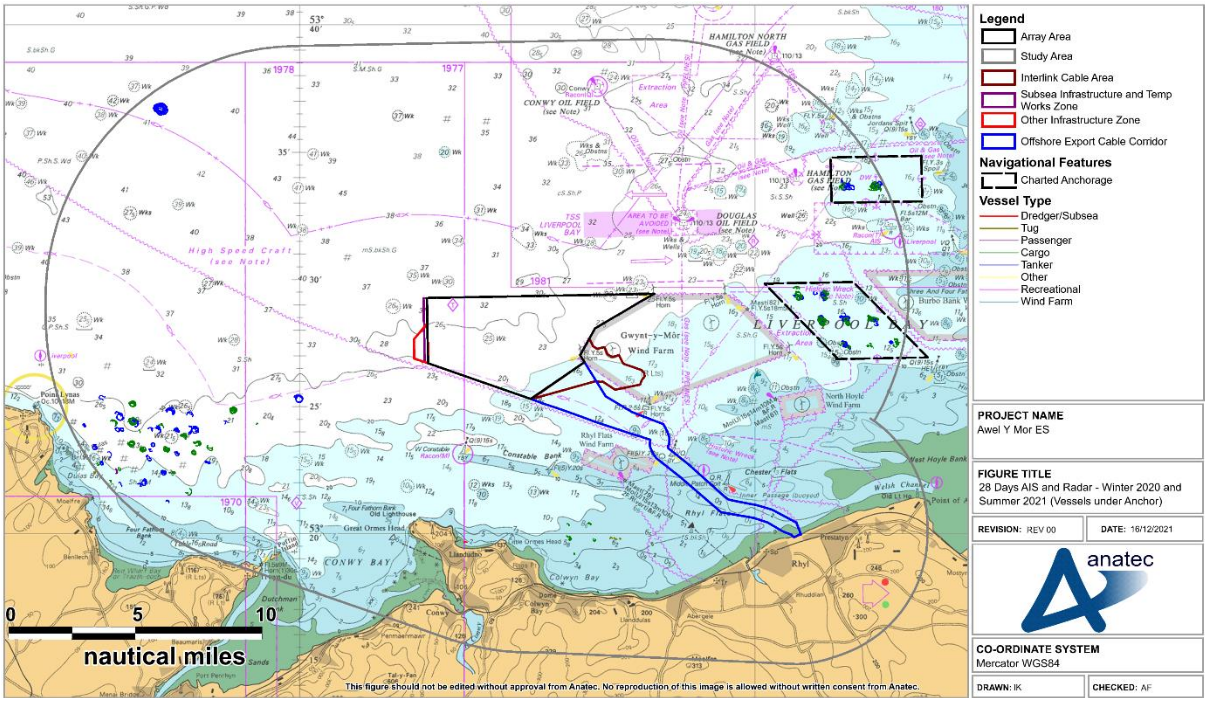


Figure 13.17: Anchored Vessels within the Study Area

166. An average of 13 unique vessels per day were recorded at anchor within the study area during the 28 day survey period, the majority of which were cargo vessels and tankers (90%). Anchoring activity by area in terms of average vessels per day is summarised as follows:

- Six vessels per day within the southern Liverpool anchorage;
- One vessel per day within the northern Liverpool (deep water) anchorage; and
- Between four and five vessels per day off Point Lynas / Dulas Bay.

167. No vessels were recorded at anchor within the array, with the nearest identified anchoring occurrence being 5NM to the east. Similarly, no anchoring activity was recorded within the offshore ECC, with the nearest anchored vessel being in excess of 2.8NM to the south east. It is noted that the long term 2019 data (see Appendix B) did capture limited activity associated with the “North Rhyl” anchorage in proximity to the offshore ECC, however this activity was limited (two instances over the year). Anchoring activity in the vicinity of the GyM Interlink Zone was also limited, with only one instance (associated with a wind farm vessel) recorded in proximity.

13.3 Vessel Sizes

13.3.1 Vessel Length

168. Vessel length was available for approximately 94% of vessels recorded during both survey periods . Figure 13.18 shows the 28 days of survey data plotted by vessel length. Following this, Figure 13.19 shows the distribution of vessel lengths.

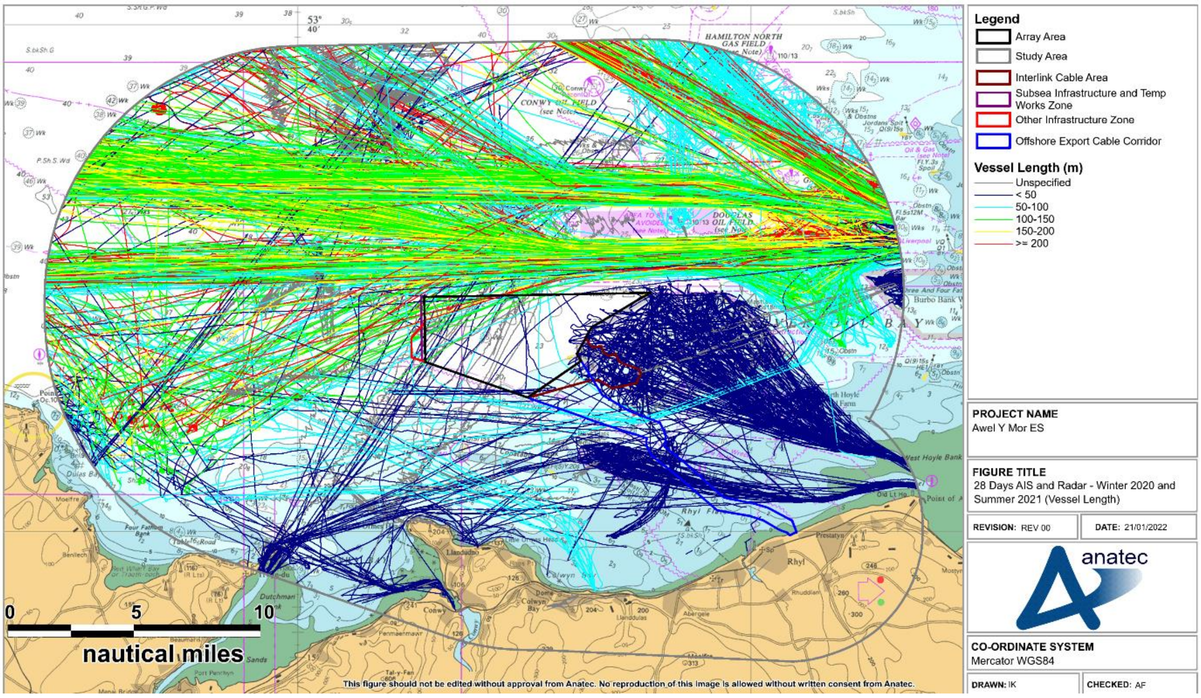


Figure 13.18: Survey Data by Vessel Length

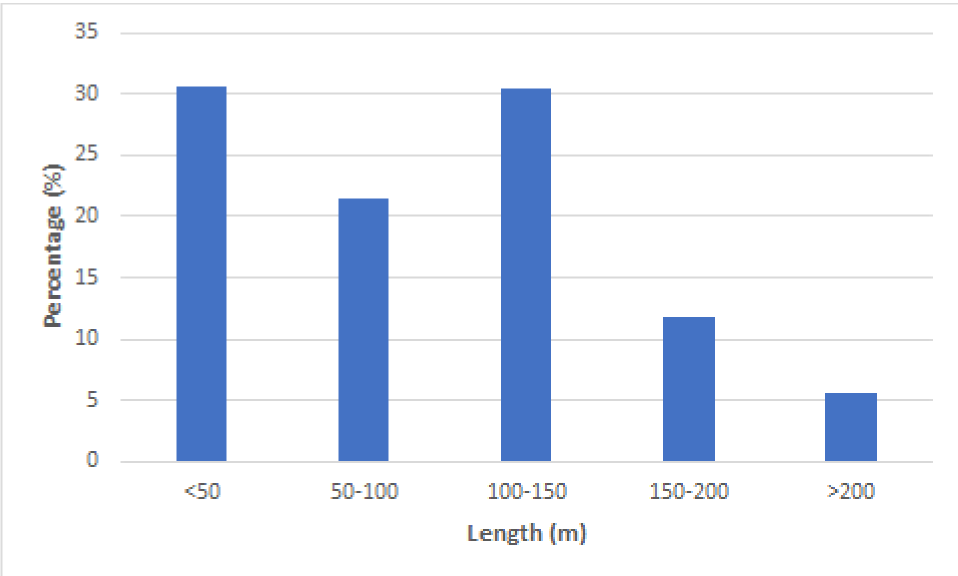


Figure 13.19: Vessel Length Distribution

169. The average length of all vessels (excluding unspecified) was 109m. The largest vessel recorded was the tanker *Front Force*, with a length of 330m. This vessel was recorded at anchor within the north west section of the study area. The smallest vessel recorded was a Class D Inshore Lifeboat (ILB) RNLI lifeboat with a length of 5m.

170. The majority of vessels less than 50m length were observed to be associated with the operational wind farms in the area (see Section 9.10). Larger vessels tended to utilise

either the Liverpool Bay TSS, or the routes bound north east out of Liverpool (in the majority associated with Belfast / Liverpool routes as per Section 13.4).

13.3.2 Vessel Draught

171. Vessel draught information was available for approximately 82% of vessels recorded during both survey periods. Figure 13.20 shows the 28 days of survey data plotted by vessel draught, with Figure 13.21 then showing the overall distribution of vessel draughts (excluding unspecified).

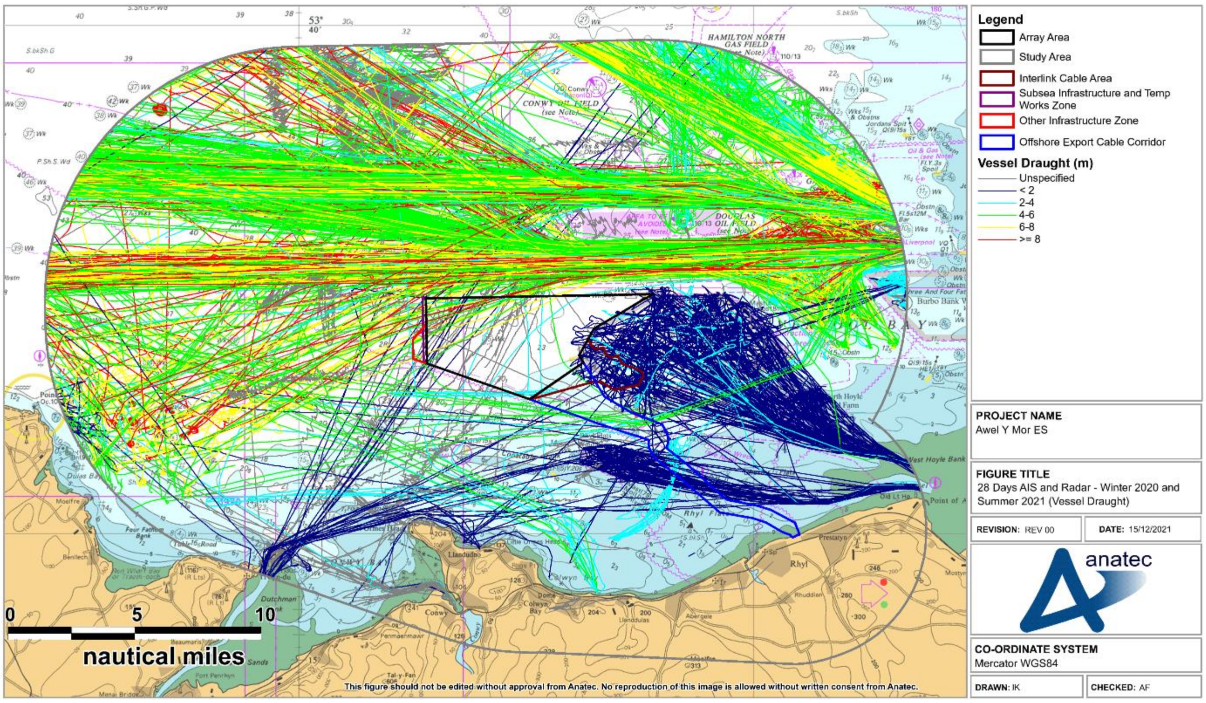


Figure 13.20: Survey Data by Vessel Draught

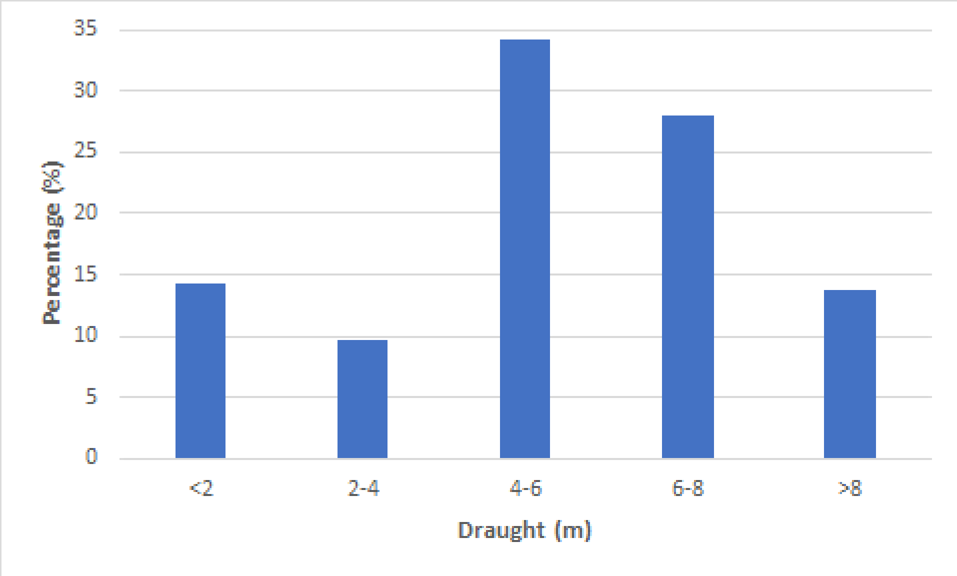


Figure 13.21: Vessel Draught Distribution

172. The average draught recorded was 5.6m, however it should be considered that cases where draught information was unavailable tended to be associated with vessels likely to be small (e.g., fishing, recreation, lifeboats). On this basis it is likely that actual average draught is smaller than the 5.6m value.

173. The vessel with the largest draught was the tanker *Front Force,* with a draught of 20.5m.

174. The majority of vessels with smaller draughts (< 2m) were observed to be wind farm vessels associated with the operational wind farms in the study area. Deeper draught vessels tended to utilise routes associated with the Liverpool Bay TSS lanes.

13.4 Vessel Routeing

13.4.1 Definition of a Main Route

175. Main routes have been identified using the principles set out in MGN 654 (MCA, 2021). Vessel traffic data are assessed and vessels transiting at similar headings and locations are identified as a main route. To help identify main routes, vessel traffic data can also be interrogated to show vessels (by name and/or operator) that frequently transit those routes identifying 'regular runner/operator routes'. The route width is then calculated using the 90th percentile rule from the median line of the potential shipping route as shown in Figure 13.22.

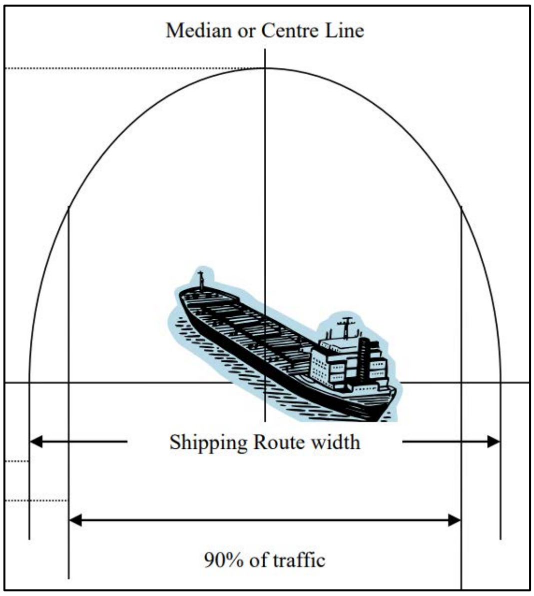


Figure 13.22: Illustration of main route calculation (MCA, 2016)

13.4.2 Pre-Wind Farm Main Commercial Routes

176. A total of 17 main routes were identified from the AIS data studied. These routes and corresponding 90th percentiles are shown relative to AyM in Figure 13.23. Following this, relevant details of each route are given in Table 13.5. This includes key terminus / origin ports, however it should be considered that these are based on the most common destinations transmitted via AIS by vessels on those routes and therefore it should not be assumed that a transit through the study area on a given route will be to one of the destinations listed.

177. To ensure all routes are captured (including low use routes), the 12 months of AIS data has been utilised to characterise routeing, as opposed to the vessel survey data which covers a specific period and therefore may omit certain activity. It is noted that all routeing within the survey data was also present in the 2019 data. Low use routes (less than 90 vessels per year) are not presented within this section, but are included within the allision and collision NRA modelling.

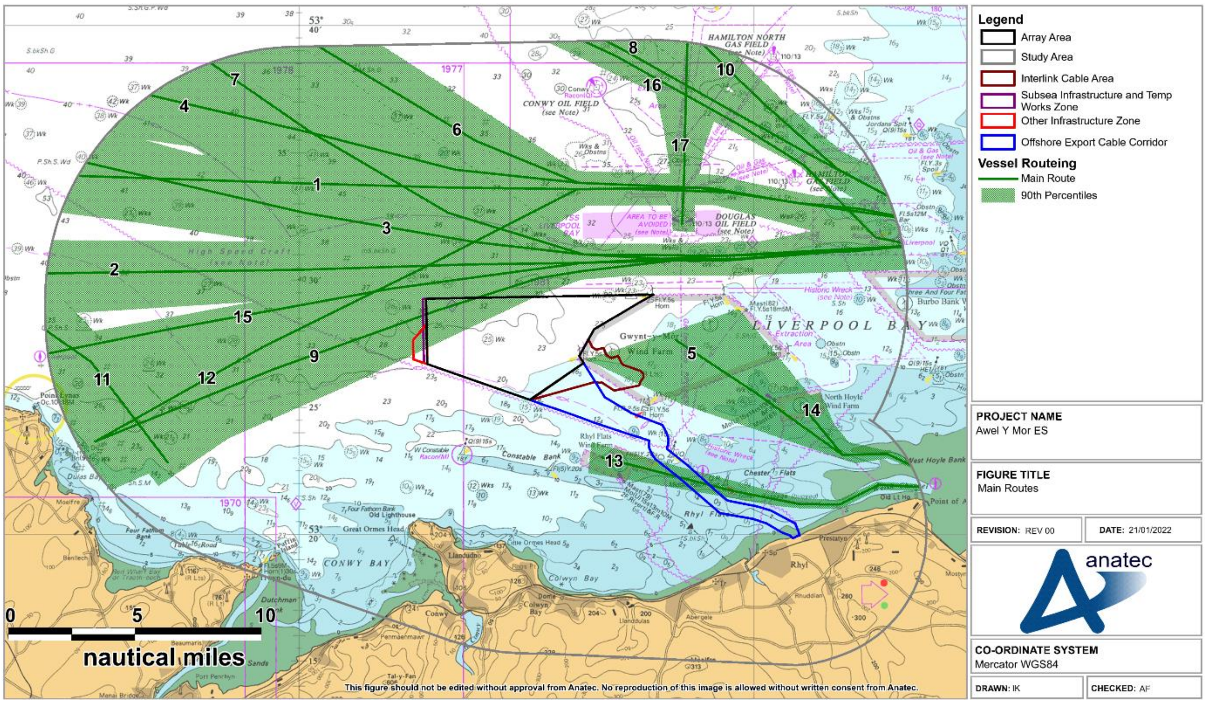


Figure 13.23: Pre Wind Farm Main Routes

Table 13.5: Main Route Details

Route	Key Terminus / Origin Ports	Vessels per Day	Summary
1	Liverpool > Dublin	10	Utilises outbound lane of Liverpool Bay TSS
2	Dublin > Liverpool	8	Utilises inbound lane of Liverpool Bay TSS
3	Dublin > Liverpool	5	Utilises inbound lane of Liverpool Bay TSS
4	Liverpool > Dublin	2	Utilises outbound lane of Liverpool Bay TSS
5	Mostyn / GyM	2	Operational wind farm traffic associated with GyM
6	Liverpool > Belfast	2	Utilises outbound lane of Liverpool Bay TSS
7	Belfast > Liverpool	2	Utilises inbound lane of Liverpool Bay TSS
8	Liverpool / Belfast	1	Traffic accessing / departing Liverpool, passes inshore of TSS
9	Point Lynas > Liverpool	1	Vessels accessing outbound lane of Liverpool Bay TSS from off Point Lynas
10	Liverpool / Belfast	1	Traffic accessing / departing Liverpool, passes inshore of TSS
11	Point Lynas	1	Route to / from anchoring area off Point Lynas

Route	Key Terminus / Origin Ports	Vessels per Day	Summary
12	Liverpool > Point Lynas	< 1	Vessels accessing area off Point Lynas from outbound lane of Liverpool Bay TSS
13	Mostyn / Rhyl Flats	< 1	Operational wind farm traffic associated with Rhyl Flats
14	Mostyn / North Hoyle	< 1	Operational wind farm traffic associated with North Hoyle
15	Holyhead > Liverpool	< 1	Utilises inbound lane of Liverpool Bay TSS
16	Belfast > Liverpool	< 1	Vessel accessing Liverpool inshore of TSS
17	Heysham / Douglas Platform	< 1	O&G traffic associated with Douglas platform

13.4.3 Adverse Weather Routeing

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

179. It was raised during the regular operators consultation (see Section 4.4) that there would be concern over the array preventing passage inshore of the array between Liverpool and Point Lynas, given that offshore transits within the TSS would not be preferred in adverse weather conditions. Vessels are currently observed transiting between GyM and Rhyl Flats, and this passage would not be impeded by the presence of the array. There may be advisory safe passing distances utilised around any cable installation or maintenance work within the offshore ECC which may interact with such vessel routeing, but any affected areas would be spatially limited and temporary.

180. Effects on adverse weather routeing of the Isle of Man Steam Packet Company ferries was raised during scoping consultation by the Isle of Man Government (see Section 4.1), noting that the ferries may utilise the TSS lanes during periods of adverse weather. Such routeing by Isle of Man Steam Packet Company ferries was not observed in either the Long Term 2019 AIS (Appendix B), or the 2020 winter survey data. Regardless, it is considered unlikely that the presence of the array would impact on such routeing, given the structures will be sited south of the TSS lanes. This aligns with the response received by the Isle of Man Steam Packet Company as part of the

regular operators consultation (see Section 4.4), whereby they stated there were no navigational safety concerns associated with AyM, and that they did not anticipate the array would impact on their routeing. They also stated (via the Isle of Man Government Section 42 response – see Section 4.2) that they were content with the current array boundaries.

181. Adverse weather routeing is considered further in Volume 2, Chapter 9: Shipping and Navigation (application ref: 6.2.9).

14 Navigation, Communication and Position Fixing Equipment

14.1 Very High Frequency Communications (Including Digital Sensitive Calling)

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

183. The WTGs had no noticeable effect on voice communications within the wind farm 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.

184. During this trial, a number of telephone calls were made from ashore, within the wind farm, and on its seawards side. No effects were recorded using any system provider (MCA and QinetiQ, 2004).

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

186. 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.dk, 2014).

187. 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, AyM is anticipated to have no significant impact upon VHF communications.

14.2 Very High Frequency Direction Finding

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

189. Throughout the 2005 SAR trials carried out at North Hoyle, the Sea King radio homer system was tested. The Sea King [5]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 wind farm, at a range of approximately 1NM, the homer system operated as expected with no apparent degradation.

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

14.3 Automatic Identification System

191. No significant issues with interference to AIS transmission from operational OWFs has been observed or reported to date. Such interference was also not evident in the trials carried out at the North Hoyle OWF (MCA and QinetiQ, 2004).

192. 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 from AyM.

14.4 Navigational Telex Systems

193. 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.

194. There are two NAVTEX frequencies. All transmissions on NAVTEX 518 Kilohertz (kHz), the international channel, are in English. NAVTEX 518kHz 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.

195. The 490kHz 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.

196. Although no specific trials have been undertaken, no significant effect on NAVTEX has been reported to date at operational developments, and therefore no significant impact is anticipated from AyM.

[5] Sea King helicopters are no longer used for SAR within UK waters.

14.5 Global Positioning Systems

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

198. 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 wind turbine tower" (MCA and QinetiQ, 2004).

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

14.6 Electromagnetic Interference

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

201. 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 should not be allowed to be affected to the extent that safe navigation is prohibited. The important factors with respect to cables that affect the resultant deviation are:

- Water depth;
- Burial depth;
- Current (alternating or direct) running through the cables;
- Spacing or separation of the two cables in a pair (balanced monopole and bipolar designs); and/or
- Cable route alignment relative to the Earth's magnetic field.

202. The export cables and Inter-Array (IA) cables are expected to be Alternating Current (AC). Studies indicate that, unlike Direct Current (DC) AC does not emit an Electromagnetic Field (EMF) significant enough to impact marine magnetic compasses (Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR), 2008).

203. No problems with respect to magnetic compasses have been reported to date in any of the trials carried out (inclusive of SAR helicopters) nor at any operational OWFs. However, 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).

14.7 Marine Radar

204. This section summarises 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, turbine 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 minimum spacing 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.

14.7.1 Trials

205. During the early years in 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.

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

207. Side lobe patterns are produced by small amounts of energy from the transmitted pulses that are radiated outside of the narrow main beam. The effects of side lobes are most noticeable within targets at short range (below 1.5NM) and with large objects. Side lobe echoes form either an arc on the Radar screen similar to range rings, or a series of echoes forming a broken arc, as illustrated in Figure 14.1.

208. 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 14.2.

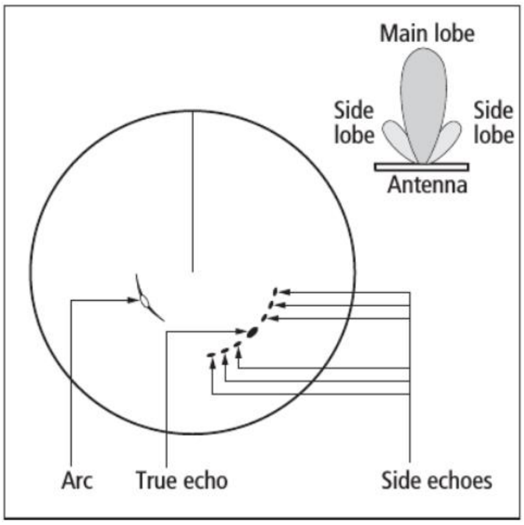


Figure 14.1: Illustration of side lobes on Radar screen

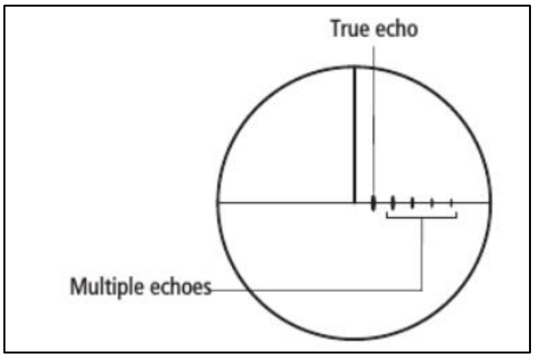


Figure 14.2: Illustration of multiple reflected echoes on Radar screen

209. Based upon 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).

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

211. Theoretical modelling of the effects of the development of the proposed Atlantic Array OWF, which was to be located off the south coast of Wales in the UK, 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. 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 (i.e., those without AIS installed which are usually fishing and recreational craft). It is noted that this situation would arise with or without WTGs in place; and
- There is potential for the performance of a vessel's ARPA to be affected when tracking targets in or near the array. Although greater vigilance is required, during the Kentish Flats trials it was shown that false targets were quickly identified as such by the mariners and then by the equipment itself.

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

213. The MCA has also produced guidance to mariners operating in proximity to OREIs in the UK which highlights Radar issues amongst others to be taken into account when planning and undertaking voyages in proximity to OREIs (MCA, 2008). The interference buffers presented in Table 14.1 are primarily based on information provided in MGN

654 (MCA, 2021), but also consider MGN 371 (MCA, 2008), MGN 543 (MCA, 2016), and MGN 372 (MCA, 2008).

Table 14.1: Distances at which impacts on marine Radar occur

Distance at Which Effect Occurs (NM)	Identified Effects on Radar - *Target size of the WTG echo increases close to the WTG with a consequent degradation on both X and S-Band Radars as noted below.*
0.5	▪ Under MGN 654 impacts on Radar use within 0.5NM are "very high" risk and are deemed intolerable. ▪ Detail included in MGN 371 (now archived) noted that: ▪ X-band Radar interference is intolerable <0.25NM. ▪ Vessels may generate multiple echoes on shore-based Radars under 0.45NM.
0.5 to <1	▪ Under MGN 654 impacts on Radar are "high" risk but can be Tolerable if ALARP.
1 to 1.5	▪ Under MGN 654 impacts on Radar between 1NM to <1.5 NM are "medium" risk but can be Tolerable if ALARP ▪ Detail included in MGN 371 (now archived) noted S-band Radar interference was present at < 1.5NM. ▪ Echoes develop at approximately 1.5NM, with progressive deterioration in the Radar display as the range closes. Where a main vessel routes passes within this range considerable interference may be expected along a line of wind turbines. ▪ Noting that the WTGs produced strong Radar echoes giving early warning of their presence.

214. As noted in Table 14.1, the onset range from the WTGs of false returns is approximately 1.5NM, with progressive deterioration in the Radar display as the range closes. If interfering echoes develop, the requirements of the Convention on 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. 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).

14.7.2 Experience from Operational Developments

215. The evidence from mariners operating in proximity to existing OWFs is that they quickly learn to adapt to any effects. This section examines existing cases of

operational wind farms in proximity to busy shipping lanes for the purpose of assessing potential impact of operational WTGs on marine radar.

14.7.2.3 Greater Gabbard and Galloper

216. Figure 14.3 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 who operate within the vicinity. The interference buffers presented in Figure 14.3 are as per Table 14.1.

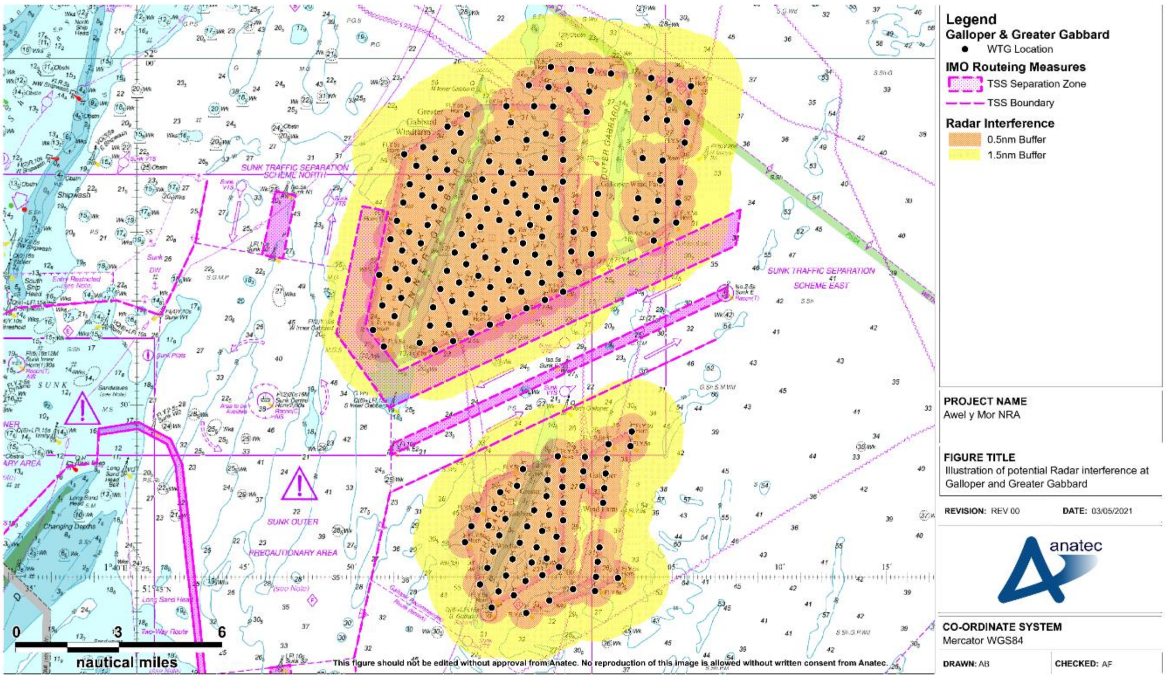


Figure 14.3: Galloper and Greater Gabbard

217. As indicated by Figure 14.3, vessels utilising these TSS lanes will experience some Radar interference based on the available guidance. Both developments are operational, and each of the lanes is used by a minimum of five vessels per day on average. However, to date, there have been no incidents recorded (including any related to Radar use) or concerns raised by the users.

218. AIS information can also be used to verify the targets of larger vessels (generally vessels over 15m in length – the minimum threshold for fishing vessel AIS carriage requirements). It is noted approximately 14% of the vessel traffic recorded within the study area was under 15m in length. 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.

14.7.2.4 Gwynt y Môr

219. Of particular relevance to AyM is the neighbouring GyM, given that both projects maintain the same separation of 0.5NM from the existing Liverpool Bay TSS. Both lanes of the TSS are utilised by approximately 15 vessels per day (see Section 13.4), and as such are considered busy shipping lanes, however there have been no reported incidents or issues raised by mariners who operate within the vicinity. This was queried at the Hazard Workshop (see Section 4.5) and the participants were not aware of any issues while navigating in proximity to GyM, noting attendees included commercial operators of the area and pilots.

220. Further details are provided in Section 14.7.5, which includes consideration of potential effects from AyM and GyM on passing traffic. Additional assessment of other navigational safety aspects of the TSS is provided in Section 9.

14.7.3 Increased Target Return

221. 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.

222. Larger WTGs (either in height or width) will return greater target sizes and/or stronger false targets. However, there is a limit to which the vertical beam width would be affected (20° to 25°) dependent upon the distance from the target. Therefore, increased WTG height in the array will not create any effects in addition to those already identified from existing operational wind farms (i.e., interfering side lobes, multiple and reflected echoes).

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

14.7.4 Fixed Radar Antenna Use in Proximity to Operational Wind Farm

224. It is noted that there are multiple operational wind farms including Galloper (see Section 14.7.2.3) 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.

14.7.5 Application to AyM

225. Upon development of AyM, based on the post wind farm routeing assessment (see Section 16) commercial vessels will pass within 1.5NM of the structures within the array and therefore may be subject to a minor level of Radar interference. Trials, modelling and experience from existing developments note that any impact can be mitigated by adjustment of Radar controls.

226. Figure 14.4 presents an illustration of potential Radar interference due to AyM based on consideration of the distances shown in 14.7.1 against the worst case layout assessed within this NRA (see Section 6.2.1). For the purposes of this figure, the Met Mast has conservatively been assumed to create the same amount of Radar interference as a WTG, and the GyM structures and potential associated interference have been included for reference.

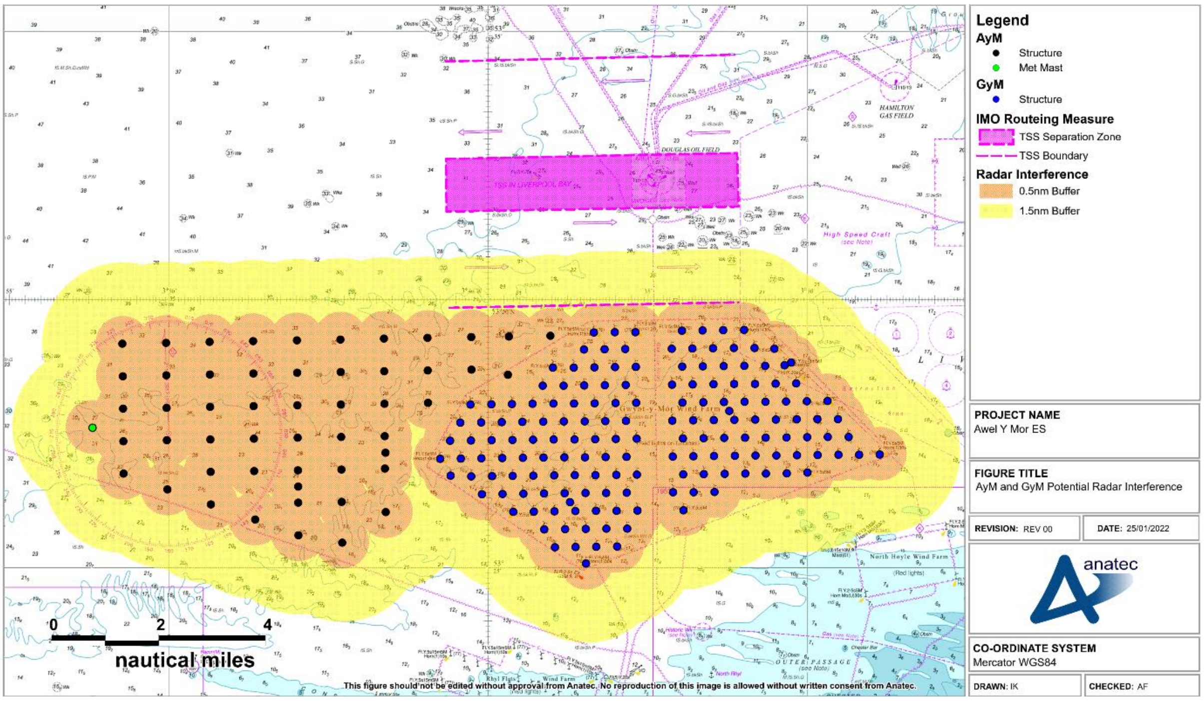


Figure 14.4: AyM and GyM Potential Radar Interference

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

228. In terms of passing traffic, vessels utilising the southern half of the Liverpool Bay TSS will pass within 1.5NM of the AyM WTGs, and as such may experience some radar interference. It is noted that as per 14.7.2.4, there have been no known reported issues to date with regards to the operational GyM.

229. Based on the findings of the Hazard Workshop and operational experience of other wind farms, there is not considered likely to be any notable effect on Radar that cannot be effectively managed by adjustment of Radar controls, particularly given no issues have been reported for the adjacent GyM (see Section 14.7.2.4).

14.8 Sound Navigation Ranging Systems

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

14.9 Noise

14.9.1 Surface Noise

231. The sound level from WTGs at a distance of 350m has been predicted to be in the range of 35 decibels (dB) and 45dB (A) (Scottish Government, 2002). Furthermore, modelling undertaken during the consenting process for the Atlantic Array OWF showed that the highest predicted level due to operational WTG noise (for a 125m tall eight-Megawatt (MW) wind turbine) is around 60dB (Atlantic Array, 2012).

232. A vessel’s whistle for a vessel of 75m length should generate in the order of 138dB and be audible at a range of 1.5NM (IMO, 1972/77); hence this should be heard above the background noise of the WTGs. Similarly, foghorns will also be audible over the background noise of the WTGs.

233. There are therefore no indications that the sound level of AyM will have a significant influence on marine safety.

14.9.2 Underwater Noise

234. In 2005, the underwater noise produced by WTGs of 110m height and with 2MW capacity was measured at the Horns Rev OWF in Denmark. The maximum noise levels recorded underwater at a distance of 100m from the WTGs was 122dB or one micropascal (µPa) (Institut für technische und angewandte Physik (ITAP), 2006).

235. During the operation and maintenance phase of AyM, the subsea noise levels generated by WTGs will likely be greater than that produced at Horns Rev given the larger WTG size, but nevertheless is not anticipated to have any significant impact as they are designed to work in pre-existing noisy environments.

14.10 Existing Aids to Navigation

236. There are numerous existing AtoN within the study area, including those marking the perimeters of the other OWFs located in proximity to the array (see Section 9.4). Given that the structures on the periphery of the array will be marked via AtoN in consultation with Trinity House, there is not considered likely to be an adverse effect on existing AtoNs. This aligns with the findings of the Hazard Workshop (see Section 4.5), where Trinity House were content that any effect on the Point Lynas leading light in particular (a key AtoN in the area) would be compensated for by the presence of the AtoN on the array.

237. One AtoN is also located within the offshore ECC. This may be required to be temporarily moved whilst construction work occurs depending on the export cable route chosen, however should any such change be required, it would be discussed with Trinity House to agree any appropriate mitigation.

14.11 Summary

238. Table 14.2 summarises the impacts of AyM on communication and position fixing equipment based on the assessment undertaken within this section.

Table 14.2: Communication and Position Fixing Equipment Assessment Summary

Topic		Sensitivity	Screen In/Out (Isolation)	Screen In/Out (Cumulative)
Type	**Specific**			
Communication	VHF	No anticipated impacts.	Screened out	Screened out
	VHF DF	No notable degradation and therefore no anticipated impacts.	Screened out	Screened out
	AIS	No anticipated impacts.	Screened out	Screened out
	NAVTEX	No anticipated impacts.	Screened out	Screened out
	GPS	No anticipated impacts.	Screened out	Screened out
EMFs	Subsea cables	No anticipated impacts.	Screened out	Screened out
	WTGs	No anticipated impacts.	Screened out	Screened out
Marine Radar	Use of marine Radar	Vessels have sufficient sea room to distance themselves from the array in line with the "*Shipping Route Template*" to mitigate any effects, and it is noted that no issues have been	Screened out	Screened out

Topic		Sensitivity	Screen In/Out (Isolation)	Screen In/Out (Cumulative)
Type	**Specific**			
		reported for the adjacent GyM.		
SONAR	SONAR Systems	No anticipated impacts.	Screened out	Screened out
Noise	WTG generated noise	No anticipated impacts.	Screened out	Screened out
	SONAR Systems	No anticipated impacts.	Screened out	Screened out

15 Cumulative Overview

239. Potential cumulative effects have been considered for activities in combination and cumulatively with AyM. This section provides an overview of the developments and projects that have been screened into the cumulative risk assessment based on the criteria provided in Section 3.4. Given the unique nature of shipping and navigation users, a bespoke tiering system has been applied to ensure relevant projects / developments are captured and assessed appropriately.

240. It is noted that any operational developments (including O&G) are considered baseline and hence are not included (see Section 9). Changes in port status or planned expansions (e.g., Liverpool gaining freeport status) and associated changes in traffic are considered to be captured within the assessed future case (see Section 16).

Table 15.1: Cumulative Screening

Project	Confidence	Development Type	Status of Development	Distance from Array (NM)	Tier	Rationale
NWTE Project	Medium	Tidal Energy	Early concept	6.9	3	No impact on relevant routes
Colwyn Bay Tidal Lagoon	Medium	Tidal Energy	Early concept	7.0	3	No impact on relevant routes
Cobra & Flotation Energy - Round 4	Low	OWF	Concept/early planning	15.6	3	No impact on relevant routes
Port of Mostyn Tidal Lagoon	High	Tidal Energy	Pre-planning	16.2	3	No impact on relevant routes
Gateway Gas Storage	Low	Gas Storage	In planning	21.9	3	No impact on relevant routes
Mersey Tidal Power	Medium	Tidal Energy	Pre planning	24.0	3	No impact on relevant routes
EnBW and BP 1 - Round 4	Low	OWF	Concept/early planning	25.5	3	No impact on relevant routes
EnBW and BP 2 - Round 4	Low	OWF	Concept/early planning	25.5	3	No impact on relevant routes

Project	Confidence	Development Type	Status of Development	Distance from Array (NM)	Tier	Rationale
Morlais Demonstrator	High	Tidal Energy Lease Area	Consented	32.5	3	No impact on relevant routes
Morlais Tidal Energy	High	Tidal Energy Lease Area	Pre-planning application	32.5	3	No impact on relevant routes
Holyhead Deep (Minesto)	High	Tidal Energy Lease Area	Scoping report submitted	34.3	3	No impact on relevant routes
Morecambe Bay Tidal Lagoon	Medium	Tidal Energy	In development	39.4	3	No impact on relevant routes
Isle of Man	Medium	OWF	Concept	40.4	3	No impact on relevant routes
Duddon Estuary Tidal Lagoon	Medium	Tidal Energy	Cooncept	43.4	3	No impact on relevant routes
Bardsey Sound	High	Tidal Energy Lease Area	Pre-Planning	51.5	3	No impact on relevant routes
Bardsey Sound (Enlli)	Medium	Tidal Energy	Pre-planning application	52.0	3	No impact on relevant routes
Codling Wind Park	Medium	OWF	Concept	69.9	3	No impact on relevant routes
Codling Wind Park Extension	Medium	OWF	Concept	70.6	3	No impact on relevant routes
North Irish Sea Array	Medium	OWF	Pre-planning application	70.7	3	No impact on relevant routes
Braymore Point	Medium	OWF	Concept	70.7	3	No impact on relevant routes
West Cumbrian Tidal Lagoon	Medium	Tidal Energy	In planning	72	3	No impact on relevant routes

Project	Confidence	Development Type	Status of Development	Distance from Array (NM)	Tier	Rationale
Cooley Point	Medium	OWF	Concept	73.5	3	No impact on relevant routes
Dublin Array	Medium	OWF	In-planning	73.7	3	No impact on relevant routes
Cloger Head	Medium	OWF	Concept	76.2	3	No impact on relevant routes
Mull of Galloway	Medium	Tidal Energy - Demonstrator Array	In development	76.2	3	No impact on relevant routes
Strangford Lough Array	High	Tidal Energy - Demonstrator Array	Pre-Planning	78.6	3	No impact on relevant routes
DeepGreen 1/10	Medium	Tidal Energy	In Planning	78.8	3	No impact on relevant routes
South Irish Sea Array	Medium	OWF	Concept	79.2	3	No impact on relevant routes
Arklow Bank Phase 2	Medium	OWF	Consented	79.4	3	No impact on relevant routes
Oriel	Medium	OWF	Concept	80.2	3	No impact on relevant routes
Kilmichael Point	Medium	OWF	Concept	80.6	3	No impact on relevant routes
Solway Firth-Venturi Enhanced Turbine Technology (VETT)	Medium	Tidal Energy	In planning	89.2	3	No impact on relevant routes
Strumble Head Tidal Energy Project	Medium	Tidal Energy	Early planning	94.9	3	No impact on relevant routes

16 Future Case Vessel Traffic

241. This section presents the predicted future case level of activity within and in proximity to AyM, and the anticipated shift in the mean positions of the main commercial routes post wind farm identified from the marine traffic data studied (see Section 13.4).

16.1 Increases in Commercial Traffic

242. Given future commercial traffic trends are dependent on various factors, and are hence difficult to predict, the NRA has assumed a potential increase of 10% within the commercial traffic allision and collision modelling, noting this value has been applied for similar UK shipping and navigation assessments.

243. It is noted that the potential for an additional P&O commercial ferry route passing inshore of the array was raised during consultation. The route is not active at the time of the NRA and has therefore not been included on a quantitative basis, however has been considered on a qualitative basis within Section 16.4.316.1.

16.2 Increases in Commercial Fishing Vessel Activity

244. There is limited reliable information on future commercial fishing vessel activity levels upon which any firm assumption could be made. The quantitative assessment of fishing allision risk has assumed a potential increase of 10% as a future case. It is noted that additional information on commercial fishing trends are contained within Volume 4, Annex 8.1: Commercial Fisheries Technical Baseline (application ref: 6.4.8.1).

16.3 Increase in Recreational Activity

245. There are no known major developments which will increase the activity of recreational vessels within the Irish Sea, nor was any associated prediction raised during consultation. As with commercial fishing activity, given the lack of reliable information relating to future trends, a 10% increase is considered conservative, and will therefore be applied.

16.4 Commercial Traffic Routeing

16.4.1 Methodology

246. It is not possible to consider all potential alternative routeing options for commercial traffic and therefore worst case alternatives have been considered based upon existing baseline routeing relative to the array (see Section 13.4).

247. Assumptions for re-routeing include:

- All alternative routes maintain a minimum mean distance of 1NM from offshore installations and existing WTG boundaries in line with the MGN 654 Shipping Route

Template (MCA, 2021). This distance is considered appropriate for shipping and navigation from a safety perspective as explained below.

- All mean routes take into account sandbanks, known routeing preferences, and IMO adopted routeing measures.

248. MGN 654 provides guidance to offshore renewable energy developers on both the NRA process and design elements associated with the development of an OWF. Annex 2 of MGN 654 defines a methodology for assessing passing distances between OWF boundaries, and states that it is "not a prescriptive tool but needs intelligent application".

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

250. It should be considered that the deviations defined within this NRA are worst case from a WTG exposure perspective, and in reality, vessels may choose to pass further from the structures.

16.4.2 Main Route Deviations – AyM in Isolation

251. The anticipated post wind farm routeing scenario is shown in Figure 16.1. In summary, of the 17 main routes identified (see Section 13.4), two are anticipated to require a minor deviation post wind farm. The absolute and percentage increases in journey distance of these three routes within the study area are detailed in Table 16.1.

252. As shown, the two affected routes are utilised by a maximum of one vessel per day. The largest deviation was to Route 9, the distance of which is estimated to increase by approximately 1.6% within the study area. An increase of 0.1% is anticipated for Route 15.

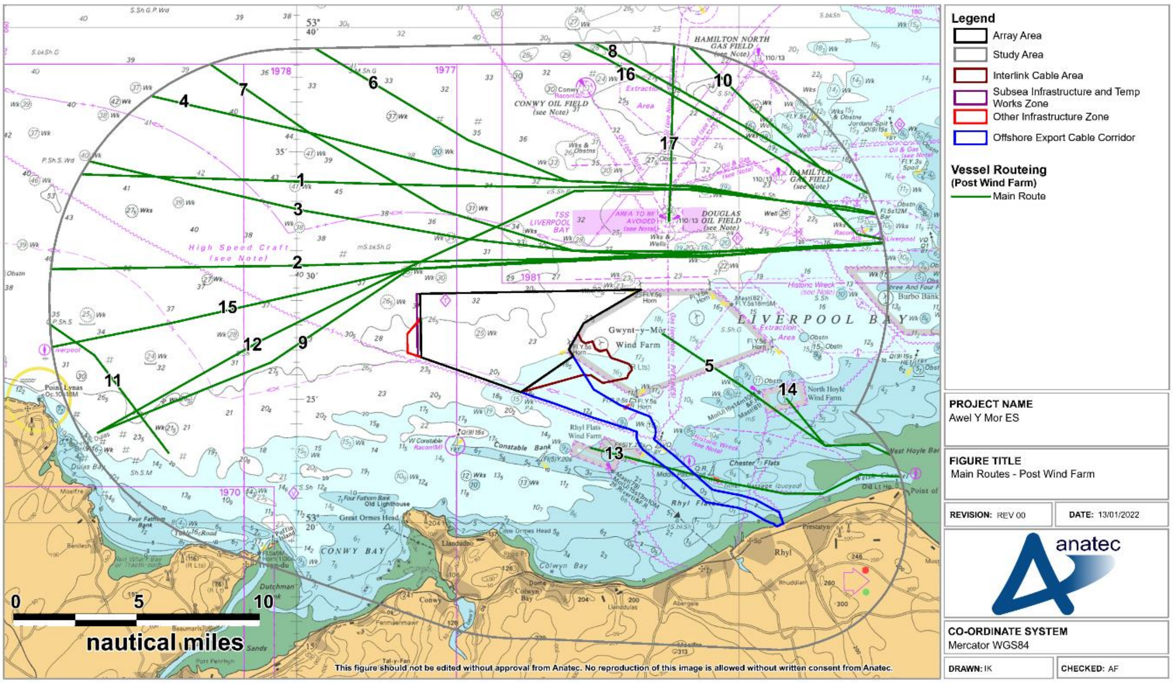


Figure 16.1: Main Routes (Post Wind Farm)

Table 16.1: Deviation Summary

Route	Vessels per Day	Distance in Study Area (NM)		Increase	
		Pre WF	Post WF	Absolute (NM)	Percentage
9	1	33.0	33.5	0.5	1.6%
15	< 1	33.9	34.0	< 0.1	0.1%

16.4.3 Main Route Deviations – Cumulative

253. The two routes anticipated as requiring deviation based on the in-isolation assessment (Routes 9 and 15 as per Section 16.4.2) do not interact with any developments screened into the cumulative assessment. As such, magnitude of cumulative deviations are anticipated to align with the in-isolation assessment. This is reflective of the location of the array being south of the Liverpool Bay TSS, and hence not interacting with the majority of routeing in the area.

254. It should be considered that additional routeing by project vessels to other future renewable projects may occur. Specific routes have not been modelled within the NRA due to uncertainty over project timelines, origin ports and traffic volumes, however increases in vessel volumes on a general basis are considered to be covered by the future case assessment (see Section 16.1).

255. It is noted that as per Section 16.1, it was raised during consultation that there is potential for a new additional P&O commercial ferry route between Mostyn and Dublin, anticipated to pass inshore of the array. There is considered to be suitable searoom inshore of the array to accommodate such a route, and it is noted that traffic in this area is notably lower than offshore of the array. As such it is not anticipated that AyM would have any notable effect on this route should it go ahead.

256. Other potential cumulative hazards are assessed in Volume 2, Chapter 9: Shipping and Navigation (application ref: 6.2.9).

17 Allision and Collision Risk Modelling

17.1 Overview

257. To inform the NRA, a quantitative assessment of the major hazards associated with allision and collision that may arise as a result of AyM has been undertaken. The following subsections outline the inputs and methodology used for the collision and allision risk modelling.

17.1.1 Allision and Collision Scenarios

258. For each element of the quantitative assessment both a pre and post wind farm scenario with base and future case vessel traffic levels have been considered. This means the following four distinct scenarios have been modelled:

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

17.1.2 Hazards Assessed

259. Hazards considered in the quantitative allision and collision 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.

260. The pre wind farm collision assessment has used the vessel traffic survey data (see Section 13) in combination with the outputs of consultation (see Section 4) and other baseline data sources. Conservative assumptions have then been made with regard to route deviations and future shipping growth as discussed in Section 16.

17.2 Pre Wind Farm

17.2.1 Encounters

17.2.1.5 Overview

261. An assessment of current vessel to vessel encounters in proximity to the array has been undertaken by replaying at high speed the data collected as part of the winter 2020 and summer 2021 vessel traffic surveys (see Section 13).

262. The model defines an encounter as two vessels passing within 1NM of each other within the same minute. This helps to identify areas where existing shipping congestion is highest, and therefore where offshore developments (e.g., an OWF)

could potentially increase this congestion (i.e., potentially increase the risk of encounters and collisions). It is noted that no account has been given as to whether the encounters are head on or stern to head; just whether the associated vessels were in close proximity.

263. To ensure the analysis is focussed on genuine encounters as opposed to vessels deliberately being in close proximity due to being involved in a planned operation, the following cases have been excluded:

- Wind farm vessel to wind farm vessel: and
- O&G vessel to O&G vessel.-

264. On this basis a total of 1,552 genuine encounters were identified within the 28 days of survey data. The identified encounters are presented in Figure 17.1, with encounter density then presented in Figure 17.2.

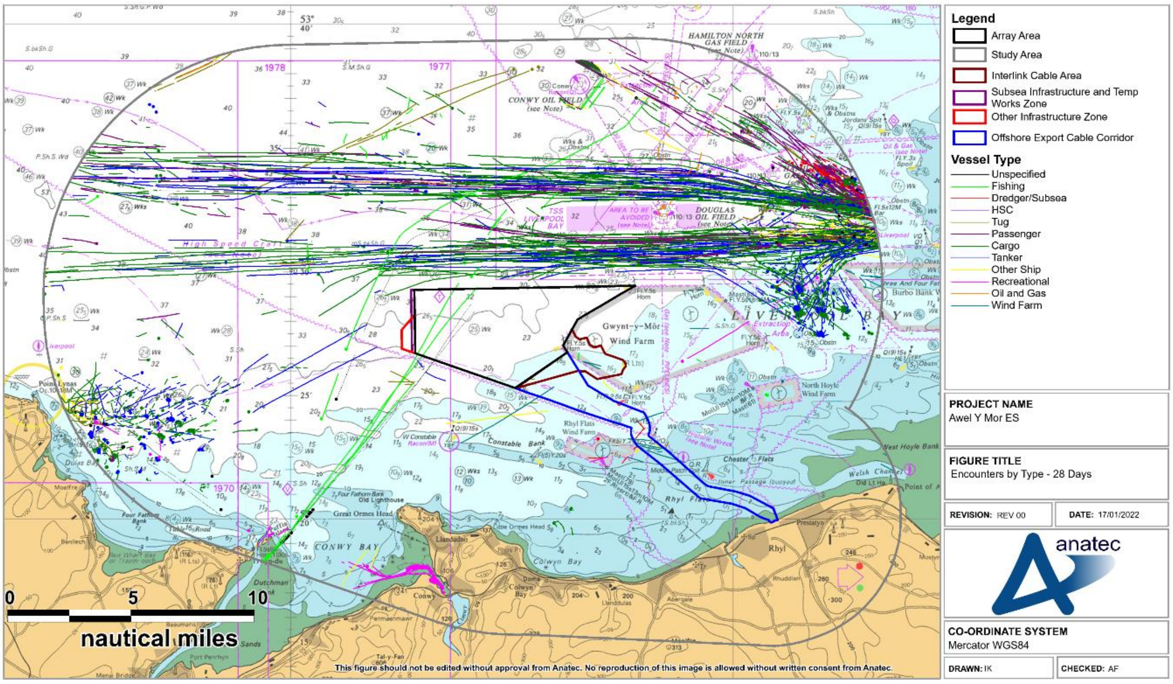


Figure 17.1: Encounters by Vessel Type

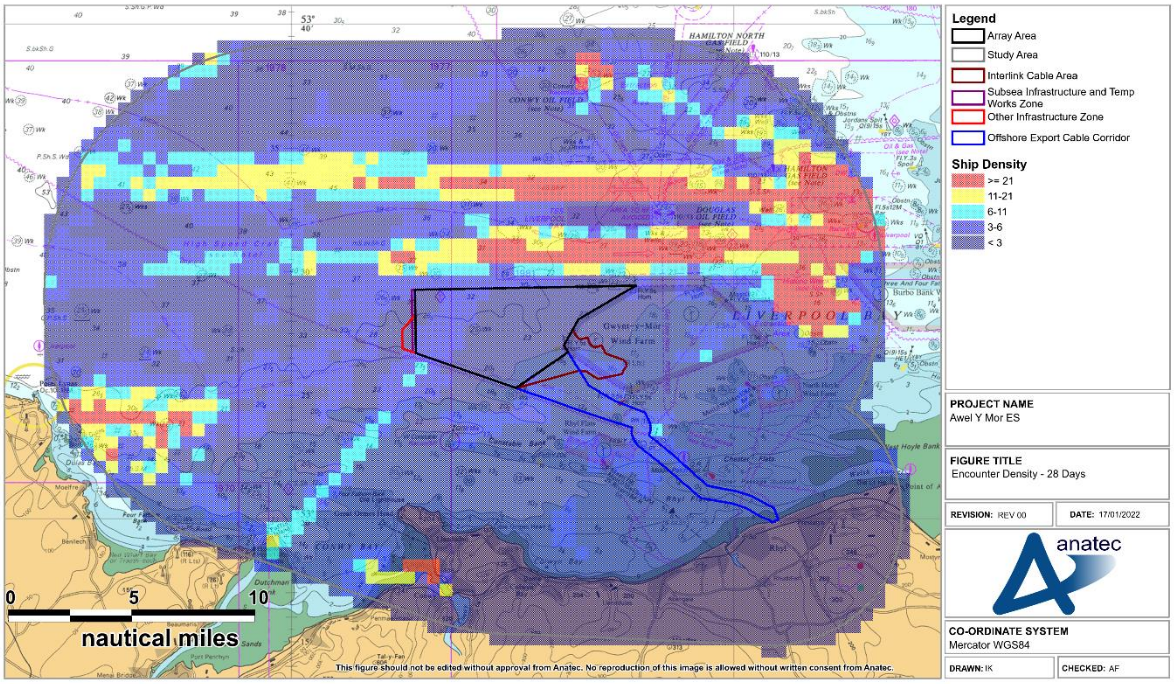


Figure 17.2: Encounter Density

265. The majority of encounters were observed to be associated with vessels utilising the Liverpool Bay TSS (noting that density was higher in the outbound lane than in the inbound lane). Encounters involving anchored vessels were also recorded within the area off Point Lynas / Dulas Bay and in the charted Liverpool anchorages.

266. Encounters inshore of the array were generally more limited, however it is noted that encounters associated with recreational activity in and near the River Conwy were identified.

17.2.1.6 Encounter Counts

267. The number of encounters recorded per day is presented in Figure 17.3 for the winter survey, and Figure 17.4 for the summer survey.

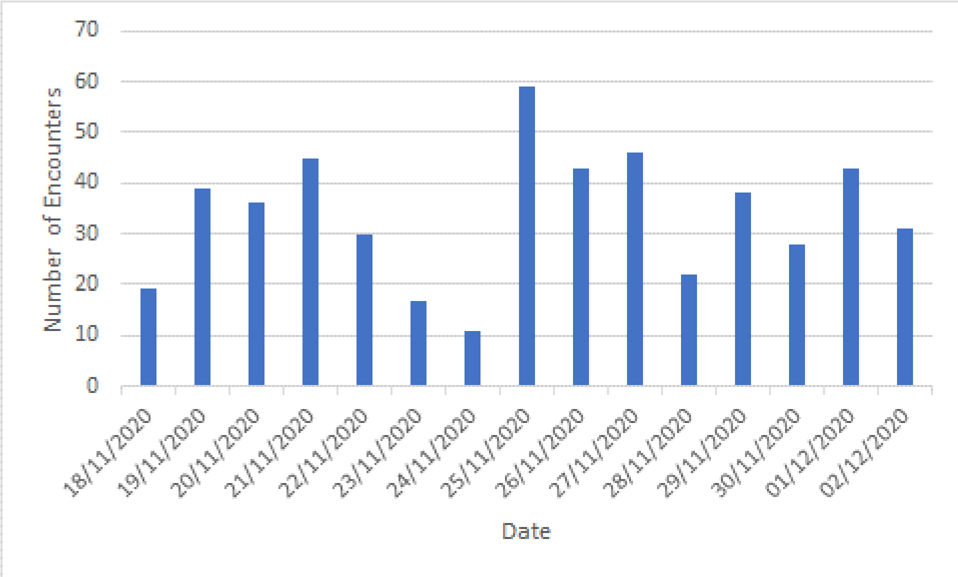


Figure 17.3: Encounters per Day – Winter 2020

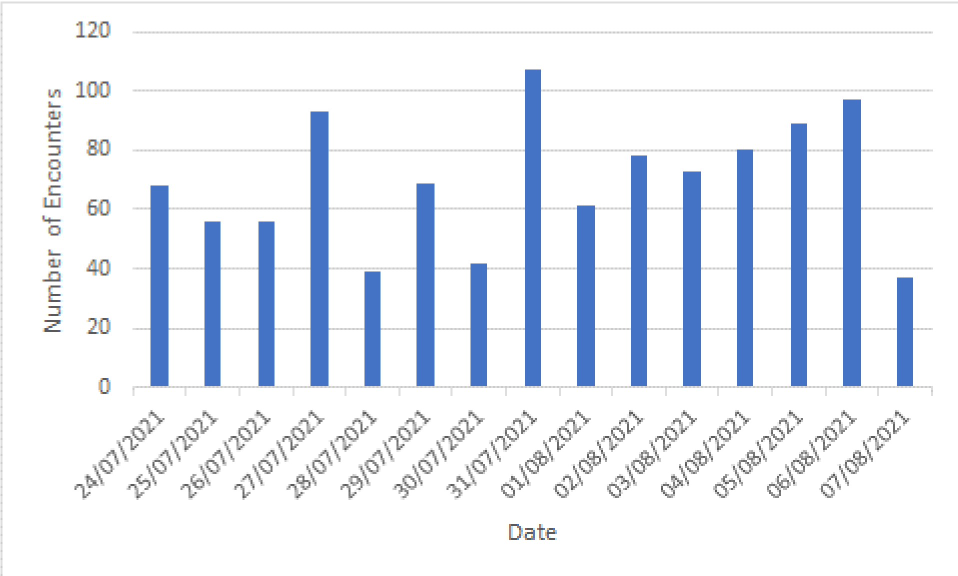


Figure 17.4: Encounters per Day – Summer 2020

268. An average of 55 encounters per day was identified over the combined 28-day survey period, noting that approximately 70% of encounters were recorded during the summer survey period. The busiest day in terms of encounters was the 31st July 2021, when 107 encounters were recorded, while the quietest day was the 24th November when just 11 encounters were recorded. It is noted that “rough” conditions were observed on the 24th November based on the weather data collected by the survey vessel (Anatec, 2021), which is likely to be a factor in the lower number of encounters.

17.2.1.7 Encounters by Vessel Type

269. The distribution of vessel types involved in the identified encounters is shown in Figure 17.5.

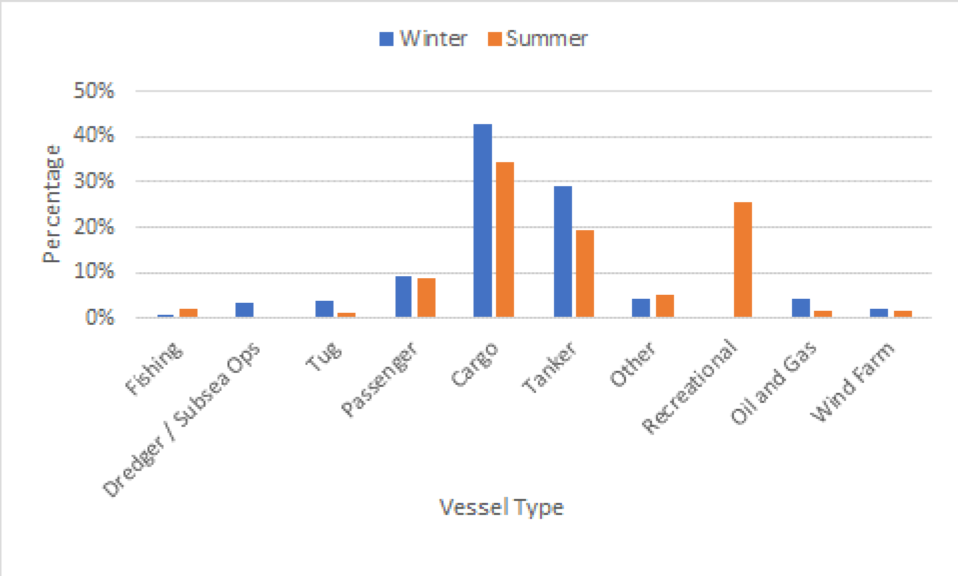


Figure 17.5: Encounters – Vessel Type Distribution

270. Overall, there was broad correlation between the two survey periods in terms of vessel type, with the only notable change being a large increase in recreational vessel encounters during summer, noting this is as would be expected. The majority of vessels involved in encounters were observed to be commercial, with cargo vessels accounting for 37% of all vessels involved in encounters, tankers accounting for 23%, and passenger vessels a further 9%.

17.2.2 Vessel to Vessel Collision

271. Using the pre wind farm vessel routeing (see Section 13.4) as input, Anatec's COLLRISK model has been run to estimate the vessel to vessel collision risk in the vicinity of the array. It is noted that low use routes identified via the long term AIS (see Appendix B) not presented as a "main route" have still been included within this modelling.

272. The results of the pre wind farm collision assessment are presented graphically in Figure 17.6, which shows a collision risk heat map presented in a 0.25x0.25NM resolution grid. Future case results are included in Section 17.4.

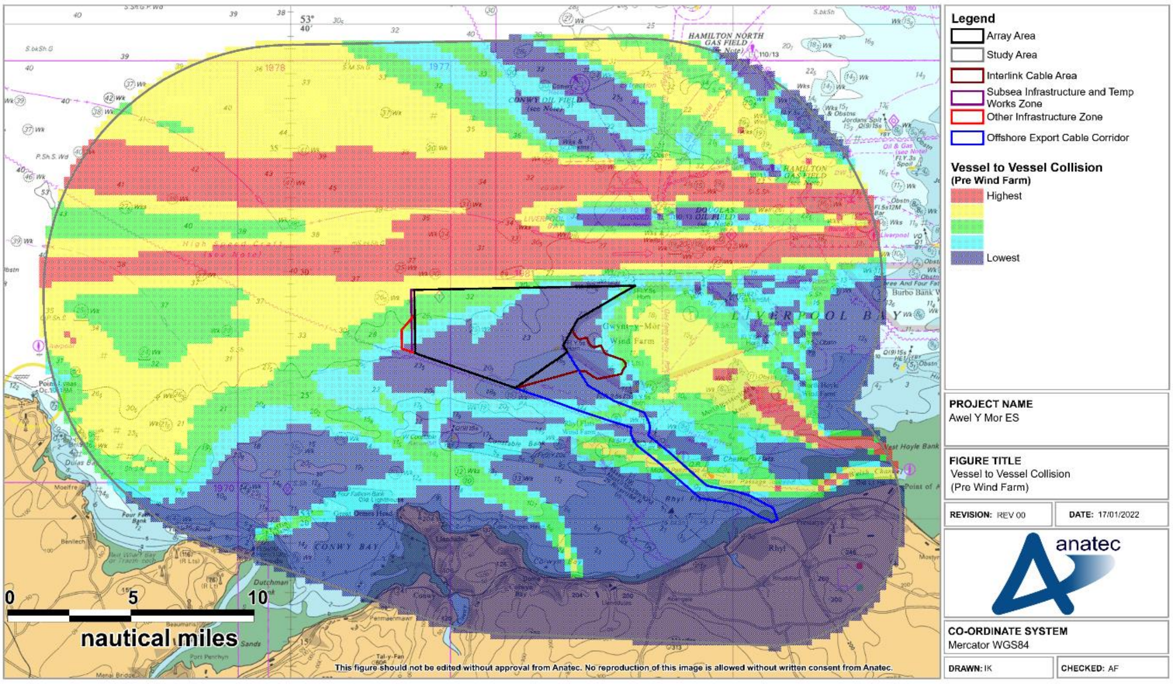


Figure 17.6: Vessel to Vessel Collision Risk – Base Case Pre Wind Farm

273. Assuming base case traffic levels, it was estimated that a vessel would be involved in a collision once per 105 years pre wind farm. The most significant area of risk was observed to be within the Liverpool Bay TSS lanes, and the associated route approaches and exits. Collision risk inshore of the array was generally low in comparison, which is indicative of the majority of commercial vessels in the study area utilising the TSS.

17.3 Post Wind Farm

17.3.1 Vessel to Vessel Collision

274. Using the predicted post wind farm routeing as input (see Section 16.4), Anatec's COLLRISK model was run to estimate the vessel to vessel collision risk post wind farm within the study area.

275. The results of the post wind farm collision assessment are presented graphically in Figure 17.7, which shows a collision risk heat map presented in a 0.25x0.25NM resolution grid. Future case results are included in Section 17.4.

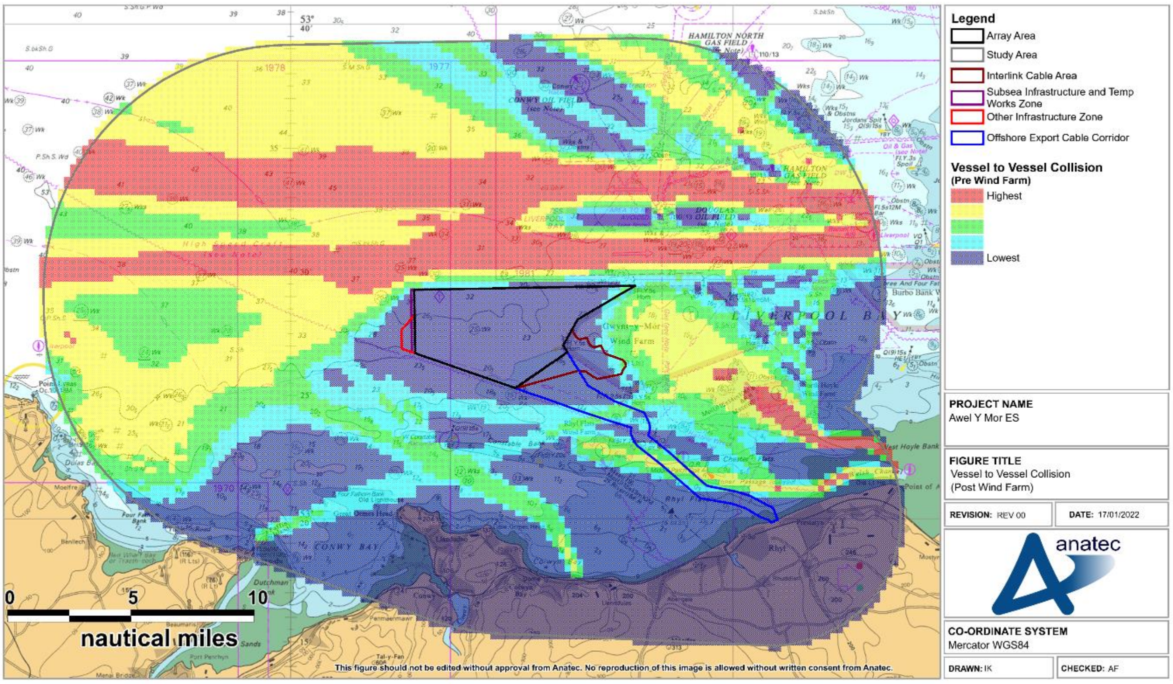


Figure 17.7: Vessel to Vessel Collision Risk – Base Case Post Wind Farm

276. Assuming base case traffic levels, it was estimated that a vessel would be involved in a collision once per 103 years post wind farm. This represents an increase of 2% over the corresponding pre wind farm case (see Section 17.2.2), and is considered indicative of the anticipated necessary deviations being limited (see Section 16.4).

277. The key area of change was observed to be around the north west corner of the array, resultant of vessels currently intersecting the array predicted to pass further west post wind farm. This is illustrated in Figure 17.8 which shows the change in collision risk between the pre and post wind farm cases.

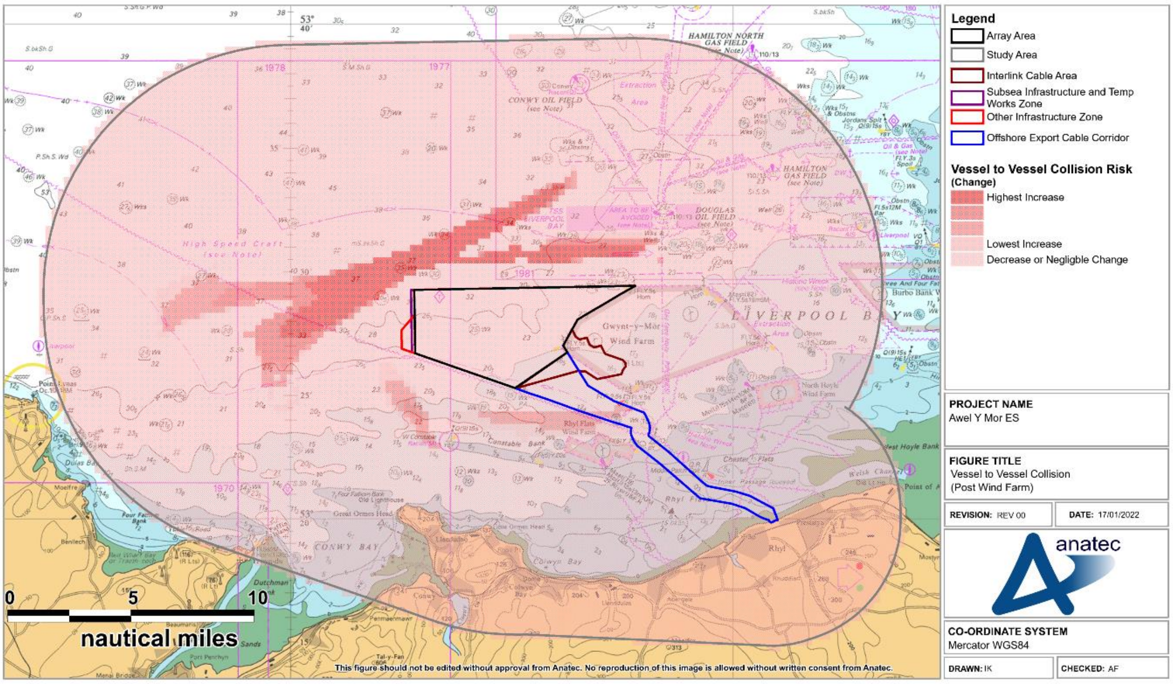


Figure 17.8: Change in Vessel to Vessel Collision Risk

17.3.2 Powered Allision Risk

278. Based upon the vessel routeing identified in the region, the anticipated change in routeing due to AyM, the mitigations in place, and levels of allision incidents to date associated with UK OWFs, the frequency of an errant vessel under power deviating from its route to the extent that it comes into proximity with a structure within the array is considered low.

279. From consultation with the shipping industry and observations at other constructing or operational UK wind farms, 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. 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 themselves (noting that final lighting and marking will be directed by and agreed with Trinity House).

280. Using the predicted post wind farm routeing (see Section 16.4) as the primary input, 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 whilst under power. A plot of the annual powered allision frequency per structure assuming base case traffic levels is presented in Figure 17.9. Future case results are provided in Section 17.4.

281. It is noted that to ensure the assessment is focused on passing commercial vessels, wind farm vessels within the adjacent GyM have not been included within the powered allision modelling.

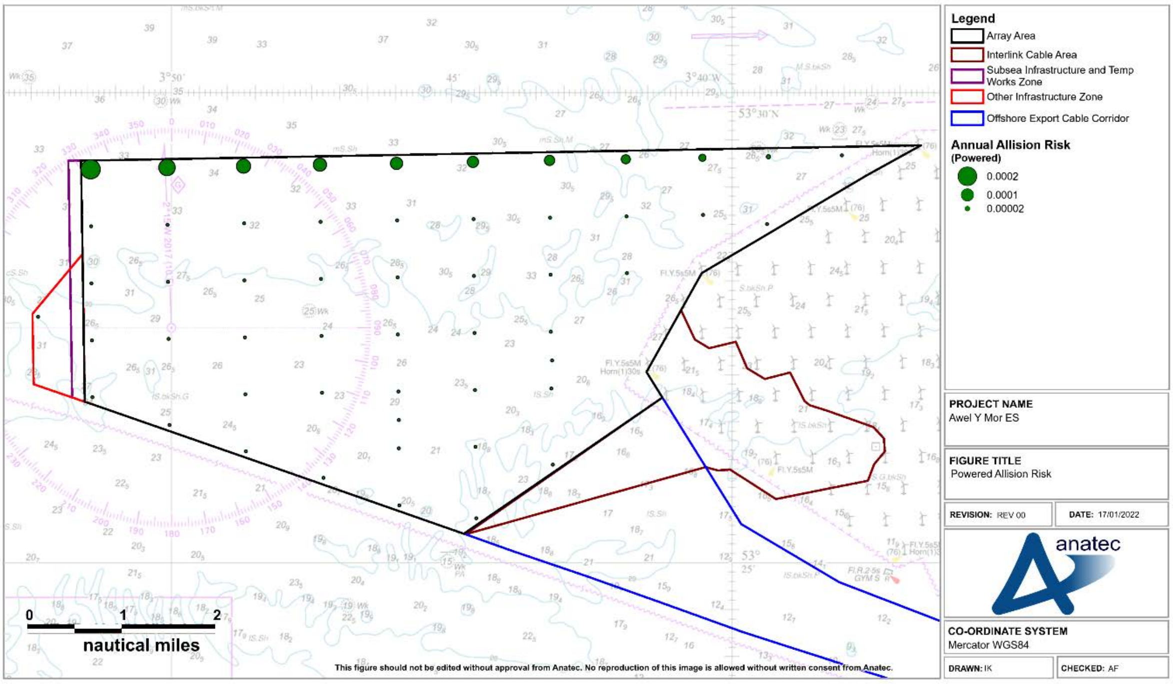


Figure 17.9: Powered Allision Risk

282. Assuming base case traffic levels, it was estimated that a vessel would allide with a structure whilst under power once per 1,160 years. The significant majority of this risk was observed to be associated with the structures on the northern periphery of the array, resultant of the traffic associated with the inbound lane of the Liverpool Bay TSS.

17.3.2.8 Met Mast

283. Powered annual allision frequency to the Met Mast was estimated to be 2.82×10^{-7}, which is notably less than that estimated at PEIR stage, and this is reflective of its shift to the south away from the Point Lynas / Dulas Bay traffic (noting it was modelled on the northern periphery at PEIR stage). As per Section 6.2.4, the position of the Met Mast is not yet finalised, and therefore the modelled position has been selected as a worst case location within the current Other Infrastructure Zone. The final position will be discussed and agreed with Trinity House.

284. It is noted that as per Section 4.2, Trinity House indicated the allision hazards assuming the Met Mast was positioned within the southern extent of the Other Infrastructure Zone should also be considered within the NRA. As can be seen in Section 13, the majority of traffic in the vicinity of the Other Infrastructure Zone is associated with Point Lynas / Dulas Bay, and as such is likely to pass further north post wind farm (see Section 16.4.2). On this basis it is considered a lower risk position than the worst case

position modelled. There may be some allision risk associated with north / south traffic, however the modelled position is still considered a worst case given it would be “isolated” relative to the eastern periphery, whereas a position in the south of the Other Infrastructure Zone would be aligned with the southern periphery.

285. The Met Mast is considered further within the powered allision assessment within Volume 2, Chapter 9: Shipping and Navigation (application ref: 6.2.9).

17.3.2.9 Periphery Alignment with GyM

286. The northern peripheries of the array and GyM maintain a consistent separation of approximately 0.5NM from the inbound lane of the Liverpool Bay TSS (see Section 9.1). This lane is utilised by approximately 15 vessels a day based on the pre wind farm routeing assessment (see Section 13.4), and therefore a notable level of traffic will pass the array. As shown in Figure 17.9, this is reflected within the powered allision modelling which shows the northern periphery to be the key area of allision risk.

287. It is considered that a notable change in TSS separation distance from that maintained by the existing GyM structures (0.5NM) would represent an increased level of risk for passing vessels. Should the separation distance not be maintained the vessels associated with the inbound lane of the TSS would encounter a “step” when passing AyM on approach to GyM which would in turn pose an increased allision risk should lighting and marking fail. Consistent separation from a routeing measure is a now well established preference of key stakeholders (e.g., Greater Gabbard and Galloper, see Section 14.7.2.3), and it is noted that there have been no powered allision incidents associated with GyM (which maintains a straight line edge parallel to the TSS with consistent separation).

288. It should be considered that straight line alignment of the northern periphery of AyM with GyM brings the TSS separation to the upper threshold of what is tolerable under MGN 654 noting potential effects on marine Radar. However, as per Section 14.7.2.4, there have no reported issues associated with GyM in terms of the 0.5NM separation.

289. On this basis, as per the framework Layout Commitments (see Section 19.1), it is intended that the northern periphery of the array will align with the northern periphery of GyM, noting that due to differing rotor diameters between the projects this will be based on the rotor tips as opposed to structure centre points.

17.3.3 Drifting Allision Risk

290. Using the post wind farm routeing as the primary input (see Section 16.4), Anatec’s COLLRISK model was run to estimate the likelihood of a drifting commercial vessel alliding with one of the wind farm structures within the array. 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 error caused by human actions.

291. The exposure times for a drifting scenario are based upon the vessel hours spent in proximity to the array. These have been estimated based upon the revised post wind farm routeing. The exposure is divided by vessel type and size to ensure these factors, which based upon analysis of historical incident data have been shown to influence incident rates, are taken into account within the modelling.

292. Using this information, the overall rate of mechanical failure within proximity to the array was estimated. The probability of a vessel drifting towards a wind farm structure and the drift speed are dependent upon the prevailing wind, wave, and tidal conditions at the time of the accident. Therefore, three drift scenarios were modelled, each using the Metocean data provided in Section 10:

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

293. The probability of vessel recovery from drift is estimated based upon the speed of drift and hence the time available before reaching the wind farm structure. Vessels which do not recover within this time are assumed to allide.

294. After modelling the drift scenarios, it was established that the flood tide dominated scenario produced the worst case results. On this basis, a plot of the annual drifting allision frequency per structure assuming base case traffic levels is presented in Figure 17.10.

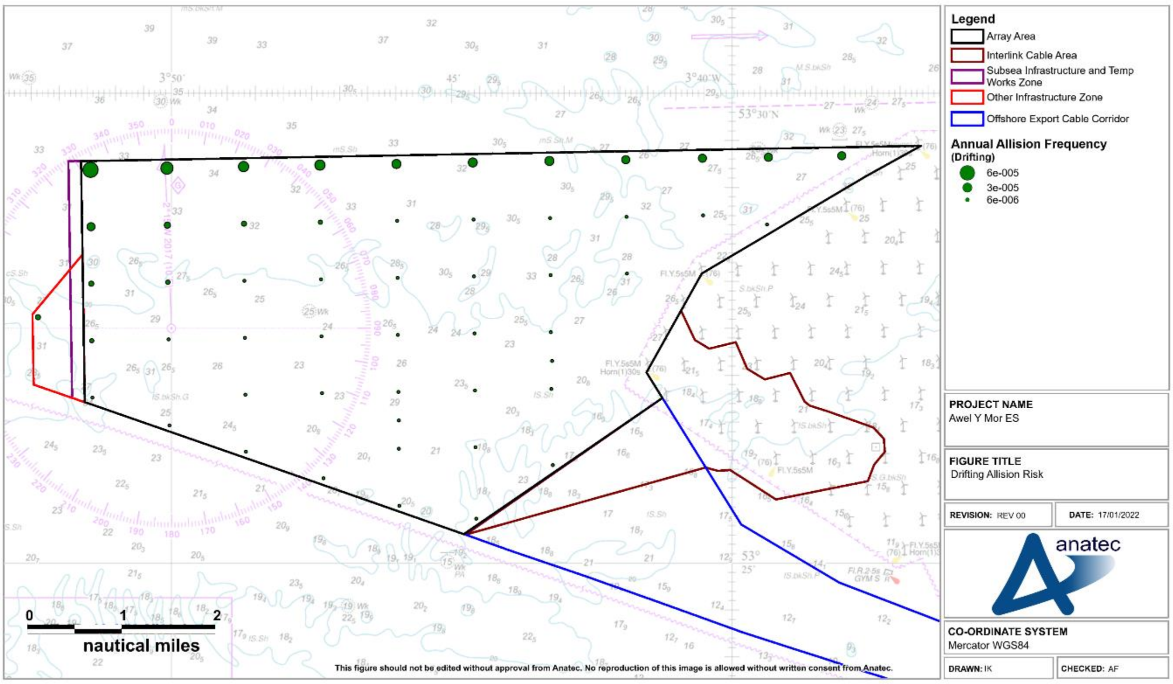


Figure 17.10: Drifting Allision Risk

295. Assuming base case traffic levels, it was estimated that a drifting vessel would allide with a structure once per 2,800 years. The significant majority of this risk was observed to be associated with the structures on the northern periphery of the array, resultant of vessels associated with the inbound lane of the Liverpool Bay TSS, noting that this includes vessels deviating around the north west corner.

17.3.4 Fishing Allision Risk

296. The 28 days of marine traffic survey data (see Section 13.2.5) was used as input to the fishing allision function of Anatec’s COLLRISK modelling software suite to assess the potential fishing vessel to structure allision risk following the construction of AyM.

297. A fishing vessel allision is classified separately from other allisions since, unlike in the case of the commercial traffic characterised via the main routes (see Section 13.4), fishing vessels may be either in transit or actively fishing within the area. Further, fishing vessels could be observed internally within the array in addition to externally (noting that experience shows that commercial vessels will generally avoid wind farm structures). The COLLRISK fishing allision model uses fishing vessel numbers, sizes (length and beam), wind farm layout, and structure dimensions as input. The likelihood of a major allision incident has been calibrated against historical maritime incident data and historical AIS vessel traffic data within operational offshore arrays in the UK. Both AIS and non AIS vessels (i.e., those recorded via Radar) have been included as input.

298. Noting uncertainty around potential fishing vessel behaviour post wind farm, it should be considered that the model conservatively assumes no changes to baseline activity in terms of proximity to structures (i.e., vessels are not altering their navigational patterns based on the presence of structures in line with good seamanship). This is considered a very conservative approach given experience shows that while commercial fishing vessels do continue to transit operational arrays, activity immediately around the structures is very likely to reduce.

299. The results of the fishing allision assessment are shown geographically in Figure 17.11.

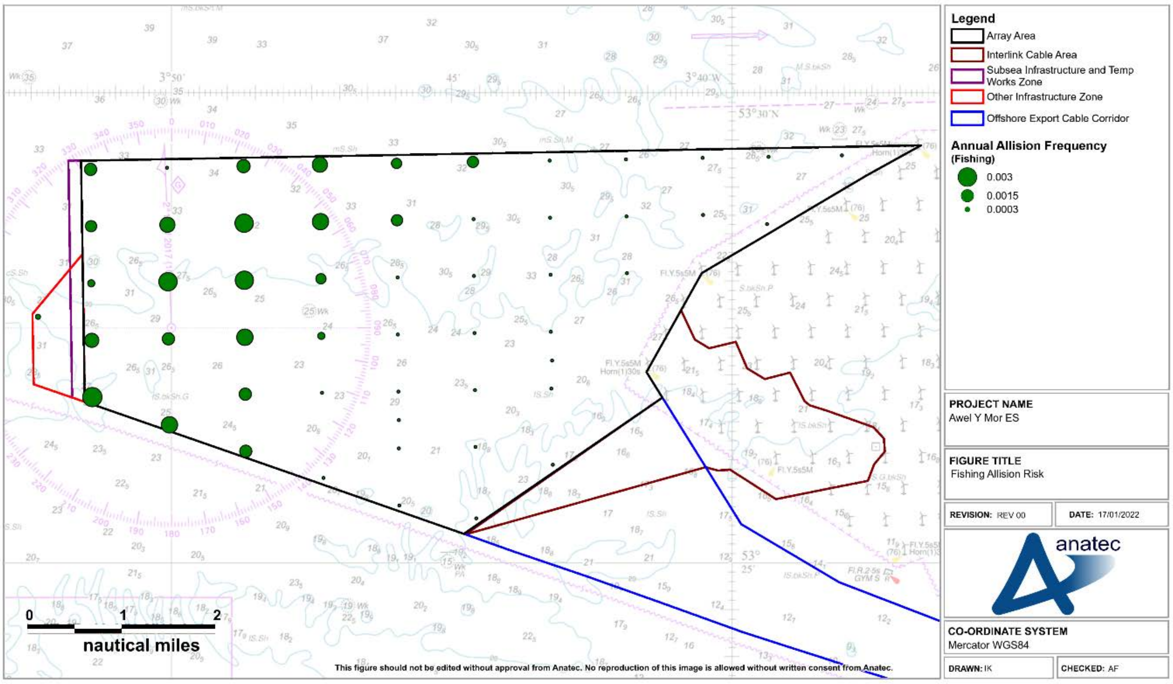


Figure 17.11: Fishing Allision Risk

300. Assuming base traffic levels, it was estimated that a vessel would allide with a structure within the array once per 28 years. The majority of this risk was observed to be associated with the structures within the western extent of the array, which aligns with the marine traffic data (see Section 13.2.5). This rose to one per 25 years assuming future case traffic levels.

301. The model is calibrated against known allision incidents within UK wind farms (see Section 12.4). 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 12.4.

17.4 Results Summary

302. As per Section 17.1, both pre and post wind farm scenarios with base case and future case traffic levels have been run. Table 17.1 summarises the results of these four scenarios.

303. It is noted that the modelled frequencies are all lower than at PEIR stage (noting fishing allision was not modelled at PEIR). This is resultant of the reduction in array post PEIR (see Section 6.1).

Table 17.1: Risk Results Summary

Collision/ allision scenario	Base case			Future case		
	Pre wind farm	Post wind farm	Change	Pre wind farm	Post wind farm	Change
Vessel to vessel collision	9.51×10^{-3} (1 every 105 years)	9.71×10^{-3} (1 every 103 years)	2.02×10^{-4}	1.17×10^{-2} (1 every 85 years)	1.20×10^{-2} (1 every 83 years)	2.51×10^{-4}
Powered vessel to structure allision	0	8.63×10^{-4} (1 every 1,160 years)	8.63×10^{-4}	0	9.52×10^{-4} (1 every 1,050 years)	9.52×10^{-4}
Drifting vessel to structure allision	0	3.63×10^{-4} (1 every 2,800 years)	3.63×10^{-4}	0	4.02×10^{-4} (1 every 2,500 years)	4.02×10^{-4}
Fishing Allision	0	3.59×10^{-2} (1 every 28 years)	3.59×10^{-2}	0	3.95×10^{-2} (1 every 25 years)	3.95×10^{-2}
Total	**9.51×10^{-3} (1 every 105 years)**	**4.68×10^{-2} (1 every 21 years)**	**3.73×10^{-2}**	**1.17×10^{-2} (1 every 85 years)**	**5.28×10^{-2} (1 every 19 years)**	**4.11×10^{-2}**

17.5 Consequences

304. The most likely consequences for the majority of hazards associated with shipping and navigation are anticipated to be minor in nature, e.g. glancing blow or minor bump. However, the worst case consequences may be severe, including incidents with Potential Loss of Life (PLL).

305. For larger commercial vessels, a powered allision incident would be more likely to result in the collapse of a structure within the array than any material damage to the vessel itself. For such larger vessels, the breach of a fuel tank is considered unlikely given the robustness of the vessel and in the case of vessels carrying cargoes which may be deemed to be hazardous (e.g., tankers or gas carriers) the additional safety features associated with these vessels would further mitigate the risk of pollution (e.g., double hulls). Similarly, in a drifting allision incident the structures within the array would likely absorb the majority of the impact energy, particularly given the likely low speed of the errant vessel and the allision energy deflected by the movement of the vessel.

306. For smaller vessels, such as fishing vessels and recreational vessels, the worst case consequences would be the risk of vessel damage leading to foundering of the vessel and potential for persons in the water and PLL.

307. A quantitative assessment of the potential consequences of a collision or allision incident is provided in Appendix D. This assessment applies the modelling results presented in this section to historical data regarding collision and allision incidents and oil pollution. The following paragraphs summarise the output of the assessment.

308. The overall annual increase in PLL estimated due to the impact of AyM on passing vessels is approximately 2.45×10^{-4} (assuming base case traffic levels) corresponding to one additional fatality in approximately 4,100 years. In terms of individual risk to people, the incremental increase estimated due to the impact of AyM for the base case is 7.37×10^{-6}.

309. Based upon the collision and allision frequencies and historical oil spill data, the overall increase in oil spilled due to AyM is estimated to be 0.18 tonnes of oil per year for the base case. From research undertaken as part of the Identification of Marine Environmental High Risk Areas (MEHRAs) in the UK (DfT, 2001) the average annual tonnes of oil spilled in the waters around the British Isles due to marine incidents in the 10-year period from 1989 to 1998 was 16,111. Therefore, the overall increase in pollution estimated for AyM represents a very low increase compared to the current average annual tonnes of oil spilled and hence can be considered minimal in comparison to the annual average.

310. On this basis, the incremental increase in risk to both people and the environment caused by AyM is estimated to be very low.

18 Hazard Screening

311. This section provides details of the hazards of relevance to shipping and navigation which have been scoped into the FSA within Volume 2, Chapter 9: Shipping and Navigation (application ref: 6.2.9), based on the findings of the NRA process.

312. It is noted that hazards associated with vessels engaged in fishing (i.e., with gear deployed) are considered in Volume 2, Chapter 8: Commercial Fisheries (application ref: 6.2.8).

313. The approach to assessment within the NRA and Volume 2, Chapter 9: Shipping and Navigation (application ref: 6.2.9) for each hazard included within the Scoping Report is given in Table 18.1.

Table 18.1: NRA Hazard Screening

Hazard at Scoping Stage	Approach in FSA	Rationale
Traffic displacement (all phases)	Split into separate collision and adverse weather routeing elements.	Specific concern was raised over adverse weather routeing during NRA consultation.
Increased vessel to vessel collision risk between third party vessels resulting from displacement and proximity to routeing measures (construction and decommissioning)	Assessed during all phases (as opposed to just construction and decommissioning).	Concern raised during consultation over vessels exiting the array into the TSS. The associated risk will differ during the operational phase given all structures will be in place.
Increased vessel to vessel collision risk between a third party vessel and a project vessel (all phases)	As per scoping.	n/a
Reduced access to local ports (all phases).	As per scoping.	n/a

Hazard at Scoping Stage	Approach in FSA	Rationale
Vessel to structure allision risk (operational phase only).	Assessed for all phases and split into powered and drifting allision elements.	Specific concerns raised during consultation around siting of the Met Mast in terms of powered allision risk. Allision risk will differ during per phase noting separate mitigations will be in place.
Reduction of under keel clearance resultant of cable protection (operational phase only).	As per scoping.	n/a
Anchor interaction with subsea cables (operational phase only).	As per scoping.	n/a
Interference with communications and position fixing equipment (operational phase only).	Assessed within the NRA.	See Section 14.
Reduction of SAR capability due to increased incident rates and reduced access for surface / air responders (operational phase only).	Assessed for all phases.	Specific queries over site access including during construction raised during consultation, and available “self help” resources will differ by phase.

314. Therefore, based on the NRA hazard screening as summarised in Table 18.1. The following hazards are assessed within Volume 2, Chapter 9: Shipping and Navigation (application ref: 6.2.9):

- Increased vessel to vessel collision risk between third party vessels resulting from displacement and proximity to routeing measures (all phases);
- Restriction of adverse weather routeing (all phases);
- Increased vessel to vessel collision risk between a third party vessel and a project vessel (all phases);
- Reduced access to local ports (all phases);
- Vessel to structure powered allision risk (all phases);

- Vessel to structure drifting allision risk (all phases);
- Reduction of under keel clearance resultant of cable protection (operational phase only);
- Anchor interaction with subsea cables (operational phase only); and
- Reduction of SAR capability due to increased incident rates and reduced access for surface / air responders (all phases).

19 Mitigation

315. The risk assessment within Volume 2, Chapter 9: Shipping and Navigation (application ref: 6.2.9) assumes certain embedded mitigation measures will be in place. These are summarised in Table 19.1 including reference to how each will be secured, noting where relevant this includes via the Schedule of Mitigation (application ref: 8.11).

Table 19.1: Embedded Mitigation

Mitigation	Summary	How the Mitigation will be Secured
MGN 654 Compliance	As required, the AyM project will comply with MGN 654 and its annexes.	Anticipated to be a Marine Licence condition as outlined in Annex 5.4.1 Outline Approach to Marine Licencing (App Ref 5.4.1) to Consents and Licences required under Other Legislation (App Ref: 5.4).
CBRA	CBRA to determine appropriate burial depths for the subsea cable and to determine where additional protection is necessary.	Anticipated to be a Marine Licence condition as outlined in Annex 5.4.1 Outline Approach to Marine Licencing (App Ref 5.4.1) to Consents and Licences required under Other Legislation (App Ref: 5.4).
Marine Pollution Contingency Plan	Production of a Marine Pollution Contingency Plan to outline procedures in the event of an accidental pollution event arising from activities associated with AyM.	Anticipated to be a Marine Licence condition as outlined in Annex 5.4.1 Outline Approach to Marine Licencing (App Ref 5.4.1) to Consents and Licences required under Other Legislation (App Ref: 5.4).
ERCoP	Production of an ERCoP in agreement with MCA and in line with MGN 654 requirements.	MGN 654 requirement
Appropriate marking on Admiralty charts	Details of AyM will be provided to the UKHO in advance of construction to ensure the buoyed construction area is displayed on nautical charts.	Anticipated to be a Marine Licence condition as outlined in Annex 5.4.1 Outline Approach to Marine Licencing (App Ref 5.4.1) to Consents and Licences required under Other Legislation (App Ref: 5.4).

Mitigation	Summary	How the Mitigation will be Secured
Promulgation of information	Details of AyM will be promulgated in advance of, and during construction via the usual means (e.g., Notice to Mariners, Kingfisher bulletin) to ensure mariners are aware of the ongoing works.	Anticipated to be a Marine Licence condition as outlined in Annex 5.4.1 Outline Approach to Marine Licencing (App Ref 5.4.1) to Consents and Licences required under Other Legislation (App Ref: 5.4).
Buoyed construction / decommissioning area	Marking of the array as a buoyed construction / decommissioning area as directed by Trinity House.	Anticipated to be a Marine Licence condition as outlined in Annex 5.4.1 Outline Approach to Marine Licencing (App Ref 5.4.1) to Consents and Licences required under Other Legislation (App Ref: 5.4).
Application for safety zones	Application for construction safety zones to be submitted to the Department of Business, Energy & Industrial Strategy (BEIS).	Application for safety zones to be made post consent under The Electricity (Offshore Generating Stations) (Safety Zones) (Applications Procedures and Control of Access) Regulations 2007 (SI No 2007/1948).
Marine coordination	Marine coordination and communication to manage project vessel movements. This will include project vessel procedures including promulgation of defined indicative project vessel transit routes to site.	Via the Schedule of Mitigation (Document 8.1).
Lighting and Marking	Lighting and marking of the array in agreement with Trinity House and in line with IALA R139 / G1162.	Anticipated to be a Marine Licence condition as outlined in Annex 5.4.1 Outline Approach to Marine Licencing (App Ref 5.4.1) to Consents and Licences required under Other Legislation (App Ref: 5.4).
Guard vessels	Use of guard vessels where identified as necessary via risk assessment.	MGN 654 requirement to consider use where appropriate

Mitigation	Summary	How the Mitigation will be Secured
Blade Clearance	Blade clearance of at least 22m above MHWS (in line with RYA Requirements) to ensure potential for recreational mast interaction with the blades is minimised.	MGN 654 requirement
Framework Layout Commitments (see Section 19.1)	Parameters within which the final layout will be defined will be agreed with the MCA and Trinity House to ensure suitable SAR and surface navigation access.	Agreed with MCA and Trinity House.

19.1 Framework Layout Commitments

316. The Applicant have developed a set of framework layout commitments to which the final layout will comply, which are shown in Table 19.2. The Applicant have discussed and agreed these with the MCA and Trinity House as per Section 4.2.

317. It is noted that these are designed to inform the overarching layout design process, and that the final layout itself will be agreed with the MCA and Trinity House as required.

Table 19.2: Framework Layout Commitments

Relevant Structures / Feature	**Layout Commitments** (To support internal layout development and approval as per consent requirements)	**Reasoning**	**Overview of Guidance** (Noting that MGN 654 and IALA R139 / G1162 should be considered alongside these commitments)
SAR Access Lanes	SAR Access Lanes shall be maintained in at least one direction (centre line orientation) within the AyM array[138] referred to as the primary line of orientation. This may be different to the GYM SAR lane orientations. The primary line of orientation should be a minimum of 500m tip to tip in AyM[6].	To maintain search and rescue asset (surface and air) coverage of the AyM and GyM arrays.	As per MGN 654 full consideration of the availability of two lines is required before one line should be considered. If the final array design has only one line of orientation a safety justification to demonstrate that it is safe for SAR access and surface

[6] Areas in the north east of the AyM array and the area where the AyM and GyM arrays interface may have restricted SAR lane coverage due to the existing GyM WTGs, however a final layout will maximise access through either the AyM or GyM array.

Relevant Structures / Feature	Layout Commitments (To support internal layout development and approval as per consent requirements)	Reasoning	Overview of Guidance (Noting that MGN 654 and IALA R139 / G1162 should be considered alongside these commitments)
	Available secondary lines of orientation in AyM, even if less than 500m, should also be considered. Structure positions will be such that a minimum of one line of orientation[7] is maintained through the GyM WTGs, noting that some GyM lane widths will be notably less than for GyM in isolation (minimum 300m widths), due to the differing rotor diameters in AyM.		navigation should be submitted to the MCA.
Position of all internal WTGs and OSPs	Structures will be arranged in lines between AyM SAR Access Lanes. Tolerance of ±150 metres may be used in agreement with the MCA and will avoid placement of structures which impact on minimum SAR Access Lanes widths. The tolerance value includes a micrositing allowance of up to 50m in any direction as required to avoid constraints. Inconsistent layout patterns may be used to maximise SAR lane coverage in the North East of the AyM array and the area where the AyM and GyM arrays interface.	To provide a degree of layout optimisation flexibility while maintaining clear lanes to facilitate SAR asset access.	As per MGN 654 structures aligned in straight rows and columns are considered a safe preference by MCA SAR helicopter pilots.
Position of all peripheral	Structures forming a line of perimeter[8] structures around the AyM array (excluding the perimeter bordering the GyM	To provide clear project boundaries for passing vessels,	The array should be of a design that enables the development to be safely lit and marked in line with Trinity

[7] Maintaining one line through GyM (due to the size and positions of AyM) may result in the loss of other GyM lines
[8] Perimeter means the external edge of the array

Relevant Structures / Feature	**Layout Commitments** (To support internal layout development and approval as per consent requirements)	**Reasoning**	**Overview of Guidance** (Noting that MGN 654 and IALA R139 / G1162 should be considered alongside these commitments)
WTGs and OSPs	array) shall, so far as is practicable, be arranged in lines. Tolerance of ±150 metres may be used in agreement with the MCA[9] and will avoid placement of structures which impact on minimum SAR Access Lanes widths or create dangerously projecting peripheral structures. The tolerance value includes micrositing of up to 50m in any direction as required to avoid constraints.	and to prevent projecting peripheral structures which present an increased risk to passing vessels.	House and IALA R139 / G1162 requirements.
Northern alignment	The northern perimeter of the AyM array will be aligned with the northern perimeter structures in GyM so far as practicable and without any dangerously projecting peripheral structures. This shall consider rotor tips rather than structure centrelines due to differences in WTG size. A micrositing allowance of up to 50m in any direction may be used as required to avoid constraints.	To ensure safe navigation for vessels transiting from the Traffic Separations Scheme by maintaining alignment with the already agreed setback distance associated with GyM.	To maintain visual consistency between the AyM and GyM arrays for passing traffic.

[9] And Trinity House

20 Through Life Safety Management

20.1 Quality, Health, Safety and Environment

318. Quality, Health, Safety and Environment (QHSE) documentation including a Safety Management System (SMS) will be in place for AyM 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.

319. 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.

20.2 Incident Reporting

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

321. 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.

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

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

324. When appropriate, the designated person (noted within the Emergency Response Co-operation Plans (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.

20.3 Review of Documentation

325. 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.

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

- Changes to AyM, conditions of operation and prior to decommissioning;
- Planned reviews; and
- Following an incident or exercise.

327. 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.

20.4 Inspection of Resources

328. All vessels, facilities, and equipment necessary for marine operations associated with AyM 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.

20.5 Audit Performance

329. 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.

330. 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.

20.6 Vessel Traffic Monitoring

331. The DCO is expected to include the requirement for construction traffic monitoring by AIS, including continual collection of data from a suitable location within the array. An assessment of a minimum of 28 days will be submitted to the MCA annually throughout the construction phase and is likely to continue through the first year of the operation and maintenance phase to ensure measures implemented are effective.

332. The data collected will be compared against the results of the vessel traffic analysis (see Section 13) and predicted future case routeing (see Section 16.4) to ensure the findings of the NRA remain valid.

20.7 Cable Monitoring

333. Subsea cables associated with AyM will be subject to periodic inspection post construction to monitor the cable protection, including burial depths. Maintenance of the protection will be undertaken as necessary.

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

20.8 Hydrographic Surveys

335. As required by MGN 654 guidance and DCO conditions, detailed and accurate hydrographic surveys will be undertaken periodically at intervals agreed with the MCA.

20.9 Decommissioning Plan

336. 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 AyM) which is considered to be a danger to navigation and which it has not proved possible to remove. Such an obstruction may require marking until such time as it is either removed or no longer considered a danger to navigation, the continuing cost of which would need to be met by the Applicant.

21 Summary and Next Steps

337. Using various baseline data sources and giving consideration to the consultation undertaken, hazards relating to shipping and navigation that may arise as a result of AyM have been identified. These findings will feed into and inform Volume 2, Chapter 9: Shipping and Navigation (application ref: 6.2.9).

21.1 Navigational Features

338. The Liverpool Bay TSS is located north of the array with a high proportion of the marine traffic within the study area utilising this routeing measure when transiting to and from the port of Liverpool.

339. There are four operational OWFs located within the study area, with the closest being GyM, located adjacent to the array. There are also three active O&G platforms present within the northern section of the study area with a number of pipelines originating from these platforms.

340. Numerous AtoN are present within the study area marking various hazards including other OWFs, and O&G platforms. There are 13 submarine cables locate within the study area associated with other OWFs, O&G platforms, and interconnectors between separate landmasses.

341. There are three marine aggregate dredging areas present within the study area, comprising of two Production areas and one Exploration and Option area.

342. Numerous ports are located in close proximity to AyM on the north Welsh and east English coasts. The closest port to AyM is Rhos-on-sea located approximately 7.4NM to the south of the array. The busiest port between 2015 and 2019 within proximity of AyM is the port of Liverpool with more than 6,000 vessel arrivals per year. Pilot boarding stations associated with a number of the ports are also located within proximity of AyM.

343. Two charted anchorage areas are located to the east of the array. Anchorage points are also located to the south of the array and commercial vessels have been recorded regularly to anchor off Point Lynas / Dulas Bay.

21.2 Historical Maritime Incidents

344. A total of 45 incidents were recorded by the MAIB between 2010 and 2019 within the study area, corresponding to an average of five incidents per year. One of these incidents, a machinery failure of a vessel associated with the O&G industry in 2012, occurred within the array. No incidents were recorded within the offshore ECC, with one incident occurring within the GyM Interlink Zone.

345. A total of 1,150 incidents were recorded by the RNLI between 2010 and 2019 within the study area, corresponding to an average of 115 incidents per year. The majority of

these incidents occurred within coastal regions to the south of the array. Five incidents occurred within the array and 22 incidents occurred within the offshore ECC.

346. A total of 96 SAR helicopter taskings were undertaken for incidents within the shipping and navigation study area, corresponding to an average of 19 taskings per year. No SAR helicopter taskings were undertaken within the array or offshore ECC.

21.3 Vessel Traffic

347. There was an average of 58 unique vessels recorded per day within the study area during the winter survey period, and 57 unique vessels recorded per day within the study area during the summer survey period. During the winter survey period, 3% of the vessels recorded within the study area intersected the array. During the summer survey period, 6% of the vessels recorded within the study area intersected the array. The majority of vessels recorded in both survey periods were commercial (cargo and tanker).

348. Commercial vessels were generally recorded transiting using the Liverpool Bay TSS with a passenger route also present within the north eastern section of the study area. Wind farm and O&G vessels were generally recorded within the study area in the vicinity of their respective developments. Marine aggregate dredgers were recorded within the study area generally transiting to the extraction areas within the study area.

349. Fishing vessels were recorded both in transit and actively fishing within the study area with these vessels generally recorded to the north and west of the array. Limited recreational activity was recorded within the study area during the survey period.

21.4 Main Routes

350. A total of 17 main routes were identified from the AIS data studied, with the majority being associated with the Liverpool Bay TSS. Of these, two are anticipated to require deviation as a result of AyM, however these deviations are all considered minor based on both the quantitative NRA findings and consultation input.

351. No additional deviations are anticipated to occur to these two routes when cumulative projects are considered in combination.

21.5 Allision and Collision Modelling

352. Based on Anatec's CollRisk modelling suite, it was estimated that collision risk to commercially routed vessels will rise by approximately 2% as a result of the likely post wind farm deviations anticipated from AyM. A powered allision was estimated to occur once every 1,160 years, and a drifting allision once every 2,800 years.

353. The fishing vessel allision return period was estimated at 28 years, noting that this conservatively assumes no change in baseline activity and is inclusive of low impact contacts.

21.6 Next Steps

354. Hazards identified as requiring further assessment based on the findings of the NRA will be assessed within Volume 2, Chapter 9: Shipping and Navigation (application ref: 6.2.9). These are as follows:

- Increased vessel to vessel collision risk between third party vessels resulting from displacement and proximity to routeing measures (all phases);
- Restriction of adverse weather routeing (all phases);
- Increased vessel to vessel collision risk between a third party vessel and a project vessel (all phases);
- Reduced access to local ports (all phases);
- Vessel to structure powered allision risk (all phases);
- Vessel to structure drifting allision risk (all phases);
- Reduction of under keel clearance resultant of cable protection (operational phase only);
- Anchor interaction with subsea cables (operational phase only); and
- Reduction of SAR capability due to increased incident rates and reduced access for surface / air responders (all phases).

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Appendix A MGN 654 Checklist

355. This appendix provides a completed MCA MGN 654 (MCA, 2021) checklist. This checklist demonstrates that the NRA is compliant with the MCA requirements for OREIs.

356. A template checklist is included as an annex to MGN 654 which has been used as the basis of this document. The template provides tables containing the requirements of MGN 654 its Annex 1 (MCA Methodology for Assessing Navigational Safety and Emergency Response Risks of OREIs). These are provided in Table A.1 and Table A.2, respectively.

357. It should be noted that in certain cases the points raised will be specifically addressed post consent – any such cases have been made clear in the text within the completed checklist.

Table A.1 MGN 654 Checklist

MGN Reference	Yes/No	Comments
Planning Stage – Prior to Consent		
Site and Installation Co-ordinates: Developers are responsible for ensuring that formally agreed co-ordinates and subsequent variations of site perimeters and individual OREI structures are made available, on request, to interested parties at relevant project stages, including application for consent, development, array variation, operation and decommissioning. This should be supplied as authoritative Geographical Information System (GIS) data, preferably in Environmental Systems Research Institute (ESRI) format. Metadata should facilitate the identification of the data creator, its date and purpose, and the geodetic datum used. For mariners' use, appropriate data should also be provided with latitude and longitude coordinates in WGS84 (ETRS89) datum.	✓	**Section 6: Project Description** Outlines the coordinates of the array.
Traffic Survey – includes:		
All vessel types	✓	**Section 13: Vessel Traffic** All vessel types are considered with specific breakdowns by vessel type given (see Section 13.2).

MGN Reference	Yes/No	Comments
At least 28 days duration, within either 12 or 24 months prior to submission of the Environmental Impact Assessment Report	✓	**Section 13: Vessel Traffic** A total of 28 day of marine traffic survey data has been collected that complies with MGN 654 requirements.
Multiple data sources	✓	**Section 8: Vessel Traffic Survey Methodology** The vessel traffic survey data includes AIS, radar and visual observation data. As per Section 7 additional data sources and consultation have also been considered to supplement the marine traffic data
Seasonal variations	✓	**Section 13: Vessel Traffic** The two 14 day marine traffic survey periods were chosen to be seasonally varied. **Appendix B – Long Term Assessment** Seasonal variation has been assessed via assessment of long term AIS data collected over the entirety of 2019. The will also include both summer and winter dedicated survey data including radar and visual observations.
MCA consultation	✓	**Section 4: Consultation** The MCA has been consulted as part of the NRA process
General Lighthouse Authority consultation	✓	**Section 4: Consultation** Trinity House has been consulted as part of the NRA process
Chamber of Shipping and shipping company consultation	✓	**Section 4: Consultation** CoS has been consulted as part of the NRA process.
Recreational and fishing vessel organisations consultation	✓	**Section 4: Consultation** The RYA and CA were consulted as part of the NRA process. Fishing

MGN Reference	Yes/No	Comments
		and recreational representatives were present at the Hazard Workshop.
Port and navigation authorities consultation, as appropriate	✓	**Section 4: Consultation** Key navigation authorities have been consulted with as part of the NRA process including ports and pilot representatives. Both local port authorities and pilots were represented at the Hazard Workshop.
Assessment of the cumulative and individual effects of (as appropriate):		
i. Proposed OREI site relative to areas used by any type of marine craft.	✓	**Section 13: Vessel Traffic** Vessel traffic data in proximity to the array has been analysed **Volume 2, Chapter 9: Shipping and Navigation (application ref: 6.2.9)** Hazards have been assessed on both an in isolation and cumulative basis
ii. Numbers, types and sizes of vessels presently using such areas	✓	**Section 13: Vessel Traffic** Vessel traffic data in proximity to the array has been analysed and includes breakdowns of daily 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 9: Navigational Features** Section 9.6 identifies marine aggregate dredging areas in proximity to the array. **Section 13: Vessel Traffic** Non-transit users were identified in the vessel traffic survey data and included recreational traffic, fishing vessels, and marine aggregate dredgers.

MGN Reference	Yes/No	Comments
iv. Whether these areas contain transit routes used by coastal, deep-draught or international scheduled vessels on passage.	✓	**Section 13.4: Vessel Routeing** Main routes in proximity to the array have been identified using the principles set out in MGN 654.
v. Alignment and proximity of the site relative to adjacent shipping routes	✓	**Section 9: Navigational Features** Section 9.1 shows the array relative to the Liverpool Bay TSS.
vi. Whether the nearby area contains prescribed routeing schemes or precautionary areas	✓	**Section 9: Navigational Features** Section 9.1 shows the array relative to the Liverpool Bay TSS.
vii. Proximity of the site to areas used for anchorage (charted or uncharted), safe haven, port approaches and pilot boarding or landing areas.	✓	**Section 9: Navigational Features** Sections 9.8 (ports), Section 9.9 (pilot boarding), and Section 9.10 (anchorages).
viii. Whether the site lies within the jurisdiction of a port and/or navigation authority.	✓	**Section 9: Navigational Features** Sections 9.8 presents the nearby ports
ix. Proximity of the site to existing fishing grounds, or to routes used by fishing vessels to such grounds.	✓	**Section 13: Vessel Traffic** Fishing vessel movements are considered in Section 13.2.5.
x. Proximity of the site to offshore firing/bombing ranges and areas used for any marine military purposes.	✓	**Section 9: Navigational Features** Section 9.11 discusses military areas, noting none are in close proximity to the array.
xi. Proximity of the site to existing or proposed submarine cables or pipelines, offshore oil / gas platform, marine aggregate dredging, marine archaeological sites or wrecks, Marine Protected Area or other exploration/exploitation sites	✓	**Section 9: Navigational Features** Section 9.3 (O&G features) Section 9.6 (marine aggregate dredging) Section 9.7 (charted wrecks) Section 9.12 (MEHRAs)
xii. Proximity of the site to existing or proposed OREI developments, in co-operation with other relevant developers, within each round of lease awards.	✓	**Section 9: Navigational Features** Section 9.7 identifies other operational OWF developments **Section 15: Cumulative Overview** Presents relevant proposed / planned OREI.

MGN Reference	Yes/No	Comments
xiii. Proximity of the site relative to any designated areas for the disposal of dredging spoil or other dumping ground	✓	**Section 9: Navigational Features** Section 9.6 shows identified foul and spoil grounds.
xiv. Proximity of the site to aids to navigation and/or Vessel Traffic Services (VTS) in or adjacent to the area and any impact thereon.	✓	**Section 9: Navigational Features** Section 9.4 identifies the AtoNs in proximity to the array.
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 17: Allision and Collision Risk Modelling** Collision and allision risk modelling has been undertaken for AyM, which includes consideration of the effect of likely vessel displacement on collision risk
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 12: Historical Maritime Incidents** Historical vessel incident data published by the MAIB, RNLI, and DfT in proximity to the array has been considered alongside historical OWF incident data throughout the UK. **Section 17: Allision and Collision Risk Modelling** Collision and allision risk modelling has been undertaken to estimate the effects of AyM on allision and collision incident rates.
xvii. Proximity of the site to areas used for recreation which depend on specific features of the area	✓	**Section 13: Vessel Traffic** Recreational traffic is considered in Section 13.2.4 noting this includes consideration of the RYA Coastal Atlas features (RYA, 2018).
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 16: Future Case Vessel Traffic** Presents a methodology for post wind farm routeing and includes an assumption of minimum

MGN Reference	Yes/No	Comments
		distance of 1NM from offshore installations and wind turbine boundaries.
b. The width of a corridor between sites or OREIs to allow safe passage of shipping.	✓	**Section 16: Future Case Vessel Traffic** Post wind farm routeing is considered including in relation to existing OWFs, noting there is not considered to be a "corridor" between AyM and the existing projects.
OREI Structures – the following should be determined:		
a. Whether any feature of the OREI, including auxiliary platforms outside the main generator site, mooring and anchoring systems, inter-device and export cabling could pose any type of difficulty or danger to vessels underway, performing normal operations, including fishing, anchoring and emergency response.	✓	**Section 17: Allision and Collision Risk Modelling** Collision and allision risk modelling has been undertaken for AyM. **Volume 2, Chapter 9: Shipping and Navigation (application ref: 6.2.9).** Based upon the baseline data and consultation undertaken, hazards have been identified and assessed using the IMO FSA, including hazards involving anchoring and emergency response.
b. Clearances of fixed or floating wind turbine blades above the sea surface are not less than 22 metres (above MHWS for fixed). Floating turbines allow for degrees of motion.	✓	**Section 19: Mitigation** The minimum blade tip height will be at least 22m over MHWS.
c. Underwater devices i. changes to charted depth ii. maximum height above seabed iii. Under Keel Clearance	✓	**Section 6: Project Description** Array, interconnector, and export cable specifications are included for the MDS for cables. **Volume 2, Chapter 9: Shipping and Navigation (application ref: 6.2.9)** Based upon the baseline data and consultation undertaken, hazards

MGN Reference	Yes/No	Comments
		have been identified and assessed using the IMO FSA, including under keel clearance effects.
d. Whether structure block or hinder the view of other vessels or other navigational features.	✓	**Section 9: Navigational Features** Section 9.4 identifies the AtoN in proximity to the array. **Section 17: Allision and Collision Risk Modelling** Collision and allision risk modelling has been undertaken for AyM and includes the use of post wind farm routes.
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 10: Meteorological Ocean Data** Provides various states of tide local to the array. **Section 13: Vessel Traffic** Vessel traffic data in proximity to the array has been analysed **Section 17: Allision and Collision Risk Modelling** The collision and allision risk models consider tidal conditions.
b. The set and rate of the tidal stream, at any state of the tide, has a significant affect on vessels in the area of the OREI site.	✓	**Section 10: Meteorological Ocean Data** Provides various states of tide local to the array. **Section 17: Allision and Collision Risk Modelling** The collision and allision risk models consider tidal conditions
c. The maximum rate tidal stream runs parallel to the major axis of the proposed site layout, and, if so, its effect.	✓	
d. The set is across the major axis of the layout at any time, and, if so, at what rate.	✓	
e. In general, whether engine failure or other circumstance could cause vessels to be set into	✓	**Section 10: Meteorological Ocean Data**

MGN Reference	Yes/No	Comments
danger by the tidal stream, including unpowered vessels and small, low speed craft.		Provides various states of tide local to the array. **Section 17: Allision and Collision Risk Modelling** The drifting allision model considers tidal conditions and assesses whether machinery failure could cause vessels to be set into danger.
f. The structures themselves could cause changes in the set and rate of the tidal stream.	✓	**Section 10: Meteorological Ocean Data** 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 19: Mitigation** Mitigations have been included as part of the NRA, and this includes MGN 654 compliance with regards to under keel clearance and changes in water depth. **Volume 2, Chapter 9: Shipping and Navigation (application ref: 6.2.9)** Based upon the baseline data and consultation undertaken, hazards have been identified and assessed within the FSA, including those associated with changes in water depths.
h. The site, in normal, bad weather, or restricted visibility conditions, could present difficulties or dangers to craft, including sailing vessels, which might pass in close proximity to it.	✓	**Section 10: Meteorological Ocean Data** Provides weather and visibility data local to AyM. **Section 13: Vessel Traffic** Vessel traffic data in proximity to the array has been analysed including recreational vessels.

MGN Reference	Yes/No	Comments
		Volume 2, Chapter 9: Shipping and Navigation (application ref: 6.2.9) Assesses hazards associated with adverse weather routeing.
i. The structures could create problems in the area for vessels under sail, such as wind masking, turbulence or sheer.	✓	**Volume 2, Chapter 9: Shipping and Navigation (application ref: 6.2.9)** Based upon the baseline data and consultation undertaken hazards have been identified and assessed within the FSA, including those associated with effects on recreational vessels.
j. In general, taking into account the prevailing winds for the area, whether engine failure or other circumstances could cause vessels to drift into danger, particularly if in conjunction with a tidal set such as referred to above.	✓	**Section 17: Allision and Collision Risk Modelling** The drifting allision risk model considers weather and tidal conditions and assesses whether machinery failure could cause vessels to be set in danger **Volume 2, Chapter 9: Shipping and Navigation (application ref: 6.2.9)** Based upon the baseline data and consultation undertaken hazards have been identified and assessed within the FSA, including those associated with drifting allision.
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: for all vessels, or for specified vessel types, operations and/or sizes. in all directions or areas, or in specified directions or areas. in specified tidal, weather or other conditions	✓	**Section 14: Navigation, Communication and Position Fixing Equipment** Potential hazards on navigation of the different communications and position fixing devices used in and around OWFs are assessed.

MGN Reference	Yes/No	Comments
		Section 17: Allision and Collision Risk Modelling Collision and allision risk modelling has been undertaken for AyM which includes use of post wind farm routeing and takes account of tidal and weather conditions **Section 19: Mitigation** Mitigations have been included within the NRA. **Volume 2, Chapter 9: Shipping and Navigation (application ref: 6.2.9)** Based upon the baseline data and consultation undertaken hazards have been identified and assessed using the IMO FSA.
b. Navigation in and/or near the site should be prohibited or restricted: for specified vessels types, operations and/or sizes. in respect of specific activities, in all areas or directions, or in specified areas or directions, or in specified tidal or weather conditions.	✓	**Section 14: Navigation, Communication and Position Fixing Equipment** Potential hazards to navigation of the different communications and position fixing devices used in and around OWFs are assessed **Section 16: Future Case Vessel Traffic** Collision and allision risk modelling has been undertaken for AyM and includes the use of post wind farm routeing which assumes commercial vessel traffic will avoid the array. **Volume 2, Chapter 9: Shipping and Navigation (application ref: 6.2.9)** Based upon the baseline data and consultation undertaken hazards

MGN Reference	Yes/No	Comments
		have been identified and assessed within the FSA
c. Where it is not feasible for vessels to access or navigate through the site it could cause navigational, safety or routeing problems for vessels operating in the area e.g. by preventing vessels from responding to calls for assistance from persons in distress	✓	**Section 16: Future Case Vessel Traffic** Assessment of post wind farm routeing which assumes commercial vessel traffic avoids the array has been undertaken.
d. Guidance on the calculation of safe distance of OREI boundaries from shipping routes has been considered	✓	**Section 16: Future Case Vessel Traffic** Presents the methodology for post wind farm routeing and includes a minimum distance of 1NM from offshore installations and WTG boundaries.
Search and rescue, maritime assistance service, counter pollution and salvage incident response. The MCA, through HM Coastguard, is required to provide Search and Rescue and emergency response within the sea area occupied by all offshore renewable energy installations 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 19: Mitigation** The Applicant will comply with MGN 654, which requires the creation of an ERCoP.
b. The MCA's guidance document Offshore Renewable Energy Installation: Requirements, Advice and Guidance for Search and Rescue and Emergency Response for the design, equipment and operation requirements will be followed.	✓	**Section 19: Mitigation** The Applicant will comply with MGN 654 and its annexes.
c. A SAR checklist will be completed to record discussions regarding the requirements, recommendations and considerations outlined in the above document (to be agreed with MCA)	✓	**Section 19: Mitigation** The Applicant will comply with MGN 654, including the requirement for a SAR checklist.

MGN Reference	Yes/No	Comments
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	✓	The Applicant will provide the requested data.
ii. On a pre-established periodicity during the life of the development	✓	
ii. Post-construction: Cable route(s)	✓	
iii. 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:	✓	**Section 14: Navigation, Communication and Position Fixing Equipment** Potential hazards to navigation from impact on the different communications and position fixing devices used in and around OWFs are assessed
i. Vessels operating at a safe navigational distance	✓	
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: Vessel to vessel; Vessel to shore; VTS radar to vessel; Racon to/from vessel	✓	**Section 14: Navigation, Communication and Position Fixing Equipment** Potential hazards to navigation from impact on the different communications and position fixing devices used in and around OWFs are assessed. This includes Radar effects as per Section 14.7.

MGN Reference	Yes/No	Comments
c. The structures and generators might produce sonar interference affecting fishing, industrial or military systems used in the area.	✓	**Section 14: Navigation, Communication and Position Fixing Equipment** Potential hazards to navigation from impact on the different communications and position fixing devices used in and around OWFs are assessed. This includes Sonar effects as per Section 14.8.
d. The site might produce acoustic noise which could mask prescribed sound signals.	✓	**Section 14: Navigation, Communication and Position Fixing Equipment** Potential hazards to navigation from impact on the different communications and position fixing devices used in and around OWFs are assessed. This includes sound effects as per Section 14.9.
e. Generators and the seabed cabling within the site and onshore might produce electro-magnetic fields affecting compasses and other navigation systems.	✓	**Section 14: Navigation, Communication and Position Fixing Equipment** Potential hazards to navigation from impact on the different communications and position fixing devices used in and around OWFs are assessed. This includes potential EMF effects as per Section 14.6.
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 Environmental Impact Assessment (EIA).The specific measures to be employed will be selected in consultation with the Maritime and Coastguard Agency and will be listed in the developer's Environmental Statement (ES). These will be consistent with international standards contained in, for example, the Safety of Life at Sea (SOLAS) Convention - Chapter V, IMO Resolution A.572 (14)3 and Resolution A.671(16)4 and could include any or all of the following:	✓	**Section 19: Mitigation** Details the embedded mitigation that will be applied.

MGN Reference	Yes/No	Comments
i. Promulgation of information and warnings through notices to mariners and other appropriate maritime safety information (MSI) dissemination methods.	✓	**Section 19: Mitigation** As per the mitigations included in the NRA, promulgation of information will be undertaken.
ii. Continuous watch by multi-channel VHF, including Digital Selective Calling (DSC).	✓	**Section 19: Mitigation** As per the mitigations included in the NRA, marine coordination will be implemented.
iii. Safety zones of appropriate configuration, extent and application to specified vessels10	✓	**Section 19: Mitigation** As per the mitigations included in the NRA, safety zones will be applied for.
iv. Designation of the site as an area to be avoided (ATBA).	✓	It is not planned to propose any areas as an ATBA, noting that consultation is ongoing.
v. Provision of AtoN as determined by the GLA	✓	**Section 19: Mitigation** As per the mitigations included in the NRA, lighting and marking will be discussed and agreed with Trinity House.
vi. Implementation of routeing measures within or near to the development.	✓	It is not planned to propose any additional routeing measures.
vii. Monitoring by radar, AIS, CCTV or other agreed means	✓	**Section 19: Mitigation** The Applicant will comply with MGN 654, including requirements to complete the SAR checklist. **Section 20: Through Life Safety Management** Outlines the plans to monitor vessel movements by AIS during construction and operations.
viii. Appropriate means for OREI operators to notify, and provide evidence of, the infringement of safety zones.	✓	**Section 19: Mitigation** Means for notifying and providing evidence of infringement of safety zones will be provided in the Safety Zone Application, submitted

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

MGN Reference	Yes/No	Comments
		post-consent as per the included mitigations.
ix. Creation of an Emergency Response Cooperation Plan with the MCA’s Search and Rescue Branch for the construction phase onwards.	✓	**Section 19: Mitigation** The Applicant will comply with MGN 654, which requires the creation of an ERCoP.
x. Use of guard vessels, where appropriate	✓	**Section 19: Mitigation** As per the mitigations included in the NRA, guard vessels will be used where appropriate
xi. Update NRAs every two years e.g. at testing sites.	✓	Not applicable to AyM.
xii. Device-specific or array-specific NRAs	✓	**Section 6: Project Description** All offshore elements have been considered in this NRA.
xiii. Design of OREI structures to minimise risk to contacting vessels or craft	✓	There is no additional risk identified to craft compared to previous offshore wind farms and so no additional measures are identified.
xiv. Any other measures and procedures considered appropriate in consultation with other stakeholders.	✓	**Section 19: Mitigation** Details of mitigations.

Table A.2 Methodology for Assessing the Marine Navigational Safety & Emergency Response Risks of Offshore Renewable Energy Installations

The following content is included:	Section	Compliant Yes/No	Comments
A risk claim is included that is supported by a reasoned argument and evidence	**7**	✓	The risk assessment within **Volume 2, Chapter 9: Shipping and Navigation** (application ref: 6.2.9) assesses risk to shipping and navigation users based on the findings of the NRA including (but not limited to) baseline data, expert opinion, modelling, outputs of the Hazard Workshops, stakeholder concern and lessons learnt from existing offshore developments.
Description of the marine environment	B3	✓	**Section 9: Navigational Features** Details relevant navigational features in the vicinity of the wind farm site. **Section 15: Cumulative Overview** Details potential future developments of relevance to AyM.
Search and Rescue overview and assessment	3.3	✓	**Section 11: Emergency Response Overview** Details existing baseline SAR resources of relevance to AyM. **Section 12: Historical Maritime Incidents** Historic incident data is assessed to determine baseline incident rates.

The following content is included:	Section	Compliant Yes/No	Comments
Description of the OREI development and how it changes the marine environment	B3	✓	**Section 6: Project Description** Presents project description elements of relevance to shipping and navigation. **Section 17: Allision and Collision Risk Modelling** Provides quantitative assessment of pre- and post-wind farm allision and collision risk.
Analysis of the marine traffic, including base case and future traffic densities and types.	B1 B2	✓	**Section 13: Vessel Traffic** Assesses base case traffic volumes, types, and behaviours. **Section 16: Future Case Vessel Traffic** Assesses and considers future case traffic (both pre- and post-wind farm). **Appendix B: Long Term Assessment** Assesses additional long term AIS data.
Status of the hazard log ▪ Hazard Identification ▪ Risk Assessment ▪ Influences on level of risk ▪ Tolerability of risk ▪ Risk matrix	C1 F1 C2 C3 C4 C5	✓	**Section 3: Navigation Risk Assessment Methodology** The Hazard Log and workshop methodology is detailed in Section 3.3. **Appendix E: Hazard Log** Presents the agreed Hazard Log.

The following content is included:	Section	Compliant Yes/No	Comments
Navigation Risk Assessment ▪ Appropriate risk assessment ▪ MCA acceptance for assessment techniques and tools ▪ Demonstration of results ▪ Limitations	D1 D2 D3 D4	✓	**Section 2: Guidance and Legislation** MGN 654 and the IMO's FSA guidelines are the primary guidance documents used during the assessment. **Section 4: Consultation** NRA approach and methodology has been discussed and agreed with MCA. **Section 17: Allision and Collision Risk Modelling** Collision and allision risk modelling has been undertaken with the results outlined numerically and graphically (where appropriate).
Risk control log	E1 G1	✓	**Section 19: Mitigation** Details the embedded mitigation that will be applied.

Appendix B Long term AIS Data Analysis

B.1 Introduction

358. This NRA appendix assesses the available marine traffic data for the Awel y Mor Offshore Wind Farm. As required under MGN 654 (MCA, 2016), the NRA and Volume 2, Chapter 9: Shipping and Navigation (application ref: 6.2.9) consider 28 days of AIS, Radar, and visual observation data as the primary marine traffic data source. When considering specific survey periods in isolation, certain activities or periods of significance to shipping and navigation may not be captured. Therefore, in line with good practice assessment procedures, this NRA has also considered a longer-term data set covering the entirety of 2019 to ensure a comprehensive overview of the marine traffic baseline can be established, including the inclusion of any seasonal variation.

359. This approach (i.e., the use of both long-term and short-term data) has been agreed with both the MCA and Trinity House.

B.1.1. Aims and Objectives

360. The key aims and objective of this appendix are as follows:

- Identify seasonal variations in marine traffic via assessment of the long-term data;
- Determine which variations are not reflected within the short-term survey data (and therefore should be fed into the NRA baseline);
- Assess which dataset (long term / survey or combination of both) should be utilised for each key NRA element that requires marine traffic data input; and
- Identify and account for any potential effects COVID-19 may have had on the survey data.

B.1.2. Effects of COVID-19

361. It is noted that the primary purpose of the longer-term dataset is to ensure a comprehensive baseline can be established by ensuring seasonal variations are captured. However, in the case of AyM, the consideration of a longer-term dataset also ensures that any tangible effects of the COVID-19 situation on the short-term survey data can be identified. The pandemic has been observed to impact upon traffic volumes in certain areas, and as such consideration of pre-pandemic data is considered prudent, noting the winter traffic survey was undertaken in November and December 2020, and the summer survey in 2021. The NRA has considered the findings of both the survey data and the longer-term data set in order to assess a worst-case scenario.

B.2 Data Sources

362. This appendix has assessed AIS data collected from coastal receivers for the entirety of 2019 (1st January – 31st December 2019). Any traffic deemed to be temporary in nature (e.g., surveys) has been excluded.

B.2.1. Study Area

363. The study area used within this appendix aligns with that used in the main NRA. Further details are provided in Section 7.1.

B.2.2. Data Limitations

B.2.3. Downtime

364. Figure B.1 presents the percentage uptime[11] per month for the AIS receivers that the AIS data used within this report has been extracted from. On average across the entire study period, the uptime for the receiver was 93%. Note, uptime was lower for January and November and this has been accounted for in the vessel counts per day presented in Section B.3.2.

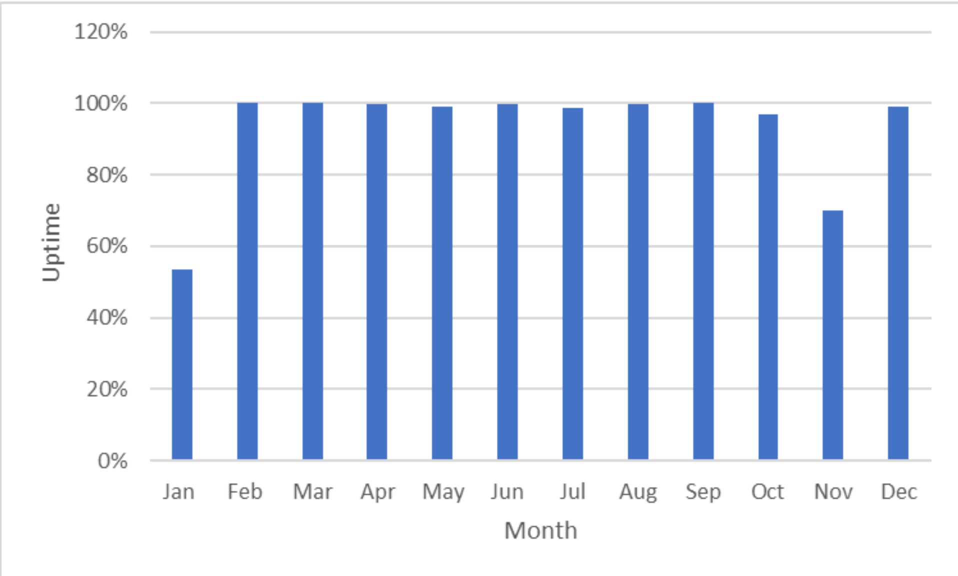

Figure B.1 **Uptime Percentage of AIS Receivers**

B.2.4. Survey Data

365. Other general limitations associated with the use of AIS data (e.g., carriage requirements) are discussed in full within Section 7.4 of the NRA.

[11] The time period when AIS data was being received by the receiver.

B.3 Long Term Assessment

B.3.1. Overview

366. An overview of all data recorded during 2019 within the study area (excluding any temporary traffic) is shown in Figure B.2, colour-coded by vessel type.

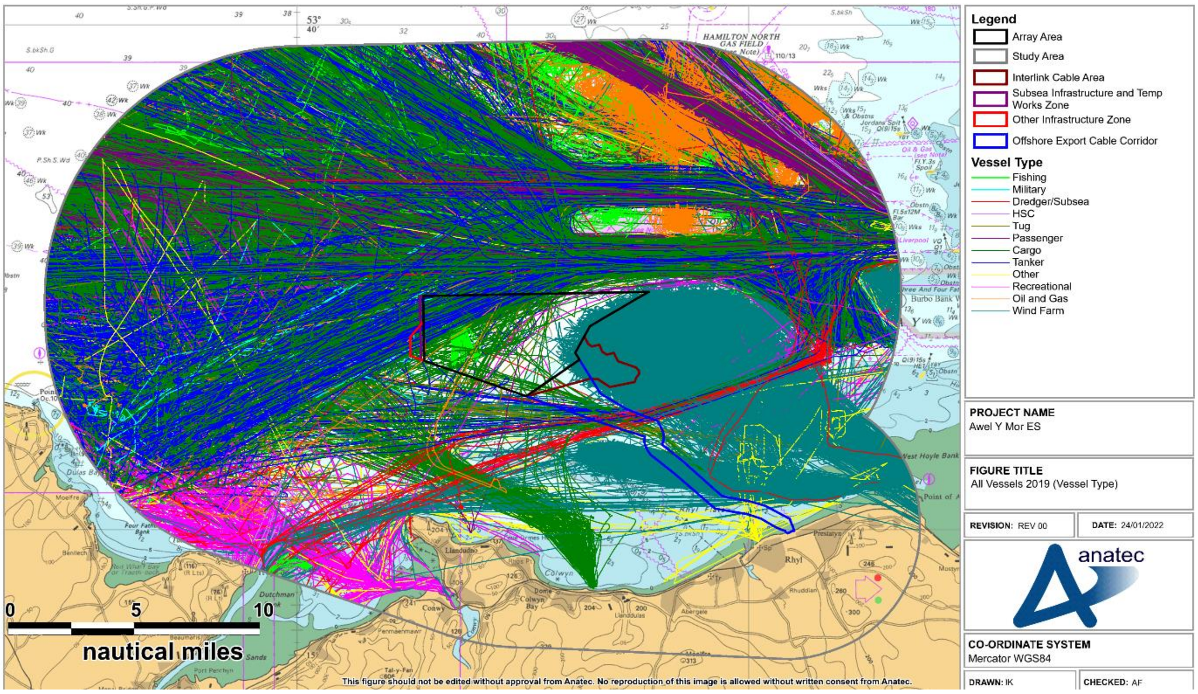

Figure B.2 **All Vessels 2019 (Type)**

367. A significant volume of commercial vessels (Section B.3.3.1) were observed utilising the Liverpool Bay TSS, noting that notable commercial traffic primarily associated with routes between Belfast and Dublin were also present in the north east section of the study area. O&G vessels (Section B.3.3.3) were, generally, recorded within the north eastern section of the study area in the vicinity of the nearby surface platforms. Wind farm vessels (Section B.3.3.5) were recorded at the operational wind farms to the south and east of Awel y Mor, specifically, Gwynt y Mor, Rhyl Flats, North Hoyle, and Burbo Bank. Wind farm vessels generally utilised ports to the east of the study area (Mostyn and Liverpool).

368. Recreational vessels (Section B.3.3.4) were, generally, recorded within coastal regions and originating from Conwy and Penrhyn ports. Fishing vessels (Section B.3.3.2) were recorded both in transit and actively fishing within the study area, mostly within the northern section of the study area, fishing vessels also utilised Penrhyn port.

B.3.2. Vessel Count

369. The average numbers of vessels recorded per day for each month of 2019 for the study area are presented in Figure B.3.

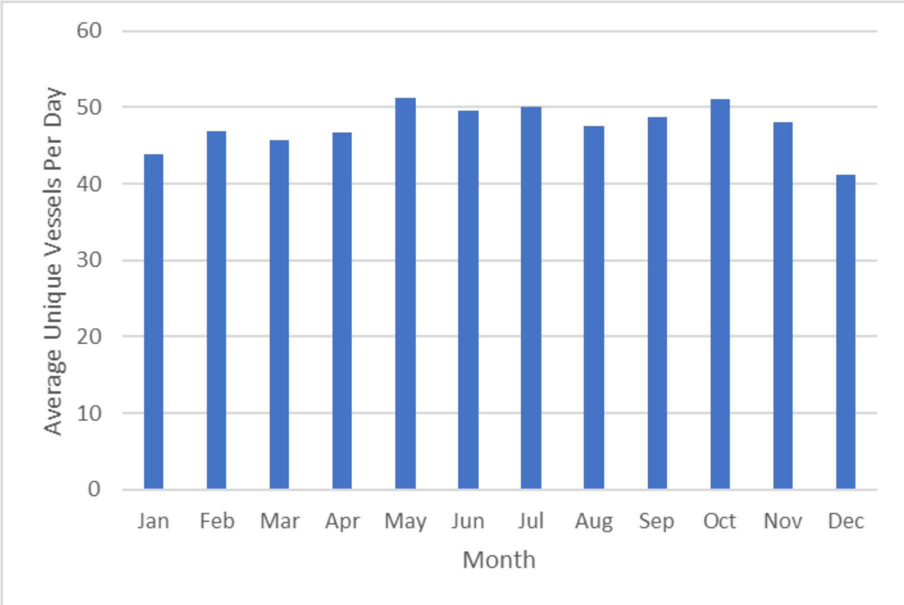

Figure B.3 **Summary of Vessel Count within the Study Area during the Study Period**

370. There was on average 48 unique vessels recorded within the study area during the study period. The busiest months were May and October with approximately 51 unique vessels per day. The quietest month was December with approximately 41 unique vessels per day. Overall, there was not considered to be a notable fluctuation in traffic volumes over the study period within the study area.

B.3.3. Vessel Type

371. The distribution of vessel types recorded during the 12-month study period within the study area are presented in Figure B.4. Note that vessel types[12] detected in low numbers (<2%) during the study period have been incorporated into the “other” category.

[12] Including the following vessels: fishing, military, marine aggregate dredgers, high speed crafts, and tugs.

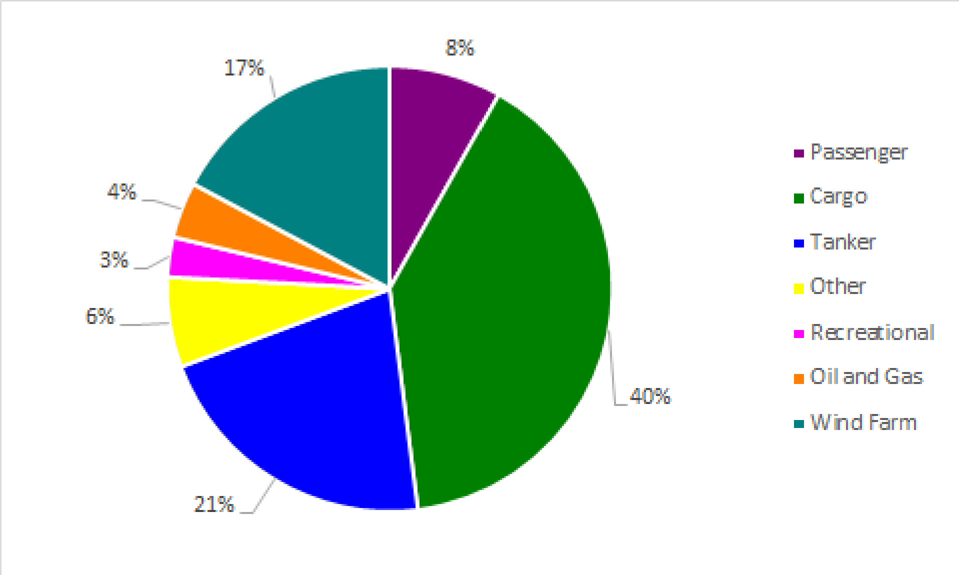

Figure B.4 **Vessel Type Distribution - 2019**

372. As can be seen from Figure B.4, the most common vessel types recorded were cargo (40%), tankers (21%), and wind farm vessels (17%). A high proportion of passenger vessels (8%) were also recorded.

B.3.3.1 Commercial Vessels

B.3.3.1.1 Overview

373. Figure B.5 presents the commercial vessels recorded via AIS within the study area during the study period.

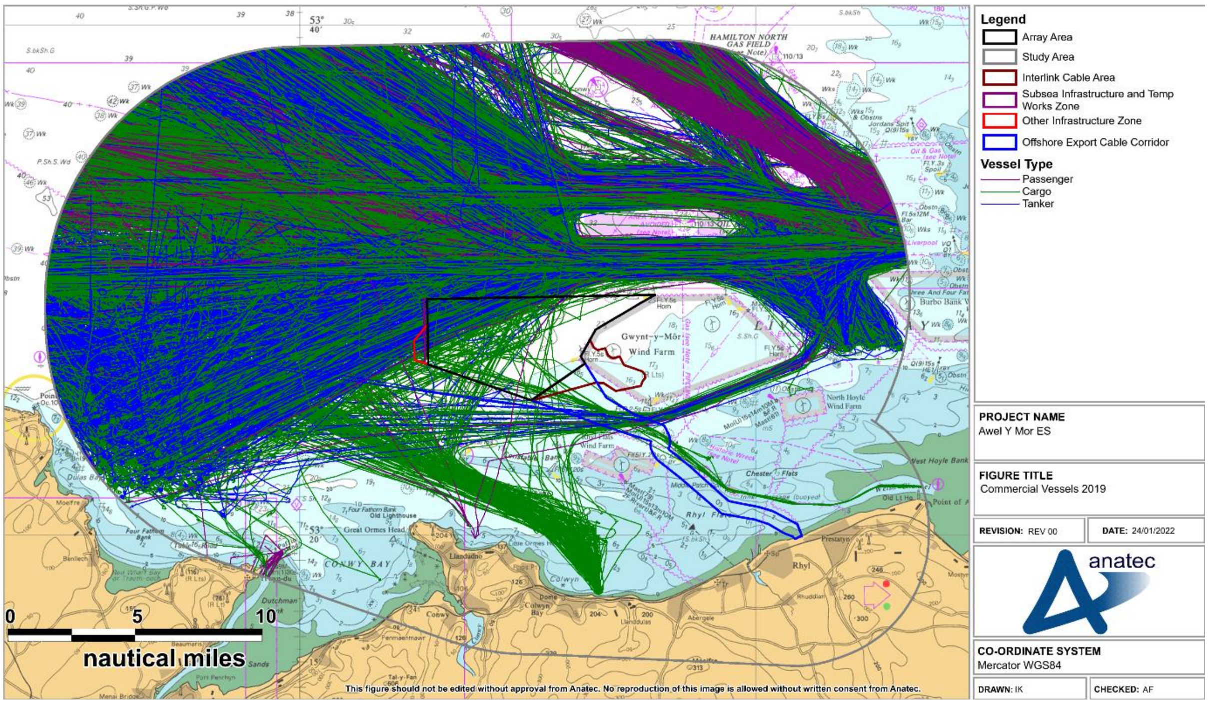

Figure B.5 **Commercial Vessels (2019)**

B.3.3.1.2 Analysis

374. A significant proportion of the commercial vessels recorded were observed to utilise the Liverpool Bay TSS, in general to or from Liverpool. A small number of cargo vessels utilised the Port of Llanddulas to the south of the study area. A passenger route between Liverpool and Belfast was recorded within the north western section of the study area operated by Stena Lines. Another commercial ferry route is present between Liverpool and Dublin mostly operated by P&O.

375. An average of approximately one commercial vessel was recorded per day transiting through the site, with the majority of these vessels observed to be accessing or departing the Liverpool Bay TSS.

376. Commercial vessels were recorded at anchor near Point Lynas / Dulas Bay and within the two anchoring areas within the eastern section of the study area (see Section B.3.3.6).

377. Figure B.6 and Figure B.7 present the unique number of cargo, tanker, passenger vessels recorded on average per day per month within the study area and the site itself, respectively. Following this, Table B.1 presents summaries of the numbers of vessels on average, the quietest month, and busiest month recorded within the study area and site itself, respectively.

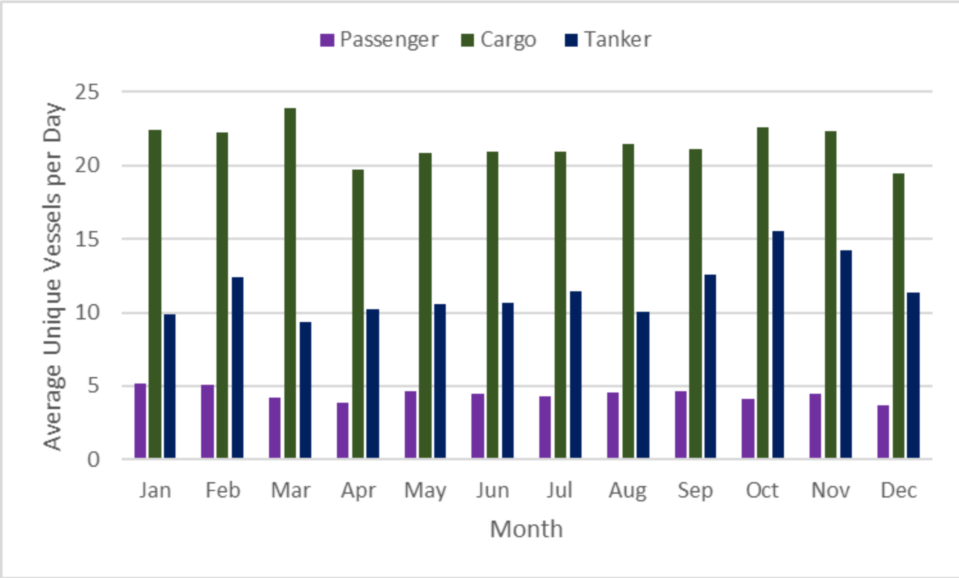

Figure B.6 **Commercial Vessel Count within the Study Area during the Study Period**

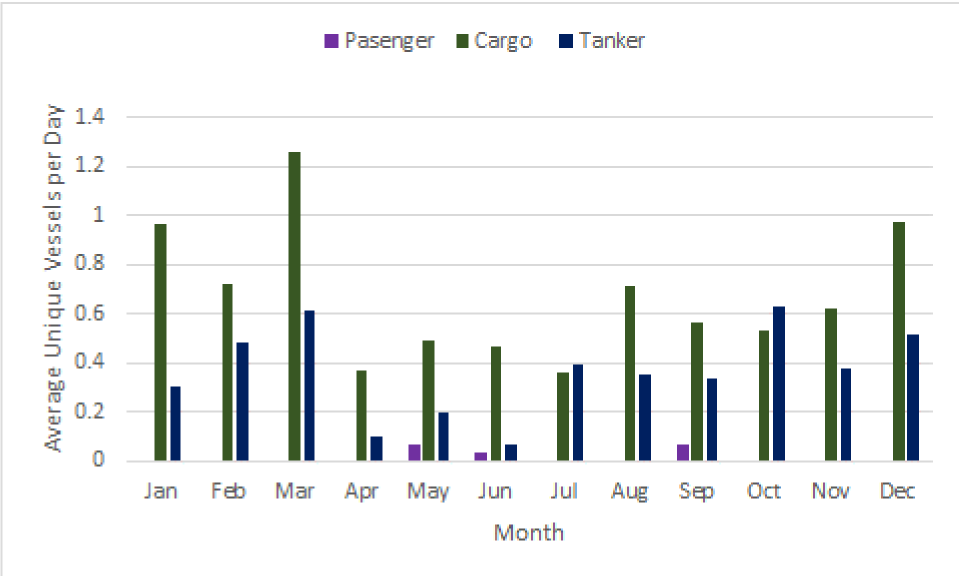

Figure B.7 **Commercial Vessel Count within the Site during the Study Period**

Table B.1 Commercial Vessel Count Summary

Vessel Type	Study Area			Site		
	Quietest	Busiest	Average	Quietest	Busiest	Average
Passenger	4	5	4	<1	<1	<1
Cargo	19	23	21	<1	<1	<1
Tankers	9	16	12	<1	<1	<1

378. The unique number of passenger, cargo, and tanker vessels per day per month recorded within the study area and site showed minimal variation during the study period.

B.3.3.2 Fishing Vessels

B.3.3.2.1 Overview

379. Figure B.8 presents the fishing vessels recorded via AIS within the study area during the study period. It should be considered that as this assessment is via AIS only, it is likely to be under representative of actual fishing vessel levels. Non-AIS fishing activity has been captured via the vessel survey data collected as per Section 8 of the NRA. Further details are also available within Volume 2, Chapter 8: Commercial Fisheries (application ref: 6.2.8).

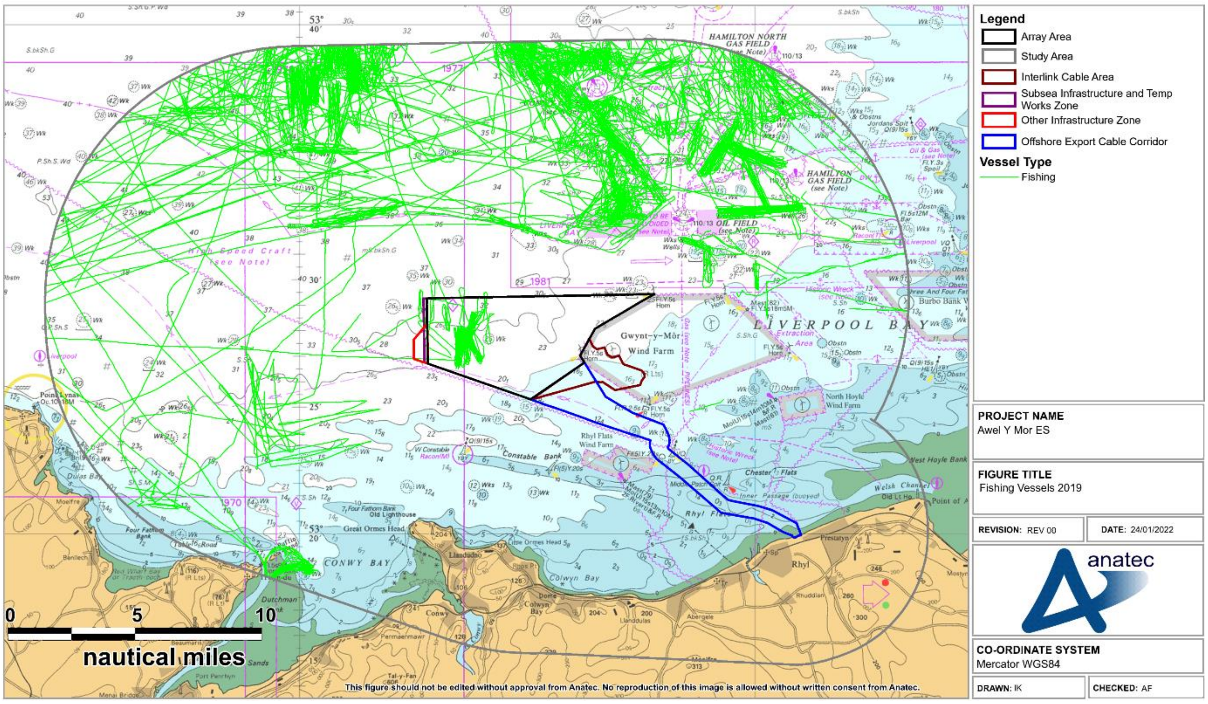

Figure B.8 **Fishing Vessels 2019**

B.3.3.2.2 Analysis

380. A speed assessment was undertaken to determine the likely status of fishing vessels within the study area (i.e., actively fishing or in transit).

381. Figure B.9 presents the results of this assessment with fishing vessels color-coded by behaviour. It is noted that the same vessel may be represented multiple times if it changes behaviour whilst in the study area. Following this the average number of

fishing vessels engaged in fishing and exclusively transiting per day for each month within the study area are summarised in Figure B.10[13].

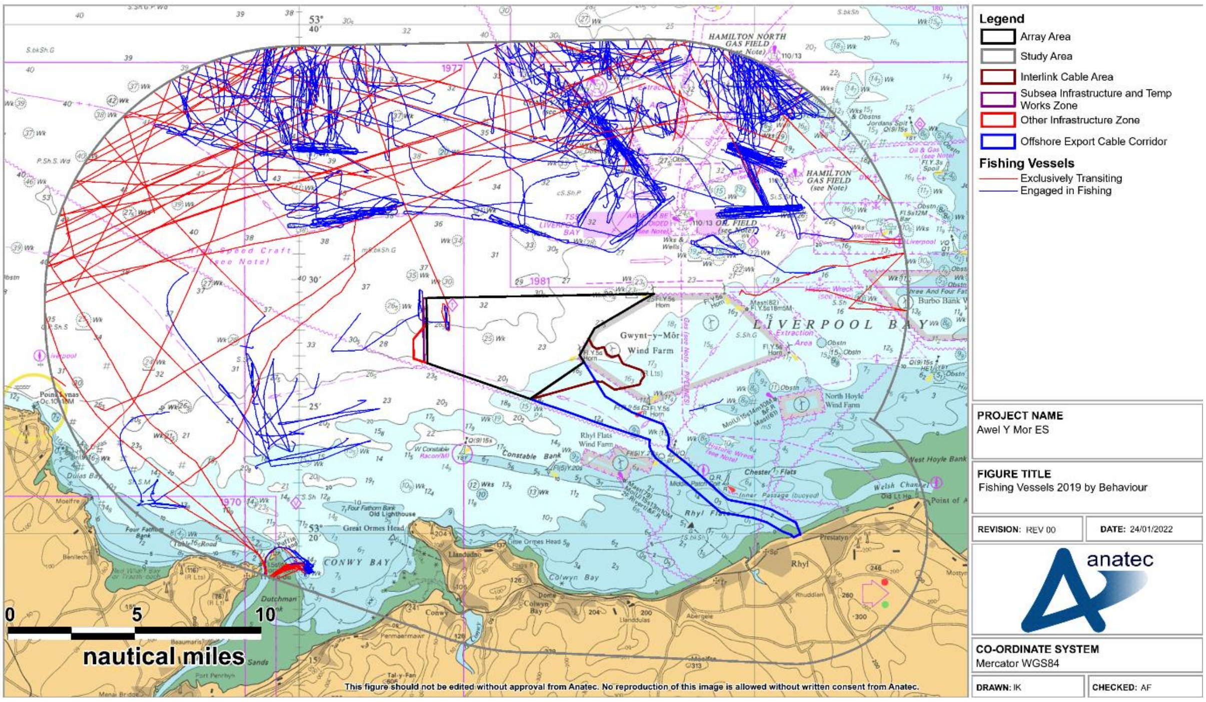

Figure B.9 **Fishing Vessels by Behaviour (2019)**

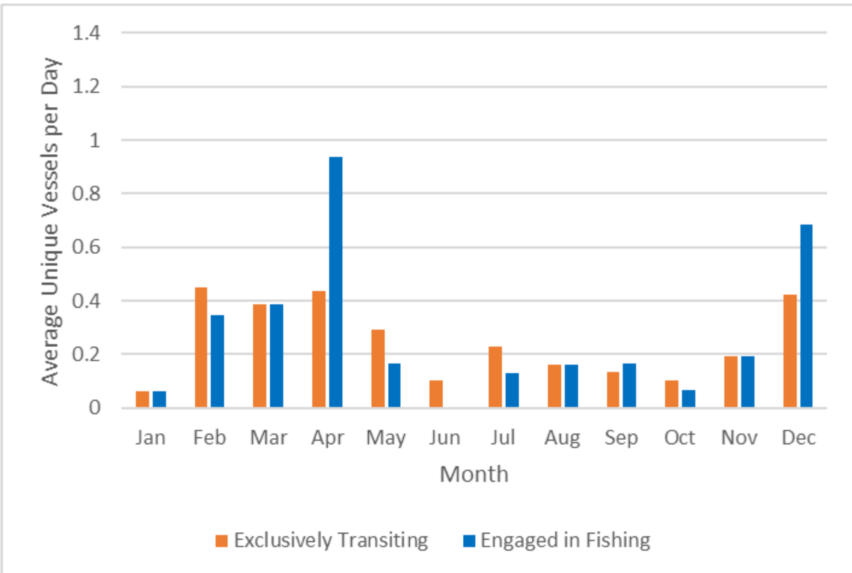

Figure B.10 **Number of Fishing Vessels by Behaviour**

[13]Note fishing vessels may have been counted twice on a given day in Figure B.10 if they displayed both types of behaviour within the study area (i.e., if a vessel transited to a fishing ground, then engaged in fishing at this location).

382. The majority of fishing vessels within the study area during the study period were engaged in fishing (mostly to the north and south of the site) with a smaller number of fishing vessels exclusively transiting. There was on average one unique fishing vessel every two days throughout the study period within the study area. Winter months were overall busier than summer months for fishing vessels within the study area during the study period, noting that smaller fishing vessels that are not required to broadcast by AIS may have not been captured (see Section 7.4 of the NRA).

B.3.3.3 Oil and Gas Vessels

B.3.3.3.1 Overview

383. Figure B.11 presents the O&G vessels recorded via AIS within the study area during the study period.

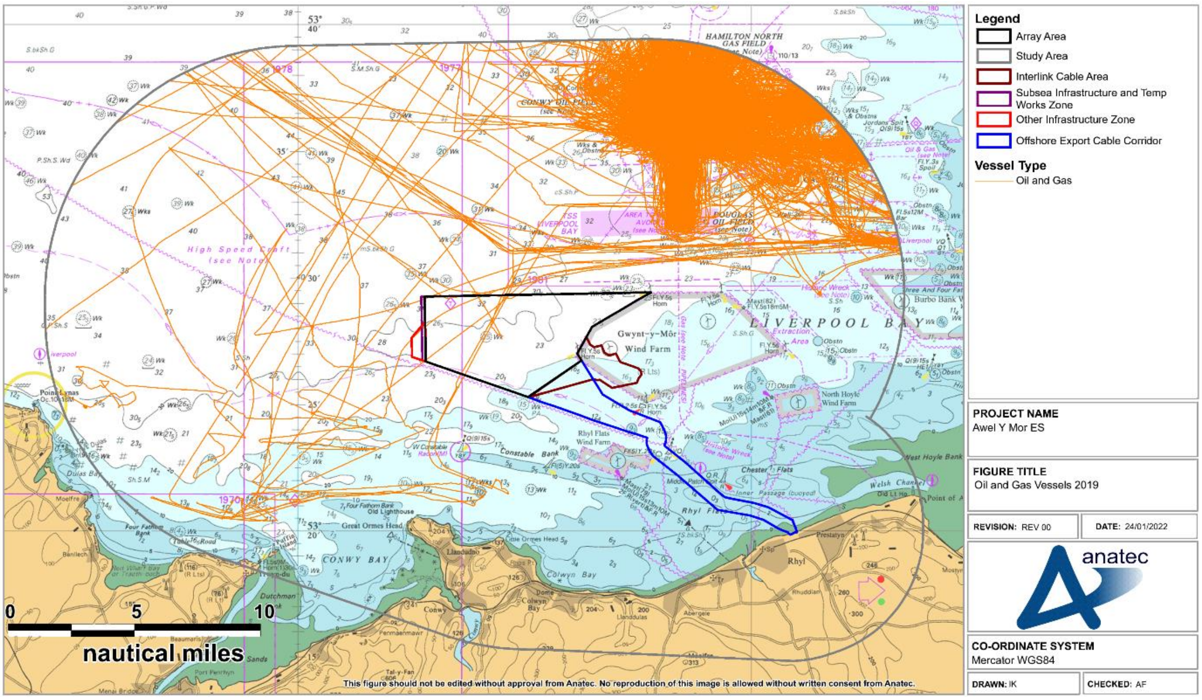

Figure B.11 **Oil and Gas Vessels 2019**

B.3.3.3.2 Analysis

384. The majority of the O&G vessels recorded during the study period was within the north eastern section of the study area, generally visiting the platforms within or in close proximity to the study area. There was an average of two unique O&G vessels recorded within the study area during the study period.

B.3.3.4 Recreational Vessels

B.3.3.4.1 Overview

385. Figure B.12 presents the recreational vessels recorded via AIS within the study area during the study period.

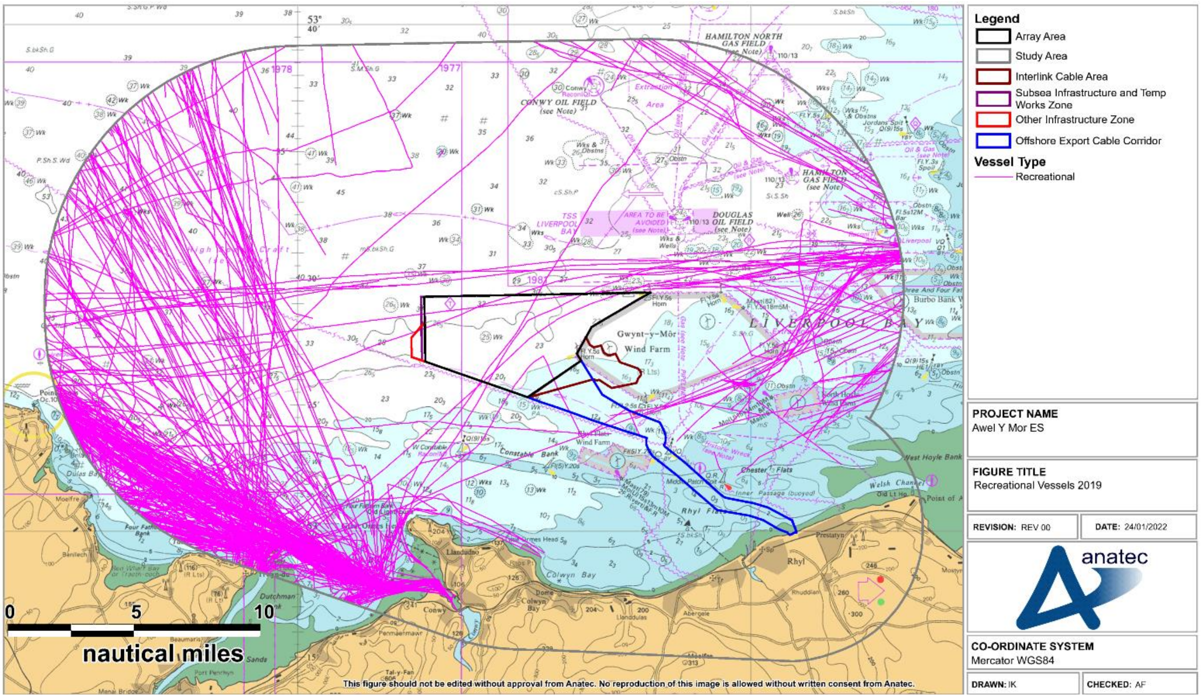

Figure B.12 **Recreational Vessels 2019**

B.3.3.4.2 Analysis

386. Recreational activity was mostly recorded within coastal regions particularly near Conwy, Port Penrhyn, and Point Lynas. A small number of recreational vessels utilised the Liverpool Bay TSS during the study period. There was an average of between one and two unique recreational vessels recorded within the study area during the study period with the majority of these recorded during the summer months.

B.3.3.5 Wind Farm Vessels

387. Figure B.13 presents the wind farm vessels recorded via AIS within the study area during the study period.

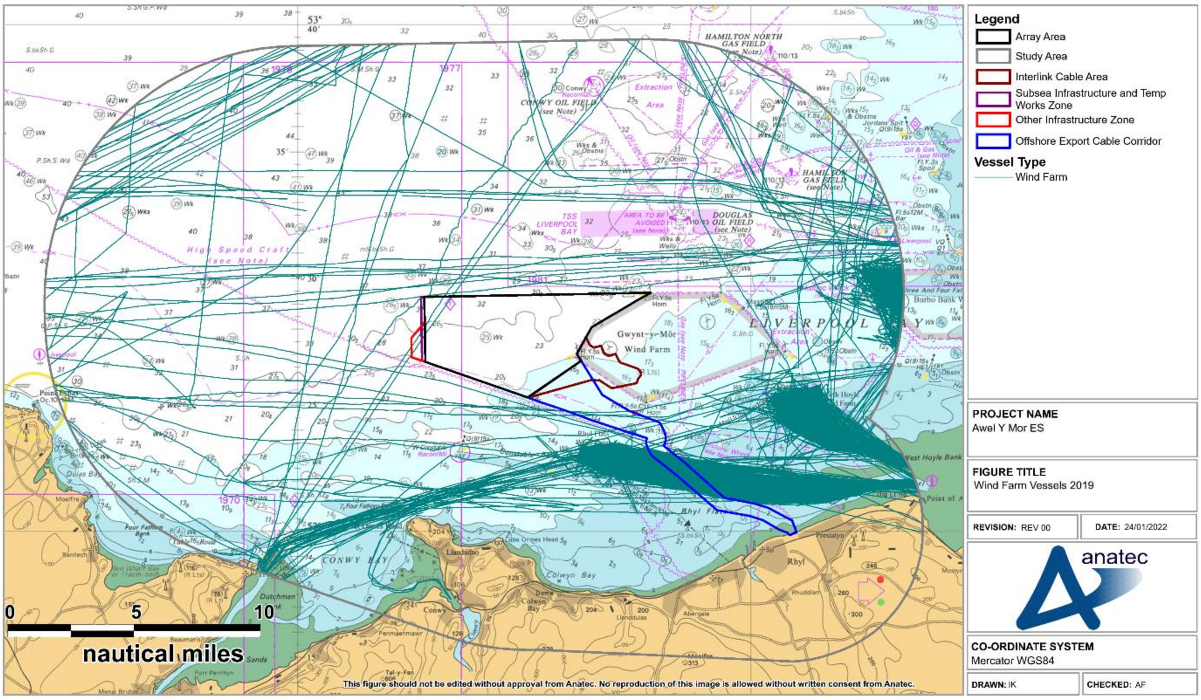

Figure B.13 **Wind Farm Vessels 2019**

B.3.3.5.1 Analysis

388. The majority of the wind farm vessels recorded within the study area during the study period were transiting to/from the other wind farms within the study area whilst utilising Liverpool or Mostyn port. A small number of wind farm vessels utilised the Liverpool Bay TSS. A number of wind farm vessels were also observed utilising a route in the north western section of the study area. There was an average of three unique wind farm vessels recorded during the study period within the study area.

B.3.3.6 Anchored Vessels

389. A speed analysis has been performed on the 12-months 2019 data to identify vessels at anchor within the study area. This analysis has identified anchored vessels as vessels transiting at <1 Knot for a period of 30 minutes or longer. Note vessels associated with other wind farms which may be moored to WTGs when performing maintenance have been removed to focus on vessels at anchor. Figure B.14 presents the vessels identified as at anchor within the study area during the 12-month study period.

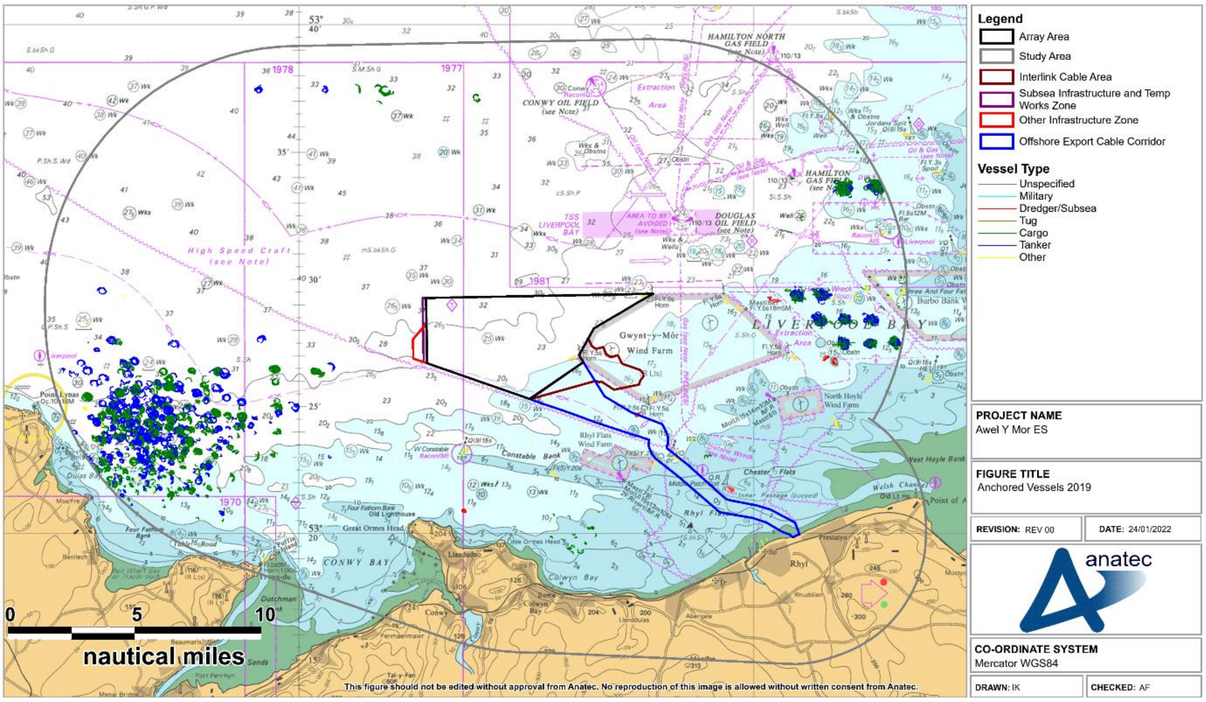

Figure B.14 **Anchored Vessels (2019)**

390. Vessels were identified at anchor within the two anchorage areas to the east of the site and to the south west of the site near Point Lynas. A smaller number of vessels were at anchor north of the site and south of the site near Little Ormes Head. The majority of anchored vessels within the study area during the study period were cargo and tanker vessels.

B.4 Summary

391. Table B.2 provides a summary of the number of vessels of each vessel type analysed in the proceeding sections within the study area during the study period.

Table B.2 Summary of Vessel Numbers Recorded during the Study Period

Vessel Type	Quietest Month	Busiest Month	Average
Passenger	4	5	4
Cargo	19	23	21
Tanker	9	16	12
Fishing	<1	1	<1
O&G	1-2	3	2
Recreational	<1	4	1-2
Wind Farm	2	5	3

B.5 Survey Data Comparison

392. As per section 7.2 of the NRA, at this stage a total of 28 days of survey data (AIS, radar, and visual observations) has been collected between 18th November 2020 and 2nd December 2020, and between 24th July 2021 and 7th August 2021. This section compares the survey data against the long term 2019 data.

393. Figure B.15 presents the vessels recorded during the 28-day study period for the study area. Following this Figure B.16 presented the proportions of each vessel type[14] recorded during the 28 day study period.

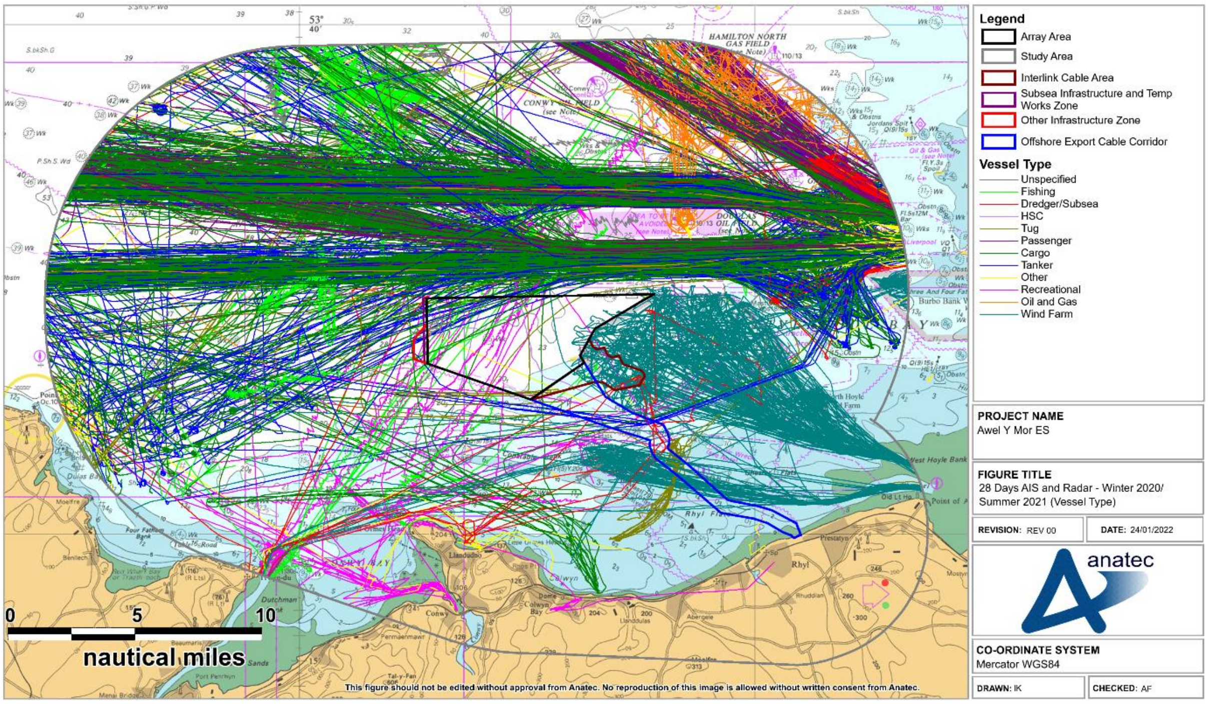

Figure B.15 **28 Days AIS and Radar - Winter 2020 and Summer 2021 Surveys**

[14] Including the following vessels for the 12-month survey period: unspecified, and tugs.

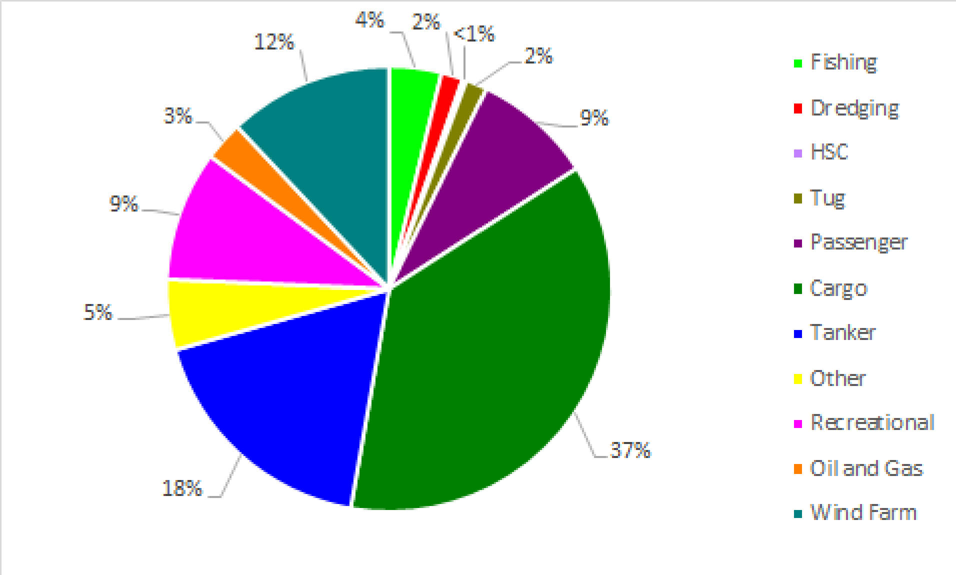

Figure B.16 **Vessel Types Recorded within the Study Area during the Study Period**

394. Commercial vessel routeing was similar between the survey data and the 2019 data with a large proportion of commercial vessels recorded utilising the Liverpool Bay TSS, or on routes in the north eastern section of the study area largely transiting between Liverpool and Belfast, and a small number of cargo vessels utilising the port of Llanddulas. There was considered to be good correlation overall in terms of vessel routeing.

395. Similar behaviour was also recorded for O&G and wind farm vessels during the 2019 survey data. O&G vessels were recorded predominantly within the northern section of the site in proximity to the platforms located in the northern section of the study area. Wind farm vessels were recorded mostly transiting to/from other wind farms within the study area.

396. Approximately one to two unique recreational vessels were recorded per day during the 12-month study period within the study area compared to approximately 5-6 unique recreational vessels recorded per day during the winter 2020/summer 2021 study period. Approximately one unique fishing vessel was recorded every two days during the 12-month study period compared to approximately two unique fishing vessels recorded per day during the winter 2020/summer 2021 study period with 70% of these vessels recorded via Radar. Fishing vessels were recorded both in transit and actively fishing within the study area during both study periods.

397. The vessel types recorded within the study area during the winter 2020/summer 2021 survey period were similar to the 12-month survey period with the most common vessel types being cargo vessels (37%), tankers (18%), and wind farm vessels (12%).

398. A comparison of the average number of each vessel type analysed in the previous sections recorded throughout the 2019 study period against the average number of

each vessel type recorded throughout the winter 2020/summer 2021 survey period for the study area are presented in Table B.3.

Table B.3 Comparison of Vessel Numbers Recorded during the Study Periods

Vessel Type	12 Months AIS Data (Vessels per Day)			Winter 2020 Survey Vessels per Day)	Summer 2021 Survey Vessels per Day)
	Quietest Month	Busiest Month	Average	Average	Average
Passenger	4	5	4	4	6
Cargo	19	24	21	21	21
Tanker	9	16	12	12	9
Fishing	<1	1	<1	3	1-2
O&G	1-2	3	2	2	1-2
Recreational	<1	4	1-2	1	10
Wind farm	2	5	3	7	7

399. With the exception of fishing vessels and O&G vessels in winter 2020, and recreational vessels and wind farm vessels in summer 2021, there was considered to be broad correlation between the long term 2019 data and the 2020/2021 surveys in terms of traffic volumes. O&G vessels, fishing vessels, recreational vessels, and wind farm vessels activity would be expected to fluctuate over the course of a year, and as such it is likely this has factored into the change, however the inclusion of radar data in the survey data is likely to also be a significant driver in the case of fishing and recreational vessels.

B.6 Summary and Conclusion

400. This appendix has analysed a long-term 12-month AIS marine traffic data set and compared the traffic behaviour, vessel numbers, and vessel types to those recorded in the winter 2020/summer 2021 marine traffic survey data. A combination of these findings shall be used to inform the risk assessment undertaken within the NRA to ensure that a worst-case realistic scenario is assessed for AyM.

401. The two data sets were largely comparable with similar vessel types utilising the area and similar vessel numbers recorded for the majority of the vessel types, noting that fishing vessels and O&G vessels were recorded in higher numbers during the winter survey than in the 2019 long term data, with recreational vessels and wind farm vessels recorded in higher numbers during the summer survey than the 2019 long

term data. Vessels were also recorded, in general, to transit through the study area using similar routes. O&G and wind farm vessels were recorded in both data sets near the respective infrastructure.

402. Given broad correlation in terms of vessel types that would be expected to experience limited fluctuation over the course of a year (cargo, tanker, and passenger), the long term 2019 data is considered as appropriate as the primary input the main routeing assessment within the NRA, noting that it includes seasonal ferry traffic not captured by the winter survey.

403. The winter 2020/summer 2021 survey data is considered as appropriate for general baseline assessment within the NRA, noting that additional data sources have been considered to assess recreational traffic.

404. Significant effects on traffic levels arising from the ongoing COVID-19 pandemic were not evident.

Appendix C Regular Operator Letter

Date: 11/03/2021

Address: [redacted]
Email:
Website:

<u>Consultation on the Proposed Awel y Môr Offshore Wind Farm in Relation to Shipping and Navigation</u>

Dear Sir/Madam,

As you may be aware, Awel y Môr Offshore Wind Farm Limited (hereafter referred to as the 'Applicant') is currently planning to submit an application for the Awel y Môr offshore wind farm (AyM), located approximately 6nm off the Welsh coast in the Irish Sea. The site boundary is adjacent to the existing Gwynt y Môr (GyM) offshore wind farm, which has been operational since 2015 (noting that AyM and GyM are considered "sister" projects).

A Scoping Report for AyM was submitted to the Planning Inspectorate in June 2020, and the Applicant is now in the process of completing the Preliminary Environmental Information Report (PEIR). As required, this will include a Navigational Risk Assessment (NRA) to support the shipping and navigation aspects of the PEIR. The outputs of the PEIR process will feed into the subsequent Environmental Statement (ES), which will include an updated NRA based on the feedback received.

An overview of the AyM array (i.e. the area where the wind turbines will be located) and the export cable corridor is provided in Figure 1. The array covers an area of approximately 33 nm^2. Further information about the development can be found here.

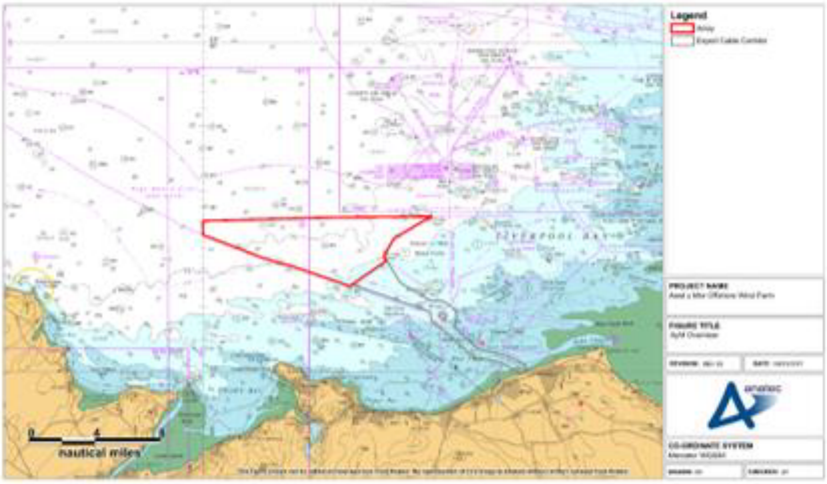

Figure 1 Overview of AyM

Page 1

Anatec has been contracted by the Applicant to provide technical support on shipping and navigation during the consenting process, including production of the NRA. A key aspect of any NRA is comprehensive consultation with relevant stakeholders, including at a local level. Therefore, as part of this process, Anatec has undertaken an assessment of 12 months of Automatic Identification System (AIS) data to identify regular commercial operators of relevance to the area. Your company's vessel(s) have been identified as regularly navigating within and/or in proximity to the array, and on this basis we invite your feedback on AyM, 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 the 26th March 2021. This will allow us to incorporate your input into the NRA currently being undertaken. We would also be grateful if you could forward a copy of this information to any other vessel operators / owners you feel may be interested in commenting.

Noting that all feedback is welcome, we are particularly interested in the following points:

1. Whether AyM is likely to impact the routeing of any specific vessels and/or route, including the nature of any change in regular passage.
2. Whether any aspect of AyM poses any safety concern to your vessels, including any adverse weather routeing (i.e., any navigational safety concerns).
3. Whether your vessels would choose to make passage internally through the array of structures.
4. Whether you are aware of any planned changes to routeing which may be relevant to AyM.
5. Whether you wish to be retained on our list of shipping and navigation stakeholders and consulted throughout the NRA process.
6. Whether you wish to attend a Hazard Workshop to discuss shipping and navigation impacts in April 2021.

Responses should be sent via email to [redacted] In the meantime, should you have any queries about the published information or require any further information to support your review, please do not hesitate to get in touch.

Yours sincerely,

[redacted]

Page 2

Appendix D Consequences

405. This Appendix presents an assessment of the consequences of collision and allision incidents, in terms of people and the environment, due to the impact of the structures within the array.

406. The significance of the impact of AyM is also assessed based on risk evaluation criteria and comparison with historical accident data in UK waters[15].

D.1 Risk Evaluation Criteria

D.1.1. Risk to People

407. With regard to the assessment of risk to people two measures are considered, namely:

- Individual risk; and
- Societal risk.

D.1.1.1 Individual Risk per Year

408. This measure considers whether the risk from an accident to a particular individual changes significantly due to the presence of the structures within the array. Individual risk considers not only the frequency of the accident and the consequence (likelihood of death), but also the individual's fractional exposure to that risk, i.e., the probability of the individual of being in the given location at the time of the accident.

409. The purpose of estimating the individual risk is to ensure that individuals who may be affected by the presence of the structures within the array are not exposed to excessive risks. This is achieved by considering the significance of the change in individual risk resulting from the presence of AyM relative to the background individual risk levels.

410. Annual individual risk levels to crew (the annual fatality risk of an average crew member) for different vessel types and the upper and lower bounds for risk acceptance criteria as suggested in IMO Maritime Safety Committee (MSC) 72/16 are shown in Figure D.1 (IMO MSC, 2001).

[15] UK waters is defined as the UK Exclusive Economic Zone and UK territorial waters means within the 12NM limit.

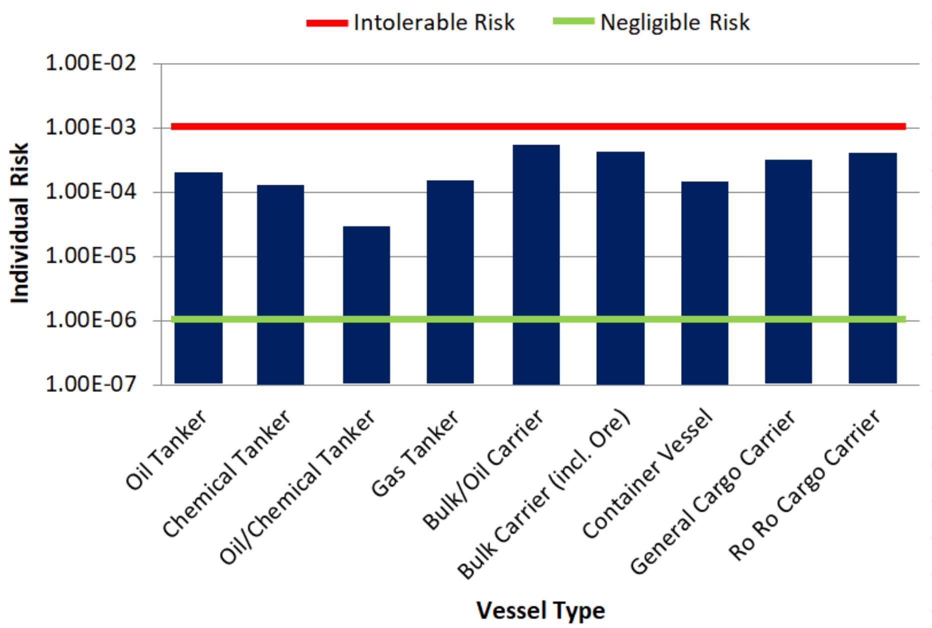

Figure D.1 Individual Risk Levels and Acceptance Criteria per Vessel Type

411. Typical bounds defining the ALARP regions for decision making within shipping are presented in Table D.1.

Table D.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

412. On a UK basis, the MCA website presents individual risks for various UK industries based on HSE data for 1987 to 1991. The risks for different industries are presented in Figure D.2.

413. The individual risk for sea transport of 2.9×10^{-4} per year is consistent with the worldwide data presented in Figure D.1, whilst the individual risk for sea fishing of 1.2×10^{-3} per year is the highest across all of the industries listed.

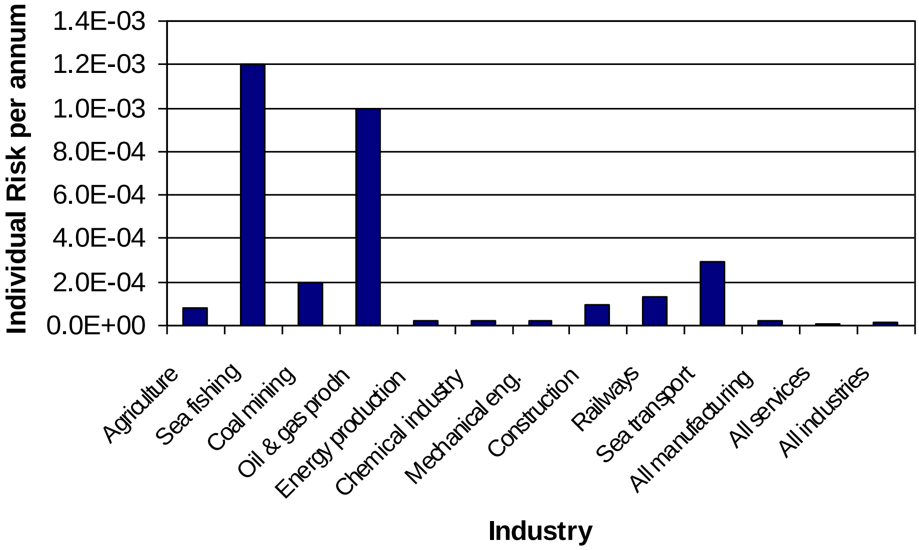

Figure D.2 Individual Risk per Year for various UK Industries

D.1.1.2 Societal Risk

414. Societal risk is used to estimate risks of accidents affecting many persons, e.g., catastrophes, and acknowledging risk averse or neutral attitudes. Societal risk includes the risk to every person, even if a person is only exposed on one brief occasion to that risk. 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.

415. Within this assessment societal risk (navigational based) can be assessed for AyM, giving account to the change in risk associated with each accident scenario caused by the introduction of the structures within the array. Societal risk may be expressed as:

- Annual fatality rate where frequency and fatality are combined into a convenient one-dimensional measure of societal risk. This is also known as Potential Loss of Life (PLL); and
- FN-diagrams showing explicitly the relationship between the cumulative frequency of an accident and the number of fatalities in a multi-dimensional diagram.

416. 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 background risk levels for the UK.

D.1.2. Risk to Environment

417. For risk to the environment the key criteria considered in terms of the effect of AyM is the potential amount of oil spilled from the vessel involved in an incident.

418. It is recognised 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 AyM compared to background pollution risk levels for the UK.

D.2 MAIB Incident Analysis

D.2.1. All Incidents

419. All UK-flagged commercial vessels are required to report accidents to the MAIB. Non-UK flagged vessels do not have to report unless they are in a UK port or are within 12NM territorial waters and carrying passengers to a UK port. There are no requirements for non-commercial recreational craft to report accidents to the MAIB, however a significant proportion of these incidents are reported to and investigated by the MAIB.

420. The MCA, harbour authorities and inland waterway authorities also have a duty to report accidents to MAIB. Therefore, whilst there may be a degree of under-reporting of accidents with minor consequences, those resulting in more serious consequences, such as fatalities, are likely to be reported.

421. 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 from an accident occurring offshore, which is the location of most relevance to AyM.

422. Taking into account these criteria, a total of 12,093 accidents, injuries and hazardous incidents were reported to the MAIB between 2000 and 2019 involving 13,965 vessels (some incidents such as collisions involved more than one vessel).

423. The locations[16] of incidents reported in the vicinity of the UK are presented in Figure D.3, colour-coded by type. It can be seen that most incidents occurred in coastal waters. The distribution of incidents by year is then presented in Figure D.4.

[16] MAIB aim for 97% accuracy in reporting the locations of incidents.

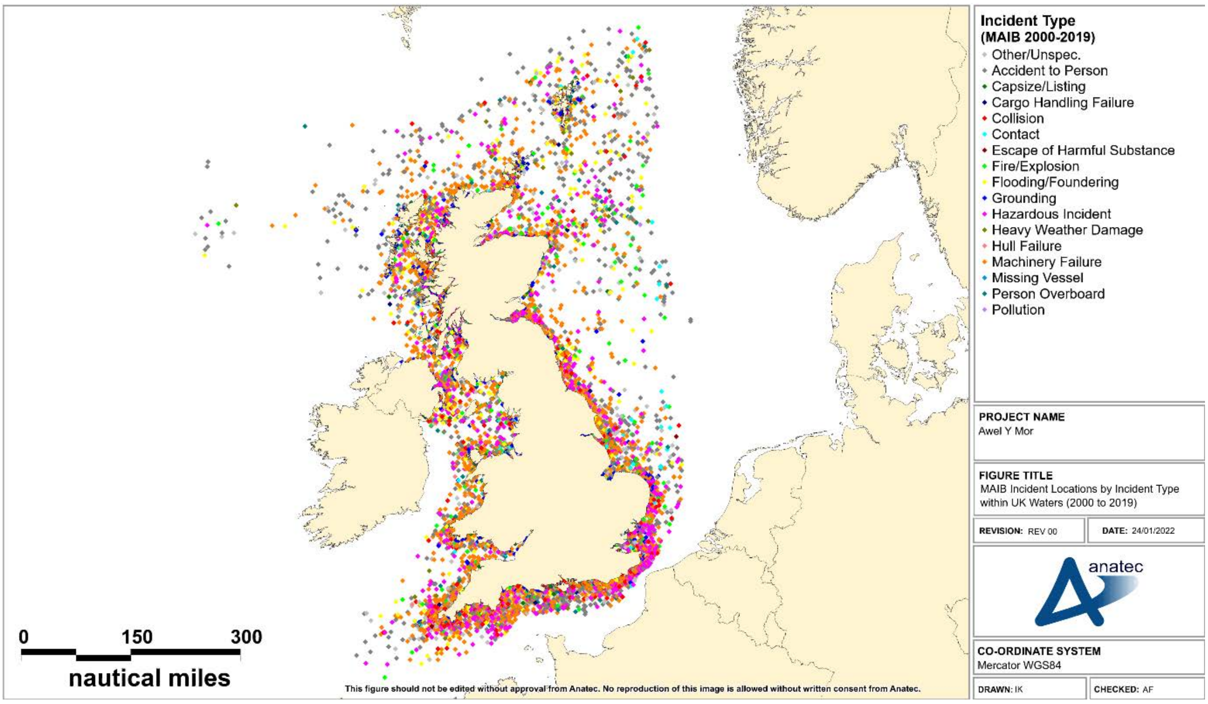

Figure D.3 Incident Locations by Type within UK Waters (MAIB 2000-2019)

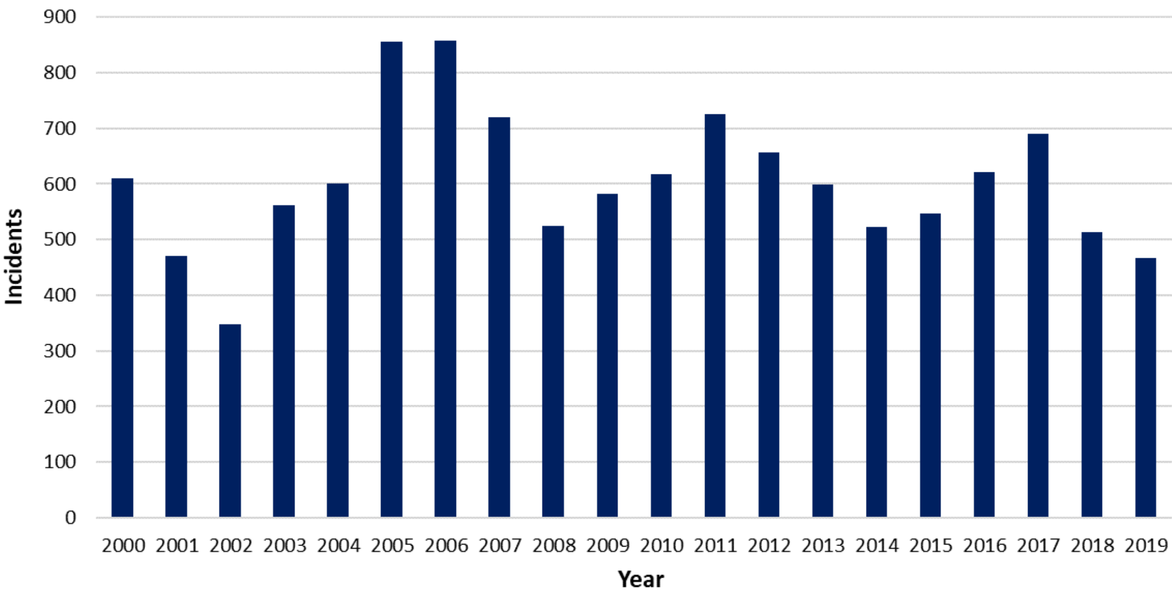

Figure D.4 Incidents per Year within UK Waters (MAIB 2000-2019)

424. The average number of incidents per year was 605. There has generally been a fluctuating trend in incidents over the 20 year period.

425. The distribution of incidents by incident type is presented in Figure D.5.

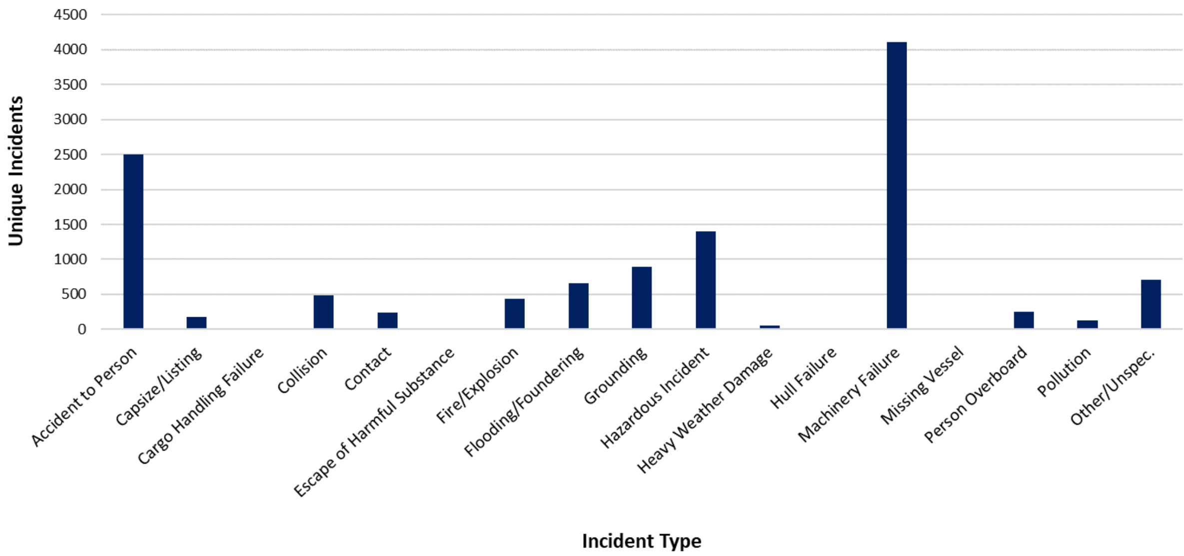

Figure D.5 Incidents by Incident Type within UK Waters (MAIB 2000-2019)

426. The most common incident types were “Machinery Failure” (34%), “Accident to Person” (21%) and “Hazardous Incident” (12%). “Collisions” and “Contacts” represented 4% and 2% of the total incidents, respectively.

427. The distribution of incidents by vessel type is presented in Figure D.6.

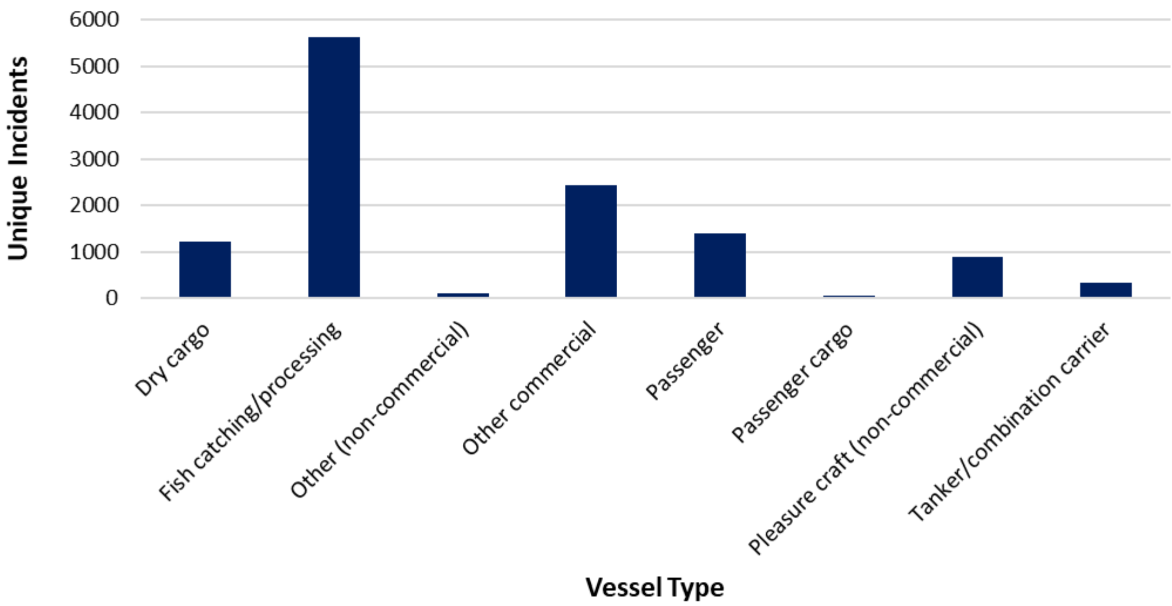

Figure D.6 Incidents by Vessel Type within UK Waters (MAIB 2000-2019)

428. The most common vessel types involved in incidents were fishing vessels (46%), other commercial vessels (20%) (which include offshore industry vessels, tugs, workboats and pilot vessels) and dry cargo vessels (10%).

429. The total number of fatalities reported in the MAIB incidents from 2000 to 2019 was 390, giving an average of 20 fatalities per year.

430. The distribution of fatalities in UK waters by vessel type and person category (namely crew, passenger and other) is presented in Figure D.7.

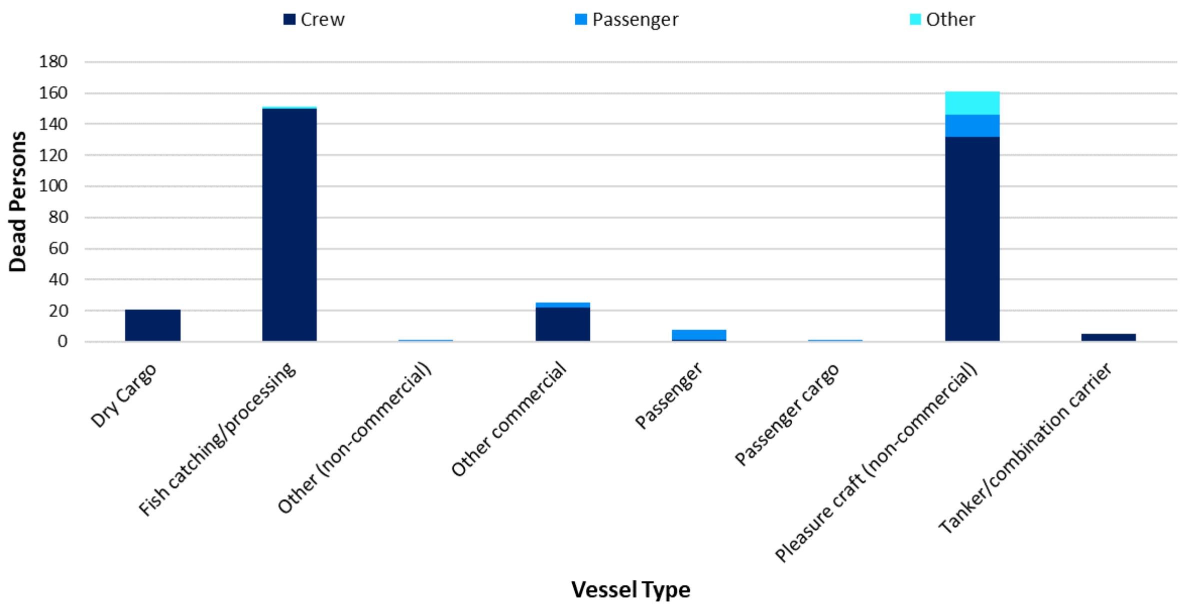

Figure D.7 Fatalities by Vessel Type for Incidents within UK Waters (MAIB 2000-2019)

431. The majority of fatalities occurred to pleasure craft (43%) and fishing vessels (40%), with crew members the main people involved (89%).

D.2.2. Collision Incidents

432. MAIB define a collision incident as "vessel hits another vessel that is floating freely or is anchored (as opposed to being tied up alongside).

433. A total of 481 collision incidents were reported to the MAIB in UK waters between 2000 and 2019 involving 1,090 vessels (in a small number of cases the other vessel involved was not logged).

434. The locations of collision incidents reported in the vicinity of the UK are presented in Figure D.8. Following this, the number of vessels involved in a collision incident by year is presented in Figure D.9.

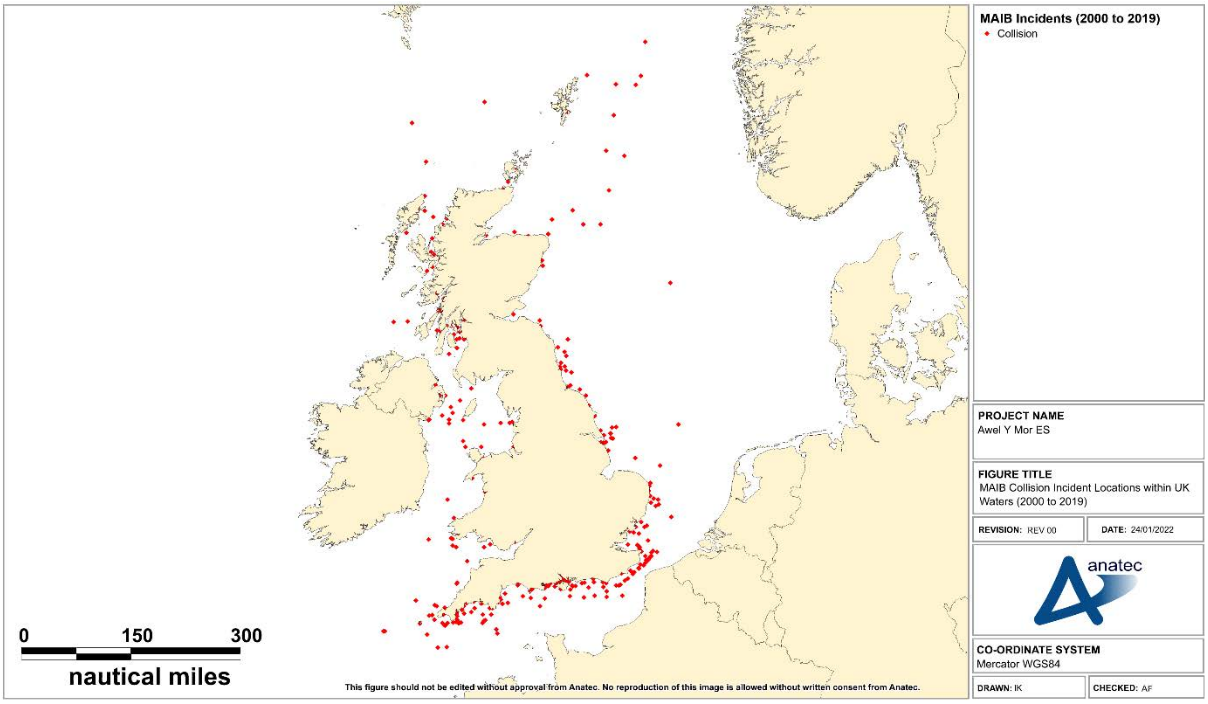

Figure D.8 Collision Incident Locations within UK Waters (MAIB 2000-2019)

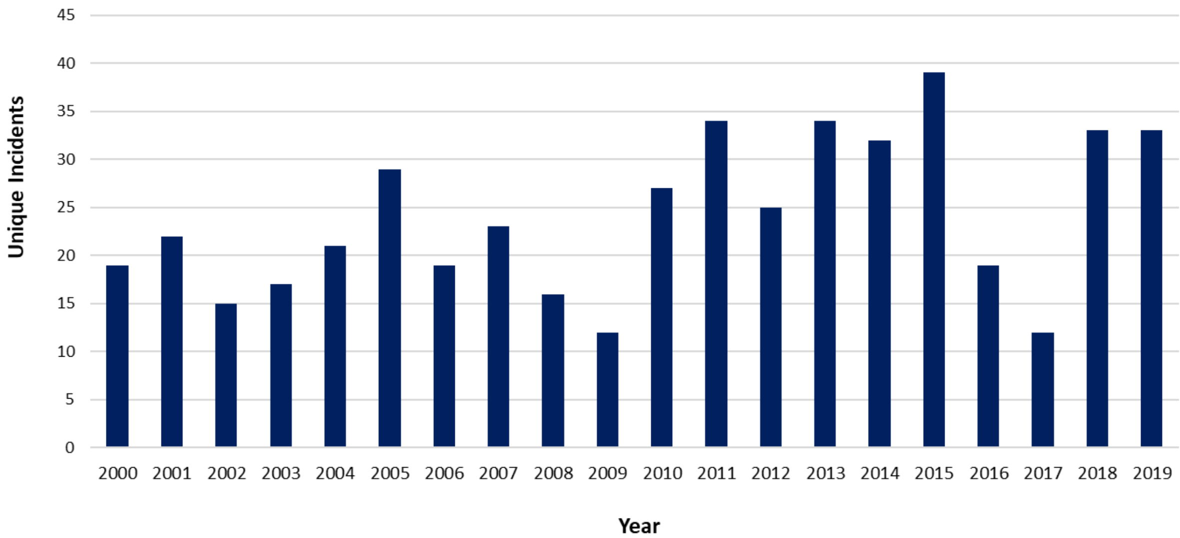

Figure D.9 Collision Incidents per Year within UK Waters (MAIB 2000-2019)

435. The average number of collision incidents per year was 14. There has been an overall increasing trend in collisions over the study period, which may be due to better reporting of less serious incidents in recent years.

436. The distribution of collision incidents by vessel type is presented in Figure D.10.

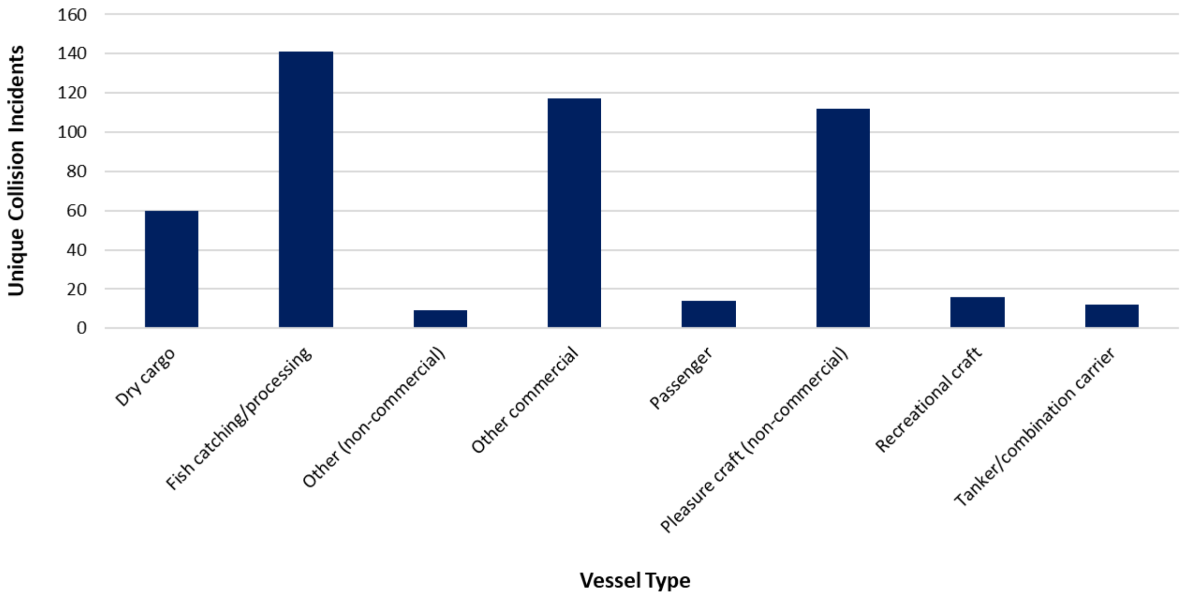

Figure D.10 Collision Incidents by Vessel Type within UK Waters (MAIB 2000-2019)

437. The most common vessel types involved in collision incidents were fishing vessels (29%), other commercial vessels (24%), non-commercial pleasure craft (23%) and dry cargo vessels (12%).

438. A total of six fatalities were reported in MAIB collision incidents within UK waters between 2000 and 2019. Details of each of these fatal incidents reported by the MAIB are presented in Table D.2.

Table D.2 **Fatal Collision Incidents (MAIB 2000-2019)**

Date	Description	Fatalities
October 2001	A dry cargo vessel and a chemical tanker collided in the south-west traffic lane of the Dover Strait TSS to the south-east of Hastings. Although the weather and visibility were good, both watchkeepers were too late to take effective avoiding action. The collision resulted in the sinking of the dry cargo vessel from which five out of six crew members were rescued.	1
July 2005	A collision between two powerboats near Castle Point, St. Mawes resulted in the death of one of the helmsmen. The incident occurred during the night with both vessels unlit whilst transiting through the area. Both helmsmen had consumed alcohol prior to the incident which is suspected to have caused reduced peripheral vision, deterioration of judgment and slower reaction times from both helmsmen, resulting in the collision.	1

Date	Description	Fatalities
October 2007	A fishing vessel was involved in a collision with a coastal general cargo vessel. The collision took place about twenty one miles off the Humber near the Rough gas field. Neither of the vessels was found to be keeping an effective lookout. The weather at the time was good with fair to good visibility. As a result of the collision, the fishing vessel suffered major structural damage and sank within seconds. Of the four crew onboard, three managed to get into a life raft and abandon the vessel, sadly the fourth member of crew has still not been recovered.	1
August 2010	An Italian registered Ro-Ro passenger ferry collided with a UK registered fishing vessel around four miles off St Abb's Head. As a result of the collision, the fishing vessel sank. The skipper was recovered from the sea but, despite an extensive search by the rescue services and a large number of local fishing vessels, the remaining crew member was lost.	1
June 2015	A collision occurred between a Rigid-hulled Inflatable Boat (RIB) and the yacht that had been carrying the RIB earlier the same day. One 36-year old man was seriously injured as a result of the incident and was airlifted to hospital before being pronounced dead later in the evening. It is believed that there were originally a dozen or so people aboard the motorboat, with the majority being taken ashore by the Cowes and Gosport lifeboats. Local rescue crews towed the RIB from the scene into Cowes, with the larger motorboat being escorted by a police launch.	1
June 2018	Emergency services were called to West Bay, Bridport following a fatal crash during a power boat race. One of the power boats taking part in the offshore circuit racing event overturned after colliding with another. A man from Canterbury, understood to be the boat’s pilot, was pronounced dead at the scene.	1

D.2.3. Contact Incidents

439. MAIB define a contact incident as when “a vessel hits an object that is immobile and is not subject to the collision regulations e.g., buoy, post, dock (too hard), etc. Also, another ship if it is tied up alongside. Also floating logs, containers etc.”

440. A total of 235 contact incidents were reported to MAIB in UK waters (excluding ports, etc.) between 2000 and 2019 involving 270 vessels (a small number of contact incidents involved a moving vessel contacting a stationary vessel).

441. The locations of contact incidents reported in the vicinity of the UK are presented in Figure D.11. Following this, the distribution of contact incidents by year is presented in Figure D.12.

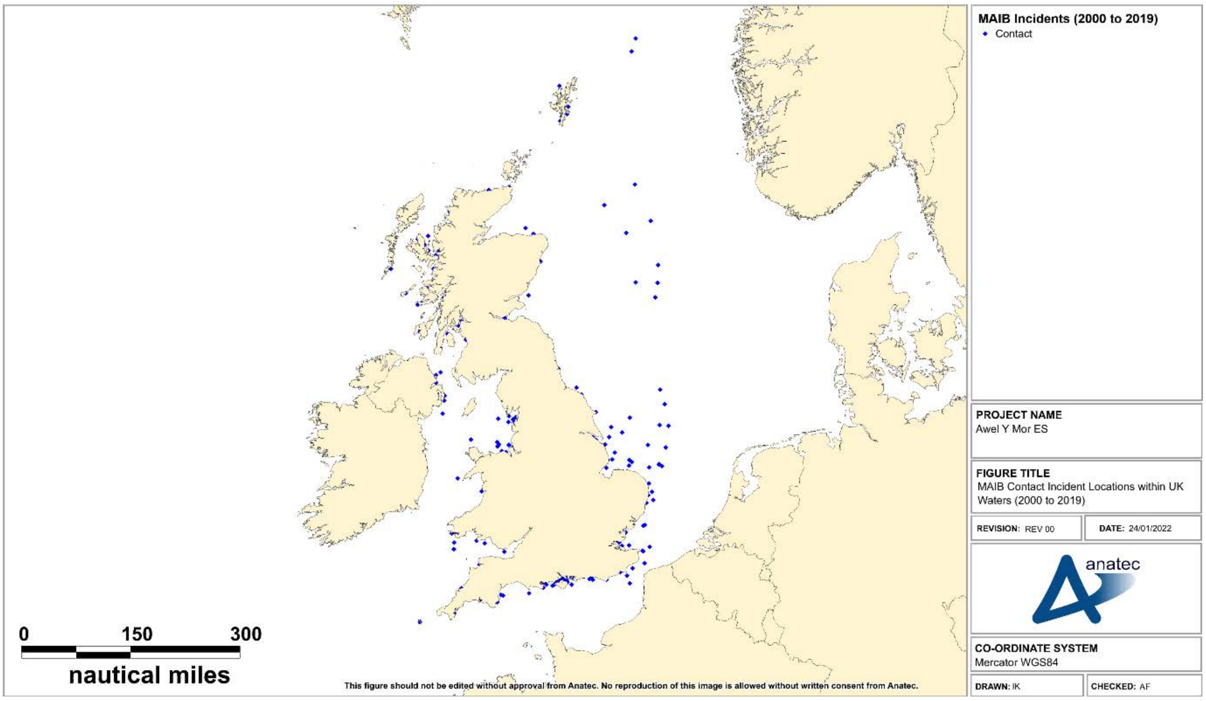

Figure D.11 Contact Incident Locations within UK waters (MAIB 2000-2019)

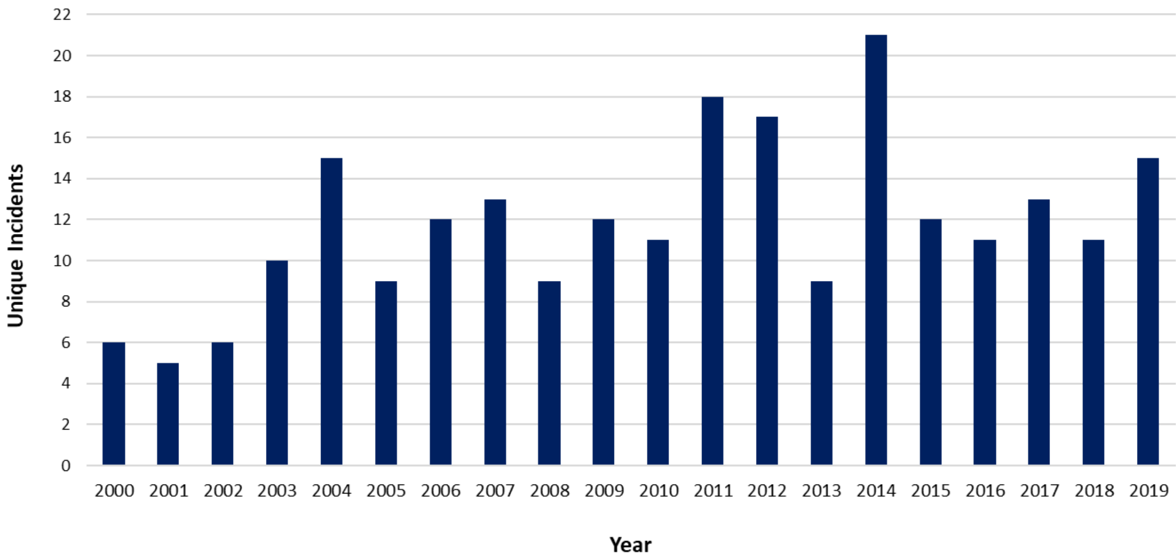

Figure D.12 Contact Incidents per Year within UK Waters (MAIB 2000-2019)

442. The average number of contact incidents per year was 12. As with collision incidents there has been an increasing trend over the 20 year period, which may be due to improved reporting of less serious incidents in recent years.

443. The distribution of vessel types involved in contacts is presented in Figure D.13.

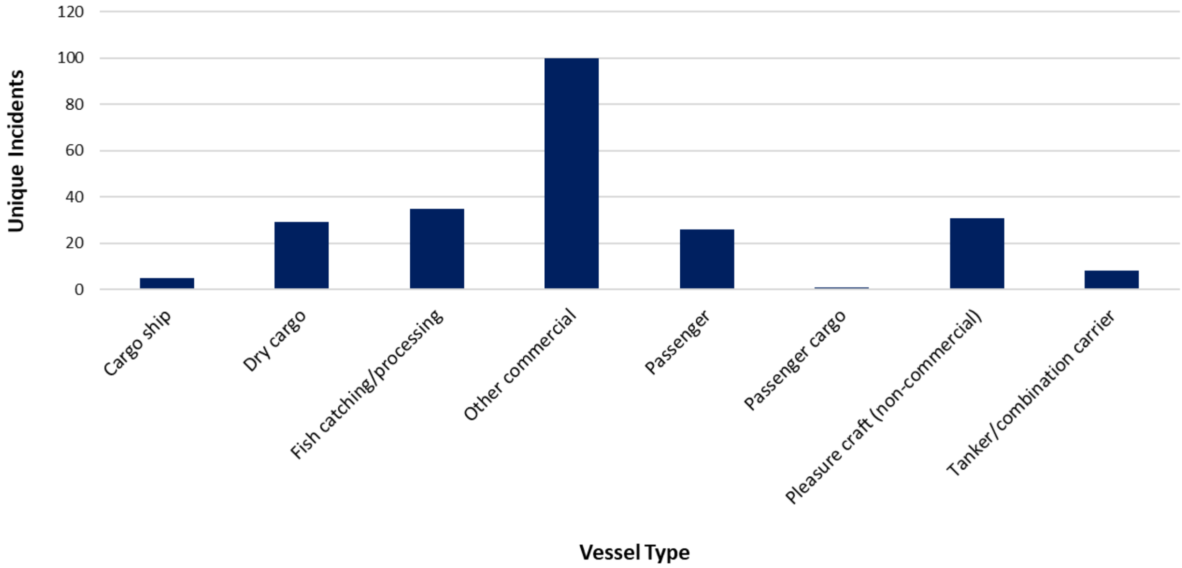

Figure D.13 Contact Incidents by Vessel Type within UK Waters (MAIB 2000-2019)

444. The most common vessel types involved in contact incidents were other commercial vessels (43%), fishing vessels (15%) and non-commercial pleasure craft (13%).

445. A total of one fatality was reported in the MAIB contact incidents within UK waters between 2000 and 2019. Details of this fatal incident reported by the MAIB are presented in in Table D.3.

Table D.3 **Fatal Contact Incidents (MAIB 2000-2019)**

Date	Description	Fatalities
June 2012	The owner of a 6m RIB took two friends from his home port on the West coast of Scotland to an Island approximately 20 miles away to attend a music festival. The three men attended the overnight event and the boat owner then set off home alone on his RIB. A local ferryman saw the RIB approaching the harbour at about 40 knots and later heard a loud bang. When he moved his ferry he saw a damaged RIB and a body floating in the water. The alarm was raised and the body was recovered. The RIB owner had suffered fatal head injuries as a result of hitting the RIB's console on impact with the jetty. The RIB was badly damaged around the bow and the fenders on the jetty were also damaged. The post mortem report revealed that the deceased had more than twice the UK drink driving alcohol limit in his blood when the accident occurred. The deceased had also taken recreational drugs.	1

D.3 Fatality Risk

D.3.1. Introduction

446. This section uses the MAIB incident data along with information on average manning levels per vessel type to estimate the probability of fatality in a marine incident associated with AyM.

447. As per the NRA, AyM is assessed to have the potential to affect the following incidents:

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

448. Of these incidents, only vessel to vessel collisions match the MAIB definition of collisions and hence the fatality analysis presented in Section D.2.2 is considered to be directly applicable to these types of incidents.

449. 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 involve a vessel striking an immobile object in the form of a WTG or OSP. From Section D.2.3 it can be seen that only one of the 235 contact incidents reported by MAIB between 2000 and 2019 resulted in fatalities.

450. However, 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 these incidents rather than the contact fatality risk rate.

D.3.2. Fatality Probability

451. Six of the 481 collision incidents reported by the MAIB in UK waters between 2000 and 2019 resulted in one or more fatalities. This gives a 1.2% probability that a collision incident will lead to a fatal accident.

452. To assess the fatality risk for personnel onboard a vessel, either crew, passenger or other, the number of persons involved in the incidents needs to be estimated. From analysis of the MAIB incident data, the average commercial passenger vessel had approximately 223 people on board (POB) (total of crew and passengers). For commercial cargo / freight vessels there was an average of approximately 15 POB. For fishing vessels the average POB was approximately 3.3 and for pleasure craft the average POB was approximately 3.3.

453. It is recognised that these numbers can be substantially higher or lower on an individual vessel basis depending upon size, subtype, etc., In particular passenger

vessel POB is likely to significantly vary. It is estimated that average passenger vessel POB within the area of relevance to AyM is 900. For the other vessel types, applying reasonable averages is considered sufficient for this analysis.

454. Using the average number of persons carried along with the vessel type information involved in collision incidents reported by the MAIB (see Figure D.10), gives an estimated 17,848 personnel onboard the vessels involved in all the collision incidents between 2000 and 2019.

455. Based on six fatalities, the overall fatality probability in a collision for any individual onboard is approximately 3.4×10^{-4} per collision.

456. It is considered inappropriate to apply this rate uniformly as the statistics indicate that the fatality probability associated with smaller craft is higher. Therefore, the fatality probability has been subdivided into three categories of vessel as presented in Table D.4. It can be seen the risk is approximately two orders of magnitude higher for people onboard small craft compared to larger commercial vessels.

Table D.4 **Fatality Probability per Collision per Vessel Category (2000-2019)**

Vessel Category	Sub Categories	Fatalities	People Involved	Fatality Probability
Commercial	Dry cargo, passenger, tanker, etc.	1	16,256	6.2E-05
Fishing	Trawler, Potter, Dredger, etc.	2	880	2.3E-03
Pleasure Craft	Yacht, small commercial motor vessel, etc.	3	713	4.2E-03

D.3.3. Fatality Risk due to AyM

457. The base case and future case annual collision frequency levels pre and post wind farm are summarised in Table D.5. Table D.6 then presents the estimated average number of POB for the local vessels operating in the area of the array.

Table D.5 Risk Results Summary

Collision/ allision scenario	Base case			Future case		
	Pre wind farm	Post wind farm	Change	Pre wind farm	Post wind farm	Change
Vessel to vessel collision	9.51×10^{-3} (1 every 105 years)	9.71×10^{-3} (1 every 103 years)	2.02×10^{-4}	1.17×10^{-2} (1 every 85 years)	1.20×10^{-2} (1 every 83 years)	2.51×10^{-4}
Powered vessel to structure allision	0	8.63×10^{-4} (1 every 1,160 years)	8.63×10^{-4}	0	9.52×10^{-4} (1 every 1,050 years)	9.52×10^{-4}
Drifting vessel to structure allision	0	3.63×10^{-4} (1 every 2,800 years)	3.63×10^{-4}	0	4.02×10^{-4} (1 every 2,500 years)	4.02×10^{-4}
Fishing Allision	0	3.59×10^{-2} (1 every 28 years)	3.59×10^{-2}	0	3.95×10^{-2} (1 every 25 years)	3.95×10^{-2}
Total	**9.51×10^{-3} (1 every 105 years)**	**4.68×10^{-2} (1 every 21 years)**	**3.73×10^{-2}**	**1.17×10^{-2} (1 every 85 years)**	**5.28×10^{-2} (1 every 19 years)**	**4.11×10^{-2}**

Table D.6 Vessel Types, Incidents and Average Number of POB

Vessel Type	Collision/Allision Incidents	Average Number of POB
Cargo / Freight	▪ Vessel to vessel collision; ▪ Powered vessel to structure allision; and ▪ Drifting vessel to structure allision.	16
Tanker	▪ Vessel to vessel collision; ▪ Powered vessel to structure allision; and ▪ Drifting vessel to structure allision.	22
Passenger	▪ Vessel to vessel collision; ▪ Powered vessel to structure allision; and ▪ Drifting vessel to structure allision.	900
Fishing	▪ Vessel to vessel collision; and ▪ Fishing vessel to structure allision.	3
Recreational	▪ Vessel to vessel collision.	3

458. From the detailed results of the collision and allision frequency modelling, the distribution of the predicted change in annual collision and allision frequency by vessel type due to AyM for the base and future cases are presented in Figure D.14.

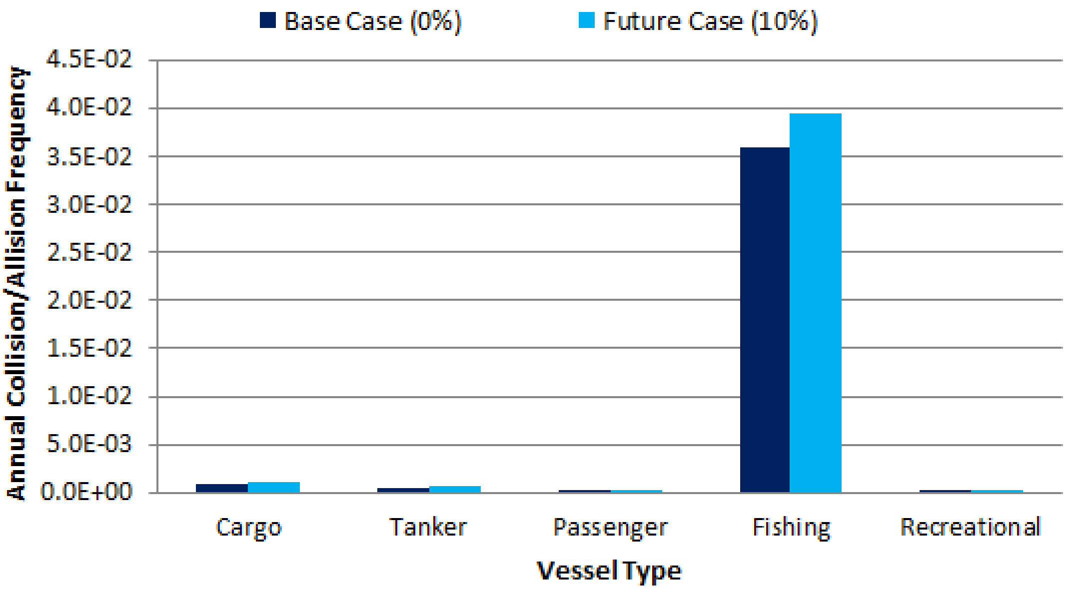

Figure D.14 Change in Annual Collision and Allision Frequency by Vessel Type

459. The majority of change in allision risk was observed to be associated with fishing vessels. This was due to the increase in allision risk to fishing vessels. Full details are provided in Section 17.3.4, but it is noted that the modelling conservatively assumes no change in baseline fishing activity post wind farm. It should also be considered that the most likely consequences of a fishing vessel allision are low impact / speed contact.

460. Combining the annual collision and allision frequency (Table D.5), the estimated number of POB each vessel type (Table D.6) and the estimated fatality probability for each vessel category (Table D.4), the annual increase in PLL due to the impact of AyM for the base case is estimated to be 2.45×10^{-4} which equates to one additional fatality in 4,100 years. The annual increase in PLL due to the impact of AyM for the future case is estimated to be 2.69×10^{-4}, which equates to one additional fatality in approximately 3,700 years.

461. The estimated incremental increases in PLL due to AyM, distributed by vessel type for the base and future cases, are presented in Figure D.15.

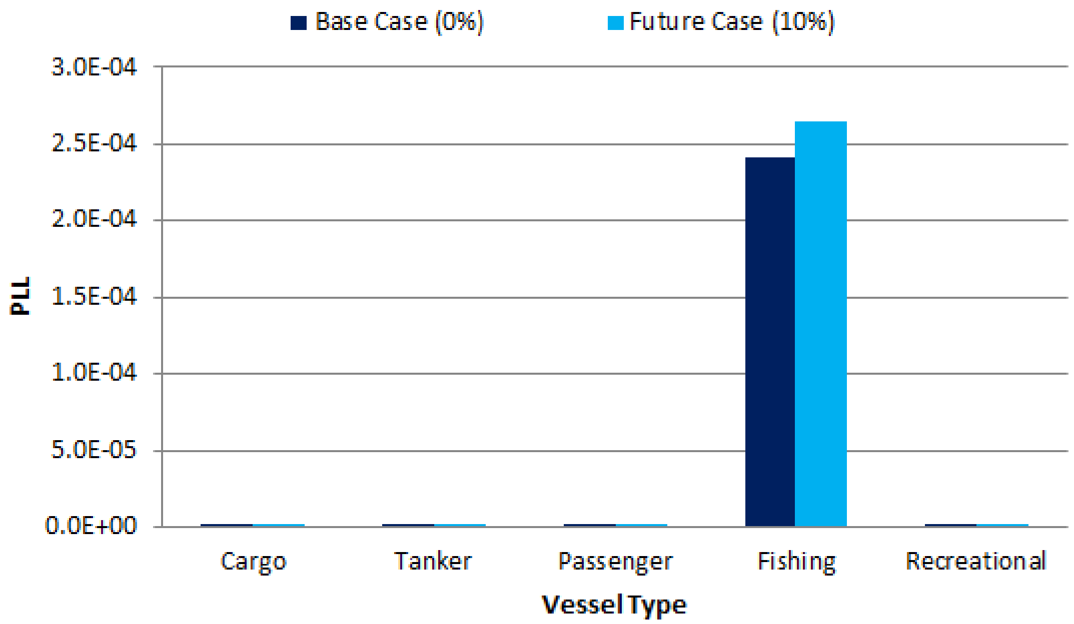

Figure D.15 Estimated change in Annual PLL by Vessel Type

462. As shown, the majority of change in PLL was associated with fishing vessels. This is reflective of the estimated allision risk to fishing vessels (see Figure D.14) and the estimated fatality probability being higher than for other vessel types (see Table D.4).

463. PLL has been converted to individual risk per annum (IRPA) based on the average number of people exposed by vessel type. The results are presented in Figure D.16.

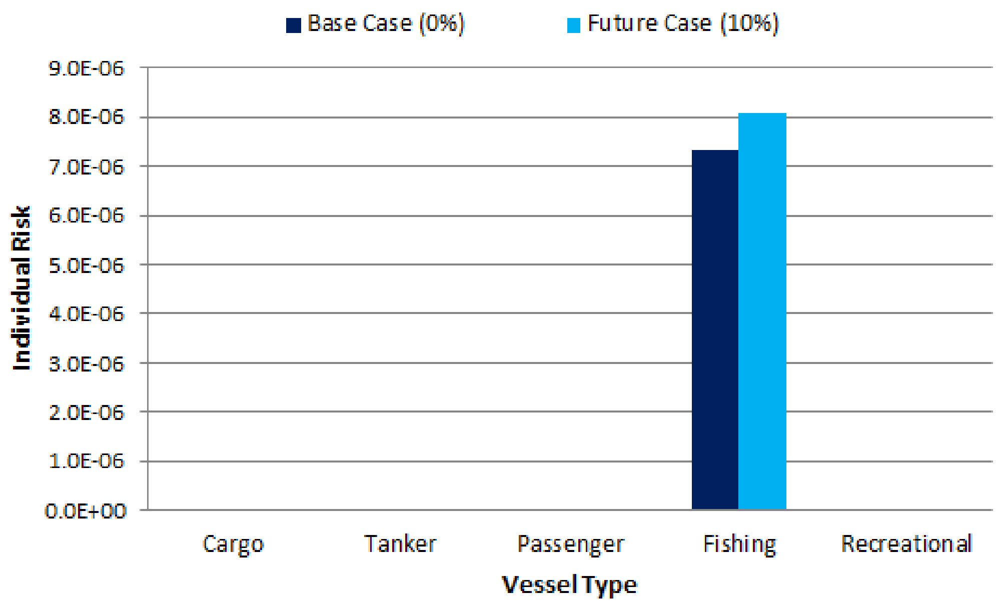

Figure D.16 Estimated change in Individual Risk by Vessel Type

464. The significant majority of individual risk was observed to be associated with fishing vessels, which is as expected given the estimated change in PLL for these vessels (see Figure D.15) and low POB (see Table D.6). However, it is noted that the individual risk to fishing vessels is still low.

D.3.4. Significance of Increase in Fatality Risk

465. The overall increase in PLL estimated due to AyM is 2.45×10^{-4}, which equates to one additional fatality in 4,100 years. In comparison to MAIB statistics, which indicate an average of 20 fatalities per year in UK territorial waters, this is considered a small change.

466. In terms of individual risk to people, the incremental increase for commercial vessels (approximately 8.87×10^{-9} for the base case) is very low when compared to the background risk level for the UK sea transport industry of 2.9×10^{-4} per year.

467. For fishing vessels, the change in individual risk attributed to AyM (approximately 7.33×10^{-6} for the base case) is considered very low compared to the background risk level for the UK sea fishing industry of 1.2×10^{-3} per year.

D.4 Pollution Risk

D.4.1. Historical Analysis

468. The pollution consequences of a collision in terms of oil spill depend upon the following:

- Spill probability (i.e. likelihood of outflow following an accident); and
- Spill size (amount of oil).

469. Two types of oil spill are considered in this assessment:

- Fuel oil spills from bunkers (all vessel types); and
- Cargo oil spills (laden tankers).

470. The research undertaken as part of the DfT's MEHRAs project (DfT, 2001) has been used as it was comprehensive and based on worldwide marine spill data analysis. From this research, the overall probability of a spill per accident was calculated based on historical accident data for each accident type as presented in Figure D.17.

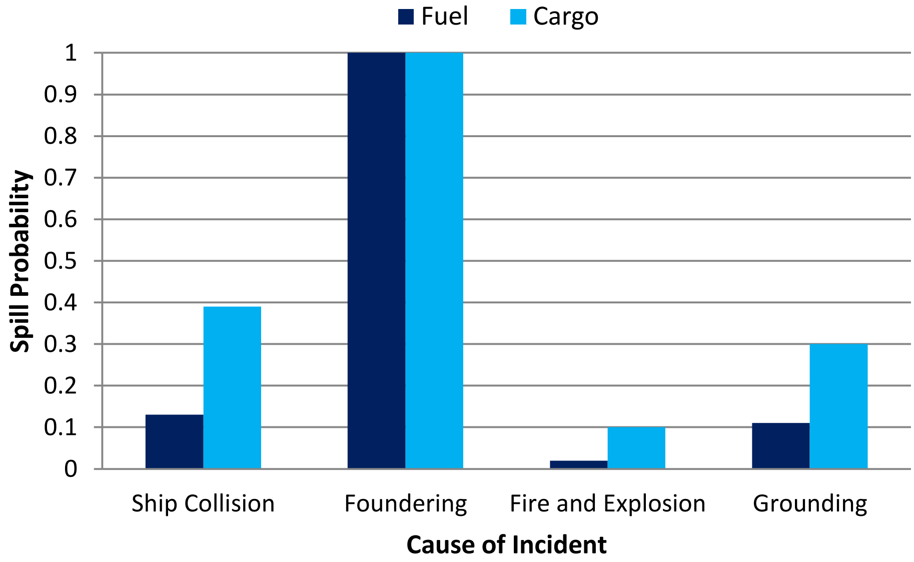

Figure D.17 Probability of an Oil Spill Resulting from an Accident

471. 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.

472. 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 the bunker capacity, and in most incidents much lower. For the types and sizes of vessels exposed to AyM, an average spill size of 100 tonnes of fuel oil is considered to be a conservative assumption.

473. For cargo spills from laden tankers, the spill size can vary significantly. The International Tanker Owners Pollution Federation (ITOPF) report 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.

474. For fishing vessel collisions, comprehensive statistical data is not available. Consequently, it is conservatively assumed that 50% of all collisions involving fishing vessels will lead to oil spill with the quantity spilled being on average five tonnes. Similarly for recreational vessels, due to a lack of data 50% of collisions are assumed to lead to a spill with an average size of one tonne.

D.4.2. Pollution Risk due to AyM

475. Applying the above probabilities to the annual collision and allision frequency by vessel type (presented in Figure D.14) and the average spill size per vessel, the amount of oil spilled per year due to the impact of AyM is estimated to be 0.18 tonnes per year for the base case and 0.20 per year for the future case.

476. The estimated increase in tonnes of oil spilled distributed by vessel type for the base and future cases are presented in Figure D.18.

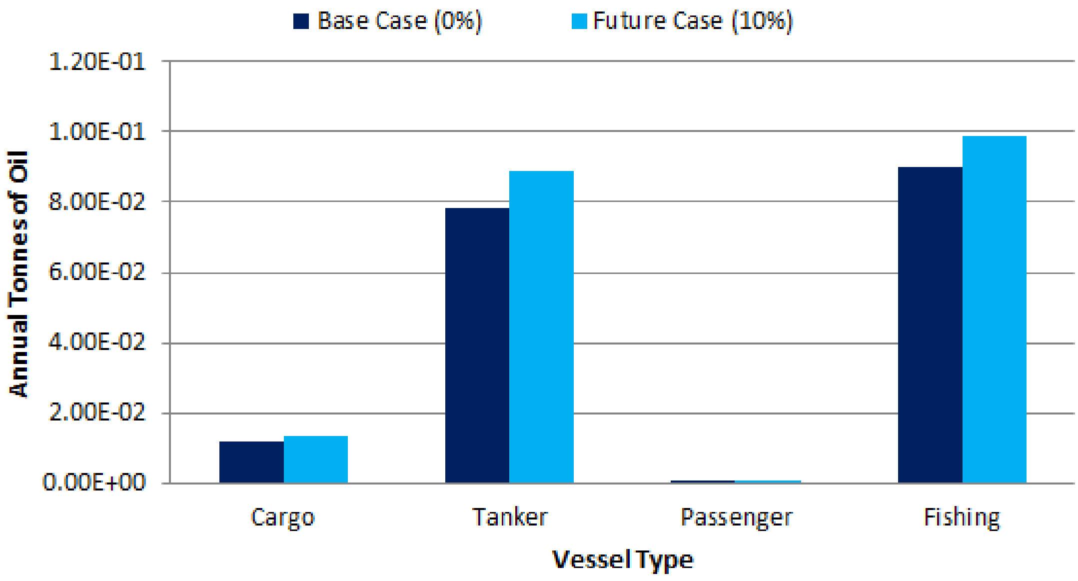

Figure D.18 Estimated change in Pollution by Vessel Type

477. The majority of the change in spill risk was observed to be associated with tankers and fishing vessels. In the case of the tankers, this was due to the large potential spill size associated with these vessels. For fishing vessels it was due to the allision risk, noting potential spill size is much smaller for these vessels.

D.4.3. Significance of Increase in Pollution Risk

478. To assess the significance of the increased pollution risk from marine vessels caused by AyM, historical oil spill data for the UK has been used as a benchmark.

479. From the MEHRAs research (DfT, 2001), the annual average tonnes of oil spilled in the waters around the British Isles due to marine accidents in the 10 year period from 1989 to 1998 was 16,111. This is based on a total of 146 reported oil pollution incidents of greater than one tonne (smaller spills are excluded as are incidents which occurred within port and 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%.

480. The overall increase in pollution estimated due to AyM of < 0.01% (increase over the 16,111 average) is considered very low compared to the historical average pollution quantities from marine accidents in UK waters.

D.5 Conclusions

481. This appendix has assessed the fatality and pollution risk associated with AyM.

691. Overall, the impact of AyM on people and the environment is relatively low compared to the existing background risk levels in UK waters. However, it should be noted that this is the localised impact of a single project and there will be additional maritime risks associated with other offshore wind farm developments in the area and the UK as a whole.

Appendix E **Hazard Log**

482. The Hazard Log (see Section 3.3 and 4.5) is presented in Table E.1

Table E.1: Hazard Log

Hazard Type	Hazard Title	Phase (C/O/D)	Embedded Mitigations	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation	Additional Comments
						Frequency	Consequences: People	Environment	Property	Business	Average	Risk		Frequency	Consequences: People	Environment	Property	Business	Average	Risk		
Commercial Vessels																						
Displacement resulting in increased Collision Risk	Increased collision risk involving commercial vessels due to temporary displacement from historical routes and reduction in available sea room	C/D	Appropriate marking on Admiralty charts Promulgation of information	Human error or navigational error Mechanical or technical failure (vessel) Adverse weather	Increased encounters between third party vessels that do not impact on compliance with COLREGS	4	1	1	1	1	1.0	Broadly Acceptable	Increased encounters between third party vessels that do impact on compliance with COLREGS and result in increased collisions	1	4	4	4	4	4.0	Broadly Acceptable		Potential for extending the TSS was discussed during Hazard Workshop, and it was agreed such a change would be beneficial for certain vessels but not others.
Collision With Projects Vessels	Increased collision risk between a commercial vessel and a project vessel due to the presence of project vessels associated with construction/decommissioning	C/D	Marine coordination Promulgation of information Application for safety zones Guard vessels	Presence of project vessels associated with construction/decommissioning Third party users not aware project vessels are engaged in operations	Increased encounters between third party vessels and project vessels that do not impact on compliance with COLREGS	4	1	1	1	1	1.0	Broadly Acceptable	Increased encounters between third party vessels and project vessels that do impact on compliance with COLREGS and result in increased collisions	2	4	3	4	4	3.8	Broadly Acceptable		
Allision	New allision risk for commercial vessels due to presence of pre commissioned structures	C/D	MGN Compliance Lighting and marking Appropriate marking on Admiralty charts Promulgation of information Application for safety zones Blade clearance Guard vessels	Presence of pre commissioned structures Human error or navigational error Mechanical or technical failure (vessel) Exposed /peripheral Met Mast Adverse weather Unfamiliarity with project Failure of Aid to Navigation	Vessel passes structure at an unsafe distance and has to make last minute adjustment to course/speed	4	1	1	1	1	1.0	Broadly Acceptable	Vessel allides with structure resulting in damage to vessel, injury and potentially pollution	2	5	4	5	4	4.5	Tolerable	Consultation with Trinity House regarding siting of Met Mast.	Trinity House raised concern over the Met Mast being outside of the array (i.e., an isolated structure). Concern was raised over potential for engine breakdown in proximity to the site, however it was also noted that there are established procedures in place (e.g., dropping anchor) for such an instance.
Restricted access to ports/harbours	Temporary restrictions on a commercial vessel's access route to a port/harbour	C/D	Cable burial risk assessment Marine coordination Appropriate marking on Admiralty charts Promulgation of information	Project vessels Cable installation	Increased journey time but no impact on schedules	3	1	1	1	1	1.0	Broadly Acceptable	Increased journey time, impacts on schedules	2	2	1	1	2	1.5	Broadly Acceptable		
Anchor interaction	Increased anchor snagging risk for commercial vessels due to subsea cables and cable protection	C/D	Cable burial risk assessment Appropriate marking on Admiralty charts Promulgation of information	Presence of subsea cables or cable protection Human error or navigational error Mechanical or technical failure Adverse weather	Vessel anchors on or drags anchor over an installed cable/protection but no interaction occurs.	3	1	1	1	1	1.0	Broadly Acceptable	Vessel anchors on or drags anchor over an installed cable/protection resulting in damage to the cable/protection and/or anchor	2	3	1	2	2	2.0	Broadly Acceptable		Raised during Hazard Workshop that avoiding allision by dropping anchor would be prioritised over avoiding cable interaction.
Displacement resulting in increased Collision Risk	Increased collision risk involving commercial vessels due to displacement from historical routes and reduction in available sea room	O	Appropriate marking on Admiralty charts Promulgation of information	Human error or navigational error Mechanical or technical failure (vessel) Adverse weather	Increased encounters between third party vessels that do not impact on compliance with COLREGS	3	1	1	1	1	1.0	Broadly Acceptable	Increased encounters between third party vessels that do not impact on compliance with COLREGS	1	4	4	4	4	4.0	Broadly Acceptable		Potential for extending the TSS was discussed during Hazard Workshop, and it was agreed such a change would be beneficial for certain vessels but not others.
Collision With Projects Vessels	Increased collision risk between a commercial vessel and a project vessel due to the presence of project vessels associated with operation and maintenance	O	Marine coordination Promulgation of information Application for safety zones Guard vessels	Presence of project vessels associated with operation and maintenance Third party users not aware project vessels are engaged in operations	Increased encounters between third party vessels and project vessels that do not impact on compliance with COLREGS	3	1	1	1	1	1.0	Broadly Acceptable	Increased encounters between third party vessels and project vessels that do impact on compliance with COLREGS and result in increased collisions	1	4	3	4	4	3.8	Broadly Acceptable		
Allision	New allision risk for commercial vessels due to presence of structures	O	MGN Compliance Lighting and marking Appropriate marking on Admiralty charts Promulgation of information Blade clearance	Presence of structures Human error or navigational error Mechanical or technical failure resulting in a vessel drifting Adverse weather Exposed / peripheral Met Mast	Vessel passes structure at an unsafe distance and has to make last minute adjustment to course/speed	4	1	1	1	1	1.0	Broadly Acceptable	Vessel allides with structure resulting in damage to vessel, injury and potentially pollution	2	5	4	5	4	4.5	Tolerable	Consultation with Trinity House regarding siting of Met Mast.	Trinity House raised concern over the Met Mast being outside of the array (i.e., an isolated structure). Concern was raised over potential for engine breakdown in proximity to the site, however it was also noted that there are established procedures in place (e.g., dropping anchor) for such an instance.
Restricted access to ports/harbours	Restrictions on a commercial vessel's access route to a port/harbour	O	Cable burial risk assessment Marine coordination Appropriate marking on Admiralty charts Promulgation of information	Project vessels Cable Maintenance	Increased journey time/distance but does not impact on schedules	3	1	1	1	1	1.0	Broadly Acceptable	Increased journey time, impacts on schedules	1	2	1	1	2	1.5	Broadly Acceptable		

Hazard Type	Hazard Title	Phase (C/O/D)	Embedded Mitigations	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences: Frequency	Consequences: People	Environment	Property	Business	Average	Risk	Worst Case Consequences	Realistic Worst Case Consequences: Frequency	Consequences: People	Environment	Property	Business	Average	Risk	Further Mitigation	Additional Comments
Anchor interaction	Increased anchor snagging risk for commercial vessels due to subsea cables and cable protection	O	Cable burial risk assessment Appropriate marking on Admiralty charts Promulgation of information	Presence of subsea cables or cable protection Human error or navigational error Mechanical or technical failure Adverse weather	Vessel anchors on or drags anchor over an installed cable/protection but no interaction occurs.	3	1	1	1	1	1.0	Broadly Acceptable	Vessel anchors on or drags anchor over an installed cable/protection resulting in damage to the cable/protection and/or anchor	1	3	1	2	2	2.0	Broadly Acceptable		Raised during Hazard Workshop that avoiding allision by dropping anchor would be prioritised over avoiding cable interaction.
Commercial Fishing Vessels (in Transit)																						
Displacement resulting in increased Collision Risk	Increased collision risk involving fishing vessels due to temporary displacement from historical routes and reduction in available sea room	C/D	Appropriate marking on Admiralty charts Promulgation of information	Human error or navigational error Mechanical or technical failure (vessel) Adverse weather	Increased encounters between third party vessels that do not impact on compliance with COLREGS	3	1	1	1	1	1.0	Broadly Acceptable	Increased encounters between third party vessels that do impact on compliance with COLREGS and result in increased collisions	1	2	2	2	2	2.0	Broadly Acceptable		
Collision With Projects Vessels	Increased collision risk between a commercial fishing vessel and a project vessel due to the presence of project vessels associated with construction/decommissioning	C/D	Marine coordination Promulgation of information Application for safety zones Guard vessels	Presence of project vessels associated with construction/decommissioning Third party users not aware project vessels are engaged in operations	Increased encounters between third party vessels and project vessels that do not impact on compliance with COLREGS	5	1	1	1	1	1.0	Tolerable	Increased encounters between third party vessels and project vessels that do impact on compliance with COLREGS and result in increased collisions	3	2	2	2	3	2.3	Broadly Acceptable		
Allision	New allision risk for commercial fishing vessels due to presence of pre commissioned structures	C/D	MGN Compliance Lighting and marking Appropriate marking on Admiralty charts Promulgation of information Application for safety zones Blade clearance Guard vessels	Presence of pre commissioned structures Human error or navigational error Mechanical or technical failure (vessel) Adverse weather Failure of Aid to Navigation Failure to take note of advisory safe passing distance Exposed / peripheral Met Mast	Vessel passes structure at an unsafe distance and has to make last minute adjustment to course/speed	4	1	1	1	1	1.0	Broadly Acceptable	Vessel allides with structure resulting in damage to vessel, injury and potentially pollution	2	4	3	4	3	3.5	Broadly Acceptable	Consultation with Trinity House regarding siting of Met Mast.	Trinity House raised concern over the Met Mast being outside of the array (i.e., an isolated structure).
Restricted access to ports/harbours	Temporary restrictions on a commercial fishing vessel's access route to a port/harbour	C/D	Cable burial risk assessment Marine coordination Appropriate marking on Admiralty charts Promulgation of information	Project vessels Cable installation	Increased journey time/distance but does not impact on schedules	4	1	1	1	1	1.0	Broadly Acceptable	Increased journey time, impacts on schedules Could result in restricted movements associated with adverse weather	3	2	1	1	2	1.5	Broadly Acceptable		
Anchor interaction	Increased anchor snagging risk for commercial fishing vessels due to subsea cables and cable protection *Note impacts associated with commercial fishing gear are outside of the scope of the NRA process, and will be therefore be assessed separately.	C/D	Cable burial risk assessment Appropriate marking on Admiralty charts Promulgation of information	Presence of subsea cables or cable protection Human error or navigational error Mechanical or technical failure Adverse weather	Vessel anchors on or drags anchor over an installed cable/protection but no interaction occurs	3	1	1	1	1	1.0	Broadly Acceptable	Vessel anchors on or drags anchor over an installed cable/protection resulting in damage to the cable/protection and/or anchor Risks to vessel stability	1	2	1	2	2	1.8	Broadly Acceptable		
Restricted access to ports/harbours	Restrictions on a commercial fishing vessel's access route to a port/harbour	O	Cable burial risk assessment Marine coordination Appropriate marking on Admiralty charts Promulgation of information	Project vessels Cable Maintenance	Increased journey time/distance but does not impact on schedules	3	1	1	1	1	1.0	Broadly Acceptable	Increased journey time, impacts on schedules Could result in restricted movements associated with adverse weather	2	2	1	1	2	1.5	Broadly Acceptable		
Displacement resulting in increased Collision Risk	Increased collision risk involving commercial fishing vessels due to displacement from historical transits to fishing grounds and reduction in available sea room	O	Appropriate marking on Admiralty charts Promulgation of information	Human error or navigational error Mechanical or technical failure (vessel) Adverse weather	Increased encounters between third party vessels that do not impact on compliance with COLREGS	3	1	1	1	1	1.0	Broadly Acceptable	Increased encounters between third party vessels that do impact on compliance with COLREGS and result in increased collisions	1	2	2	2	2	2.0	Broadly Acceptable		
Collision With Projects Vessels	Increased collision risk between a commercial fishing vessel and a project vessel due to the presence of project vessels associated with operation and maintenance	O	Marine coordination Promulgation of information Application for safety zones Guard vessels	Presence of project vessels associated with operation and maintenance Third party users not aware project vessels are engaged in operations	Increased encounters between third party vessels and project vessels that do not impact on compliance with COLREGS	4	1	1	1	1	1.0	Broadly Acceptable	Increased encounters between third party vessels and project vessels that do impact on compliance with COLREGS and result in increased collisions	3	2	2	2	3	2.3	Broadly Acceptable		

Hazard Type	Hazard Title	Phase (C/O/D)	Embedded Mitigations	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation	Additional Comments
						Frequency	Consequences					Risk		Frequency	Consequences					Risk		
							People	Environment	Property	Business	Average				People	Environment	Property	Business	Average			
Allision	New allision risk for commercial fishing vessels due to presence of structures	O	MGN Compliance Lighting and marking Appropriate marking on Admiralty charts Promulgation of information Blade clearance	Presence of structures Human error or navigational error Mechanical or technical failure resulting in a vessel drifting Adverse weather Exposed / peripheral Met Mast	Vessel passes structure at an unsafe distance and has to make last minute adjustment to course/speed	4	1	1	1	1	1.0	Broadly Acceptable	Vessel allides with structure resulting in damage to vessel, injury and potentially pollution	2	4	3	4	3	3.5	Broadly Acceptable	Consultation with Trinity House regarding siting of Met Mast.	Trinity House raised concern over the Met Mast being outside of the array (i.e., an isolated structure).
Anchor interaction	Increased anchor snagging risk for commercial fishing vessels due to subsea cables and cable protection *Note impacts associated with commercial fishing gear are outside of the scope of the NRA process, and will be therefore be assessed separately.	O	Cable burial risk assessment Appropriate marking on Admiralty charts Promulgation of information	Presence of subsea cables or cable protection Human error or navigational error Mechanical or technical failure Adverse weather	Vessel anchors on or drags anchor over an installed cable/protection but no interaction occurs	3	1	1	1	1	1.0	Broadly Acceptable	Vessel anchors on or drags anchor over an installed cable/protection resulting in damage to the cable/protection and/or anchor Risks to vessel stability	1	2	1	2	2	1.8	Broadly Acceptable		
Recreational Vessels (2.5 to 24 metres)																						
Displacement resulting in increased Collision Risk	Increased collision risk involving recreational vessels due to temporary displacement from historical cruising routes and reduction in available sea room	C/D	Appropriate marking on Admiralty charts Promulgation of information	Human error or navigational error Mechanical or technical failure (vessel) Adverse weather	Increased encounters between third party vessels that do not impact on compliance with COLREGS	3	1	1	1	1	1.0	Broadly Acceptable	Increased encounters between third party vessels that do impact on compliance with COLREGS and result in increased collisions	1	2	2	2	2	2.0	Broadly Acceptable		It was raised during the Hazard Workshop that a "central database" of active safety zones would be of benefit.
Collision With Projects Vessels	Increased collision risk between a recreational vessel and a project vessel due to the presence of project vessels associated with construction/decommissioning	C/D	Marine coordination Promulgation of information Application for safety zones Guard vessels	Presence of project vessels associated with construction/decommissioning Third party users not aware project vessels are engaged in operations	Increased encounters between third party vessels and project vessels that do not impact on compliance with COLREGS	5	1	1	1	1	1.0	Tolerable	Increased encounters between third party vessels and project vessels that do impact on compliance with COLREGS and result in increased collisions	3	2	2	2	3	2.3	Broadly Acceptable		
Allision	New allision risk for recreational vessels due to presence of pre commissioned structures	C/D	MGN Compliance Lighting and marking Appropriate marking on Admiralty charts Promulgation of information Application for safety zones Blade clearance Guard vessels	Presence of pre commissioned structures Human error or navigational error Mechanical or technical failure (vessel) Adverse weather Failure of Aid to Navigation Failure to take note of advisory safe passing distance Exposed / peripheral Met Mast	Vessel passes structure at an unsafe distance and has to make last minute adjustment to course/speed	4	1	1	1	1	1.0	Broadly Acceptable	Vessel allides with structure resulting in damage to vessel, injury and potentially pollution	2	4	3	4	3	3.5	Broadly Acceptable	Consultation with Trinity House regarding siting of Met Mast.	Trinity House raised concern over the Met Mast being outside of the array (i.e., an isolated structure).
Restricted access to ports/harbours	Temporary restrictions on a recreational vessel's access route to a port/harbour	C/D	Cable burial risk assessment Marine coordination Appropriate marking on Admiralty charts Promulgation of information	Buoyed construction/ area/decommissioning area or advisory safe passing distances Project vessels	Increased journey time/distance but does not impact on schedules	4	1	1	1	1	1.0	Broadly Acceptable	Increased journey time, impacts on schedules Could result in restricted movements associated with adverse weather	3	2	1	1	2	1.5	Broadly Acceptable		
Anchor interaction	Increased anchor snagging risk for recreational vessels due to subsea cables and cable protection	C/D	Cable burial risk assessment Appropriate marking on Admiralty charts Promulgation of information	Presence of subsea cables or cable protection Human error or navigational error Mechanical or technical failure Adverse weather	Vessel anchors on or drags anchor over an installed cable/protection but no interaction occurs	3	1	1	1	1	1.0	Broadly Acceptable	Vessel anchors on or drags anchor over an installed cable/protection resulting in damage to the cable/protection and/or anchor Risks to vessel stability	1	2	1	2	2	1.8	Broadly Acceptable		It was suggested that local users in the Rhyl area could be consulted with regards to areas where anchoring may be sought near the landfall.
Displacement resulting in increased Collision Risk	Increased collision risk involving recreational vessels due to temporary displacement from historical cruising routes and reduction in available sea room	O	Appropriate marking on Admiralty charts Promulgation of information	Human error or navigational error Mechanical or technical failure (vessel) Adverse weather	Increased encounters that do not impact on compliance with COLREGS	3	1	1	1	1	1.0	Broadly Acceptable	Increased encounters that do impact on compliance with COLREGS and result in increased collisions	1	2	2	2	2	2.0	Broadly Acceptable		
Collision With Projects Vessels	Increased collision risk between a recreational vessel and a project vessel due to the presence of project vessels associated with operation and maintenance	O	Marine coordination Promulgation of information Application for safety zones Guard vessels	Presence of project vessels associated with operation and maintenance Third party users not aware project vessels are engaged in operations	Increased encounters between third party vessels and project vessels that do not impact on compliance with COLREGS	4	1	1	1	1	1.0	Broadly Acceptable	Increased encounters between third party vessels and project vessels that do impact on compliance with COLREGS and result in increased collisions	3	2	2	2	3	2.3	Broadly Acceptable		

Hazard Type	Hazard Title	Phase (C/O/D)	Embedded Mitigations	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation	Additional Comments
						Frequency	Consequences: People	Environment	Property	Business	Average	Risk		Frequency	Consequences: People	Environment	Property	Business	Average	Risk		
Allision	New allision risk for recreational vessels due to presence of structures	O	MGN Compliance Lighting and marking Appropriate marking on Admiralty charts Promulgation of information Blade clearance	Presence of structures Human error or navigational error Mechanical or technical failure resulting in a vessel drifting Adverse weather Exposed / peripheral Met Mast	Vessel passes structure at an unsafe distance and has to make last minute adjustment to course/speed	4	1	1	1	1	1.0	Broadly Acceptable	Vessel allides with structure resulting in damage to vessel, injury and potentially pollution	2	4	3	4	3	3.5	Broadly Acceptable	Consultation with Trinity House regarding siting of Met Mast.	Trinity House raised concern over the Met Mast being outside of the array (i.e., an isolated structure).
Restricted access to ports/harbours	Restrictions on a recreational vessel's access route to a port/harbour	O	Cable burial risk assessment Marine coordination Appropriate marking on Admiralty charts Promulgation of information	Presence of structures Project vessels	Increased journey time/distance but does not impact on schedules	3	1	1	1	1	1.0	Broadly Acceptable	Increased journey time, impacts on schedules Could result in restricted movements associated with adverse weather	2	2	1	1	2	1.5	Broadly Acceptable		
Anchor interaction	Increased anchor snagging risk for recreational vessels due to subsea cables and cable protection	O	Cable burial risk assessment Appropriate marking on Admiralty charts Promulgation of information	Presence of subsea cables or cable protection Human error or navigational error Mechanical or technical failure Adverse weather	Vessel anchors on or drags anchor over an installed cable/protection but no interaction occurs	3	1	1	1	1	1.0	Broadly Acceptable	Vessel anchors on or drags anchor over an installed cable/protection resulting in damage to the cable/protection and/or anchor Risks to vessel stability	1	2	1	2	2	1.8	Broadly Acceptable		It was suggested that local users in the Rhyl area could be consulted with regards to areas where anchoring may be sought near the landfall.
Grounding	Increased risk of grounding for recreational vessels due to cable protection	O	MGN Compliance Cable burial risk assessment Appropriate marking on Admiralty charts Promulgation of information	Reduction of water depths following installation of cable protection	Vessel transits over a area of reduced clearance causing vibration etc. but does not make contact	4	1	1	1	1	1.0	Broadly Acceptable	Vessel makes contact with cable protection resulting in damage to the vessel and potentially pollution	2	4	1	4	3	3.0	Broadly Acceptable		
All Vessels																						
Interference with marine navigation, communications and position fixing equipment	Presence of structures, export and inter array cables may interfere with equipment used on board all vessels.	O	MGN Compliance Cable burial risk assessment Appropriate marking on Admiralty charts Promulgation of information	Human error relating to adjustment of Radar controls Presence of structures	Infrastructure has no effect upon the Radar, communications and navigation equipment on a vessel	5	1	1	1	1	1.0	Tolerable	Delay to response request leading to loss of life	3	1	1	1	1	1.0	Broadly Acceptable		
Use of aids to navigation	Presence of structures may prevent use of existing aids to navigation	O	Lighting and marking Appropriate marking on Admiralty charts	Visual intrusion from wind farm structures	Short-term inability to utilise an aid to navigation but no effect on the vessel's transit	4	1	1	1	1	1.0	Broadly Acceptable	Short-term inability to utilise an aid to navigation resulting in an allision or grounding incident with damage to vessel, injury and potentially pollution	2	3	3	3	3	3.0	Broadly Acceptable		Trinity House were content that any effects on the Point Lynas leading light would be compensated for by the AtoNs on the array.
Emergency response																						
Emergency response	Presence of structures may restrict access/response for existing emergency responders	C/O/D	MGN Compliance Marine Pollution Contingency Plan ERCoP Marine coordination Promulgation of information	Wind farm array not designed to facilitate responder access Adverse weather	Delay to response request	2	1	1	1	2	1.3	Broadly Acceptable	Delay to response request leading to loss of life	1	5	5	5	5	5.0	Tolerable	Agreement of layout with MCA post consent. Discussions with MCA around appropriate comms procedures for inclusion in ERCoP.	Note during Hazard Workshop, RNLI raised issues around communication with GyM, and requested communication procedures be put in place for AyM.

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