Appendix 14.2 Cumulative Regional Navigation Risk Assessment

Morecambe Offshore Windfarm: Generation Assets

Preliminary Environmental Information Report

Volume 2

Irish Sea: CRNRA

Irish Sea Round 4 Offshore Wind Farms: Cumulative Regional Navigation Risk Assessment

bp, EnBW, Cobra and Flotation Energy

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EXECUTIVE SUMMARY

The developers of the Mona, Morgan and Morecambe Offshore Wind Farms (the Projects) within the east Irish Sea have collaborated to commission a Cumulative Regional Navigation Risk Assessment (CRNRA), which is reported within this document. This assessment has been undertaken in compliance with relevant legislation, policy and guidance applicable to shipping and navigation assessments. The purpose of this collaborative approach is to assess the relevant potential cumulative effects of the array areas of all three Projects on shipping and navigation receptors (S&N). The objectives are to provide a focused assessment of the key cumulative effects associated with the three Projects, and in particular, the safety of navigation through the corridors between them.

The assessment identified a CRNRA study area which includes numerous shipping routes, ports, and existing activities, such as oil and gas, offshore wind and aggregates in the east Irish Sea. The majority of large commercial shipping is routed through existing Traffic Separation Schemes (TSS) into the Port of Liverpool. Four principal commercial ferry companies operate throughout the CRNRA study area, with services between Liverpool, Heysham, Douglas and the island of Ireland. Fishing by static and mobile gear varies in intensity across the CRNRA but is shown to occur throughout the Irish Sea. Recreational cruising is concentrated mostly inshore, although some offshore cruising routes exist. Analysis of historical incident data determined relatively low frequencies of navigational incidents adjacent to the three Project sites.

By comparing the three Project boundaries and proposals with the existing activities, and accounting for projected future traffic profile, several key impacts were identified:

Impact Assessment:

An assessment of the impacts of the Projects on recognised sea lanes essential to international navigation determined that access to the TSSs in the CRNRA study area would be maintained.

An assessment of the impacts of the Projects on ferry vessel routeing determined that there would be necessary deviation of Stena, Isle of Man Steam Packet Company and Seatruck routes around the array areas in both normal and adverse weather conditions. This deviation in normal conditions would be less than five minutes for most ferry routes, with the exception of Stena services between Liverpool and Belfast, with increases of between 7 and 15 minutes dependent on route. Existing passages are up to eight hours duration (dependent on route), with existing services having significant variation in turnaround times and transit times of greater than 25 minutes. The increase in passage distance and time duration associated with the Projects is unlikely to have significant schedule impacts but could increase pressures on operators. The presence of the Projects may also necessitate additional watchkeeping requirements to ensure safe navigation within the corridors and effective collision avoidance.

During significant adverse weather, the assessment determined that several corridors between Projects would no longer be safe to navigate, and a more circuitous route required. This would increase the schedule impacts by between 15 and 60 minutes (dependent on route). This is likely to necessitate increased cancellations of services as existing timetables would not be viable with anticipated turnaround times.

An assessment of the impacts of the Projects on commercial ship routeing determined that the principal shipping routes were into Liverpool (with at least one vessel movement per day) and would necessitate a deviation to the southwest of Mona Array Area, but this was not so significant to impact the viability of Liverpool as a port. Less trafficked routes into Heysham and Douglas would necessitate greater deviations, which are unlikely to make such services unviable.

An assessment of the impacts of the Projects on small craft routeing determined that there is sufficient spacing between turbines across all three offshore wind farms to facilitate safe navigation for fishing and recreational craft. There may be some effect of offsetting these vessels into adjacent channels where these vessels choose not to do so, which could increase the risk of collision with larger vessels.

The principal corridors created between the Projects were tested against guidance and precedents. All three corridors between the Projects meet both Maritime and Coastguard Agency (MCA) and World Association for Waterborne Transport Infrastructure (PIANC) guidance. However, were the vessel numbers between Mona and Morgan Array Areas to increase, or vessels to be larger in size, it would fail the PIANC guidance. Projects elsewhere in the North Sea have proposed corridors which are comparable in geometries to those between the three Projects, and in some cases narrower.

An assessment of the impacts of the Projects on collision and allision risk determined that, with the exception of the waters south of Mona Array Area which are already congested, it is unlikely that multiple large commercial vessels would be concurrently navigating within the corridors (<10% likelihood of 2 or more vessels). The arrays lie adjacent to commercial shipping and ferry routes and therefore there is the potential for vessels to emerge undetected from within the array areas at speed with limited opportunity or reduced sea room for collision avoidance. All of the corridors are likely to contain multiple small craft at times which are at risk of collision with other passing vessels. The Mona-Morgan corridor is at the confluence of meeting scenarios between vessels from multiple directions, with limited visibility and a relatively narrow corridor to comply with the Convention on the International Regulations for Preventing Collisions at Sea (COLREGs). The Mona Array Area reduces the capability for westbound vessels out of Liverpool TSS to comply with COLREGs obligations for crossing vessels heading southeast from the Isle of Man.

The orientation and width of the corridors reduces the capability of vessels to respond to an emergency by altering their heading, such as during a fire or cargo shift incident. The layouts and wind turbine generator locations and orientations within the Projects array areas will be further assessed to ensure compliance with obligations for continued access for search and rescue (SAR) assets. The boundaries of the Projects, in relation to shipping routes, and accounting for decommissioning activities, would not substantially increase the risk to oil and gas activities.

An assessment of the impacts of the Projects on communications, radar and positioning systems determined that most effects are negligible. Effects to radar are inherent when navigating adjacent to offshore wind farms. It is likely that such effects will be experienced for vessels navigating all three Projects.

Navigation Risk Assessment:

A risk assessment was undertaken, supported through a hazard workshop attended by representatives from ferry operators, regulators, commercial bodies, oil and gas, ports, fishing community and recreational users. Fifty six (56) hazards were identified, split across different hazard types, vessel types and areas. The findings of the workshop were considered with the analysis and wider assessment undertaken by the Project teams to derive the overall risk assessment results.

Five hazards were assessed as being High Risk – Unacceptable. Firstly, the risk of collision between Ferry/Passenger and a Ferry/Passenger or Cargo/Tanker between Mona and Morgan Array Areas or South Mona Array Areas was scored highly given the reduced channel width and confluence of large vessel routes. Secondly, collisions involving Ferry/Passenger or Cargo/Tanker and small craft throughout the CRNRA study area were also deemed unacceptable due to reduced collision avoidance in the narrow corridors. Of the hazards 42 were assessed as Medium Risk. The highest of these are represented by collisions and allisions involving Ferry/Passenger vessels and between large ships and small craft, often in the Morgan-Walney, Mona-Morgan and South Mona Array Areas.

Additional risk control options to reduce these risks to Broadly Acceptable or Tolerable if As Low as Reasonably Practicable (ALARP) were identified. They include boundary changes, greater engagement and promulgation of information and coordination of activities between the Projects and vessel movements amongst others. These additional controls are conceptual only at this stage and have not been implemented but are anticipated to be appropriate for mitigating these unacceptable risks. Furthermore, it is not possible to state that those hazards scored as Medium Risk are Tolerable as they cannot be considered ALARP until all appropriate risk control options are tested.

Summary:

In summary, the findings of this CRNRA are that the cumulative effects for the Mona, Morgan and Morecambe Projects would result in hazards with Unacceptable navigational risk scores and therefore additional risk control options are required. Some appropriate additional controls have been identified but have not been implemented for assessment within the Preliminary Environmental Information Report (PEIR). The Projects have committed to exploring these additional risk controls through further studies and engagement with stakeholders to ensure they are appropriate and adequate for reducing risks to ALARP prior to Application for their respective Development Consent Orders. Appropriate risk controls will then be secured through the respective DCOs or marine licences.

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ABBREVIATIONS

Abbreviation	Detail
AIS	Automatic Identification System
ALARP	As Low as Reasonably Practicable
AtoN	Aid to Navigation
BEIS	Department for Business, Energy and Industrial Strategy
BWEA	British Wind Energy Association
CBRA	Cable Burial Risk Assessment
CCTV	Closed Circuit Television
CGOC	Coastguard Operations Centre
CHA	Competent Harbour Authority
COLREGs	Convention on the International Regulations for Preventing Collisions at Sea, 1972
COVID-19	Coronavirus disease 2019
CPA	Closest Point of Approach
CRNRA	Cumulative Regional Navigation Risk Assessment
CTV(s)	Crew Transfer Vessel(s)
DCO	Development Consent Order
DfT	Department for Transport
DSC	Digital Selective Calling
DWT	Deadweight Tonnes
EEXI	Energy Efficiency eXisting ship Index
EIA	Environmental Impact Assessment
EMODnet	European Marine Observation and Data Network
EMSA	European Maritime Safety Agency
EnBW	Energie Baden-Wurttemberg AG
ERCOP	Emergency Response and Cooperation Plan
ERRV(s)	Emergency Rescue and Recovery Vessel(s)
EU	European Union
FSA	Formal Safety Assessment
GNSS	Global Navigation Satellite System
GOMO	Guidance for Offshore Marine Operations
GT	Gross Tonnage
GW	GigaWatt
HAT	Highest Astronomical Tide
HAZID	Hazard Identification
HMCG	His Majesty's Coastguard
HSE	Health, Safety and Environment
IALA	International Association of Marine Aids to Navigation and Lighthouse Authorities
ICW	In Collision With
IHO	International Hydrographic Organisation
IMO	International Maritime Organization
IOER	Integrated Offshore Emergency Response
IoM	Isle of Man
IoMSPC	Isle of Man Steam Packet Company
IPS	Intermediate Peripheral Structures
LAT	Lowest Astronomical Tide
Lo-Lo	Lift-on/Lift-off
LOA	Length Overall
LPS	Local Port Service
m/s	meter per second
MAIB	Marine Accident Investigation Branch
MCA	Maritime and Coastguard Agency
MDS	Maximum Design Scenario

Abbreviation	Detail
MGN	Marine Guidance Note
MMO	Marine Management Organisation
MNEF	Marine Navigation Engagement Forum
MODU	Mobile Offshore Drilling Unit
MSC	Maritime Safety Committee
MW	MegaWatt
NEPDA	North East Potential Development Area
NFFO	National Federation of Fishermen's Organisations
NLB	Northern Lighthouse Board
NM	Nautical Miles
NPS	National Policy Statement
NRA	Navigation Risk Assessment
NSIP	Nationally Significant Infrastructure Projects
OSPAR	The Convention for the Protection of the Marine Environment of the North-East Atlantic
PDE	Project Design Envelope
PEIR	Preliminary Environmental Information Report
PEXA	Practice and Exercise Area
PIANC	The World Association for Waterborne Transport Infrastructure
PLB	Personal Locator Beacon
PPE	Personal Protective Equipment
QHSE	Quality, Health, Safety and Environment
RIDDOR	Reporting of Injuries, Disease and Dangerous Occurrences Regulations 2013
RNLI	Royal National Lifeboat Institution
Ro-Ro	Roll-on/Roll-off
RoPax	Roll-on/Roll-off Passenger
RYA	Royal Yachting Association
S&N	Shipping and Navigation
SAR	Search and Rescue
SBM	Single Buoy Mooring
SCV	Small Commercial Vessel
SHA	Statutory Harbour Authority
SIRA	Simplified IALA Risk Assessment
SOLAS	Safety of Life at Sea
SPS	Significant Peripheral Structure
STCW	International Convention on Standards of Training, Certification and Watchkeeping for Seafarers
TEU	Twenty-foot Equivalent Unit
TSS(s)	Traffic Separation Scheme(s)
UK	United Kingdom
UKHO	UK Hydrographic Office
UNCLOS	The United Nations Convention on the Law of the Sea (UN, 1982)
VHF	Very High Frequency
VMS	Vessel Monitoring System
VTS	Vessel Traffic Service
yr	Year

1. INTRODUCTION

1.1 BACKGROUND AND INCEPTION

In 2021, the Crown Estate announced that it had selected six proposed new offshore wind projects in the waters around England and Wales, through a process known as Offshore Wind Leasing Round 4. These included three sites in the east Irish Sea (The “Projects"):

- Mona Offshore Wind Project, developed by Energie Baden-Wurttemberg AG (EnBW) and bp Alternative Energy Investments Limited (bp), at 1.5GW.
- Morgan Offshore Wind Project Generation Assets, developed by Energie Baden-Wurttemberg AG (EnBW) and bp Alternative Energy Investments Limited (bp), at 1.5GW.
- Morecambe Offshore Windfarm Generation Assets, developed by Cobra Instalaciones y Servicios, S.A. and Flotation Energy Ltd, at 480MW.

The government classifies major energy projects over 100MW in generating capacity as Nationally Significant Infrastructure Projects (NSIP) under the Planning Act 2008. Scoping reports have been submitted to the Planning Inspectorate for the generation assets for all three Projects as below:

- **Mona Scoping Report (generation and transmission assets)**: 05 May 2022.
- **Morgan Scoping Report (generation assets)**: 15 June 2022.
- **Morecambe Scoping Report (generation assets)**: 23 June 2022.

Both the Morgan and Morecambe Offshore Wind Projects were scoped into the Pathways to 2030 workstream under the Offshore Transmission Network Review. The output of this process concluded that both Projects should work collaboratively in connecting the offshore wind farms to the National Grid at Penwortham in Lancashire. Therefore, a separate joint application is being made for the shared offshore export cable corridors to landfall and shared onshore export cable corridors to onshore substations. The Scoping Report for the Morgan and Morecambe Offshore Wind Farms Transmission Assets was submitted on the 28 October 2022.

Offshore wind farms have the potential to negatively impact upon navigational safety or commercial shipping routes. Therefore, a Navigation Risk Assessment (NRA) is required to demonstrate that these effects are Tolerable, or if not, identify mitigation measures to reduce them to As Low as Reasonably Practicable (ALARP). These effects may be more significant in a cumulative context rather than individually for each project.

Given the concurrency at which these three offshore wind farms are progressing through the Planning process, and that each Project is located within 10 nautical miles (nm) of one another, many stakeholders have raised the potential significance of cumulative effects. In a conventional approach to Environmental Impact Assessment (EIA), each Project would progress the cumulative assessment independently within each NRA which is both inefficient and requires repetitive consultation with stakeholders.

The objective of the Cumulative Regional NRA (CRNRA) is thus to enable The Planning Inspectorate and stakeholders to engage with, and understand, the potential cumulative effects of the Projects. Adopting a regional (collaborative) approach to assessment will also enable individual Project to quantify and manage the cumulative effects in a coordinated, consistent and efficient manner. This assessment dovetails with the individual NRAs of each Project, required as part of their Development Consent Order (DCO) applications.

Separate individual NRAs are being prepared by all three Projects, each of which will reference the findings of this CRNRA for consideration of cumulative effects.

1.2 DOCUMENT STRUCTURE

This NRA consists of the following chapters and sections:

- **Section 1**: Introduction and Background.
- **Section 2**: Policy Guidance and Legislation.
- **Section 3**: NRA Methodology and Data Sources.
- **Section 4**: Projects Description and Maximum Design Envelope.
- **Section 5**: Description of Marine Environment.
- **Section 6**: Description of Existing Marine Activities.
- **Section 7**: Future Case Traffic Profile.
- **Section 8**: Cumulative Impact Assessment.
- **Section 9**: Cumulative Navigation Risk Assessment.
- **Section 10**: Conclusions and Recommendations.
- **Appendix A**: Cumulative Hazard Log.
- **Appendix B**: Summary of Hazard Workshop.

1.3 CRNRA ASSUMPTIONS

Several key assumptions are made within the CRNRA:

1. A single operational phase assessment with the Projects in place is undertaken. Any cumulative effects due to concurrent construction of the Projects is not possible to assess given immature timetables.
2. A 2035 future case assessment is considered, accounting for any changes in vessel numbers or activity at that time (see **Section 7**).

3. The CRNRA excludes assessment of transmission infrastructure, such as cable routes or any offshore booster stations.
4. Additional cumulative projects are included within this development. It is assumed that Awel-Y-Mor is granted consent but that no other offshore wind farms are developed. Principally the Isle of Man (IoM) offshore wind farm and hydrocarbon projects are scoped out of this assessment due to a lack of information available at the time the CRNRA was commenced[1].
5. A Maximum Design Scenario (MDS) for each Project parameter (turbine spacing, numbers and size etc.) is developed and presented in **Section 4**.
6. The CRNRA focusses on the impacts as a result of the presence of all three Projects, particularly the corridors between them, and thus localised site specific issues are expanded upon in each individual Project's NRA.

[1] It should be noted that this assumption has subsequently been challenged by some stakeholders, particularly the Isle of Man Department of Infrastructure. Consultation is ongoing with the Isle of Man government and Isle of Man Offshore Wind Farm and their inclusion within the CRNRA will be reviewed as part of the ongoing assessment.

2. POLICY, GUIDANCE AND LEGISLATION

Offshore wind farm developments are subject to numerous legislation, policy and guidance requirements with respect to shipping and navigation. The CRNRA is undertaken in compliance with these requirements, with further details contained within the respective Project's individual NRAs. In particular, the National Policy Statement (NPS) for Renewable Energy EN-3 states that "*2.6.169: In considering what interference, obstruction or danger to navigation and shipping is likely and its extent and nature, the Infrastructure Planning Commission should have regard to the likely overall effect of the development in question and to any cumulative effects of other relevant proposed, consented and operational offshore wind farms.*"

3. NRA METHODOLOGY

3.1 OVERVIEW

The NRA has been produced in accordance with the Maritime and Coastguard's (MCA) Marine Guidance Note (MGN) 654 (MCA, 2021) and follows the International Maritime Organisations' (IMO) Formal Safety Assessment (FSA) (IMO, 2018). This assessment considers all identified impacts of the Projects on shipping and navigation receptors. The FSA defines a risk as "the combination of frequency and the severity of the consequence" (IMO, 2018). Therefore, the likelihood and consequence of these impacts are assessed through the collection of significant datasets and consultation. Details of the risk criteria and matrix methodology are contained within **Section 9**.

The International Association of Lighthouse Authorities (IALA) Simplified IALA Risk Assessment method (SIRA) follows the FSA process and allows Competent Authorities (and other organisations) to assess maritime and navigation risk in their waters so that they can meet their obligations for the management of navigation safety (e.g. obligations under international conventions such as Safety of Life At Sea (SOLAS), national domestic legislation, etc.).

Details of the overarching methodology are provided in the following IALA Guidance:

- Guideline 1018 - Risk Management
- Guideline 1138 - The Use Of The Simplified IALA Risk Assessment Method.

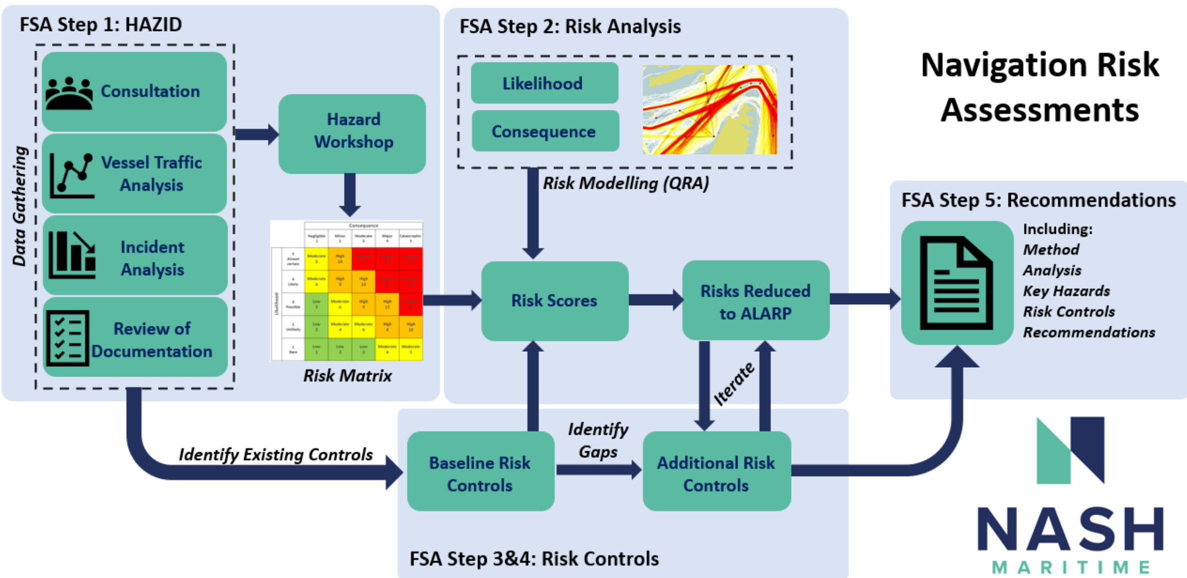


Figure 1: CRNRA methodology.

3.2 DEFINITION OF CRNRA STUDY AREA

The study area of the CRNRA is defined as the region of the east Irish Sea bounded by the Isle of Man to the northwest, and the Welsh and English coasts to the south and east respectively (see **Figure 2**).

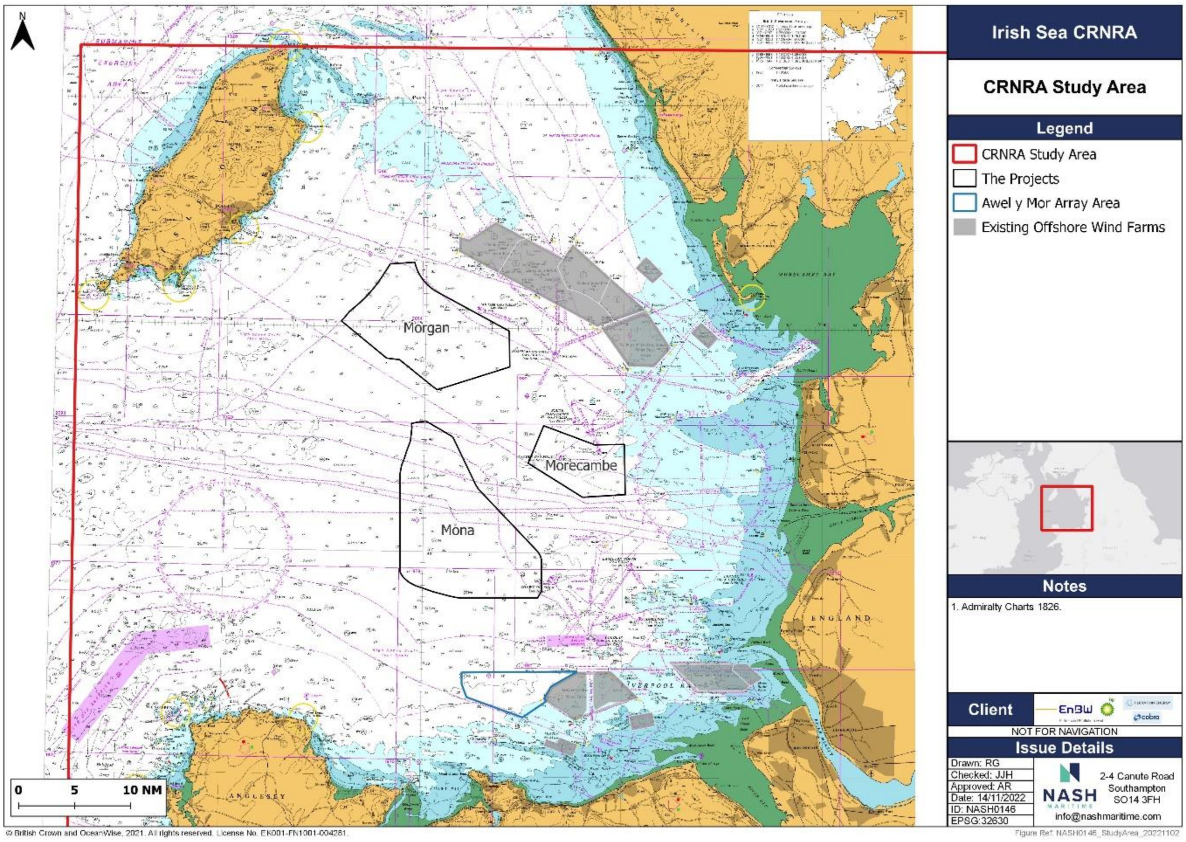


Figure 2: CRNRA study area.

3.3 SUMMARY OF DATA SOURCES AND INFORMATION GATHERING

3.3.1 Consultation and Engagement

Consultation has been undertaken with stakeholders prior to and during the CRNRA to interface with various regulators and stakeholders at an early stage and as part of assessing risk. **Table 1** describes the engagement which has included a range of forums:

- Marine Navigation Engagement Forum (MNEF) (2021-2022), a quarterly engagement shipping and navigation forum was established in 2021. The purpose was to enable developers to regularly update stakeholders on plans and progress of the Morgan and Mona Offshore Wind Projects, and for stakeholders to express views or concern on the impacts of the Projects upon their activities which the developers can respond to, aspiring to reach a state of co-existence.

- Specific meetings with stakeholders through 2021 to 2022 (see **Table 1** for summary)
- Tripping on the Isle of Man Steampacket Company's (IoMSPC) Ben-my-Chree between Douglas and Heysham (05 April 2022) to experience navigation through the CRNRA study area from the master's perspective
- Hazard Workshop (see **Section 9.4** and **Appendix B**)
- Full bridge simulator sessions conducted at HR Wallingford (2022)
- Scoping report submissions through 2022
- Scoping opinion responses for all three Projects (2022).

Table 1: Consultation summary.

Date	Consultee	Project	Purpose and Issues Raised	Response to Issues within this NRA
14 October 2021	MCA	Morgan and Mona	Project introduction and proposed approach. Data collection strategy (incl. survey timings).	Survey details contained within **Section 6.1.2**.
10 November 2021	MNEF Members	Morgan and Mona	Project introduction and proposed approach. Site selection in relation to S&N constraints. Impacts of COVID-19 on data collection. Impacts to Ferry Operators (Safety and Commercial). Relation of impacts on ferry routes with regulation and guidance. Sensitivity of ferry operator schedules.	Data collection strategy is provided in **Section 6.1** and **Section 6.1**. Commercial impacts to ferry operators are described in **Section 8.3**. Safety impacts to ferry routes are described throughout the impact assessment within **Section 8** and the risk assessment within **Section 9**.
01 February 2022	MCA & Trinity House	Morgan and Mona	Methodological Engagement Update on proposed approach for assessment. Status of NPS updates. Requirement for cumulative assessment. Adverse ship routeing assessment. Consenting of Walney Extension and assessment of gap with the North East Potential Development Area (NEPDA). Modelling to reflect local navigational conditions.	Relevant methodology and guidance is given in **Section 2** and **Section 3**. Cumulative impacts are contained within this document. Safety of the corridor between the Walney array area and proposed Morgan Array Area are described throughout the impact assessment within **Section 8** and the risk assessment within **Section 9**.
07 February 2022	Seatruck Ferries Stena Line Isle of Man Steam Packet Company (IoMSPC)	Morecambe	Project introduction and proposed approach. Methodological Engagement Impacts to Ferry Operators (Safety and Commercial). Requirement for cumulative assessment.	Commercial impacts to ferry operators are described in **Section 8.3**. Safety impacts to ferry routes are described throughout the impact assessment within **Section 8** and the risk assessment within **Section 9**. Cumulative impacts are contained within this document.

Date	Consultee	Project	Purpose and Issues Raised	Response to Issues within this NRA
09 February 2022	Chamber of Shipping IoMSPC	Morecambe	Project introduction and proposed approach. Methodological Engagement Impacts to Ferry Operators (Safety and Commercial). Requirement for cumulative assessment. Requirement for analysis of vessel traffic data.	Commercial impacts to ferry operators are described in **Section 8.3**. Safety impacts to ferry routes are described throughout the impact assessment within **Section 8** and the risk assessment within **Section 9**. Cumulative impacts are contained within this document. Data collection strategy is provided in **Section 3.3** and **Section 6.1**
09 February 2022	Department for Business, Energy and Industrial Strategy (BEIS)	Morgan and Mona	Methodological Engagement Introduction to Projects and proposed approach for assessment. Status of NPS updates and role of BEIS. Engagement with wider stakeholders.	Relevant methodology and guidance is given in **Section 2** and **Section 3**. Consultation strategy is described in **Section 3.3**.
14 February 2022	Chamber of Shipping Seatruck Ferries Stena Line IoMSPC MCA	Morgan and Mona	Methodological Engagement Relation of impacts on ferry routes with regulation and guidance. Site selection in relation to S&N constraints. Impacts to Ferry Operators (Safety and Commercial). Need for a cumulative assessment Adverse weather routeing decision making Need for collaborative engagement in assessment.	Commercial impacts to ferry operators are described in Section 8.3. Safety impacts to ferry routes are described throughout the impact assessment within **Section 8** and the risk assessment within **Section 9**. Cumulative impacts are contained within this document. Adverse weather routeing impacts are described in **Section 8.3.3**.
03 March 2022	MCA	Morecambe	Methodological Engagement Update on proposed approach for assessment. Requirement for cumulative assessment. Consideration of Red Line Boundaries changes.	Relevant methodology and guidance is given in **Section 2** and **Section 3**. Cumulative impacts are contained within this document.
09 March 2022	Defence Infrastructure Organisation	Morecambe	Project introduction and proposed approach. Methodological Engagement Requirement for pre-application to determine impacts to Ministry of Defense	Relevant methodology and guidance is given in **Section 2** and **Section 3**. Relation of Projects to practice and exercise areas are descried in **Section 5.1.6**.

Date	Consultee	Project	Purpose and Issues Raised	Response to Issues within this NRA
10 March 2022	Peel Ports Associated British Ports Isle of Man Harbours & Coastguard	Morecambe	Project introduction and proposed approach. Methodological Engagement Requirement for cumulative assessment. Impacts to radar, and freight, cargo and passenger services.	Cumulative impacts are contained within this document. Impacts to commercial operators are described in **Section 8.4**. Impacts to vessel radar are described in **Section 8.12**.
15 March 2022	Seatruck Ferries Stena Line IoMSPC P&O	Morgan and Mona	Request for Info Letter Questionnaire issued to operators requesting details of existing operational details and constraints in normal and adverse weather.	Commercial impacts to ferry operators are described in **Section 8.3**. Safety impacts to ferry routes are described throughout the impact assessment within **Section 8** and the risk assessment within **Section 9**.
04 April 2022	IoMSPC	Morgan and Mona	Baseline Data Gathering Review of current operations and constraints. Review of impacts and decision making in adverse weather. Review of future changes to operations Significance and potential impacts to IoMSPC and IoM.	Commercial impacts to ferry operators are described in **Section 8.3**. Safety impacts to ferry routes are described throughout the impact assessment within **Section 8** and the risk assessment within **Section 9**.
05 April 2022	IoMSPC	Morgan and Mona	Crossing from Douglas to Heysham aboard Ben-my-Chree. Discussions with master on decision making.	N/A
05 April 2022	Seatruck Ferries	Morgan and Mona	Baseline Data Gathering Site selection and shipping and navigation constraints. Potential impacts of Projects on safety and commercial operations for Seatruck. Review of current operations and constraints. Review of impacts and decision making in adverse weather. Review of future changes to operations.	Commercial impacts to ferry operators are described in **Section 8.3**. Safety impacts to ferry routes are described throughout the impact assessment within **Section 8** and the risk assessment within **Section 9**. Future case scenario development is described in **Section 7**.

Date	Consultee	Project	Purpose and Issues Raised	Response to Issues within this NRA
14 April 2022	Stena	Morgan and Mona	Baseline Data Gathering Potential impacts of Projects on safety and commercial operations for Stena. Review of current operations and constraints. Review of impacts and decision making in adverse weather. Review of future changes to operations	Commercial impacts to ferry operators are described in **Section 8.3**. Safety impacts to ferry routes are described throughout the impact assessment within **Section 8** and the risk assessment within **Section 9**. Future case scenario development is described in **Section 7**.
20 April 2022	Spirit Energy	Morgan and Mona	Impacts to Spirit Energy Impacts to marine and aviation movements to offshore platforms and rigs. Requirement for safe passing distances and exclusion areas. Increased traffic flow and collision risk.	Oil and gas activities are described in **Section 5.2** and **Section 6.2.2.6**. Safety impacts to oil and gas operations are described throughout the impact assessment within **Section 8** and the risk assessment within **Section 9**.
21 April 2022	Royal Yachting Association (RYA)	Morgan and Mona	RYA Consultation and Survey Strategy Introduction to Projects and assessment approach. Availability of RYA Recreational Atlas. Summer survey strategy. Further engagement opportunities.	Data collection strategy is provided in **Section 3.3** and **Section 6.1**
05 May 2022	Harbour Energy	Morgan and Mona	Impacts to Harbour Energy Decommissioning Plan for Millom West. Impacts to marine and aviation movements to offshore platforms and rigs. Requirement for safe passing distances and exclusion areas. Increased traffic flow and collision risk.	Oil and gas activities are described in **Section 5.2** and **Section 6.2.2.6**. Safety impacts to oil and gas operations are described throughout the impact assessment within **Section 8** and the risk assessment within **Section 9**.
06 May 2022	MNEF Members	Morgan and Mona	Project update. Cumulative impacts of multiple Projects on ferry operations. How the cumulative impacts will be assessed or examined. Impacts of Projects on IoM economy/society. Extent of incident data. Safety of navigating in gaps. Consequences of allisions with Wind Turbine Generators.	Cumulative impacts are contained within this document. Data collection strategy is provided in **Section 3.3** and **Section 6.1**. Impacts of Projects, including consequences, are described in **Section 8** and the risk assessment within **Section 9**.

Date	Consultee	Project	Purpose and Issues Raised	Response to Issues within this NRA
12 May 2022	RYA	Morecambe	RYA Consultation and Survey Strategy Introduction to Project and assessment approach. Requirement for cumulative assessment. Summer survey strategy.	Data collection strategy is provided in **Section 3.3** and **Section 6.1.** Cumulative impacts are contained within this document.
23 May 2022	Trinity House	Morgan and Mona	Scoping Opinion Assessment Approach MGN654 Compliance Cumulative Impacts to be Assessed Additional and impacts to existing Aids to Navigation Decommissioning Plan. Export Cable corridor marking and protection.	Relevant methodology and guidance is given in **Section 2** and **Section 3**. Cumulative impacts are contained within this document. Embedded risk controls are described in **Section 4.1.**
30 May 2022	MCA	Morgan and Mona	Scoping Opinion Assessment Approach MGN654 Compliance Impacts on vessel routeing and adverse weather routeing. Cumulative Impacts to be Assessed. Turbine layouts to comply with MGN654. Export Cable corridor marking and protection.	Relevant methodology and guidance is given in **Section 2** and **Section 3**. Cumulative impacts are contained within this document. Impacts on vessel routeing are described in **Section 8.2/8.3/8.4**. Embedded risk controls are described in **Section 4.1.**
31 May 2022	Isle of Man Government	Morgan and Mona	Scoping Opinion Cumulative impacts of multiple developments. Inclusion of IoM Orsted offshore wind farm proposal. Impacts on IoMSPC routes into Douglas. Impacts to adverse weather routeing and safe shelter. Impacts to Search and Rescue (SAR) capabilities.	Cumulative impacts are contained within this document. Commercial impacts to ferry operators are described in **Section 8.3**. Safety impacts to ferry routes are described throughout the impact assessment within **Section 8** and the risk assessment within **Section 9**. Impacts to SAR capability are described in **Section 8.10**.
15 June 2022	Planning Inspectorate	Morgan and Mona	Scoping Opinion Assessment Approach and study area.	Relevant methodology and guidance is given in **Section 2** and **Section 3**. The CRNRA study area is described in **Section 3.2**.

Date	Consultee	Project	Purpose and Issues Raised	Response to Issues within this NRA
30 Jun 2022	Seatruck	Morgan and Mona	Bridge Simulations Preparations Determination of routes for assessment. Review of weather conditions and constraints. Definition of traffic and emergency scenarios. Assessment criteria and run order.	**Section 3.3.5** provides a high-level summary of the navigational simulations.
20 July 2022 21 July 2022	IoMPSC	Morgan and Mona	Bridge Simulations Preparations Determination of routes for assessment. Review of weather conditions and constraints. Definition of traffic and emergency scenarios. Assessment criteria and run order.	**Section 3.3.5** provides a high-level summary of the navigational simulations.
09 August 2022	Seatruck Ferries Stena Line IoMSPC Chamber of Shipping MCA Trinity House	Morecambe	Update of the shipping and navigation Project timeline. Presentation of operator passage plans. Impact of the Project to Liverpool to Belfast ferry route. Decommissioning schedules for fixed assets and platforms. Increase in passenger traffic on IoMSPC routes, with additional vessel confirmed on Liverpool/Douglas route. Displacement of vessels leading to increased vessel-to-vessel interaction. Impact of cumulative projects on future adverse weather routing.	Future case scenario development is contained within **Section 7**. Commercial impacts to ferry operators are described in **Section 8.3**. Safety impacts to ferry routes are described throughout the impact assessment within **Section 8** and the risk assessment within **Section 9**.
11 August 2022 12 August 2022	Stena Line	Morgan and Mona	Bridge Simulations Preparations Determination of routes for assessment. Review of weather conditions and constraints. Definition of traffic and emergency scenarios. Assessment criteria and run order.	**Section 3.3.5** provides a high-level summary of the navigational simulations.
17 August 2022 18 August 2022 19 August 2022	IoMSPC	Morgan and Mona	Bridge simulations. Safety of transits in adverse weather and traffic through the Morgan-Walney corridor.	**Section 3.3.5** provides a high-level summary of the navigational simulations. Safety impacts to ferry routes are described throughout the impact assessment within **Section 8** and the risk assessment within **Section 9**.

Date	Consultee	Project	Purpose and Issues Raised	Response to Issues within this NRA
23 August 2022 24 August 2022 25 August 2022	Stena Line	Morgan and Mona	Bridge simulations. Safety of transits in adverse weather and traffic through Mona-Morgan/Mona-Morecambe corridors.	**Section 3.3.5** provides a high-level summary of the navigational simulations. Safety impacts to ferry routes are described throughout the impact assessment within **Section 8** and the risk assessment within **Section 9**.
08 September 2022 09 September 2022	Seatruck	Morgan and Mona	Bridge simulations. Safety of transits in adverse weather and traffic through Mona-Morgan corridor.	**Section 3.3.5** provides a high-level summary of the navigational simulations. Safety impacts to ferry routes are described throughout the impact assessment within **Section 8** and the risk assessment within **Section 9**.
03 October 2022	Various	Morgan, Mona and Morecambe	Webinar to prepare for Hazard Identification (HAZIDs) Workshop.	**Section 9** describes the findings of the hazard workshop.
10 October 2022	MNEF Members	Morgan, Mona and Morecambe	Project update. Application process. Approach to cumulative assessment. Introduction to Morgan/Morecambe combined transmission Project.	**Section 2** describes the relevant legislation and policies.
10 October 2022	Various	Morgan, Mona and Morecambe	Cumulative Hazard Workshop.	**Section 9** and **Appendix B** describes the findings of the hazard workshop.
11 October 2022	Various	Morgan and Mona	Mona and Morgan Hazard Workshops.	**Section 9** and **Appendix B** describes the findings of the hazard workshop.
12 October 2022	Various	Morecambe	Morecambe Hazard Workshop	**Section 9** and **Appendix B** describes the findings of the hazard workshop.

3.3.2 Vessel Traffic Datasets

Vessel traffic data from several sources was utilised to determine baseline conditions.

- High fidelity Automatic Identification System (AIS) data for 2019 for whole Irish Sea
- Marine Maritime Organisation (MMO) 2019 anonymised AIS data
- European Marine Observation and Data Network (EMODNet) 2019 vessel density grids
- RYA Coastal Atlas (2022)
- UK Vessel Monitoring System (VMS) 2019 Data
- The Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR) European Union (EU) VMS 2017 data
- Department for Transport (DfT) Shipping Statistics (2022).

Two 14-day traffic surveys have been conducted for each individual Project; which is analysed within the respective individual Project NRAs.

3.3.3 Incident Data

Four accident datasets were utilised to support this assessment:

- Marine Accident Investigation Branch (MAIB) accidents database (1992 to 2021)
- Royal National Lifeboat Institution (RNLI) incident data (2008 to 2019)
- DfT SAR helicopter taskings (2021)
- G+ Accident data (2021).

3.3.4 Other Data Sources

Other datasets were utilised to support this assessment:

- Marine aggregate dredging licences (Crown Estate 2022)
- Offshore Renewables (Crown Estate 2022)
- Industrial Infrastructure (Turbines, Oil and Gas, cables etc.) (Oceanwise, 2022)
- Oil and Gas Activity (Oil and Gas Authority, 2022)
- Admiralty Charts (2022)

- Admiralty Sailing Directions
- Passage plans and vessel information provided by ferry operators (2022)
- Admiralty Total Tide
- MetOcean Data provided by the Projects.

3.3.5 Full Bridge Simulations

Full bridge simulations of ferry passages through the Irish Sea were commissioned by bp/EnBW. The aim of the simulations was to understand, in more detail, potential navigation impacts of the Projects on existing commercial ferries and to test the viability and safety of commercial ferry transits through corridors between the Projects in normal and adverse weather conditions.

The simulations were administered by HR Wallingford between July and September 2022 following initial engagement in which the scope of the simulations, simulation scenarios and assessment criteria were agreed together with verification of the ship models being tested. Each simulation session was attended by ferry masters and officers:

- **IoMSPC** – model verification 21 to 22 July, simulations 16 to 19 August.
- **Stena Line** – model verification 11 to 12 August, simulations 23 to 25 August.
- **Seatruck** – models previously agreed, simulations 08 to 09 September.
- **P&O** – tested by NASH team only 26 August.

The assessment criteria and simulation scenarios used within the simulations were developed and agreed with the ferry companies prior to simulations. Realistic traffic scenarios, emergency situations and normal/adverse weather conditions were determined based off the analysis contained within this NRA, and consultation with ferry operators.

As the detailed report was in preparation at time of the hazard workshops, participants brought learnings from the simulations to the hazard workshop in a qualitative manner. In summary, the simulation sessions reached the following broad conclusions:

- All corridors could be safely navigated in relatively normal weather conditions and in the absence of other traffic
- Across the 40 runs performed, there were no collisions between vessels or allisions with the turbines, however, excessive ship motion was experienced, and, in some situations, adequate Closest Point of Approach (CPA) criteria was not maintained between vessels and the offshore wind farms
- In many runs, there was insufficient searoom between the proposed Mona and Morgan Array Areas to maintain adequate CPA from other vessels and resulted in large alterations of course or reduction of speed

- In some runs, there was insufficient searoom between the Morgan and Walney Array Areas to maintain adequate CPA from other vessels, and resulted in large alterations of course or reduction of speed
- In significant adverse weather, the Morgan-Walney gap was not considered to be safely navigable due to excessive motions aboard the vessel, difficulty in maintaining vessel control and inadequate CPA from structures or other vessels
- During periods of high traffic density and as a result of the presence of the Mona Array Area, westbound vessels departing Liverpool had a reduced ability to give-way in accordance with the collision regulations for vessels approaching the Liverpool Traffic Separation Scheme (TSS) from the northwest
- In adverse weather, alterations of course around the Projects resulted in excessive vessel motions when compared to existing routeing practices
- In some runs, emergency manoeuvres were compromised due to reduced searoom and presence of other traffic
- The simulations identified operational impacts including a requirement for increased transit distance and increased senior manning levels on the bridge for longer durations.

4. PROJECT DESCRIPTION AND MAXIMUM DESIGN ENVELOPE

An NRA is assessed on the project design envelope (PDE), also known as the Rochdale Envelope (see the Planning Inspectorate's Advice Note Nine). The PDE sets out the design assumptions and parameters from which the realistic MDS's are drawn for the NRA. Therefore, the project description is indicative and the 'envelope' has been designed to include flexibility to accommodate further project refinement during detailed design, post consent.

An MDS relevant to shipping and navigation receptors would typically consider:

- The largest extent of the development
- The longest duration of activities
- The most Project vessel movements
- The maximum number of structures
- The minimum spacing between structures
- The longest lengths of cables
- The minimum cable burial
- The maximum height of cable protection.

The CRNRA, however, considers the Projects at a regional scale and therefore is principally concerned with the physical footprint and arrangement of the surface infrastructure that might present a hazard to navigation. The following sections describe the broad principals used to undertake the cumulative assessment. Further detail on each Project will be contained within their respective Preliminary Environmental Information Report (PEIR) submissions.

Given the early stage of development, without fully defined PDEs in place, a table of assumptions has been developed in order to characterise the key shipping and navigation impacts and facilitate the CRNRA (see **Table 2**).

4.1 EMBEDDED RISK CONTROL MITIGATIONS

Table 3 describes industry standard risk controls that would be present for all three offshore wind farms. These are considered embedded in the risk assessment process rather than additional requirements.

Table 2: Assessment basis for CRNRA.

Key Project Feature	Morgan	Mona	Morecambe
Project Boundaries (equivalent to PEIR boundaries)	Crown Estate Lease Area (322km^2)	Scoping Boundary (450km^2)	Crown Estate Lease Area (125km^2)
Construction Activities	Not included as part of CRNRA		
Operational Scenario	2035	2035	2035
Other Projects	Assume development of Awel-y-Mor Proceed on basis of no IoM offshore wind farm		
Maximum number of Turbines	107 wind turbines + 4 substations	107 wind turbines + 4 substations	40 wind turbines + 2 substation
Spacing between Turbines	Vessels less than 24m can and will navigate within the array area. Modelling to consider boundary and internal contact risk using quantitative and qualitative means.		
Lines of Orientation	One or more	One or more	One or more
Operations and Maintenance Base and Activities	Assume: Northwest England (from east). Up to 2,351 operations and maintenance vessel movements/year.	Assume: North Wales/Northwest England (from south). Up to 2,351 operations and maintenance vessel movements/year.	Assume Northwest England (from east). Up to 776 operations and maintenance vessel movements/year.
Turbine Size and parameters	Lower blade height >34m Lowest Astronomical Tide (LAT). Maximum rotor diameter of 280m. Upper blade height above LAT of 324m.	Lower blade height >34m LAT. Maximum rotor diameter of 280m. Upper blade height above LAT of 324m.	Maximum Rotor Diameter: 300m. Maximum blade tip height: 345m above Highest Astronomical Tide (HAT). Minimum blade tip clearance: 22m above HAT.
Marking and Lighting	Compliance with IALA G1162 (2021): • Isolated structures should have white flashing Mo (U) ≤15s, nominal range of 10nm. Mounted below lowest port of arc of any rotor blade but greater than six metres above HAT. Availability >99% (IALA Category 2). • Each structure to display yellow identification panels with black lettering. • Fixed structures to be painted yellow all around from the level of HAT to at least 15 metres. • A Significant Peripheral Structure (SPS), on the corners of the offshore wind farm, may be fitted with a special yellow flashing mark, with a nominal range of five nautical miles. • Any Intermediate Peripheral Structures (IPS), between SPS, may also be marked with flashing yellow lights, with a nominal range of two nautical miles. • Hazard Warning Signals, Racons or AIS may be fitted. • All lighting and marking arrangements will be promgulated through Notice to Mariners (NtM) and to UK Hydrographic Office (UKHO).		

Table 3: Applied risk controls.

ID	Title	Description	Risks mitigated	How the measure will be secured
Promulgation and Awareness (PROM)				
PROM1	Notice to Mariners	To ensure that the appropriate authorities are informed of works being carried out in waters adjacent to the Projects. To include: -UKHO -MCA -Kingfisher -Trinity House -Northern Lighthouse Board (NLB) -RYA -Local Ports and Harbours -Oil and Gas operators -MMO -NRW.	All direct impacts of Projects.	Secured through relevant conditions as part of the marine license(s).
PROM2	Site Marking and Charting	Site is marked on nautical charts including an appropriate chart note.	All direct impacts of Projects.	Secured through relevant conditions as part of the marine license(s).
PROM3	Safety Zone	Application and use of safety zones. These will consist of a radius of 500m from platform/wind turbines edge (at sea level) whilst undergoing active construction or major maintenance. 50m safety zones will be applied for around wind turbines or platforms which are partially constructed, but not undergoing active construction activities.	Risk of allision with structures.	Application under Electricity Regulations 2007
PROM4	Fisheries Liaison and Co-existence Plan	Provision of detailed Project information to fishermen, to aid coexistence, such as site and export cable route location for upload into fish plotters.	Fishing hazards, including snagging of cables.	Secured through relevant conditions as part of the marine license(s).
Emergency Response (EMER)				
EMER1	Emergency Response and Cooperation Plan (ERCOP)	ERCOP with agreement of MCA.	Reduction of consequences of incidents.	Secured through relevant conditions as part of the marine license(s).

ID	Title	Description	Risks mitigated	How the measure will be secured
EMER2	Marine Pollution Contingency Plan	Measures will be adopted to ensure that the potential for release of pollutants from construction and operations and maintenance activities is minimised, which will include accidental spills, planning, response and notification requirements.	Reduction of consequences of incidents.	Secured through relevant conditions as part of the marine license(s).
EMER3	Periodic Exercises	Periodic emergency management and response exercises will be run by developer, ran in conjunction with SAR.	Reduction of consequences of incidents.	Industry best practice
EMER4	Incident Investigation and Reporting	There are statutory incident reporting requirements and expectations: -MAIB (Merchant Shipping Act) -Health, Safety and Environment (HSE), Reporting of Injuries, Diseases and Dangerous Occurrences. Regulations 2013 (RIDDOR) -Harbour Authority under Port Marine Safety Code. Risk assessments to be reviewed following incidents, and additional risk controls identified if appropriate.	Reduction of likelihood of incident reoccurrence.	Statutory requirement
Site Design (DES)				
DES1	Aids to Navigation (AtoNs)	Suitable AtoNs lighting and marking of the offshore wind farm site shall be undertaken complying with IALA Recommendations G1162 (IALA, 2021), to be finalised and approved in consultation with MCA and Trinity House through an Aids to Navigation Management Plan. Fog horns to alert vessels to the position of structures when visibility is poor. Note planned update to O-139 to include painting reference from waterline (not HAT). wind turbine informal naming/associated markings shall not interfere with formal AtoNs. AIS transponders to be placed on periphery corner wind turbines.	Risk of allision with structures.	Secured through relevant conditions as part of the marine license(s).

ID	Title	Description	Risks mitigated	How the measure will be secured
DES2	Buoyed Construction Area	Buoys deployed around construction work in array area in line with Trinity House requirements and may include a combination of cardinal and/or safe water marks. To be finalised and approved in consultation with MCA and Trinity House through an Aids to Navigation Management Plan.	Risk of allision with structures or collision with construction vessels.	Secured through relevant conditions as part of the marine license(s).
DES3	Hydrographic Surveys	MGN654 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 and the UKHO.	Risk of grounding or snagging of cables.	Secured through relevant conditions as part of the marine license(s).
DES4	Cable Burial Risk Assessment (CBRA) and periodic validation surveys	CBRA to be undertaken pre-construction, including consideration of under keel clearance. All subsea cables will be either fully buried to at least 0.5m (where ground conditions permit and burial tool performance allows), partially buried (buried but not to target depth) with rock protection, or surface laid with the over-placement of cable protection. Selected methods will be based on the risk assessment and the protection will be periodically monitored and maintained as practicable. No more than 5% reduction in water depth (referenced to Chart Datum) will occur at any point on the cable route without prior written approval from the Licensing Authority.	Risk of grounding or snagging of cables.	Secured through relevant conditions as part of the marine license(s).
DES5	Air Draught Clearance	Wind turbine blades will have at least 22m clearance above MHWS	Risk of allision/contact with structures.	Secured through relevant conditions as part of the marine license(s).
DES6	Layout Plan and Lines of Orientation	Wind turbine and offshore substation platform layout plan to be agreed with MCA and Trinity House prior to construction and must maintain at least one line of orientation unless justified and agreed with the MCA.	Risk of allision/contact with structures and ensuring access for SAR.	Secured through relevant conditions as part of the marine license(s).

ID	Title	Description	Risks mitigated	How the measure will be secured
DES7	Electromagnetic interference minimisation	A Cable Specification and Installation Plan will be prepared. This will include the technical specification of offshore electrical circuits, and a desk-based assessment of attenuation of electro-magnetic field strengths, shielding and cable burial depth in accordance with industry good practice.	Impact on navigation and communications equipment.	Secured through relevant conditions as part of the marine license(s).
DES8	Construction Method Statement and Programme	Construction programme and plan to be submitted to MCA and Trinity House for consultation. Where possible, construction to follow linear progression avoiding disparate construction sites across development area.	Risk of allision with structures or collision with construction vessels.	Secured through relevant conditions as part of the marine license(s).
Operational Management (OPS)				
OPS1	Marine Co-ordination	Coordination of Project vessels during construction and co-ordination during operations and maintenance by the Project Marine Co-ordination Centre to ensure Project vessels do not present unacceptable risks to each other or third parties. Project marine traffic coordination plans to be made available to all maritime users. Information and warnings will be distributed via Notices to Mariners and other appropriate media (e.g. Admiralty Charts and fishermen's awareness charts) to enable vessels and operators to effectively and safely navigate around the array area and activities during the offshore cable corridor construction.	Risk of allision with structures or collision with vessels.	Secured through relevant conditions as part of the marine license(s).
OPS2	Vessel Standards	All work vessels operating on behalf of Projects will have: -MCA Vessel Coding (e.g. small commercial vessel (SCV) and workboat code) -Appropriate Insurance -Crewed by suitably trained/qualified personnel -AIS (Class A/B) -Very High Frequency (Ch16) -Appropriate mooring arrangements.	Risk of allision with structures or collision with vessels.	Industry best practice

ID	Title	Description	Risks mitigated	How the measure will be secured
OPS3	Personal Protective Equipment (PPE)	All personnel to wear the correct PPE suitable for the location and role at all times, as defined by the relevant Quality, Health, Safety and Environment (QHSE) documentation. This will include the use of Personal Locator Beacons (PLBs).	Minimising risk of loss of life.	Industry best practice
OPS4	Guard Vessels	Use of guard vessels as required.	Risk of allision with structures or collision with construction vessels.	MGN654 recommendation.
OPS5	Inspection and Maintenance Programme	Regular maintenance regime by developer to check the Project infrastructure, its fittings and any signs of wear and tear. This should identify any failings which might result in a failure.	Minimising risk of Project asset failure.	Industry best practice
OPS6	Training	Applicants are responsible for ensuring that all staff engaged on operations are competent to carry out the allocated work.	Minimising risk of loss of life.	Industry best practice
OPS7	Compliance with International, UK and Flag State Regulations inc. IMO conventions	Compliance from all vessels associated with the Projects with international maritime regulations as adopted by the relevant flag state (e.g. International Convention for the Prevention of Collision at Sea (COLREGS) (IMO, 1972) and International Convention for the Safety of Life at Sea (SOLAS (IMO, 1974)).	Risk of allision with structures or collision with vessels.	Statutory requirement

ID	Title	Description	Risks mitigated	How the measure will be secured
OPS8	Vessel health and safety requirements	As industry standard mitigation, the Applicant will ensure that all Project related vessels meet both IMO conventions for safe operation as well as HSE requirements, where applicable. This shall include the following good practice: • Wind farm associated vessels will comply with International Maritime Regulations; • All vessels, regardless of size, will be required to carry AIS equipment on board; • All vessels engaged in activities will comply with relevant regulations for their size and class of operation and will be assessed on whether they are "fit for purpose" for activities they are required to carry out • All marine operations will be governed by operational limits, tidal conditions, weather conditions and vessel traffic information. • Walk to work solutions will be utilised where possible.	Minimising risk of loss of life.	Industry best practice
Site Monitoring (MON)				
MON1	Continuous Watch	Continuous watch by multi-channel VHF, including Digital Selective Calling (DSC).	Responding to incidents swiftly.	MGN654 Recommendations
MON2	Vessel Traffic Monitoring	Continuous monitoring during construction and immediate period post construction to MCA approval.	Identification of unanticipated Project impacts.	Secured through relevant conditions as part of the marine license(s).

5. DESCRIPTION OF MARINE ENVIRONMENT

5.1 PRINCIPAL NAVIGATIONAL FEATURES

Key relevant features relevant to the CRNRA study area and features relating the management of vessels and safety of navigation are described in this section.

Principle navigational features within the CRNRA study area have been identified using the appropriate UKHO Admiralty charts and UKHO Admiralty Sailing Directions appropriate to the area. Principle navigational features in proximity to the Projects are shown in **Figure 3**.

5.1.1 Responsible Authorities – MCA

The Projects are in a region of general navigation in UK waters with the MCA as the responsible authority for safe navigation. Additional authorities are responsible for navigation in port approaches and within Isle of Man territorial waters.

5.1.2 IMO Routeing Schemes, Reporting Measures and Recommended Channels

There are two IMO adopted routeing measures located in proximity to the array areas. The Liverpool Bay TSS is located approximately 1.8nm southeast of the southeast boundary of the Mona Array Area, as shown in **Figure 3**. This TSS deconflicts vessel traffic on passage to/from the Mersey ports and maintains a safe distance between vessels, the oil and gas infrastructure to the north and the Gwynt-Y-Mor Windfarm to the south. The Off Skerries TSS is located 18nm southwest of the Mona Array Area to separate traffic transiting around the northwest coast of Anglesey.

The area surrounding the Douglas oil field infrastructure is charted as an Area to be Avoided with the accompanying note: ‘The IMO-adopted Area to be Avoided should only be entered by authorised vessels to access the Douglas oil field’.

There are no reporting measures within the CRNRA study area.

5.1.3 Aids to Navigation

AtoNs located in proximity to array areas are shown in **Figure 3**. A range of AtoNs are situated to the northeast of the Morgan Array Area marking the Walney and Walney Extension offshore wind farms. These AtoNs include cardinal marks indicating where the safe water is and markings of the wind turbines on the periphery of the windfarms to indicate the extent of the area. The West of Duddon Sands Windfarm located adjacent to the southeast boundary of the Walney Windfarm also has cardinal marks to identify the safe water.

The Morecambe westerly cardinal mark is located approximately 5nm northeast of the Morecambe Array Area. This buoy marks the western extent of Shell Flat on the south approaches to Lune Deep.

The oil and gas infrastructure in the area (see **Section 5.2.3** for further detail) has lights to identify surface infrastructure and buoyage to identify sub-surface infrastructure which may pose a hazard to navigation.

5.1.4 Pilot Boarding Stations

Pilot boarding stations for the ports in the CRNRA study area with Competent Harbour Authority (CHA) status are shown on **Figure 3**. The pilot stations and their distances from the windfarms are provided in **Table 4**, all of which are more than 10nm from the array areas.

Table 4: Key pilot boarding stations.

Boarding Station	Location Relative to Project		
	Mona Array Area	Morgan Array Area	Morecambe Array Area
Liverpool	14nm southeast	30nm southeast	15nm southeast
Point Lynas (Liverpool heavy weather)	13nm southwest	30nm southwest	29nm southwest
Mostyn	20nm southeast	39nm southeast	24nm southeast
Mostyn Outer (vessels over 95m Length Overall (LOA))	15nm southeast	35nm southeast	23nm south
Heysham/Fleetwood	30nm northeast	26nm east	18nm northeast
Barrow	26nm northeast	19nm east	13nm northeast
Douglas	23nm northwest	12nm northwest	32nm northwest

5.1.5 Vessel Traffic Services

None of the Projects are located in a Vessel Traffic Service (VTS) area or Local Port Service (LPS) area. The Port of Liverpool operates the only VTS in the east Irish Sea. The VTS covers the Liverpool Statutory Harbour Authority (SHA) area monitoring vessel traffic through AIS and Radar.

5.1.6 Practice and Exercise Area (PEXA) Schemes

There is a firing practice area (D406) located approximately 3.5nm to the north of the Morgan Array Area. No restrictions are placed on the right to transit the firing practice areas at any time. The firing practice area is operated using a clear range procedure, meaning that firing only takes place when the area is confirmed clear of all shipping.

5.1.7 Anchorages and waiting areas

Two charted anchorages are located within the Port of Liverpool SHA Area, as shown on **Figure 3**. One of these lies to the south of the approaches to Liverpool between the Burbo Bank Extension and Gwynt y Mór windfarms. The other anchorage is to the north of the approaches to the Mersey.

Douglas Bay is used as an anchorage for vessels waiting to enter the Port of Douglas and for cruise vessels when undertaking tendering operations.

There is an anchorage called Rhyl North used by vessels waiting for pilotage to the Port of Mostyn located directly north of the Mostyn Pilot Boarding Station.

Heysham Port has a designated anchorage located in Lune Deep adjacent to the Pilot Boarding Station.

5.1.8 Disposal Areas

There are nine licenced disposal areas in the CRNRA study area. Each active disposal area and the distance to each of the array areas is presented in **Table 5**.

Table 5: Active disposal areas.

Disposal Area	Location Relative to Project		
	Mona Array Area	Morgan Array Area	Morecambe Array Area
Douglas	21nm northwest	10nm northwest	31nm northwest
Douglas Harbour	23nm northwest	12nm northwest	31nm northwest
Barrow D	25nm east	19nm east	12nm northeast
Morecambe Bay: Lune Deep	30nm east	24nm east	16nm northeast
Site Y	8nm southeast	24nm southeast	9nm southeast
Site Z	14nm southeast	28nm southeast	13nm southeast
Burbo Bank Extension offshore wind farm	13nm southeast	31nm southeast	16nm southeast
Mersey	26nm southeast	40nm southeast	25nm southeast
Mostyn Deep	20nm southeast	40nm southeast	25nm southeast

5.1.9 Wrecks

There are over 1,300 charted wrecks in the CRNRA study area. These are identified on navigational charts.

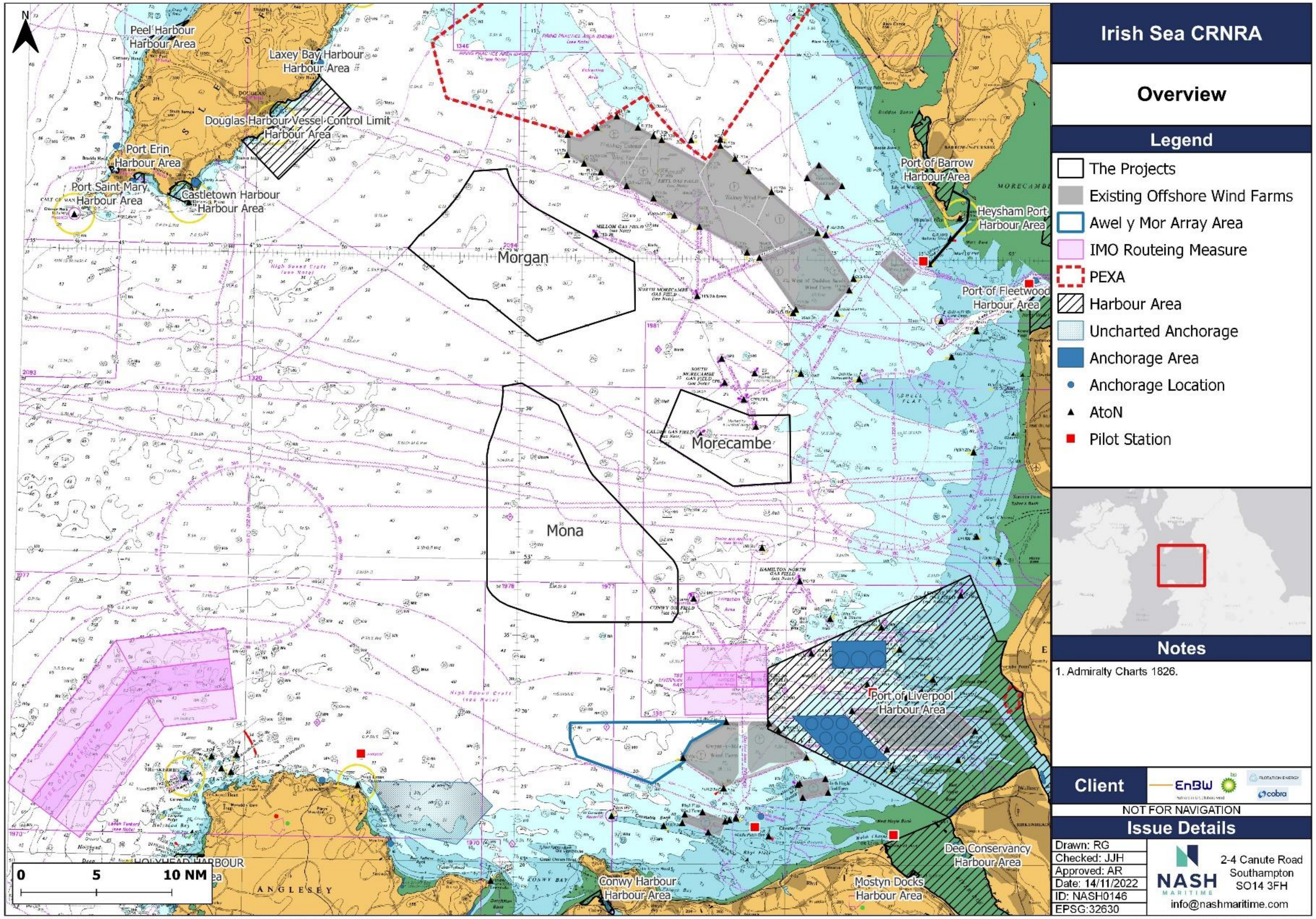


Figure Ref: NASH0146_Existing_environment

Figure 3: Existing offshore activities and infrastructure.

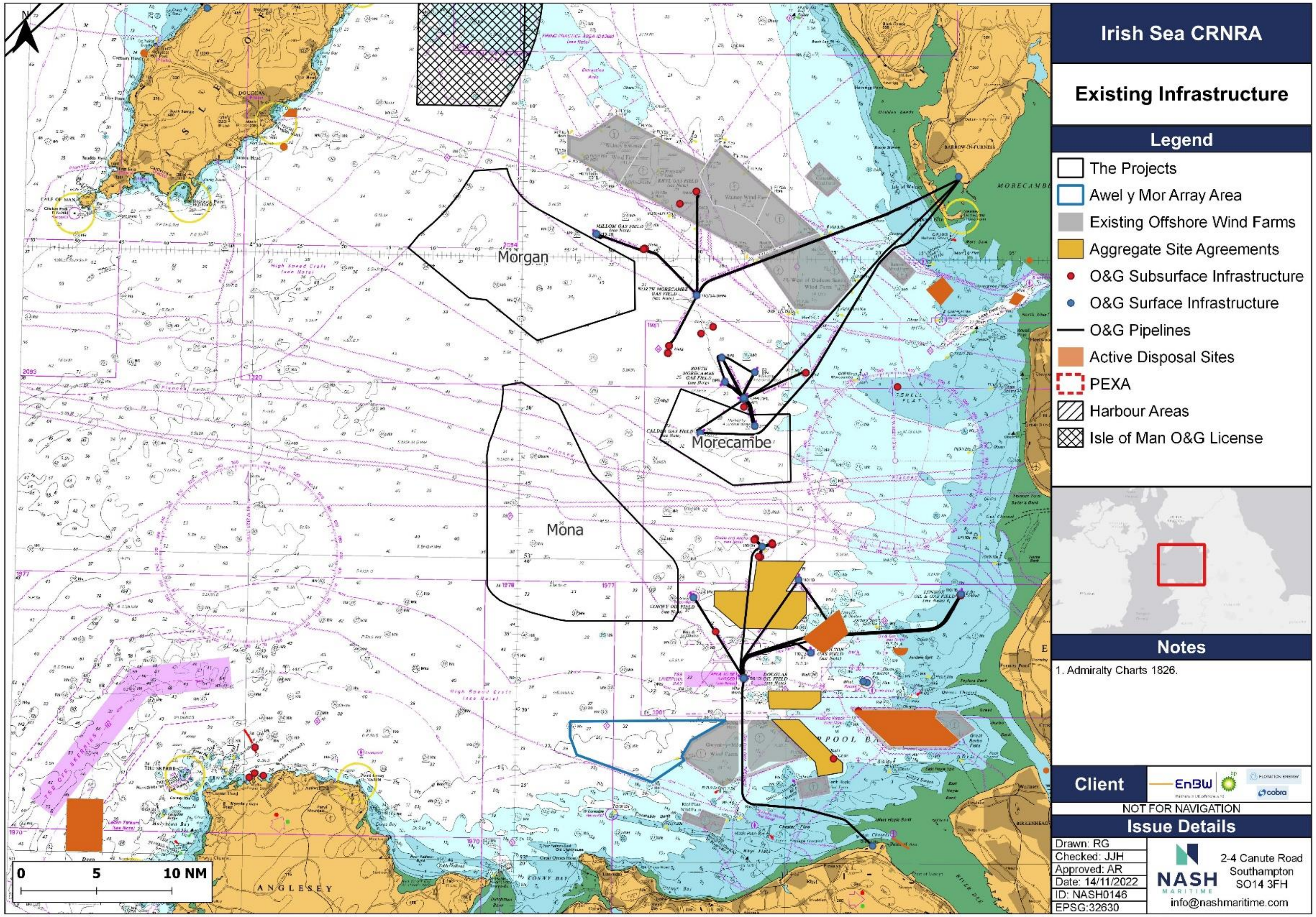


Figure Ref: NASH0146_Existing_environment_O&G

Figure 4: Existing offshore activities and infrastructure – oil and gas and aggregate.

5.2 EXISTING INFRASTRUCTURE

5.2.1 Ports and Harbours

Nearby ports and harbours are shown in **Figure 3** and **Table 6**. The nearest ports are Liverpool, Douglas on the Isle of Man. All Projects lie outside of the limits of any ports or harbours.

Table 6: Key ports and harbours in the CRNRA study area.

Name	Type	Location Relative to Project		
		Mona Array Area	Morgan Array Area	Morecambe Array Area
UK Mainland Ports				
Port of Liverpool	Major regional port.	25nm southeast	40nm southeast	24nm southeast
Heysham Port	Commercial shipping port.	36nm northeast	31nm east	23nm northeast
Port of Fleetwood	Recreational/ fishing port	30nm east	28nm east	19nm northeast
Port of Barrow	Commercial shipping port	30nm northeast	20nm east	18nm northeast
Port of Mostyn	Commercial shipping port	23nm southeast	42nm southeast	27nm southeast
Conwy Harbour	Recreational/ fishing port	19nm south	38nm south	29nm south
Holyhead	Commercial shipping port	28nm southwest	42nm southwest	43nm southwest
Isle of Man Ports				
Douglas Port	Commercial shipping port.	23nm northwest	12nm northwest	32nm northwest
Laxey Bay	Recreational/ fishing port	25nm northwest	13nm northwest	32nm northwest
Castletown Harbour	Recreational/ fishing port	27nm northwest	16nm west	35nm northwest
Port St Mary	Recreational/ fishing port	28nm northwest	19nm west	41nm northwest
Port Erin	Recreational/ fishing port	29nm northwest	20nm west	40nm northwest
Peel	Recreational/ fishing port	33nm northwest	22nm northwest	43nm northwest
Ramsey	Recreational/ fishing port	31nm northwest	17nm northwest	37nm northwest

5.2.2 Other Offshore Wind Projects

Existing offshore wind infrastructure within the CRNRA study area is listed in **Table 7** and shown in **Figure 3**.

Table 7: Other offshore wind.

Name	Type	Location Relative to Project			Status
		Mona Array Area	Morgan Array Area	Morecambe Array Area	
Gwynt-y-Môr Wind Farm	Operational wind farm (576MW capacity)	7.6nm southeast	28nm southeast	15.5nm south	Operational since 2015
North Hoyle Wind Farm	Operational wind farm (60MW capacity)	13.6nm southeast	33nm southeast	20nm south	Operational since 2004
Rhyl Flats Wind Farm	Operational wind farm (90MW capacity)	12.7nm south	33nm southeast	22nm south	Operational since 2009
Burbo Bank Wind Farm (including extensions)	Operational wind farm (90MW plus 258MW extension)	13.1nm southeast	33nm southeast	16nm southeast	Operational since 2007, extension operational since 2017
West of Duddon Sands Wind Farm	Operational wind farm (389MW capacity)	16.8nm northeast	8nm east	6.7nm north	Operational since 2014
Barrow Wind Farm	Operational wind farm (90MW capacity)	23nm northeast	16.5nm east	11.5nm northeast	Operational since 2006
Walney Wind Farm (including extensions)	Group of operational wind farms (total capacity of 1026MW)	15nm northeast	4.1nm northeast	10nm north	Operational since 2011, with extensions operational in 2012 and 2018
Ormande Wind Farm	Operational wind farm (150MW capacity)	22.6nm northeast	12.8nm	14.4nm north	Operational since 2012

5.2.3 Oil and Gas

Oil and gas infrastructure within proximity of the array area is listed in **Table 8** and shown in **Figure 4**. Several of the Projects are in close proximity to, or overlap, with both surface or subsurface infrastructure associated with the oil and gas industry.

Table 8: Oil and gas infrastructure.

Name	Type	Location Relative to Project			Status
		Mona Array Area	Morgan Array Area	Morecambe Array Area	
South Morecambe gas field	Manned	10nm northeast	7nm southeast	1nm north with DP3 within the Array Area	Producing. Decommissioning of two drilling platforms commenced in 2021.
Calder gas field	Normally unmanned	7nm northeast	9nm southeast	Located within array area	Producing
North Morecambe gas field	Manned	10nm northeast	4nm east	6nm north	Producing
Millom gas field	Normally unmanned	11nm north	0.5nm north	11nm northwest	Producing
Conwy oil field	Manned	Located 0.8nm from the southeast boundary of the array area	19nm southeast	8nm south	Producing
Douglas oil field	Manned	6nm southeast	26nm southeast	12nm south	Producing
Hamilton North gas field	Normally unmanned	7nm east	22.5nm southeast	6nm south	Producing
Hamilton gas field	Normally unmanned	9nm southwest	25nm southeast	11nm south	Producing
Lennox oil and gas field	Normally unmanned	18nm east	28nm southeast	13nm southeast	Producing

5.2.4 Submarine Cables

The Irish Sea has a significant number of cables, primarily telecommunication connections between the UK and the Isle of Man and Ireland along with numerous export cables from existing offshore windfarms. The nautical charts show a total of 10 submarine cables pass through the CRNRA study area and 7 pass through the array areas, as shown in **Figure 3**.

5.2.5 Aggregate Extraction

There are three aggregate and extraction areas to the south east of the sites, these are shown in **Figure 4** and listed in **Table 9**.

Table 9: Aggregate and extraction areas.

Name	Type	Location Relative to Project		
		Mona Array Area	Morgan Array Area	Morecambe Array Area
Area 457: Liverpool Bay	Extraction Area	2nm east	19nm southeast	5nm south
Area 392/393: Hilbre Swash	Extraction Area	9nm southeast	29nm southeast	15nm south
Area 1808:	The Crown Estate 2018/19 Marine Aggregates Tender	8nm southeast	27nm southeast	14nm south

5.3 METOCEAN CONDITIONS

In this section, MetOcean conditions are described for the CRNRA study area for the wind and wave climate, tide and currents, and visibility. Additional work was undertaken by HR Wallingford, to underpin the bridge navigation simulations and summarised here together with information provided within Admiralty Sailing Directions West Coasts of England and Wales Pilot, NP37, 21st Edition, 2022.

5.3.1 Wind and Wave

Figure 5 shows the modelled wind speeds and directions within the centre of the CRNRA study area for the years 1988 to 2018. The predominant wind direction is from the southwest, and account for the greatest proportion of strong wind events. The Admiralty Sailing Directions state that gales are reported between 12 days/year (Walney) and 30 days/year for Ronaldsway).

The Met Office North West Shelf Reanalysis Hindcast covers the period 1980 to 2021 and is based on coupled NEMO and WaveWatchIII hydrodynamics and wave models, with the wave model forced with ECMWF ERA5 model winds. The wave models horizontal resolution is between 3km to 1.5km in coastal waters. Model wave data was downloaded for the southeast Irish Sea and a subset of model points were extracted and analysed by HR Wallingford.

Annual average wave conditions at a point (53.8°N, -4.0°E) within the area of interest is shown in **Figure 6**. These demonstrate that wave conditions are predominantly southwesterly and account for the majority of wave conditions greater than 2.5m Hs. **Table 10** demonstrates the extreme wave conditions within the CRNRA study area, with 4.2m Hs and 50 knot winds from the southwest the typical annual extreme.

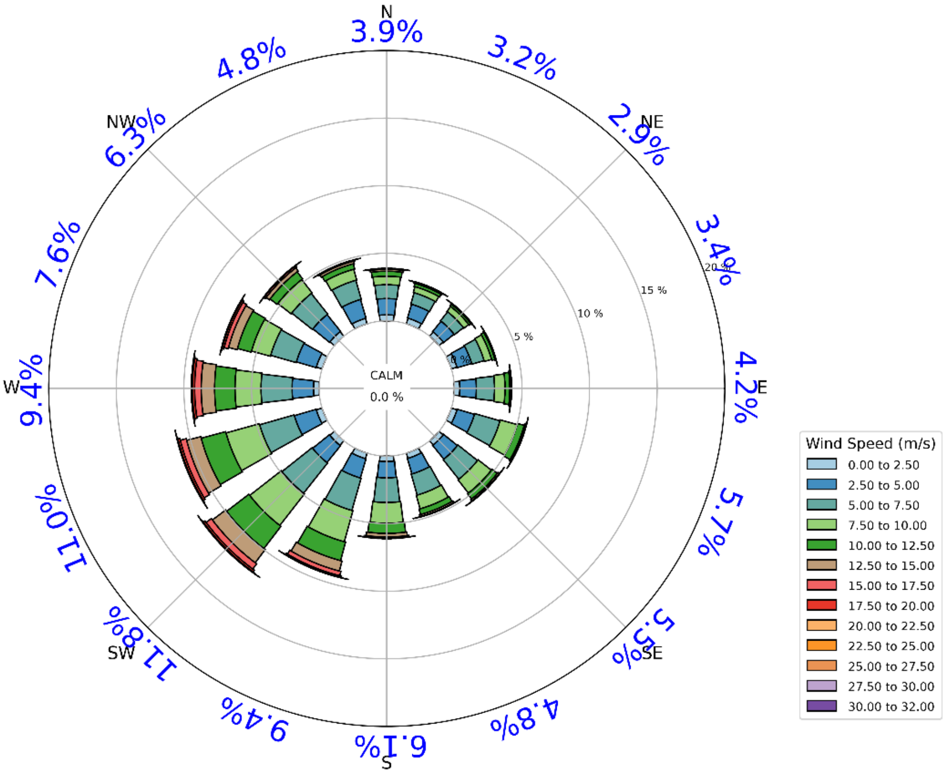


Figure 5: Annual average wind rose (1988 to 2018) - HR Wallingford.

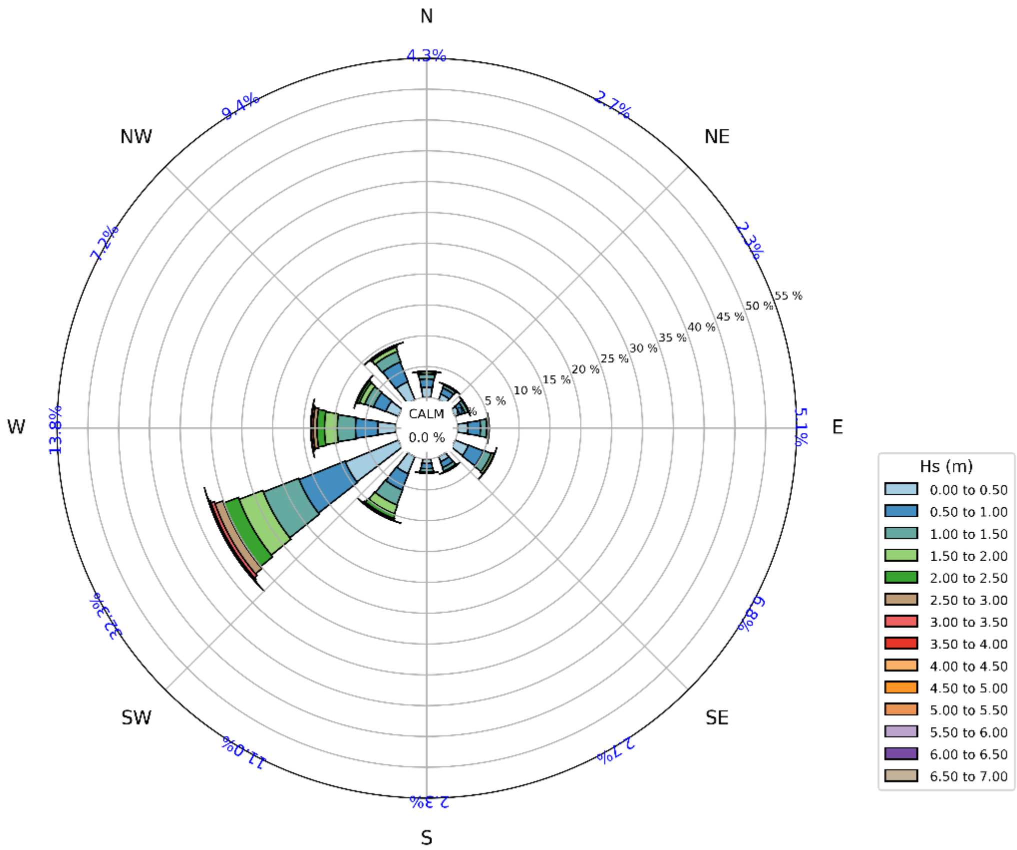


Figure 6: Annual average wave rose (53.8N, -4.0E) 1980 to 2021 - HR Wallingford.

Table 10: Summary of wave extremes. Source: Met Office NWS model (1980 to 2021). Analysed by HR Wallingford.

Return Period	Significant wave height Hs (m)	Wave Direction	Corresponding Approximate Wind Speed (kts)
Weekly (1 in 50)	1.6	232	15
Monthly (1 in 10)	2.9	264	30
Yearly (1 in 1)	4.2	227	50
1 in 5 years	4.6	236	-
1 in 10 years	5.4	240	-

5.3.2 Tidal

Flow modelling for a spring tide by HR Wallingford for the Irish Sea is shown in **Figure 7**. The maximum flow speeds within the CRNRA study area are less than 1.5m/s.

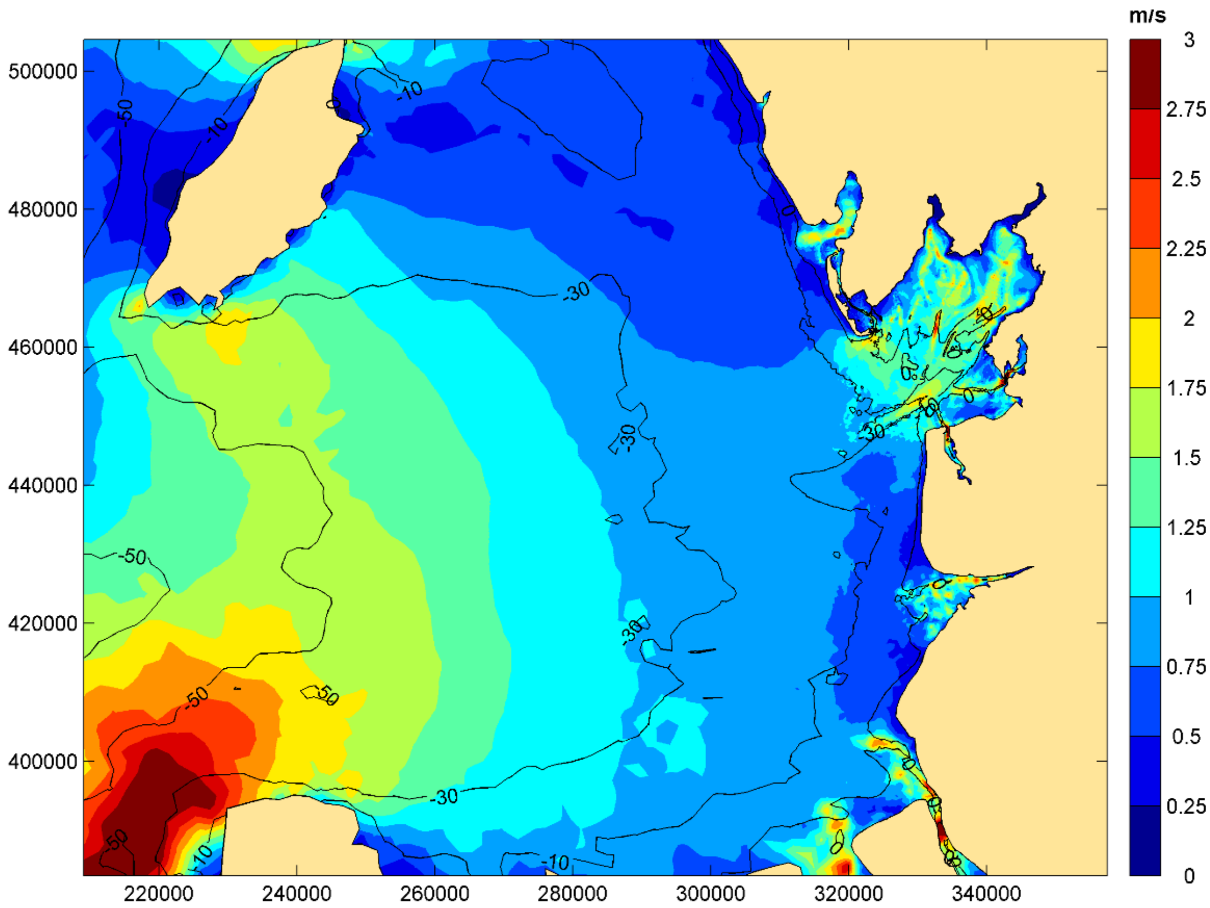


Figure 7: Maximum current flow speeds (m/s) for spring tide. Source: HR Wallingford.

5.3.3 Visibility

The Admiralty Sailing Directions report fog between 12 days/year (Crosby), 24 days/year (Ronaldsway) and 43 days/year (Blackpool).

5.4 SEARCH AND RESCUE

5.4.1 HMCG

His Majesty's Coastguard (HMCG) is responsible for requesting and coordinating SAR activities within the UK's SAR region. The local coastguard base for the region is Holyhead Coastguard Operations Centre (CGOC). The nearest HMCG helicopter base is located at Caernarfon Airport, Gwynedd. The Caernarfon facility provides a 24-hour search and rescue service, with two Sikorsky S-92 helicopters.

5.4.2 RNLI

There are 19 RNLI lifeboat stations within the CRNRA study area, as detailed in **Table 11** and shown in **Figure 8**.

Table 11 RNLI stations.

Name	Type	Distance from array area		
		Mona Array Area	Morgan Array Area	Morecambe Array Area
England & Wales				
Blackpool	Lifeboat station with three inshore lifeboats, including an Atlantic 85 and two D class lifeboats.	25nm east	27 nm southeast	15 nm east
Lytham St Annes	Shannon class all-weather lifeboat and a D class inshore boat. Lifeboats are housed in Lytham and St Annes.	24nm east	29 nm southeast	17 nm east
New Brighton	Operates a B class Atlantic 85 lifeboat.	25nm southeast	25nm southeast	40nm southeast
Hoylake	Shannon class lifeboat.	23nm southeast	39nm southeast	24nm southeast
West Kirby	D class lifeboat.	24nm southeast	41nm southeast	26nm southeast
Flint	D class lifeboat.	30nm southeast	49nm southeast	33nm southeast
Rhyl	Shannon class all-weather lifeboat and a D class inshore boat.	18.5nm southeast	40nm southeast	26nm south
Llandudno	Shannon class all-weather lifeboat and a D class inshore boat.	16nm south	36nm south	27nm south
Conwy	D class lifeboat.	19nm south	38nm south	30nm south
Beaumaris	B class lifeboat.	21nm south	40nm south	34nm southwest
Moelfre	Tamar class and D class lifeboats.	17nm south	34nm south	32nm southwest
Holyhead	Severn class and D class lifeboats.	28nm southwest	43nm southwest	43nm southwest
Trearddur	B class and D class lifeboats.	29nm southwest	45nm southwest	44nm southwest
Barrow	Tamar class and D class lifeboats.	30nm northeast	22nm east	19nm northeast
Morecambe	D class and Hover class lifeboats.	39nm northeast	33nm east	27nm northeast

Name	Type	Distance from array area		
		Mona Array Area	Morgan Array Area	Morecambe Array Area
Fleetwood	Shannon and D class lifeboats.	30nm northeast	28nm east	18nm northeast
Isle of Man				
Port Erin	B class lifeboat.	29nm northwest	20nm west	40nm northwest
Port St Mary	Trent class and D class lifeboats.	28nm northwest	19nm west	40nm northwest
Douglas	Mersey class lifeboat.	23nm northwest	12nm northwest	32nm northwest
Ramsey	Shannon class lifeboat.	30nm northwest	17nm northwest	37nm northwest

5.4.3 Other assets

All vessels have an obligation under the SOLAS convention to render assistance to persons or vessels in distress. For incidents adjacent to offshore wind farms, it is common for Project craft such as Crew Transfer Vessels (CTVs) to be the first responders.

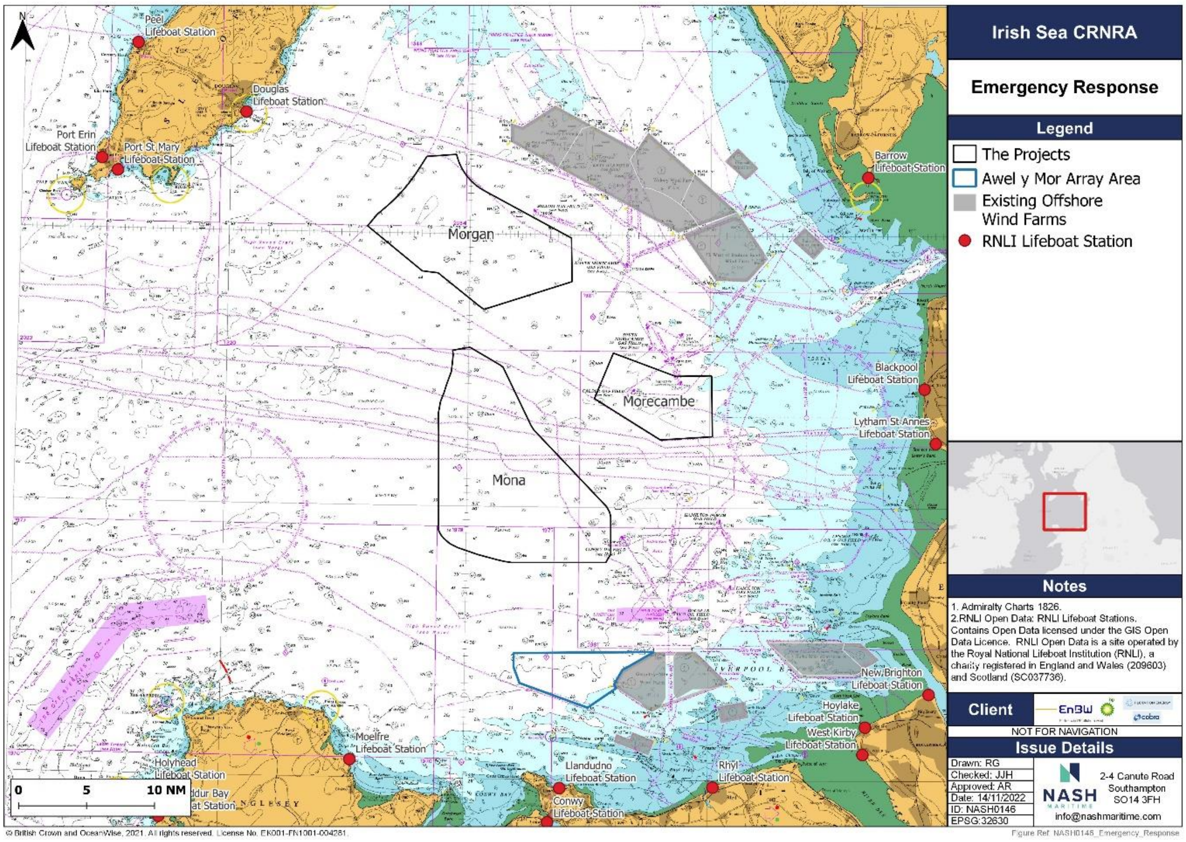


Figure 8: Emergency response stations.

6. DESCRIPTION OF EXISTING MARITIME ACTIVITIES

6.1 INTRODUCTION

A description of existing marine activities in the CRNRA study area is presented based on the data collected as listed in **Section 3.3**. The following section includes:

- Description of COVID-19 effects
- Details of the vessel traffic surveys
- Analysis of vessel traffic by:
    - Traffic types
    - Determination of vessel routes
    - During adverse weather
    - Non-Transit Activity
- Analysis of historical maritime incidents.

6.1.1 Effects of COVID-19

Since early 2020, the COVID-19 pandemic has substantially impacted recreational and commercial vessel movements both globally and locally. It is therefore possible that data collected between 2020 and 2022 may be influenced by the pandemic although vessel traffic is expected to largely return to pre-pandemic levels. As such, where appropriate, datasets have been used that precede the pandemic (including AIS data for 2019 for the whole Irish Sea) to benchmark those collected more recently and in order to provide a representative description of the baseline vessel traffic activity.

6.1.2 Vessel Traffic Surveys

In compliance with MGN654, the Projects have undertaken 2 14-day vessel traffic surveys of the individual sites. Whilst some reference is made to the identification of small craft such as fishing and recreational within the CRNRA, they are not directly analysed within this assessment. The principal dataset used in **Section 6.2** is a full years AIS data for the whole east Irish Sea for the year 2019. Each individual Project NRA will contain the analysis and interpretation of their respective MGN654 traffic surveys. These traffic surveys have greater recency, having been conducted during winter 2021/2022 and summer 2022.

6.2 VESSEL TRAFFIC ANALYSIS

6.2.1 Overview

Annualised vessel traffic density is displayed in **Figure 9**, which presents the number of vessel transits through each grid cell. The figure shows that:

- Several key vessel high density routes in the CRNRA study area are determined by the convergence/divergence of traffic using the Liverpool Bay TSS located approximately 1.8nm southeast of the most southeast boundary of the Mona Array Area
- Several vessel traffic routes run from Douglas and Heysham through the Morgan and Mona Array Areas
- Many of the most defined routes are associated with ferry services which cross the entire CRNRA study area, principally between Heysham, Liverpool, Douglas and the island of Ireland
- Service vessel activity is prevalent including to the north of Morecambe Array Area for oil and gas activity and also associated with existing offshore wind farms.

Figure 10 shows all vessel tracks by vessel draught. It can be seen that deeper draught vessels over 10m largely navigate through the south of the CRNRA study area between the Liverpool Bay TSS, across the north coast of Wales and the Off Skerries TSS. A number of these deeper draught vessels are also shown using the bay on the east side of Anglesey to anchor. Vessel traffic within the Morgan and Morecambe Array Areas largely comprises of vessels with a draught under 7.5m. Some vessels with a draught over 7.5m navigate across the southwest portion of the Mona Array Area, from Liverpool northwest towards Ireland.

Figure 11 shows all vessel tracks by vessel length. As with vessels of deeper draught, vessels over 200m are largely navigate through the south of the CRNRA study area between the Liverpool Bay TSS, across the north coast of Wales and the Off Skerries TSS. There is also a proportion of the vessels over 200m LOA shown transiting through the southwest portion of the Mona Array Area towards the south end of the Isle of Man and Belfast. There are distinct vessel traffic routes of vessels between 100 and 200m in length, due to the major ferry routes from Liverpool to Belfast. Vessels transiting through the Morgan and Morecambe Array Area are largely under 200m LOA.

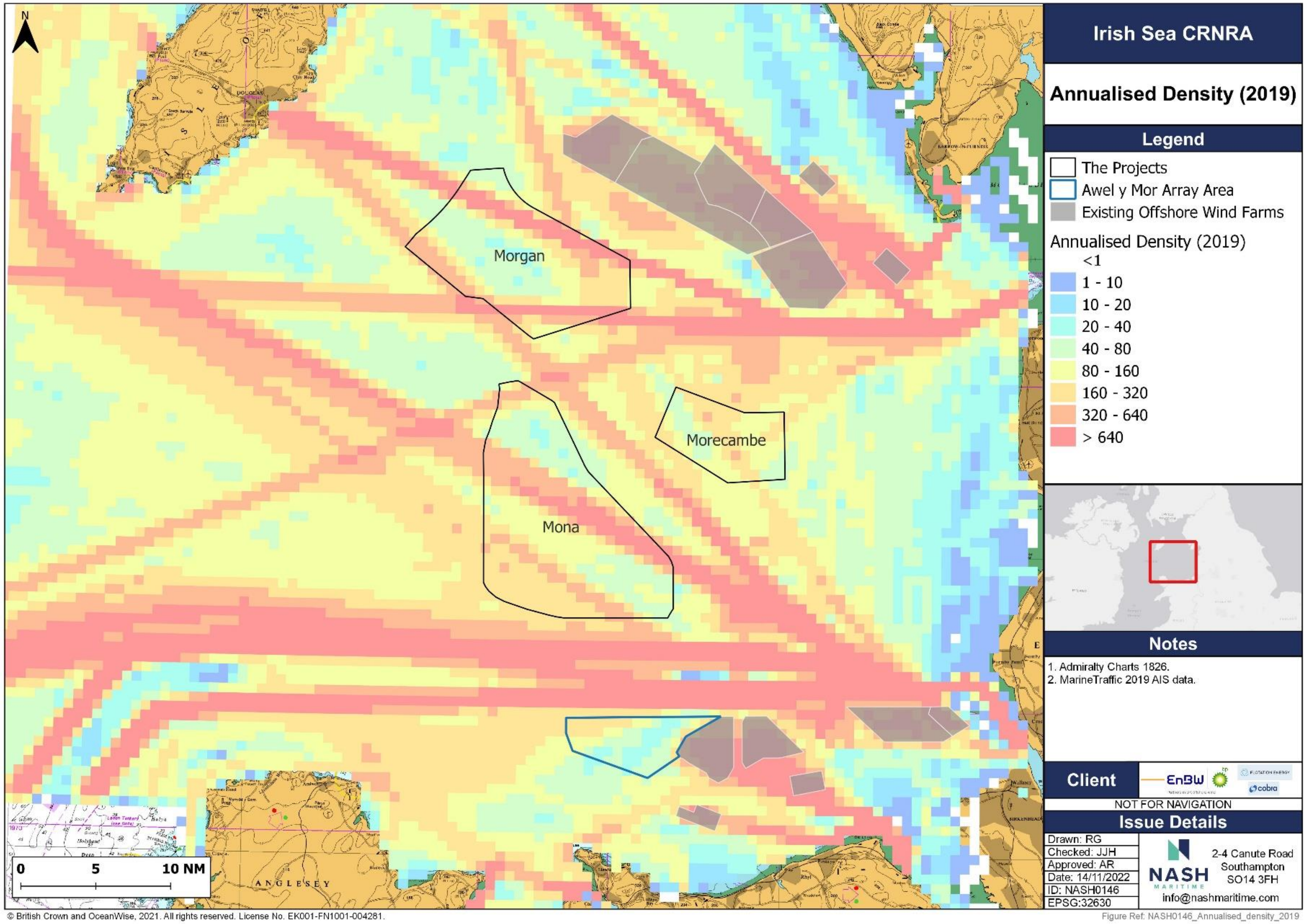


Figure 9: Annualised vessel traffic density in the CRNRA study area (2019).

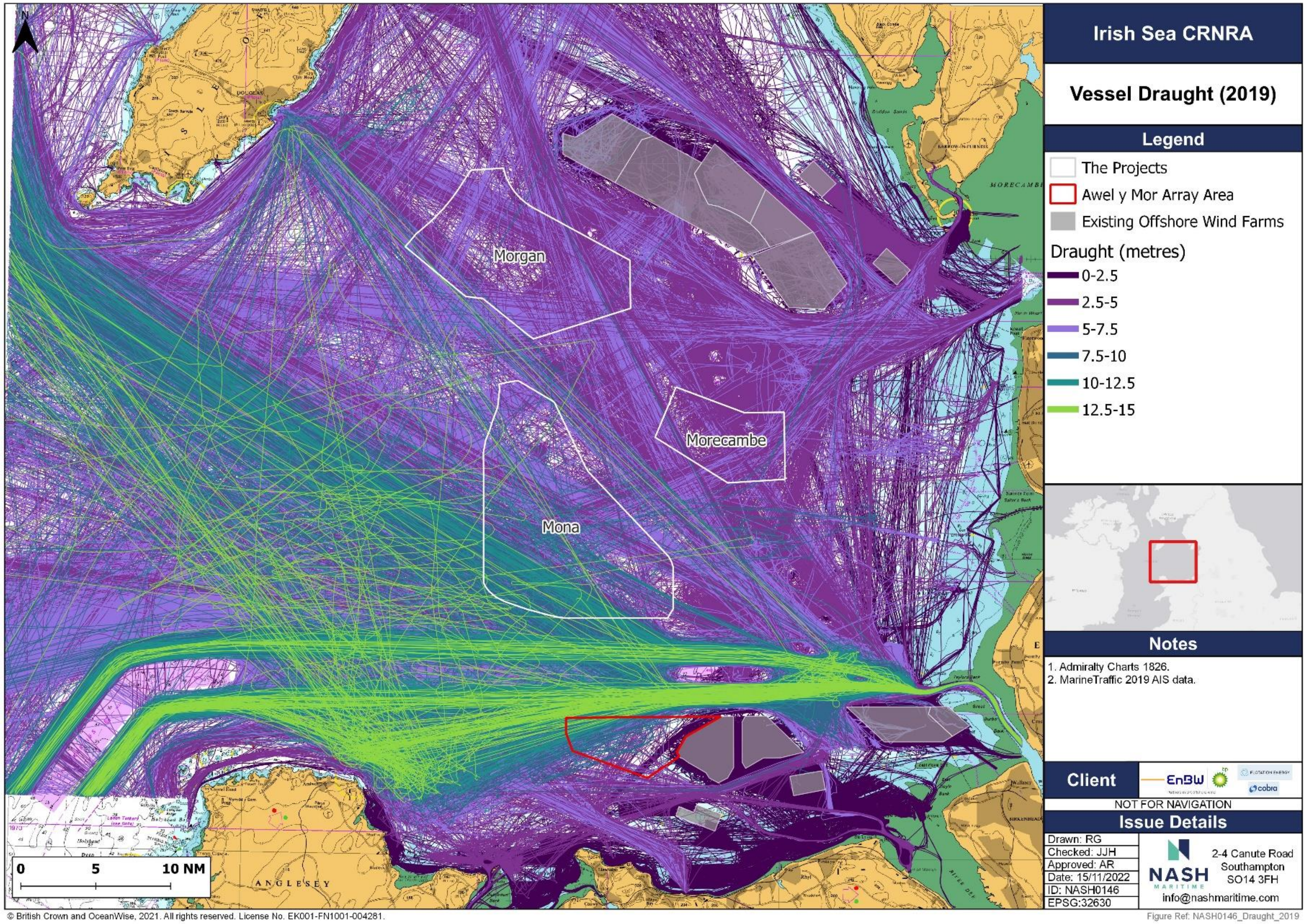


Figure 10: Vessel tracks by draught in the CRNRA study area (2019).

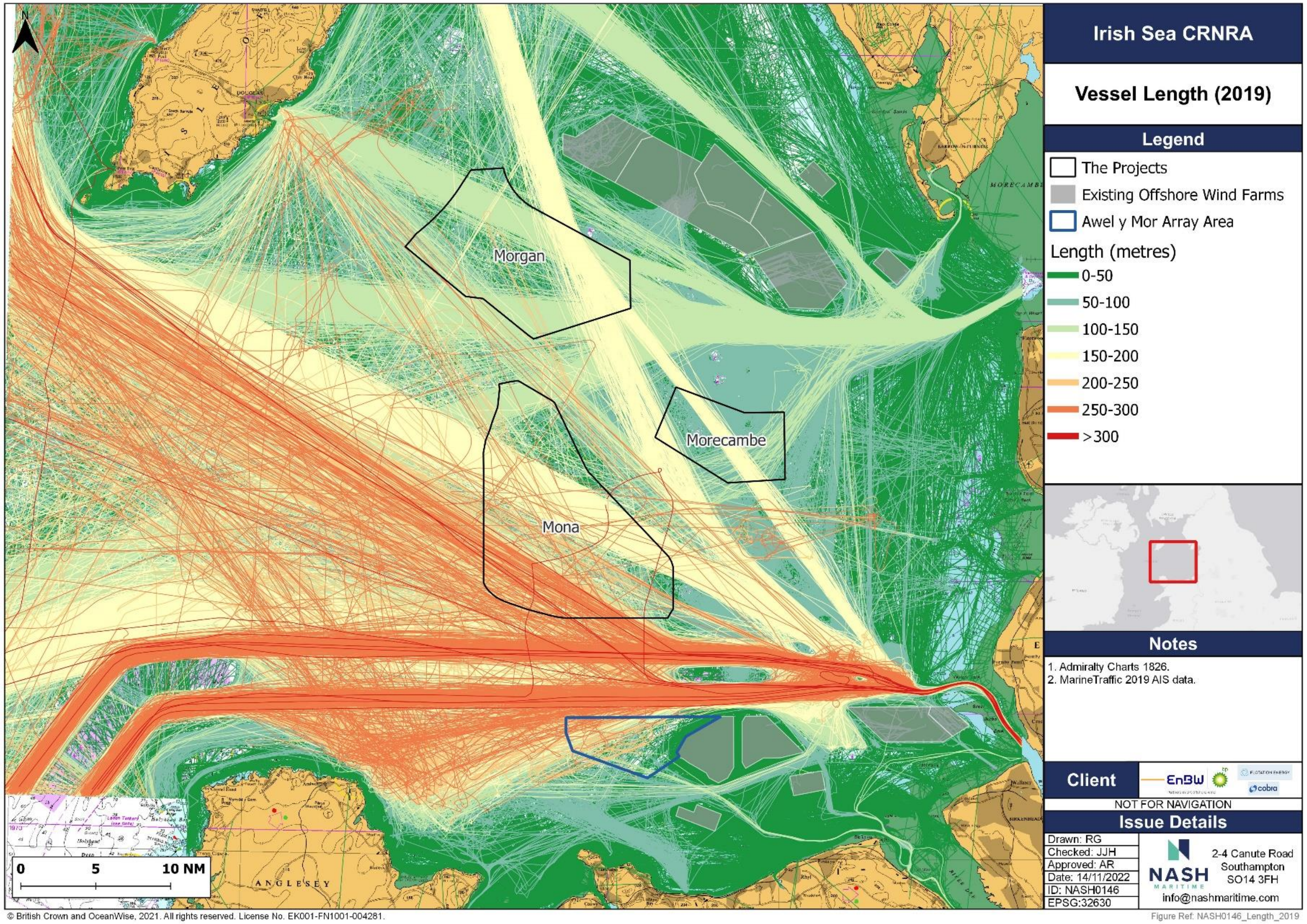


Figure 11: Vessel Tracks by LOA in the CRNRA study area (2019).

6.2.2 Vessel Tracks by Type

The following sections consider the vessel traffic by types for AIS data obtained for the period 01 January 2019 to 31 December 2019. The collection of radar and visual data during the vessel traffic surveys undertaken for each individual Project have been used to supplement the understanding of vessel traffic movements in the CRNRA study area.

6.2.2.1 Commercial

The tracks of cargo vessels and tankers are shown in **Figure 12** and **Figure 13**, respectively.

There are multiple cargo vessel routes shown in **Figure 12,** with the inward and outward bound routes for the Port of Liverpool to the south of the Mona Array Area showing a wide distribution of tracks. This is mainly due to vessels converging on approach to Liverpool from a range of other ports or vessels diverging once departing Liverpool and exiting the Liverpool Bay TSS. Most of the cargo vessel tracks transiting between Liverpool and the northern Irish Sea passing west of the Isle of Man are shown to pass through the Mona Array Area.

Cargo vessel tracks between the ports of Barrow or Heysham and the Off Skerries TSS are shown passing through the centre of the Morecambe and Mona Array Areas. Most of the cargo vessel tracks passing through the Morgan Array Area are between the east side of the Isle of Man and either the Port of Liverpool or the Off Skerries TSS.

Tanker tracks in **Figure 13** mostly pass through the Liverpool Bay TSS, although a limited number also pass northwest through the Mona Array Area, northwest towards the Isle of Man. A variety of tanker types are recorded including crude oil, Liquified Natural/Petroleum Gas, chemical and asphalt/bitumen. Some of the tankers which do not use the Liverpool Bay TSS are observed to pass to the east of the Mona Array Area, through the Morgan and Morecambe Array Areas and towards the northern Irish Sea. The 77m Keewhit accounts for the majority of tanker movements in the east portion of the CRNRA study area.

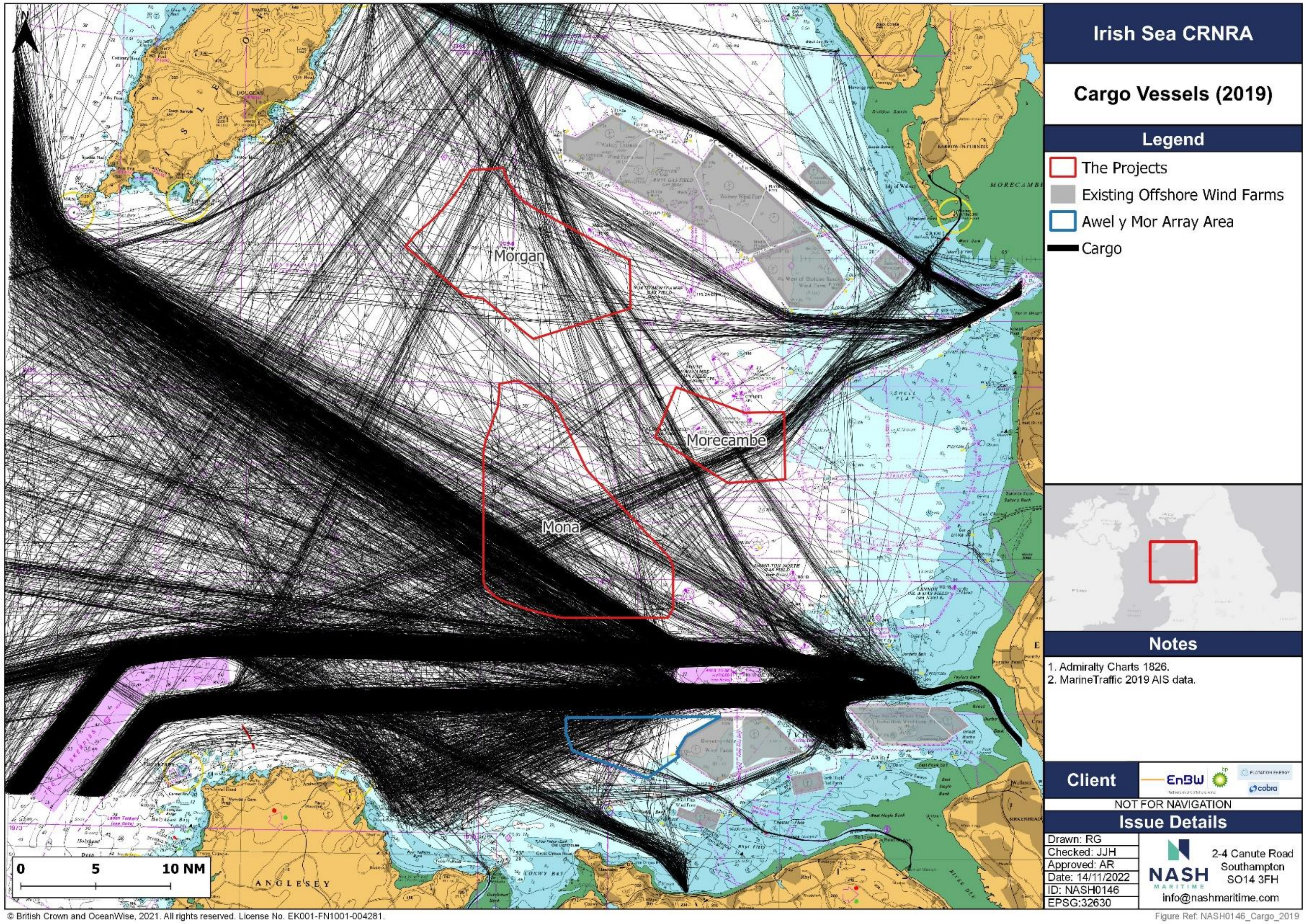


Figure 12: Cargo vessel tracks in CRNRA study area (2019).

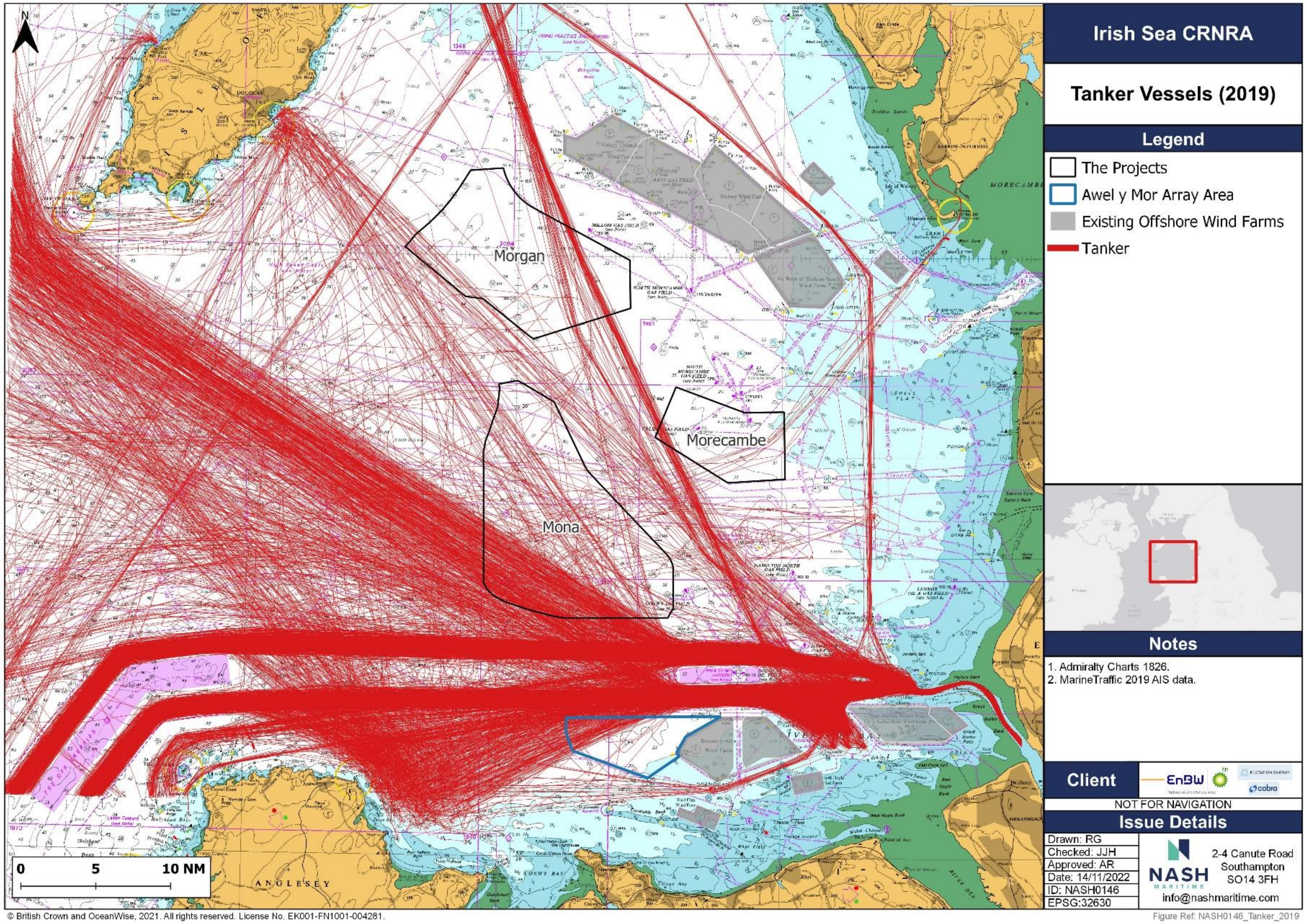


Figure 13: Tanker vessel tracks in the CRNRA study area (2019).

6.2.2.2 Ferries

There are multiple ferry routes in operation within the region, primarily between Heysham or Liverpool and Ireland or the Isle of Man with tracks crossing each of the array areas. The tracks of ferries are shown in **Figure 14**, including passenger and freight services. Four principal operators are identified in the east Irish Sea. IoMSPC operate between Douglas, Liverpool and Heysham. Seatruck operate between Heysham, Liverpool, Warrenpoint and Dublin. Stena operate between Liverpool, Heysham and Belfast. Finally, P&O operate between Liverpool and Dublin.

Ferry tracks for the main operators in the area are displayed in **Figure 15**. The ferry tracks show adverse weather routeing where alternative courses are used to reduce the effects of the prevailing wind and wave conditions. See **Section 6.2.4.2** for information on each of the routes.

6.2.2.3 Cruise ships

Tracks of cruise ships are shown in **Figure 14.** Cruise vessel activity in the area is centred around the Port of Liverpool and Douglas. Liverpool has a cruise terminal which has a regular cruise itinerary and provides turnaround services. Cruise vessels at Douglas regularly anchor in Douglas Bay using tenders to take passengers ashore. Cruise ships up to 345m in length (Queen Mary 2) have called at Liverpool and proceeded to navigate through the CRNRA study area. However, most cruise ships recorded during 2019 were between 200 and 300m in length.

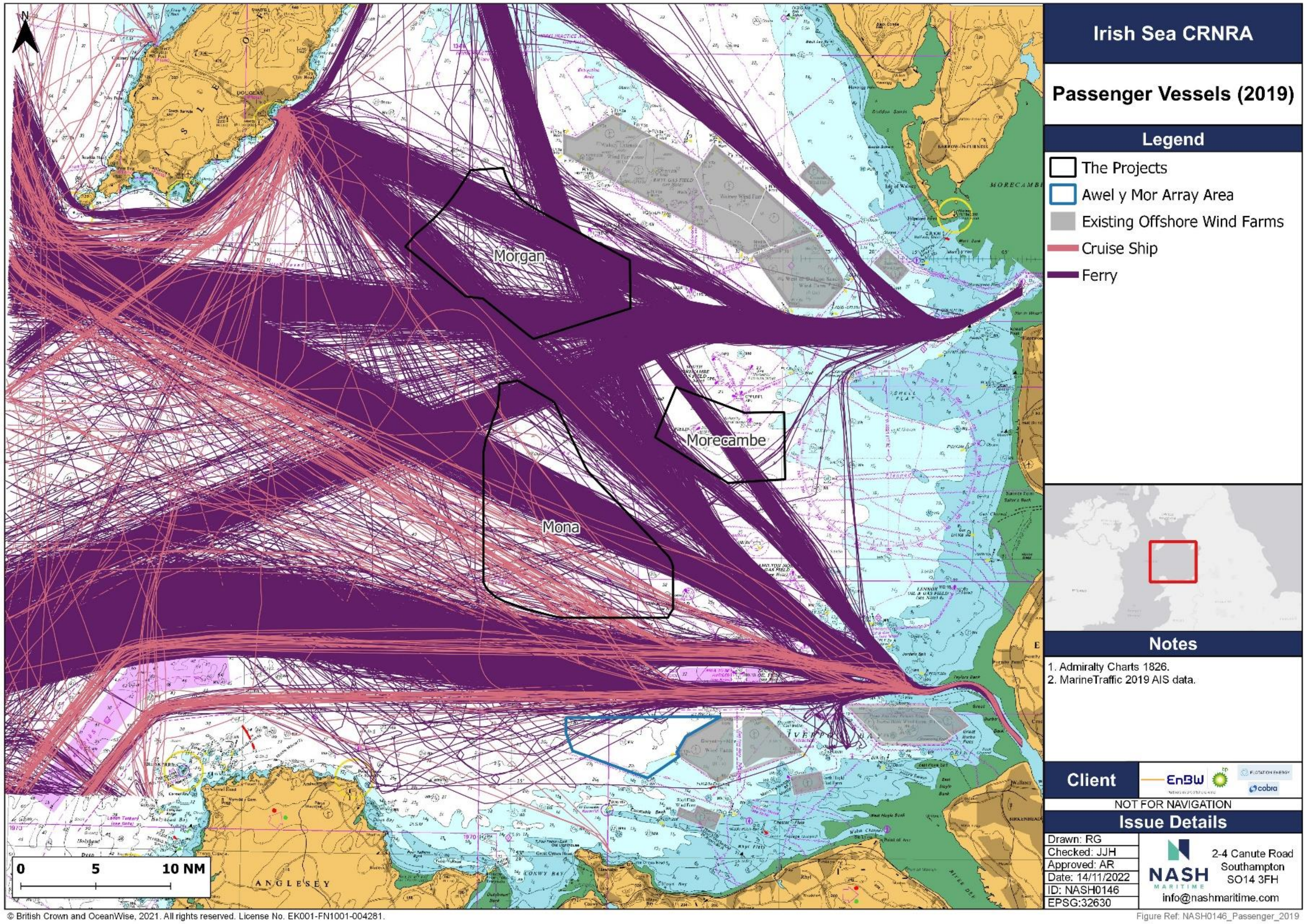


Figure 14: Cruise ship and ferry vessel tracks in the CRNRA study area (2019).

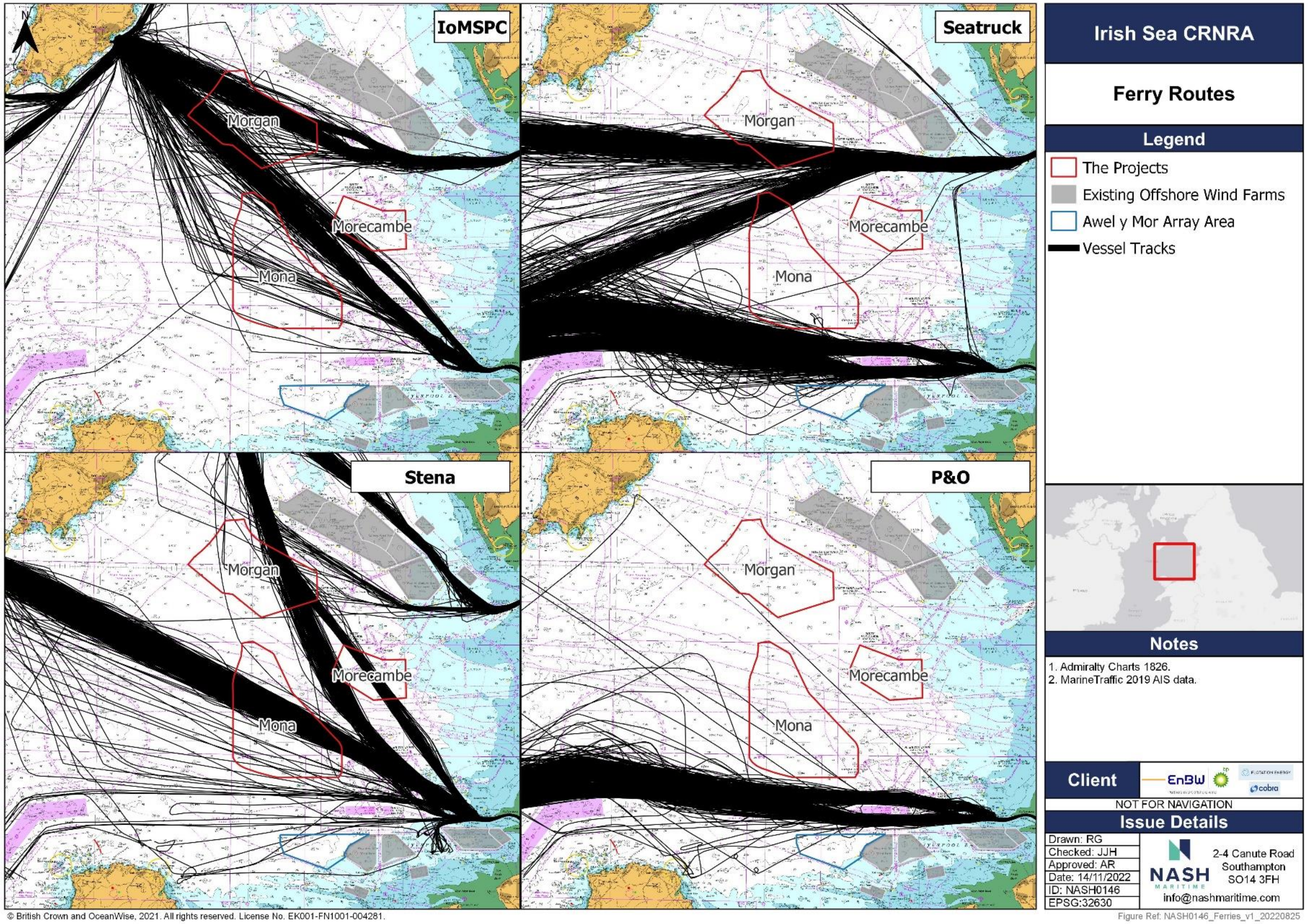


Figure 15: Ferry routes by operator in the CRNRA study area (2019).

6.2.2.4 Recreational

Recreational vessel activity is shown in **Figure 16**. Historical AIS data and the RYA Coastal Atlas have been combined to determine which areas are likely to have greater recreational intensity. There is little recreational activity in the Project Array Areas, with most recreational activity occurring along the coast, particularly along the entrance to Liverpool, and around Holyhead, Douglas and Rhyl. However, some recreational vessels transit through the Mona, Morgan and Morecambe Array Areas between Liverpool and the Isle of Man and Heysham/Barrow and Conwy Bay with vessels transiting to/from clubs and marinas.

During the vessel traffic surveys between the three sites, it was noted that very few recreational craft were recorded by AIS or radar. Approximately one vessel per day was recorded navigating through or adjacent to each Project site respectively during the summer traffic surveys, but no recreational craft were identified during the winter surveys. This suggests significant seasonality in recreational movements through the CRNRA study area.

6.2.2.5 Fishing

Commercial fishing in the east Irish Sea region has a wide spatial distribution and targets a number of valuable fisheries for demersal, pelagic and shellfish species. Key shellfish species include; king scallop, and queen scallop which are targeted by dredges; and whelk, lobster and crab, which are targeted by pots. The most important demersal target species include bass, sole, thornback ray and plaice, which are typically caught by beam and otter trawlers. Pelagic fish landings from this area are mainly of herring and mackerel, which are predominantly caught by pelagic trawls. Fishing ports in the region with the highest fishing efforts are Amlwch, Conwy, Holyhead and Fleetwood. Fishing vessels are also active from Annan, Douglas, Kilkeel, Kirkudbright, Maryport and Peel. In addition, Belgian trawlers are known to operate throughout the CRNRA study area.

The tracks of fishing vessels are shown in **Figure 17**. There is considerable fishing activity within and near the Morgan, Mona and Morecambe Array Areas. However, some fishing vessels are engaged in guard vessel duties or other survey works and account for some of the concentrations around oil and gas installations. Between the winter and summer traffic surveys it was noted that between zero and two fishing vessels fish in the array areas and might be expected to be present in any future corridors. The Isle of Man Queen Scallop season accounts for a concentration to the northwest of the Morgan Array Area. Up to 10 concurrent fishing boats might be encountered within this area.

Figure 18 shows the intensity of fishing activity as recorded by the MMO using the VMS, required on fishing vessels over 15m LOA. For those vessels recorded in the VMS, there is a small area of high-density fishing activity within the Mona and Morgan Array Areas and along the south coast of the Isle of Man.

Additional data and analysis on fishing activity is contained within each individual Project Commercial fishery chapter.

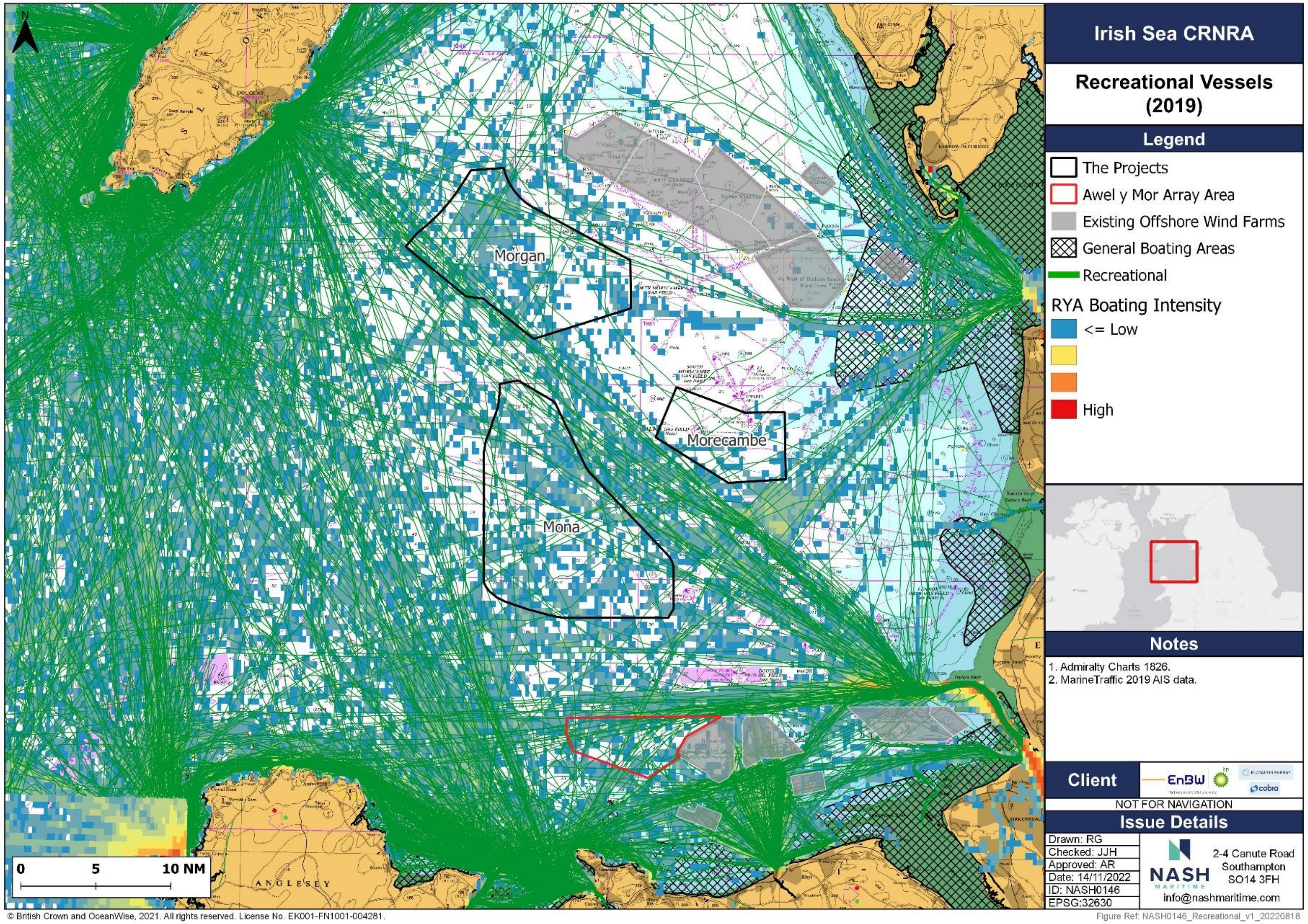


Figure 16: Recreational vessel activity in the CRNRA study area (2019).

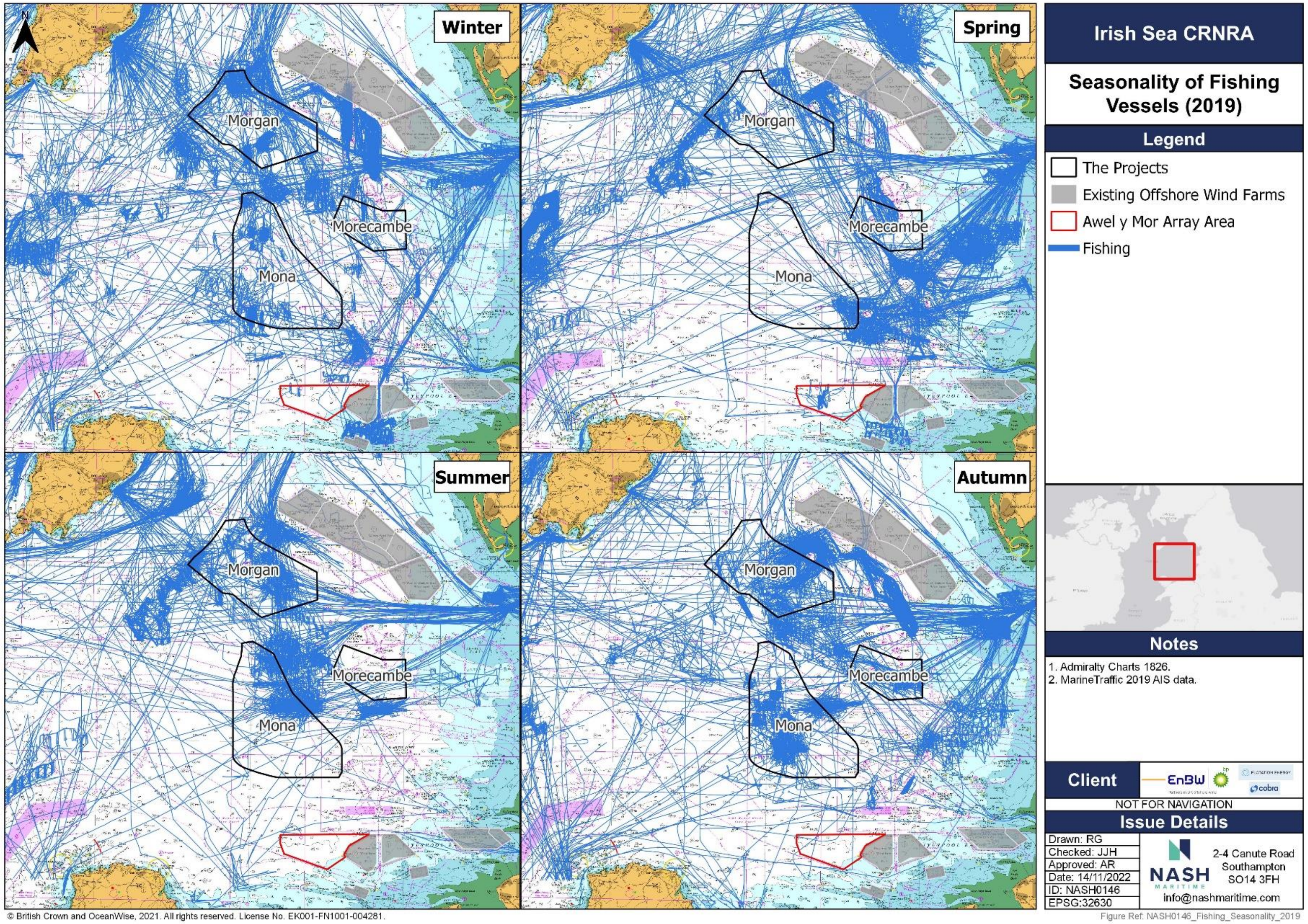


Figure 17: Fishing Vessel Activity in the CRNRA study area (2019).

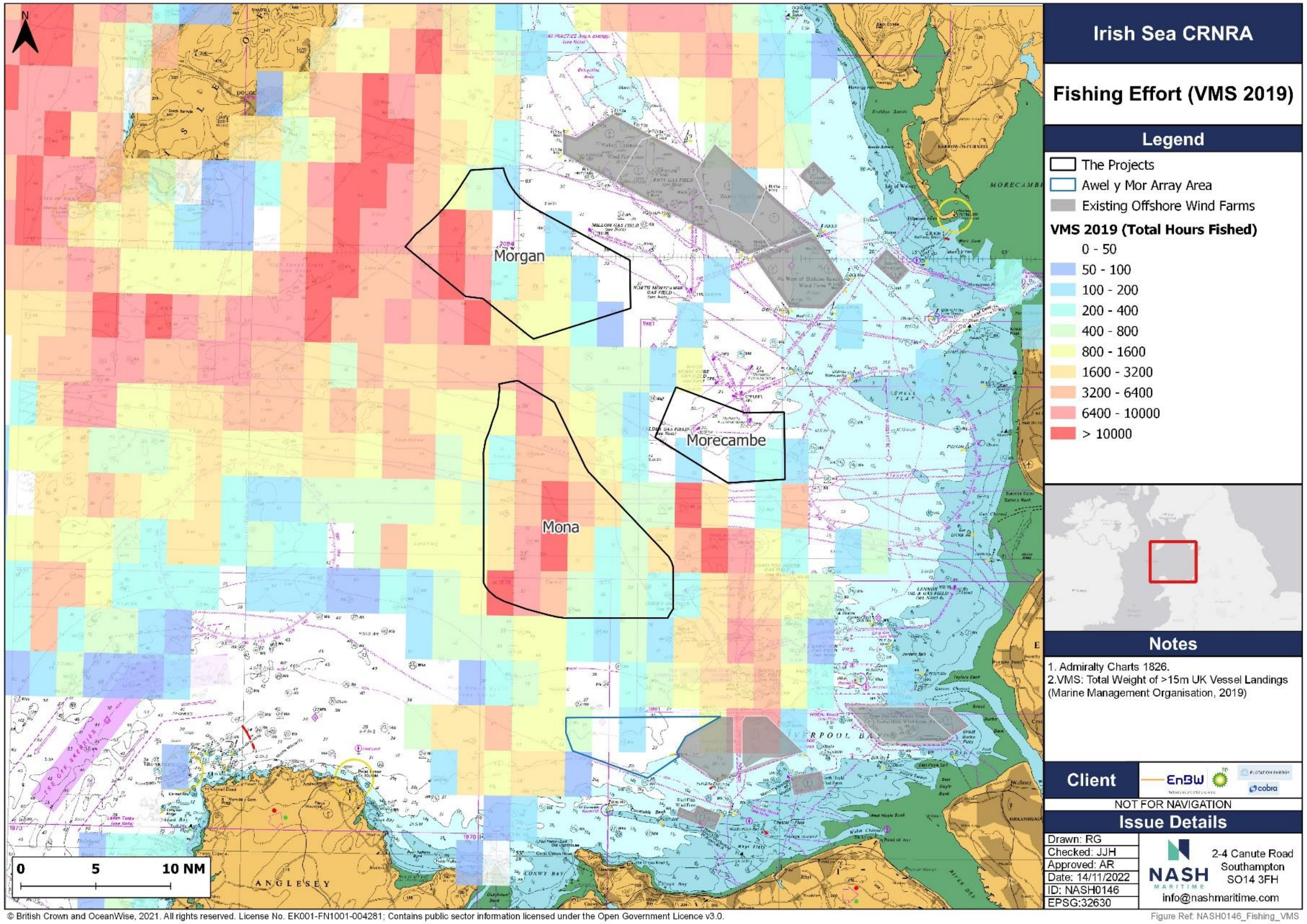


Figure 18: Fishing vessel activity (VMS) in CRNRA study area.

6.2.2.6 Tug and Service

Tug and service vessel activity is shown in **Figure 19** with vessels associated with oil and gas infrastructure, aggregate sites and existing wind farms. There is substantial tug and service vessel activity within the area, particularly surrounding existing wind farms to the northeast and southeast of the cumulative schemes.

CTVs operate between operations and maintenance bases (primarily out of Liverpool, Barrow and Douglas) and the existing offshore wind farms to the north (Walney and West of Duddon Sands) and south (Burbo Bank and Gwynt y Mor) of the CRNRA study area. CTV transit through the Projects within the CRNRA study area, although the frequency of transits is low (<1 vessel/day). The primary route through the Morgan Array Area is to the north, transiting southeast-northwest between Douglas and Barrow. Transits through Morecambe Array Area use two routes; a northwest-southeast route between Liverpool and Walney, and a northeast-southwest route between Barrow aligned with Off Skerries TSS which intersects the Mona Array Area. Transits through the east region of the CRNRA study area pass north/south between Liverpool and the offshore wind farms to the north, totalling 158 transits/year. 21 of these tracks passed within 1nm of the northeast corner of the Morecambe Array Area.

Oil and gas associated supply ships and standby safety vessels have a high intensity within the Morecambe Array Area and east of Mona and Morgan Array Areas where platforms are located. Oil and gas service vessels mostly operate out of Heysham or Liverpool. In 2019, approximately two vessels per day passed through the Morecambe Array Area. A low-use route (1 vessel/month) through the gap between Mona and Morgan Array Areas is used by supply ships from Aberdeen undertaking operations associated with platforms at South Morecambe gas field.

The activities of dredgers are concentrated to the east and southeast of the CRNRA study area within aggregate extraction sites. A low-use route is used by dredgers between Heysham and Off Skerries TSS (<1 vessel/month). SAR vessels are dispersed throughout the CRNRA study area and concentrated along the coastline. Pilot vessels operations are undertaken out of Anglesey, Mostyn, Liverpool, Heysham and Barrow. No pilot vessels intersected the Project Array Areas in 2019.

Other vessel types are distributed across the CRNRA study area. A high concentration of vessels is associated with survey activities south of Walney to the north of the Morgan Array Area. <1 vessel/day transited within any of the Project Array Areas in 2019.

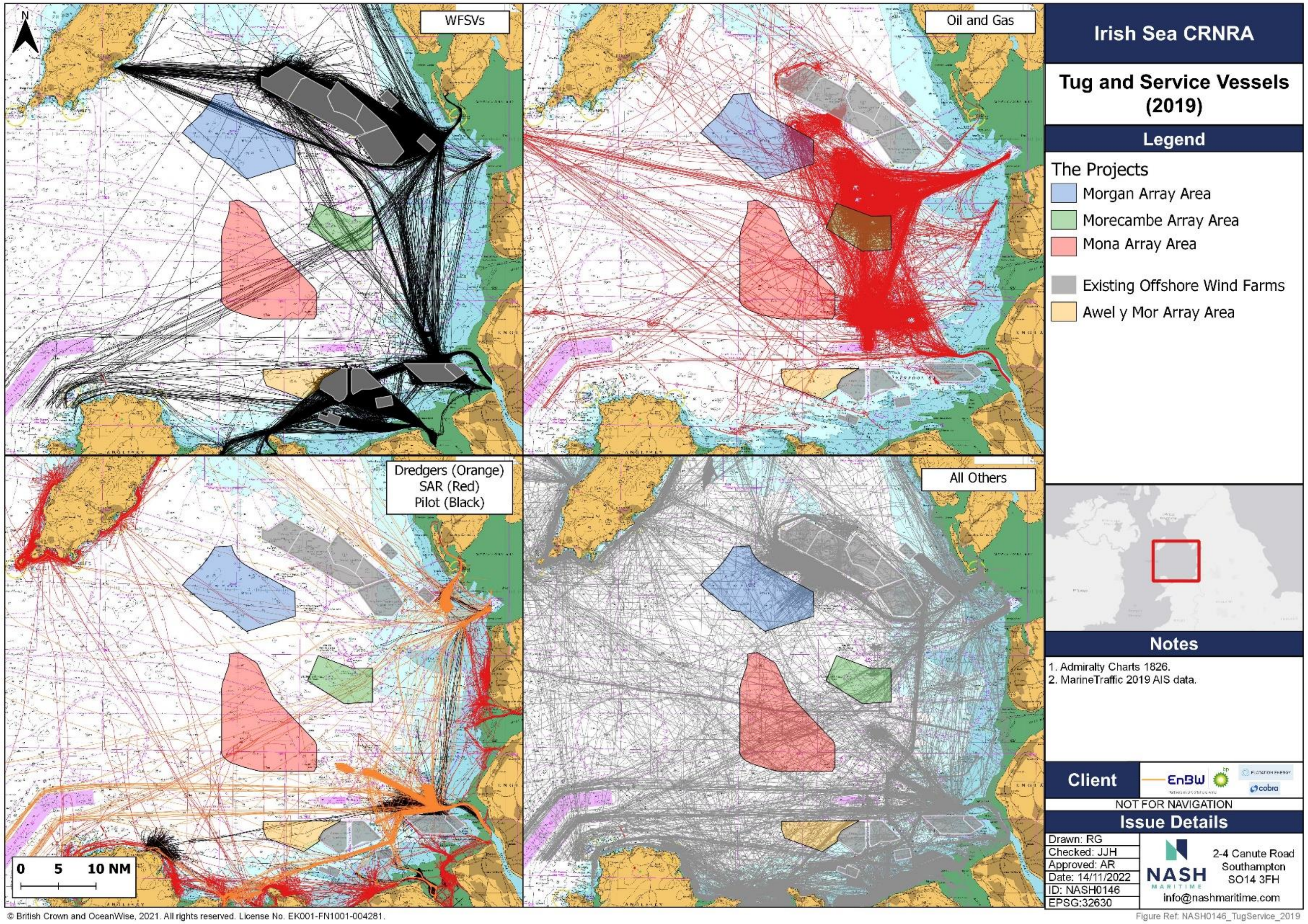


Figure 19: Tug and service vessel tracks in CRNRA study area (2019).

6.2.3 Vessel Traffic Counts and Seasonality

6.2.3.1 Count by vessel Type

Figure 20 shows that Mona and Morgan Array Areas have similar array area vessel count profiles with approximately 12 vessels passing through each site per day. Passenger vessels are responsible for the majority of this activity, representing 70% of vessel traffic. This is mainly the regular ferry routes present in the area. Morecambe Array Area has considerably less traffic passing through the site each year at only four vessels per day.

The Mona Array Area has a higher number of commercial vessels passing through the array area than the other offshore wind farm sites, with approximately four cargo and tankers per day. Morgan and Morecambe Array Areas combined, only represent 26% of the total commercial traffic through all three array areas. In contrast to Morgan and Mona Array Areas, the Morecambe Array Area has a high level of tug and service vessel activity, accounting for 60% of tug and service vessel traffic in the array area.

The 5nm buffer around the Mona Array Area has the highest vessel count at approximately 44 vessels per day. As within the array areas, passenger vessels contribute to the highest proportion of traffic - 50%. As also shown in the Mona Array Area count, the Mona Array Area 5nm buffer experiences the highest commercial traffic out of all the offshore wind farms with approximately 14 cargo and tanker vessels per day. In contrast, the Morecambe and Morgan 5nm buffers combined, only exhibit approximately three commercial vessels per day. Instead, the Morecambe and Morgan 5nm buffers have high tug and service activity of 12 vessels passing through each site per day.

A noticeable difference between the array areas and the 5nm buffers (other than the evident increase in total count) is that in the 5nm buffers, the proportion of total activity attributed to fishing, is 162% higher than in the array areas.

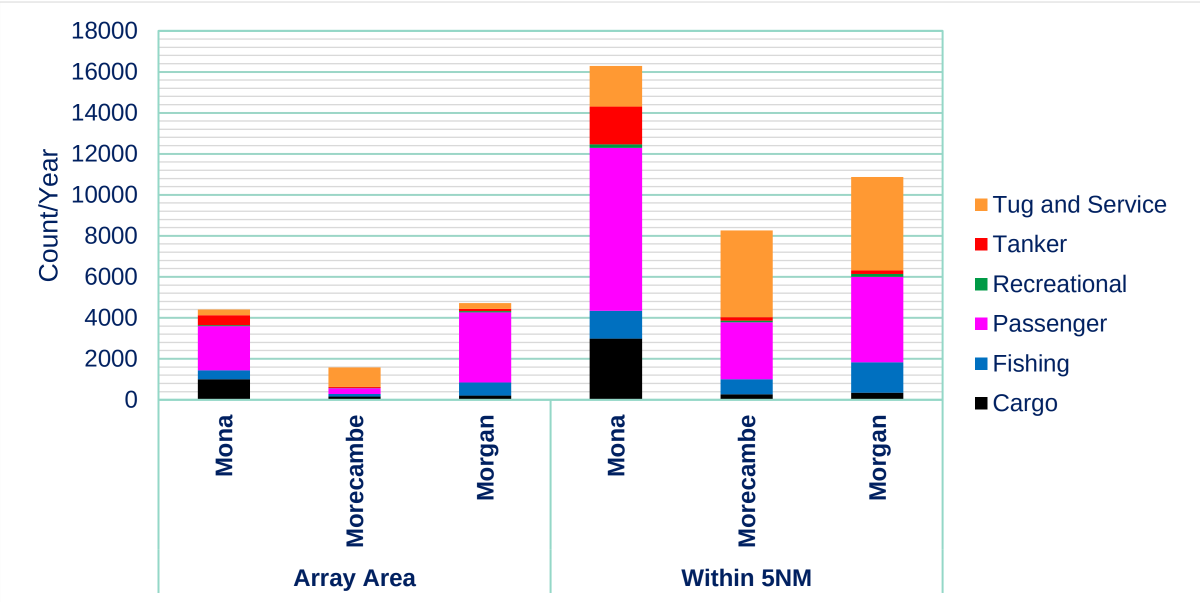


Figure 20: Vessel count per year by vessel type for Mona, Morecambe and Morgan Array Areas and 5NM buffers (2019).

6.2.3.2 Count by Vessel Size

Figure 21 shows that all three offshore wind farm array areas have a similar 50-100m vessel count of less than three vessels per day. However, counts of other vessel length vary greatly between the different array areas.

Over half of the vessels passing through Morgan Array Area are 100 to 150m in length. The site had five vessels per day smaller than 100m, but only one vessel larger than 150m per day. The Mona Array Area has the largest number of vessels over 150m in length out of the three offshore wind farm sites, with a count of approximately five >150m vessels per day. Morecambe Array Areas has a noticeably low count of 100 to 150m vessels and instead has a larger proportion of 50 to 100m vessels passing per year, contributing to 67% of vessel traffic through the array area.

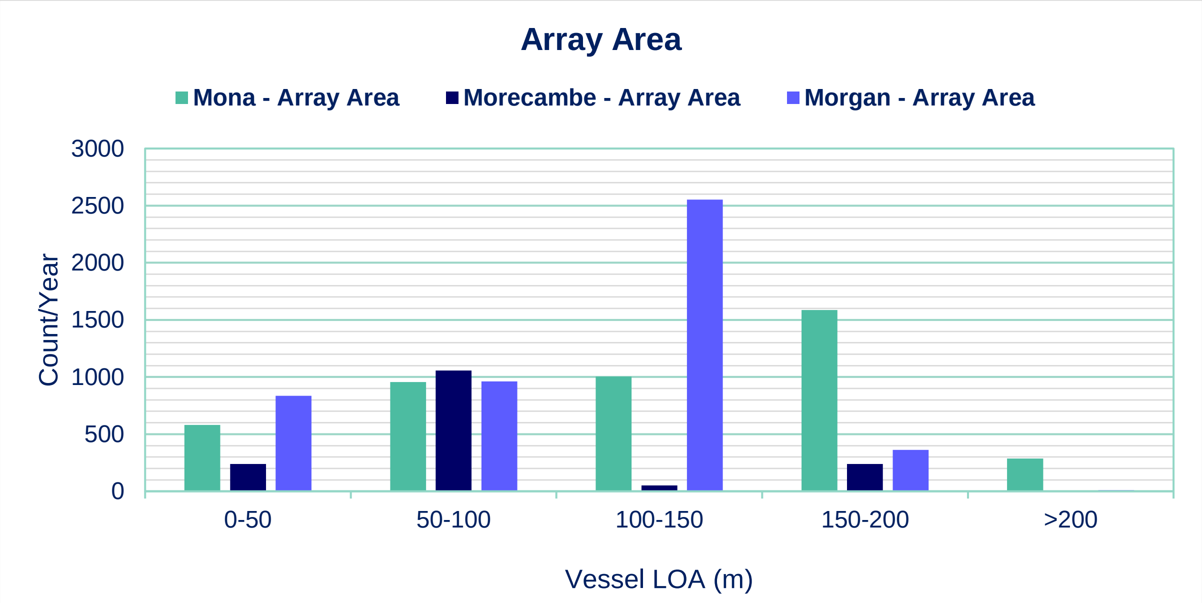


Figure 21: Vessel count per year by vessel LOA (m) for Mona, Morecambe and Morgan Array Areas (2019).

Figure 22 provides the vessel count per year for the array areas and a 5nm buffer. Comparing **Figure 21** and **Figure 22** shows that the proportion of vessels with length <150m is significantly higher in the 5nm buffers than in the array areas. Only 16% of total vessel traffic through the 5nm buffers is over 150m in length, compared to 23% in the array areas. The Morgan 5nm buffer (**Figure 22**) experiences the highest number of smaller vessels <50m, whilst the Mona 5nm buffer (as also seen in the array areas) has the highest number of large vessels >150m. Vessels between 50 to 150m in length contribute to 32% of Morgan 5nm buffer activity, 40% of Morecambe 5nm buffer activity and 60% of Mona 5nm buffer activity.

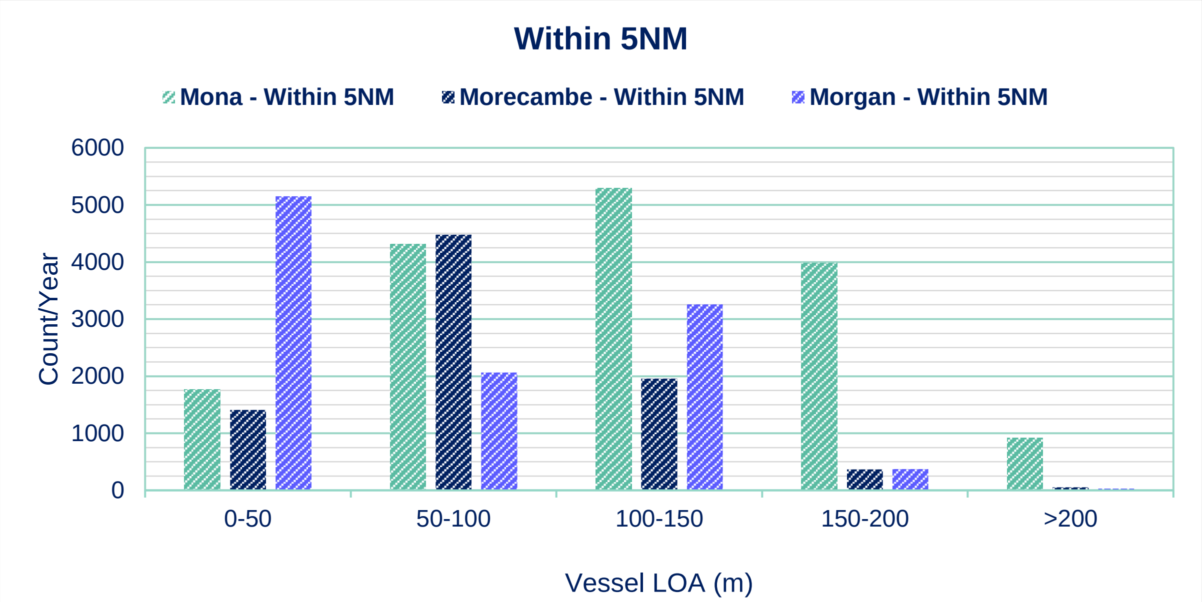


Figure 22: Vessel count per year by vessel LOA (m) for Mona, Morecambe and Morgan 5NM buffers (2019).

6.2.3.3 Monthly Count

In **Figure 23,** Morgan and Mona Array Areas show a seasonal trend that peaks over the summer months (May to August) and decreases in the winter months (November –to February). Morgan and Mona Array Areas see a seasonal count increase of 67% and 34% respectively. This is primarily due to an increase in ferry service operations, recreational and fishing activity. In contrast, the Morecambe Array Area count remains relatively similar throughout the year, only seeing a significant peak in December.

As shown in **Figure 24,** all three offshore wind farm 5nm buffers show a significant seasonal trend. Mona, Morgan and Morecambe 5nm buffers see a seasonal count increase of 46%, 191% and 134% respectively.

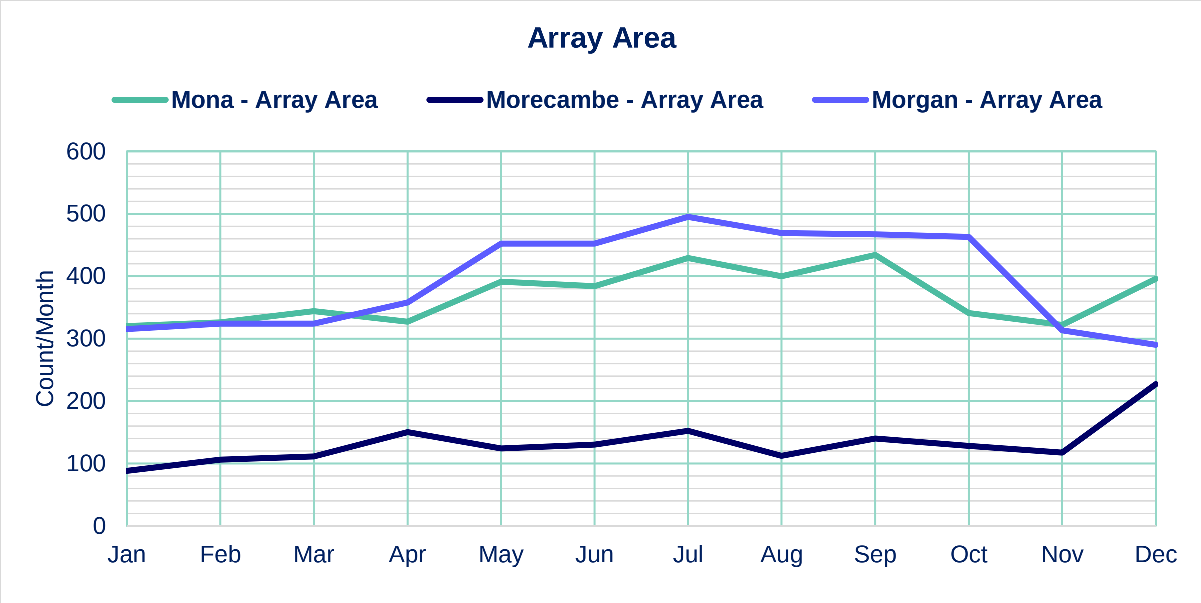


Figure 23: Vessel count per month for Mona, Morecambe and Morgan Array Areas (2019).

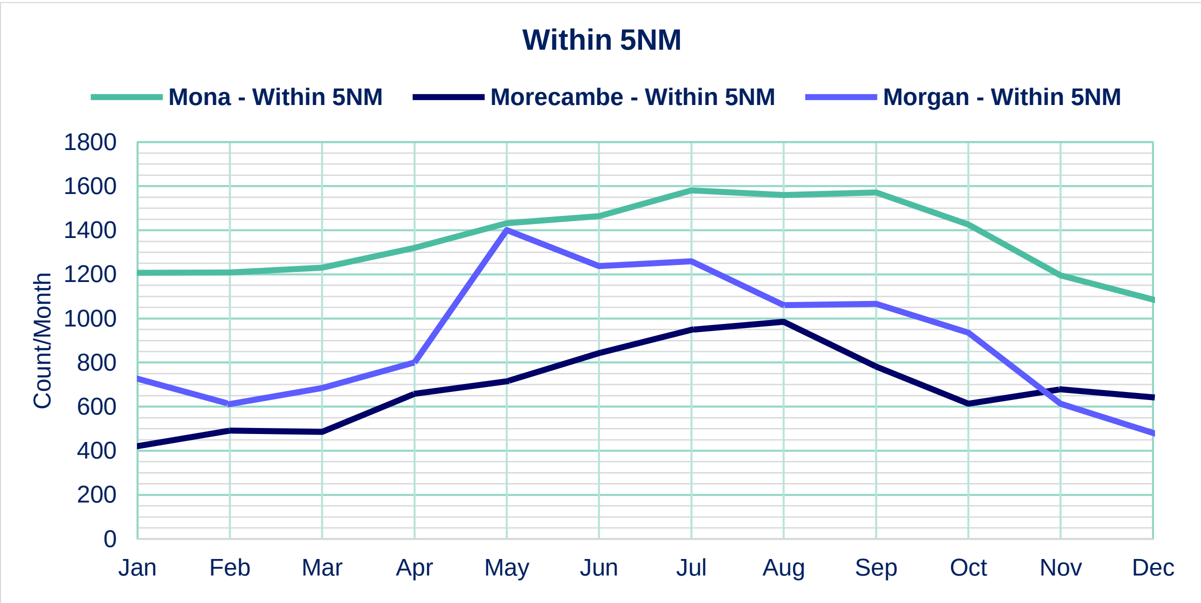


Figure 24: Vessel count per month for Mona, Morecambe and Morgan 5 NM buffers (2019).

6.2.4 Identification of Vessel Routes

MGN654 (MCA, 2021) provides guidance regarding the definition of shipping routes in order to inform offshore wind farm assessments. To account for variation of tracks taken by vessels, the guidance note establishes the 90th percentile corridor principles, the central portion of traffic on a route containing the majority of vessel traffic. The 90th percentile concept considers that as vessels navigate between specific locations, they may take a variety of routes due to avoiding other traffic or as a result of leeway from wind or waves. To minimise any anomalous tracks and therefore mark the usual width of a specified route, the MCA advise using the centre

90th percentile of the determined Total Route Width (see **Figure 25**) around the assumed Median or Centre Line, for all vessels engaged on passage between the same two points.

To identify the 90th percentile routes, the following data processing steps were undertaken:

- **Step 1:** Vessel tracks filtered to commercial only (cargo, tanker and passenger)
- **Step 2:** Tracks along a defined route selected
- **Step 3:** Gate transects constructed along the length of the route (ensuring transects at course changes are included)
- **Step 4:** Calculate number of tracks through cross track transect subsections
- **Step 5:** Calculate location of 90th percentile through transect (**Figure 26**)
- **Step 6:** Draw polygon capturing all 90th percentile locations on each transect.

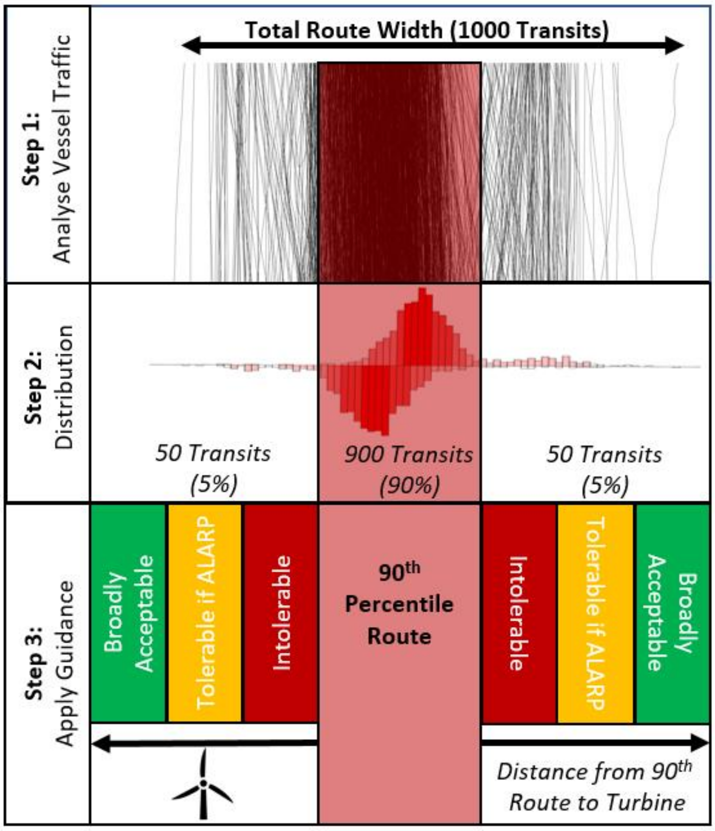


Figure 25: Identification of 90th percentile routes.

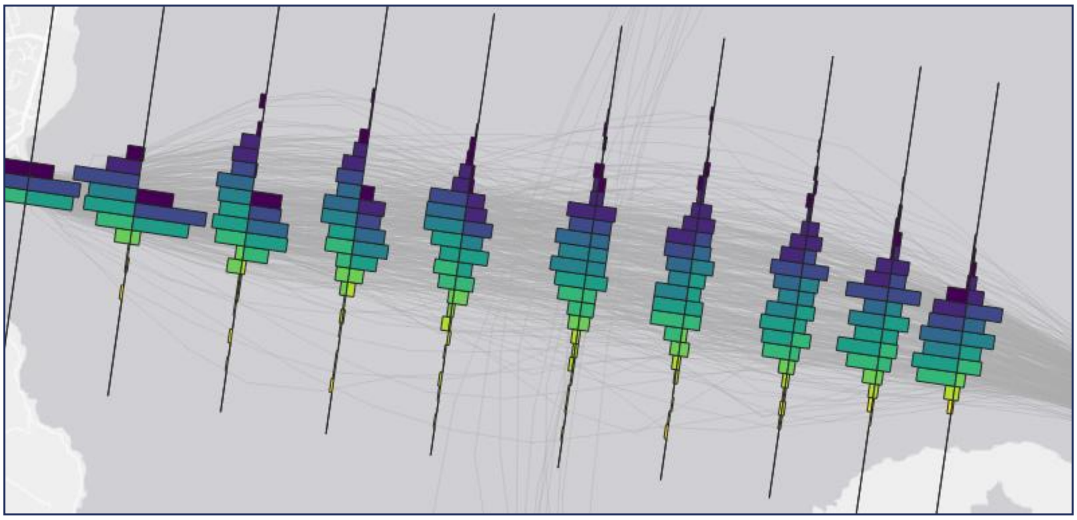


Figure 26: Determination of 90th percentile transects using cross track distributions.

6.2.4.1 Commercial Routes

Commercial vessel routes have been identified in **Figure 27** which also shows the number of vessel transits per day. These routes and their interaction with each Project Array Area are described in **Table 12**. Where appropriate, connecting to specific east or west bound TSS lanes, the routes have been differentiated, otherwise they include all transits in both directions. The routes with more than one vessel transit per day are all to/from the Port of Liverpool. The route between the Liverpool Bay TSS and the Off Skerries TSS has the most vessel traffic with four to six vessel transits per day in either direction, and is clear of the Projects.

The Mona Array Area has two vessel routes passing through the array area with more than one vessel move per day. Both of these routes are vessels transiting between the northern Irish Sea to the west of the Isle of Man and the Liverpool Bay TSS. There are multiple routes through the Morgan Array Area with zero to one vessel transits per day used by vessels related to the ports in the area.

There are four commercial vessel routes which intersect with the Morgan Array Area. All of these routes had zero to one vessel transits per day in 2019. These routes are either used by vessels associated with Douglas or to the north of the Isle of Man.

Three commercial vessel routes with zero to one vessel transits per day intersect with the Morecambe Array Area.

Table 12: Statistics of commercial vessel routes in CRNRA study area.

ID	Route	Approximate Annual Crossings	Baseline Distance (nm)	Intersects Array Area		
				Morgan	Mona	Morecambe
		Greater than one transit per day				
1	Liverpool TSS to Skerries TSS (E)	2,006	46.9	X	X	X
3	Skerries TSS to Liverpool TSS (W)	1,767	51.6	X	X	X
13	Liverpool TSS to W IoM (W)	704	53.0	X	✓	X
2	W IoM to Liverpool TSS (E)	525	55.1	X	✓	X
12	Liverpool TSS to Irish Sea (W)	410	50.1	X	X	X
		Less than one transit per day				
14	E IoM to Heysham	170	49.2	X	X	X
9	Irish Sea to Liverpool TSS (E)	137	49.9	X	X	X
18	Liverpool to W IoM	128	61.0	X	✓	X
15b	Liverpool to E IoM - Central	113	70.5	✓	X	✓
16	Douglas to Heysham	93	48.7	✓	X	X
4	Liverpool TSS to Skerries TSS via Anglesey (E)	82	48.4	X	X	X
20	Southern Irish Sea to Solway Firth	63	69.8	X	X	X
10	Liverpool TSS to Inshore Anglesey (W)	53	42.6	X	X	X
21	Off Skerries TSS to Solway Firth	48	74.6	✓	X	X
11	Liverpool TSS to Irish Sea (W)	45	49.2	X	X	X
5	Inshore Anglesey to Liverpool TSS (E)	45	42.5	X	X	X
17	Irish Sea to Liverpool TSS (E) via Anglesey	29	63.1	X	✓	X
6	Off Skerries TSS to Heysham (E)	23	71.2	X	✓	✓
24	Off Skerries TSS to Barrow (E)	23	66.9	X	✓	✓
23	Liverpool to E West of Duddon Sands	22	36.6	X	X	X
15c	Liverpool to E IoM - E	20	68.0	✓	X	✓
22	Douglas to Liverpool TSS	20	51.1	✓	✓	X
8	Heysham to Off Skerries TSS (W)	18	73.9	X	✓	✓
7b	Off Skerries TSS to Barrow (W) - South	17	69.4	X	✓	✓
15a	Liverpool to E IoM - W	17	77.6	✓	✓	✓
19	Douglas to Liverpool TSS (E)	16	51.7	✓	✓	X
7a	Off Skerries TSS to Barrow (W) - North	10	69.0	X	✓	✓

6.2.4.2 *Ferry Routes*

The ferry routes in the CRNRA study area are presented in **Table 13** along with a count of the crossings during 2019. There are 11 ferry routes through the CRNRA study area, split between four operators. **Figure 29** shows all routes divided between the four operators and includes passage plan information provided by IoMSPC, Stena and Seatruck during consultation.

The IoMSPC ferries operate between Douglas on the Isle of Man, and either Heysham or Liverpool. The Heysham/Douglas route is the most frequently run route with 1,286 transits/year (three to –four per day) and passes east/west between South Morecambe gas field and West of Duddon Sands and Walney offshore wind farms through the northern region of the Morgan Array Area. The Liverpool/Douglas route has 674 transits/year (two per day), passing northwest/southeast through the CRNRA study area. The passage plan for the route traverses between Morecambe and Mona Array Areas and intersects the southwest extent of Morgan Array Area. The vessel Manannan runs a seasonal service on this route, with four transits per day in summer. The route runs primarily west of the single buoy mooring to the south of Morecambe Array Area but a small proportion of transits are to the east of the Single Buoy Mooring (SBM) within the Hamilton North gas field (53 transits per year, <1 per day). During consultation it was confirmed vessels transit east of the SBM on northbound transits to avoid congestion in Liverpool Bay TSS (thereby exiting the TSS earlier) and are dependent on current and forecast weather conditions to ensure safe and comfortable passage for passengers.

Stena Line operates routes between Belfast and either Liverpool or Heysham. Vessels between Heysham and Belfast operate on a route between Barrow/Ormonde and West of Duddon Sands/Walney offshore wind farms (1,150 transits per year, three per day). Vessels using the route between Belfast and Liverpool pass east or west of the Isle of Man dependent on prevailing metocean conditions. Primarily, vessels use the westerly route that passes northwest-southeast through the central portion of the Mona Array Area with 1,442 transits/year (three to four vessels per day). Ferries passing east of the Isle of Man transit northwest/southeast on two planned routes. One route passes southwest of Morecambe Array Area to the west of the Calder platform, and through the east of the Morgan Array Area (200 transits per year). 80% of traffic used on this route is southbound traffic. The second route passes directly through the Morecambe Array Area to the east of Calder and through the east extent of the Morgan Array Area and is utilised by northbound traffic exiting Liverpool Bay TSS (153 transits per year, less than one vessel per day).

Seatruck operates two east-west routes through the CRNRA study area. Heysham to Warrenpoint passes through the south extent of the Morgan Array Area with 967 transits/year (3/day). The Heysham to Dublin route passes between Morecambe and Morgan Array Areas, intersecting the northern tip of the Mona Array Area. 523 transits were recorded on this route in 2019, of which 499 intersected the Mona Array Area. Seatruck also operates a route between Liverpool to Dublin south of the CRNRA study area between Awel y Mor and Mona Array Area (1,800 transits per year, five per day).

P&O ferries operate a route between Liverpool and Dublin which passes south of the CRNRA study area between Awel y Mor and the Mona Array Area with 1,600 transits/year (five per day).

Table 13: Ferry routes and annual crossings by operator.

Operator	Route	Example Vessels (2019 to 2022)	Approximate Annual Crossings (2019)
IoMSPC	HEY - DOUG	Ben-my-Chree	1,286
	LIV - DOUG	Manannan	628
	LIV - DOUG	Ben-my-Chree	46
Stena	LIV - BEL W	Stena Imprimis, Stena Forecaster, Stena Lagan, Stena Mersey, Stena Forerunner, Stena Horizon, Stena Natalita	1,442
	LIV - BEL E (W of CALDER)	Stena Forecaster, Stena Lagan, Stena Mersey, Stena Forerunner, Stena Horizon	200
	LIV - BEL E (E of CALDER)	Stena Lagan, Stena Mersey	153
	HEY - BEL	Stena Hibernia, Stena Scotia	1,150
Seatruck	HEY - WAR	Seatruck Performance, Seatruck Precision	967
	HEY - DUB	Seatruck Pace, Seatruck Panorama	523
	LIV-DUB	Seatruck Pace, Seatruck Power, Seatruck Panorama, Seatruck Progress	1,800
P&O	LIV-DUB	Mistral, Norbay, Norbank	1,600

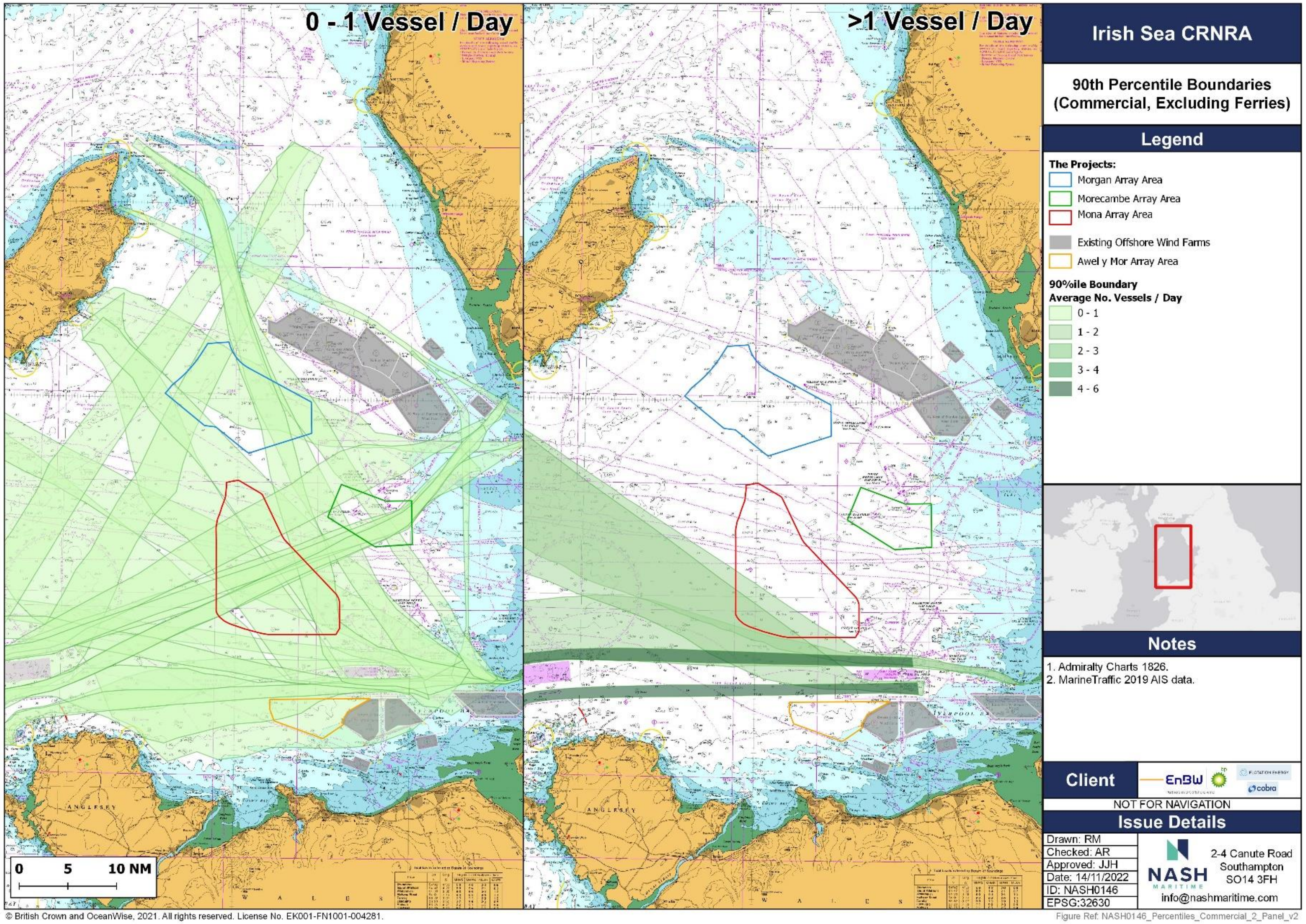


Figure 27: Commercial vessel routes in the CRNRA study area.

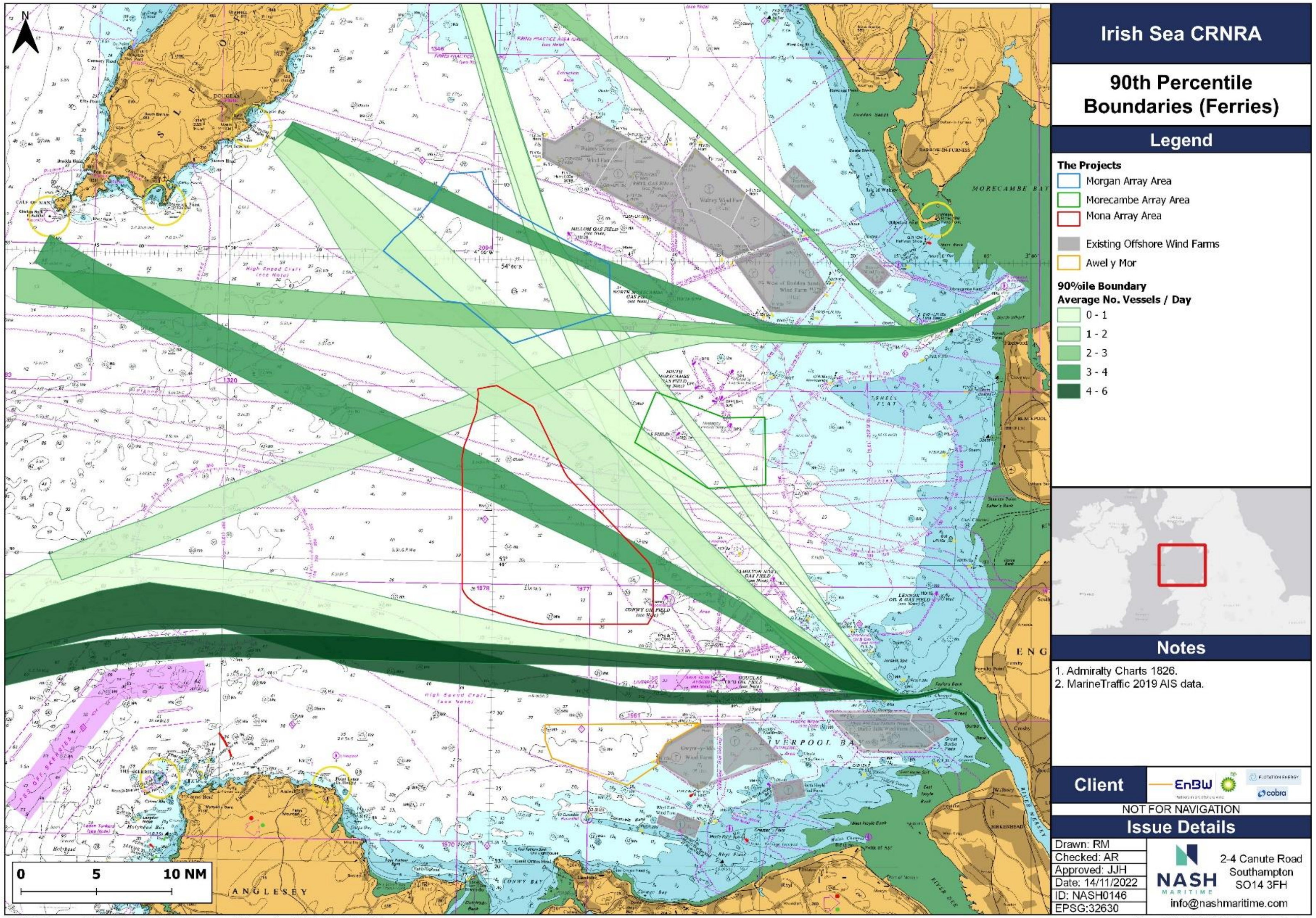


Figure Ref: NASH0146_Percentiles_Ferries

Figure 28: 90th percentile routes of principal ferry routes in the CRNRA study area.

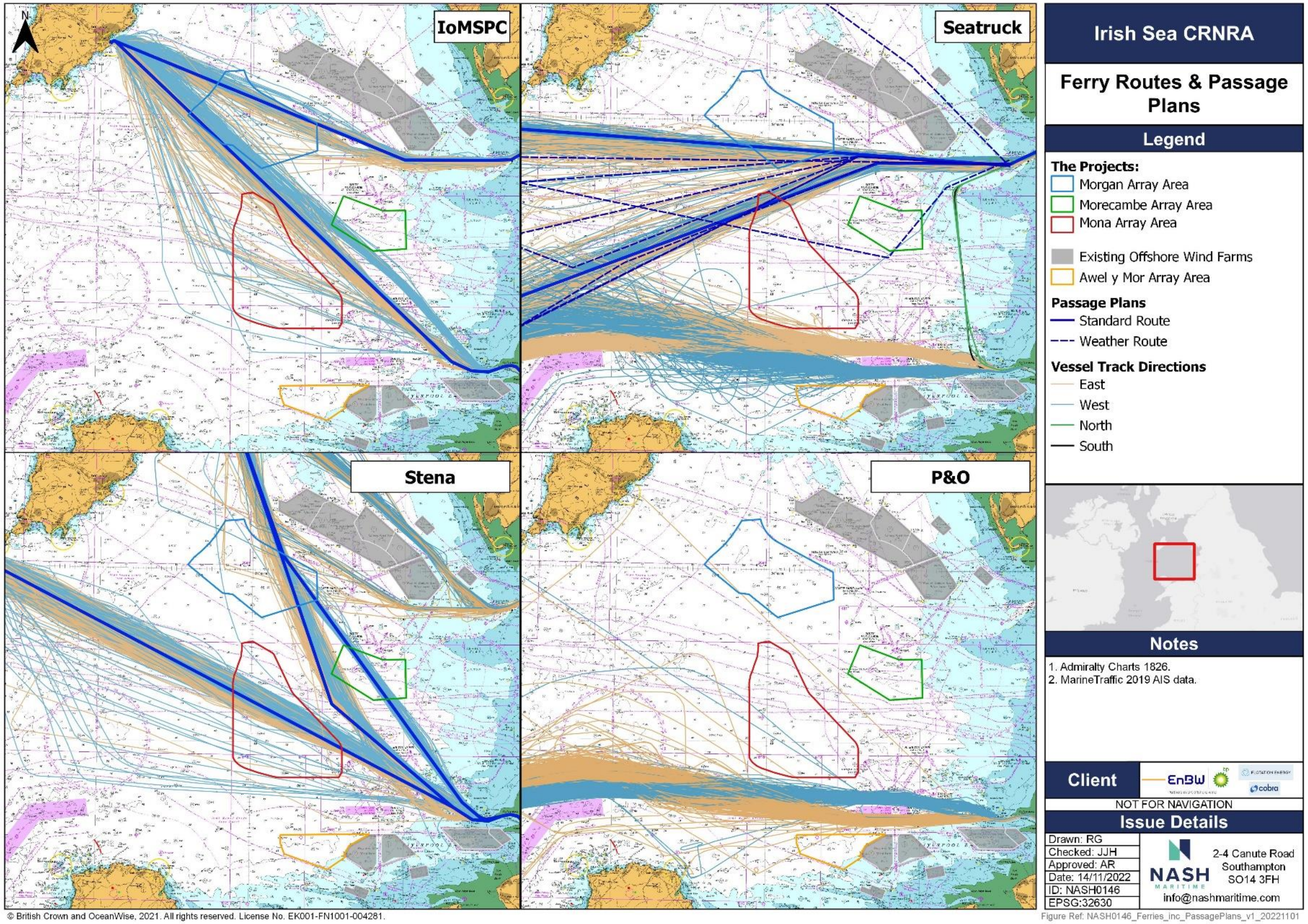


Figure 29: Ferry route passage plans.

6.2.5 Adverse Weather Routeing

6.2.5.1 Commercial Routeing

Analysis of vessel tracks during MetOffice named storms in 2019 are shown in **Figure 30** which shows that alternative routeing isn't used in every period where there is adverse weather and repeatable adverse weather routeing behaviours taken by commercial shipping were not clearly identified. The decision to use an alternative route will largely depend on the direction of the swell, waves and wind. There is an apparent reduction in the activities of fishing and recreational craft, as they seek shelter. In addition, there is greater demand for the anchorage to the east of Anglesey by commercial vessels.

6.2.5.2 Ferries Routeing

Many ferry services continue to operate in gale force winds. **Figure 31** indicates the non-typical routes taken by ferries, including during adverse weather routes. This has been undertaken by comparing 2019 vessel tracks with the 90th percentile routes. In general, prevailing south westerly adverse weather typically results in ferries taking a more south-westerly transit in order to both control the course relative to the conditions and take advantage of the lee from the shore. This minimises dangerous motions aboard the vessel and improves passenger comfort.

Both the IoMSPC routes show significant deviation to the southwest of their current routes as vessels both take advantage of the shelter from the Welsh coast and manage the motion of the vessel by maintaining advantageous orientation to the waves. The Stena Liverpool to Belfast route, shows similar deviation to the southwest when passing to the west of the Isle of Man, but little deviation from the 90th percentile routes when passing to the east. The Heysham to Belfast route demonstrates that in adverse weather, masters may choose to pass to the west of the existing Irish Sea offshore wind farms, rather than pass between West of Duddon Sands and Barrow. Deviation from the 90th percentile routes for Seatruck tends to occur further west, with tracks diverging in the region of the proposed offshore wind farms.

Section 8.3.3 contains detailed analysis for the impact of adverse weather on ferry routeing.

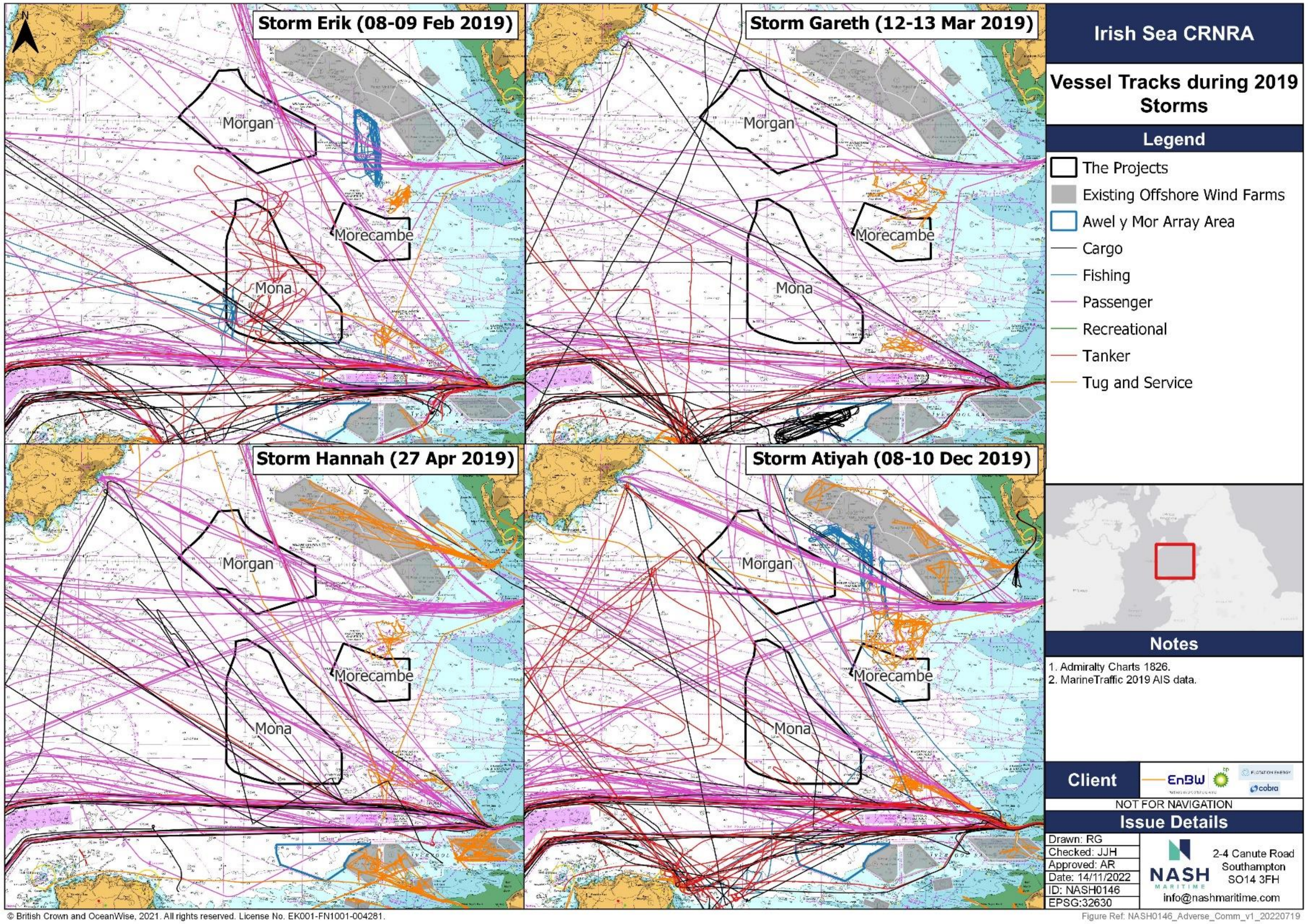


Figure 30: Vessel tracks during Met Office 2019 named storms.

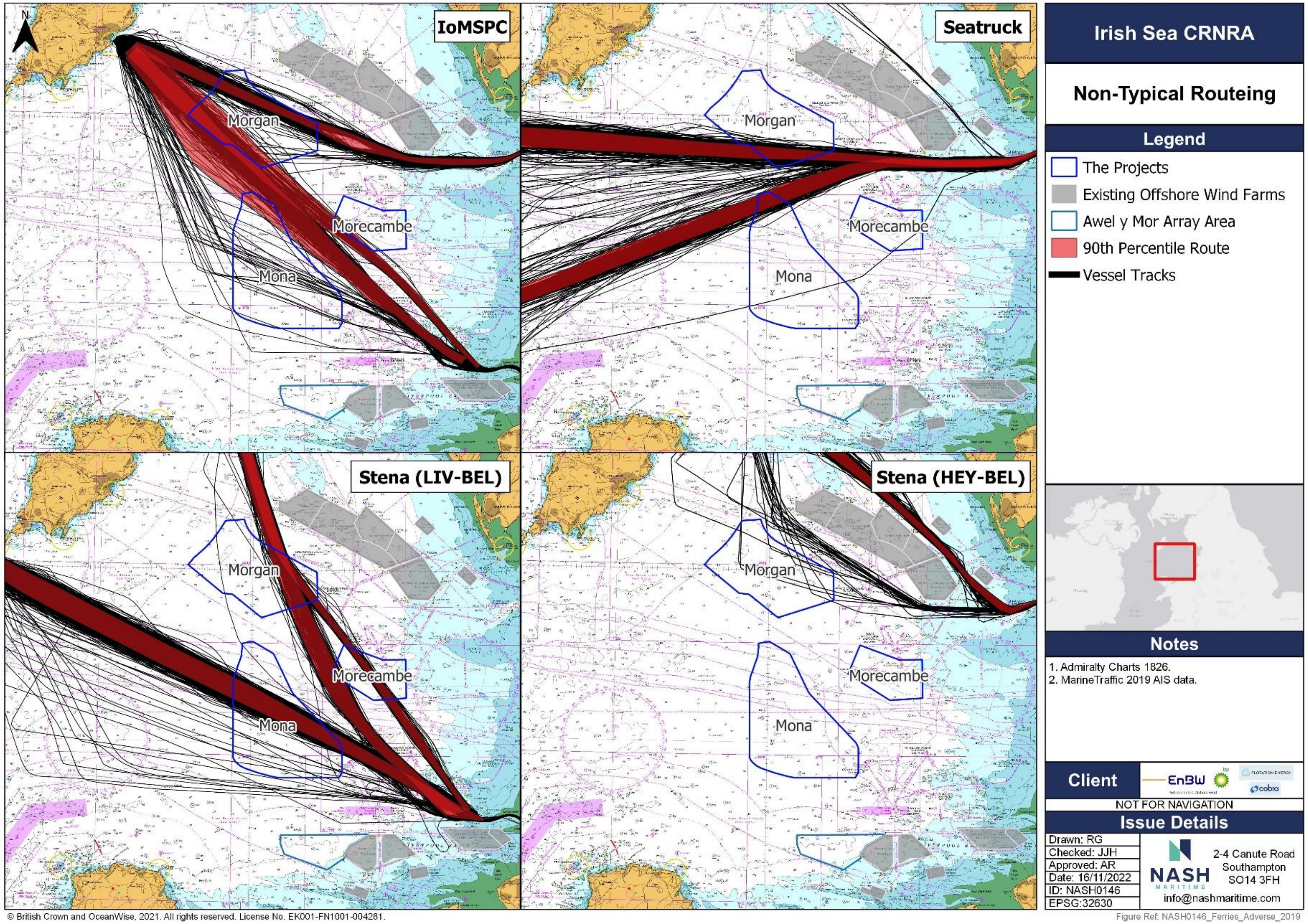


Figure 31: Ferries non-typical and adverse routes.

6.2.6 Non-Transit Activity (including anchoring and loitering, and out of region pilot transfer)

Anchored or vessels not in transit are shown in **Figure 32**. The intensity of anchoring has been identified by extracting AIS positions with speeds of less than 0.5knots for vessels over 100m in length. Non-Transit tracks have been extracted manually through identifying vessels which are not navigating directly between two locations (as opposed to those shown in **Section 6.2.4**).

There is significant anchored vessel activity shown off the east coast of Anglesey near the Point Lynas Pilot Boarding Station. Use of this area as an anchorage is not displayed on the navigational chart but is regularly used by crude oil tankers waiting to berth at the Tranmere oil jetty on the River Mersey.

There is also anchoring activity shown at the designated anchorages to the north and south of the entrance to the River Mersey as well as at Douglas Bay. There is evidence of anchoring sporadically through the Mona Array Area. There has been no anchoring activity identified in the Morgan or Morecambe Array Areas.

There are extensive non-transit vessel tracks through the Mona Array Area shown between the Liverpool Bay TSS, Douglas Bay, the northern Irish Sea and the anchorage off the east coast of Anglesey. There are limited non-transit vessel tracks through the Morgan and Mona Array Areas.

During consultation, it was identified that during strong northwesterlies, it was common for vessels to undertake pilotage transfers in the lee of the Isle of Man at Douglas, rather than at Liverpool. A letter from Laxey Towing Company explained that on average 175 ships per year are attended to, although during 2019 this was 75. Through correlation with the 2019 AIS data, **Figure 33** shows the tracks of those considered to have conducted this behaviour, including 15 over 200m in length, 42 tankers, 32 cargo ships and two cruise ships. It is notable that during significant adverse weather events, these transfers can result in convoys of vessels navigating between Liverpool and Douglas. For example, on the 13 January 2019, three vessels simultaneously departed the Anglesey anchorage and three departed Liverpool, meeting at Douglas to conduct transfers. Furthermore, on the 12 November 2019, five ships took pilots at Douglas and transited together into Liverpool, albeit three took the TSS and two transited directly.

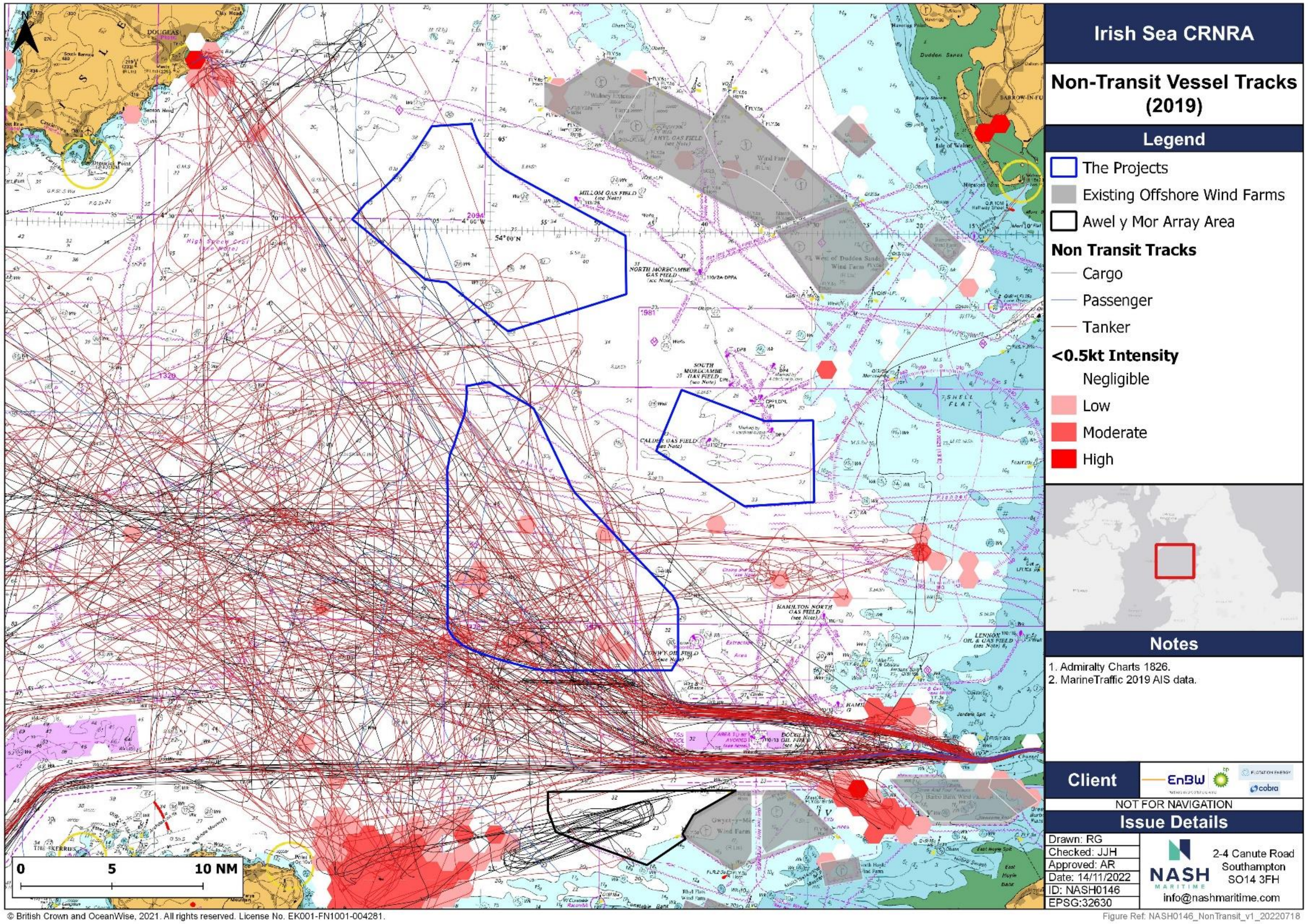


Figure 32: Non-transit vessels (anchored or loitering).

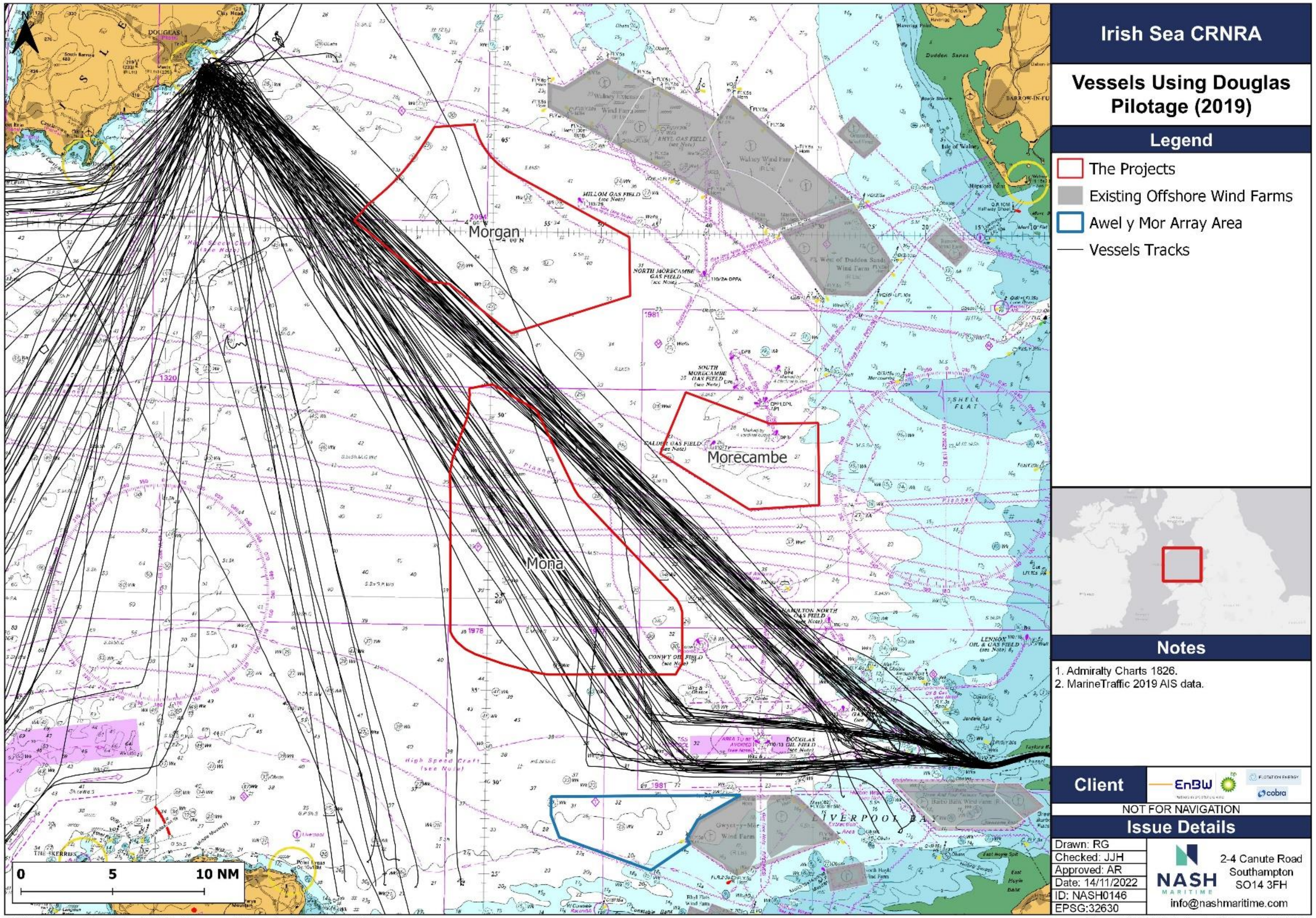


Figure 33: Vessels embarking or disembarking pilots at Douglas.

6.3 INCIDENT ANALYSIS

6.3.1 Incidents Associated with Offshore Wind Farms

To better understand the types and frequency at which navigational incidents might occur with the Projects, analysis was conducted of historical accidents associated with UK operational offshore wind farms. Analysis was conducted of the MAIB database (2010 to 2019), RNLI databases (2008 to 2019), MAIB reports and news reports.

In total, 69 incidents were identified between 2010 and 2019 (see **Table 14**). This includes six collisions between vessels, 29 allisions of a vessel with a fixed structure, 21 groundings and 13 near misses. Where the information is available, 36% occurred within the array boundary, 43% occurred within ports or harbours and 20% occurred on-transit between the two. 82% of incidents involved project craft (such as CTVs or construction vessels). Few allisions are recorded by a non-project vessel, however, anecdotally there have been more allisions involving fishing and recreational vessels which are unreported.

Table 14: Incident frequency for offshore wind farm relevant incidents between 2010 to 2019 in UK.

Vessel	Allision	Grounding	Collision	Collision - Near Miss
Project Vessel	27	21	9	15
Fishing	2	0	0	2
Recreational	0	0	2	4
Other	0	0	1	5

From the historical incident record and using an estimate of the number of years of operation for UK offshore wind farms, incident rates per an average project are derived (see **Table 15**) (see Rawson and Brito, 2022). The accident return rates are generally low, between 10 and 45 operational years between incidents, the majority accounted for by project vessels. Therefore, over a typical 25 to 35 year operational duration it would be expected that a typical project would experience three allisions, two groundings and one collision or near miss. It is notable that there are no recorded accidents involving large commercial shipping and offshore wind farms in the UK. Nor did any of the recorded navigational incidents across the UK sector result in loss of life.

Table 15: Average incident rate per project between 2010 to 2019 in UK.

Incident Type	Number	Rate/yr	Return Period
Collision	6	0.022	1 in 45.4yr
Grounding	21	0.077	1 in 13.0yr
Near Miss	13	0.048	1 in 20.9yr
Total Allision	29	0.107	1 in 9.4yr
CTV Allisions	27	0.099	1 in 10.1yr
Fishing Allisions	2	0.007	1 in 136.9yr
Total	69	0.254	1 in 3.9yr

6.3.2 Incidents Within CRNRA Study Area

Figure 34 and **Table 16** show navigational incidents recorded in the CRNRA study area between the MAIB (1992 to 2021) and RNLI (2008 to 2020) databases. In processing the incidents, non-navigationally significant incidents have been removed, such as shore based activities (e.g. people cut off by the tide or swimmers in distress). Furthermore, duplicate values recorded in both databases have been removed.

In total there were 4,161 incidents identified in the CRNRA study area with ten in the Morgan Array Area, ten in the Mona Array Area and five in the Morecambe Array Area. This equates to 0.7 incidents per year for Morgan and Mona Array Areas with 0.38 per year for Morecambe Array Area. None of the incidents in any of the array areas resulted in fatalities.

Three of the ten incidents in the Morgan Array Area are mechanical failure or damage to a vessel. Of these two were related to recreational vessels and one involved a fishing vessel. The other incidents in the array area were a fire onboard a passenger vessel, a fire on a fishing vessel, a contact incident involving a fishing vessel, a near miss involving a passenger vessel and two personal injuries. There is also one grounding of a recreational vessel in the array area, however given that the water depth is approximately 30m, it is unlikely to have occurred in this location.

The most frequent incident type which occurred in the Mona Array Area was related to mechanical failure or damage to a vessel with seven reported out of the ten incidents in the area. The other three incidents where two near misses and one foundering of a fishing vessel.

There were two incidents involving mechanical failure or damage to a vessel in the Morecambe Array Area. The other incidents were a near miss involving a fishing vessel, a contact involving a tug or service vessel and a personal injury.

Figure 35 shows the number of incidents per year, with approximately 255 RNLI incidents and 50 MAIB incidents reported per year. There appears to have been a gradual increase in reported MAIB incidents over the analysis period. The extent to which this may be influenced by improved reporting standards is unclear, but is reflective of a wider national trend.

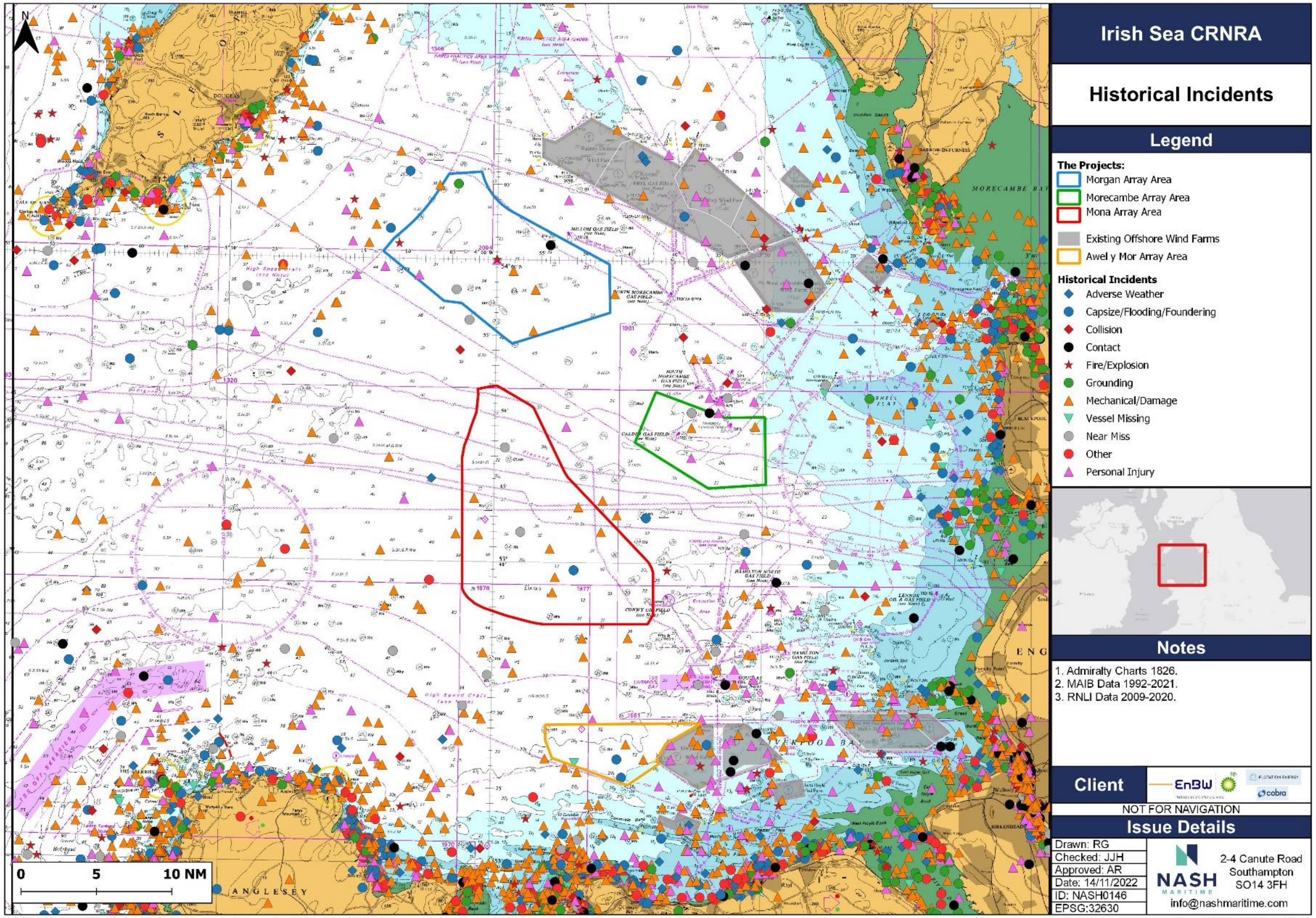


Figure Ref: NASH0146_Incidents

Figure 34: Historical incidents in the CRNRA study area.

Table 16: Total incident count in the CRNRA study area.

	Cargo	Fishing	Fixed Installation	Military	Not Classified	Passenger	Recreational	Tanker	Tug & Service	Total
Adverse Weather	0	16	0	0	0	0	280	0	6	302
Capsize/Flooding/Foundering	2	16	0	0	0	4	221	0	15	258
Collision	30	7	1	0	1	9	16	0	31	95
Contact	113	6	1	1	0	29	17	0	31	198
Fire/Explosion	12	6	0	0	1	13	19	0	31	82
Grounding	12	24	0	0	2	4	269	0	34	345
Mechanical/Damage	69	220	0	2	11	30	1,561	0	87	1,980
Missing Vessel	0	4	0	0	0	0	50	0	0	54
Near Miss	10	6	0	0	2	5	12	0	10	45
Other	1	44	0	0	4	5	215	0	5	274
Personal Injury	50	71	0	0	5	62	255	2	83	528
Total	299	420	2	3	26	161	2,915	2	333	4,161

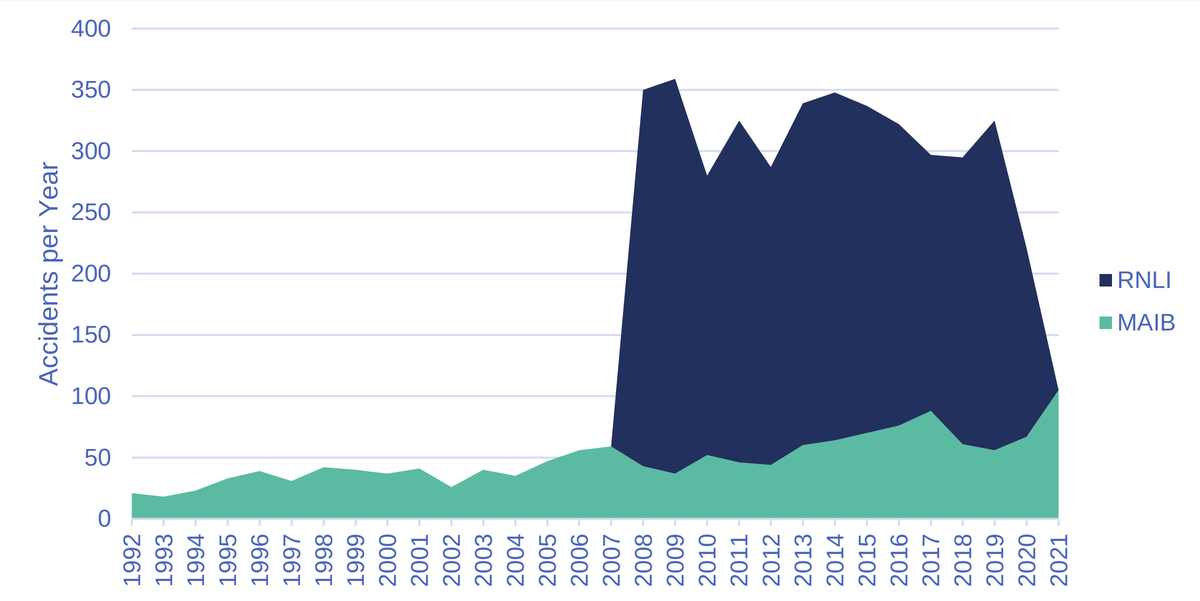


Figure 35: Incidents per year (note RNLI data applicable 2008 to 2020 only).

The incidents recorded within 10nm of the Project Array Areas is presented in **Table 17** and **Figure 36**. There were 64 incidents recorded within 10nm of the Mona Array Area, 70 for Morgan Array Area and 50 for Morecambe Array Area.

There were five recorded collisions within 10nm of the Morecambe Array Area, three recorded by the MAIB and two by the RNLI. One of the MAIB recorded collisions occurring in 1993 involved a tug and a trawler resulting in material damage to the trawler. The other two collisions did not result in damage to either vessel. One of these involved a Mobile Offshore Drilling Unit (MODU) and a tug occurring in 1993, the other was between a tanker and a fishing vessel in 2000. There were ten near misses recorded within 10nm of the array areas since 2008. Four in Mona, four in Morgan and two in Morecambe Array Areas.

Table 17: Incidents per year within 10NM of Mona, Morgan and Morecambe Array Areas.

Year	All	Within 10nm of Array Areas		
		Mona	Morgan	Morecambe
2008	350	5	8	7
2009	359	6	3	5
2010	280	2	3	2
2011	325	3	6	4
2012	287	5	6	3
2013	339	12	7	3
2014	348	6	8	6
2015	337	1	5	2
2016	322	8	7	5
2017	297	9	5	3
2018	295	1	6	4
2019	325	5	3	4
2020	221	1	2	2
2021	105	0	1	0

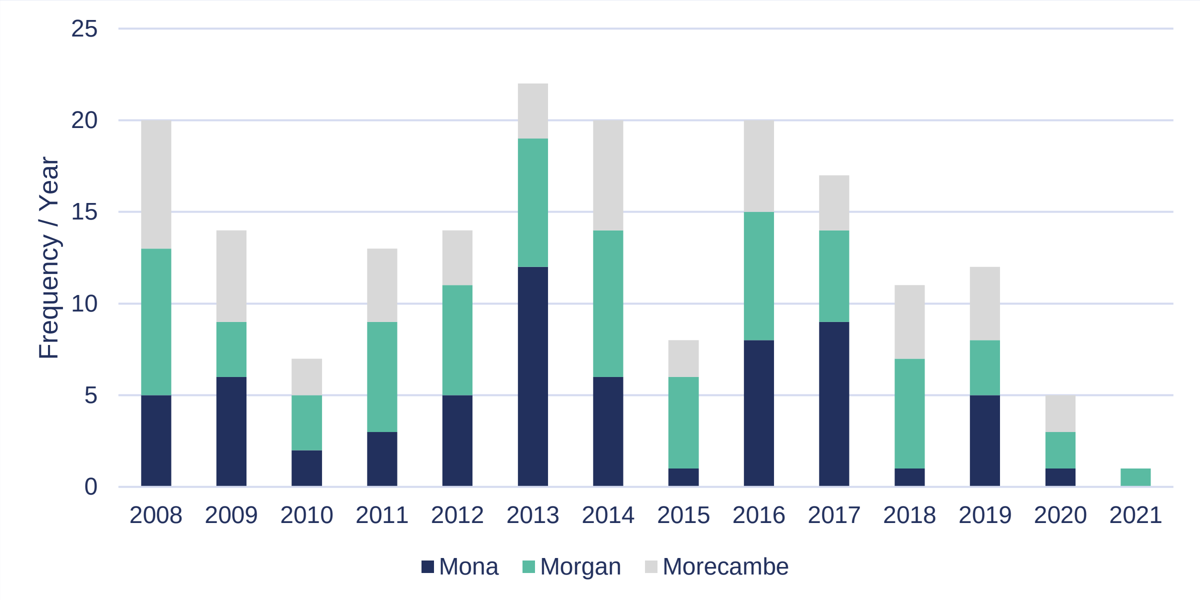


Figure 36: Incidents per year within 10NM of Mona, Morgan and Morecambe.

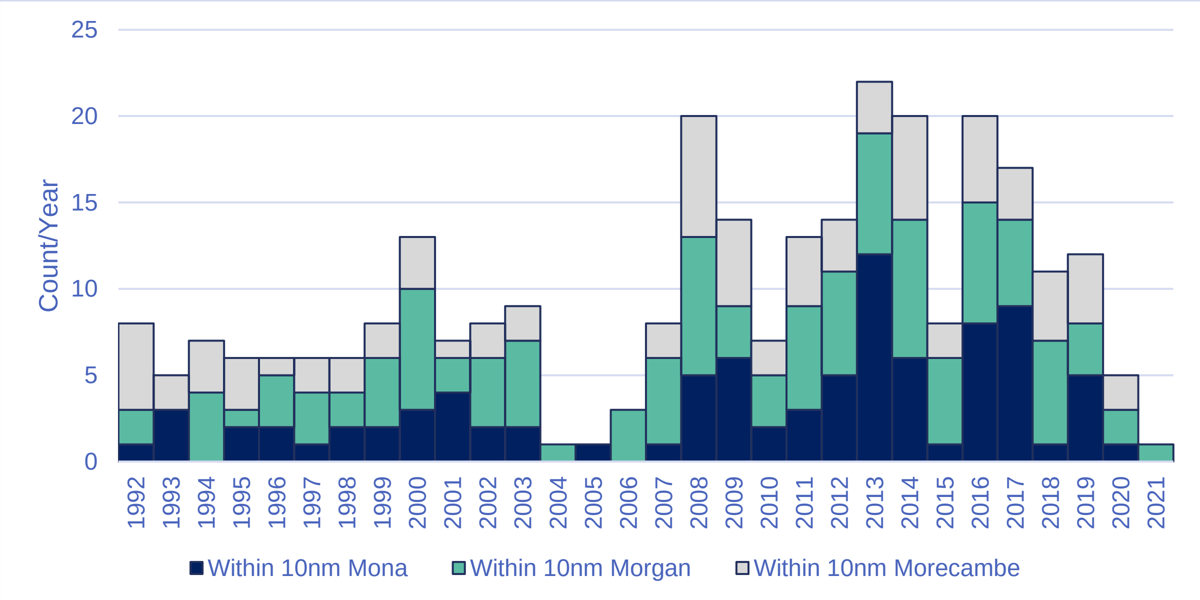


Figure 37: MAIB/RNLI accident frequencies within 10NM per year (2008 to 2020).

Table 18 calculates annual incident rates within 10nm of each array area by vessel type. Due to improved reporting standards and to enable direct comparison of MAIB/RNLI data, this has been limited to the years 2008 and 2020. For all three CRNRA study areas, the most likely incidents per year are fishing and recreational craft involved in “other” incidents (such as mechanical failure, flooding etc.). Very few incidents involve large commercial or passenger vessels or collisions, contacts or groundings.

Table 18: MAIB/RNLI accident frequencies within 10NM of Array Areas per year (2008 to 2020).

	Incident Type	Cargo	Fishing	Fixed Installation	Military	Not Classified	Passenger	Recreational	Tanker	Tug and Service	Total
Mona	Collision	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
	Contact	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
	Grounding	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	**0.08**
	Other	0.31	1.38	0.00	0.00	0.08	0.15	2.54	0.00	0.92	**5.38**
	Total	**0.31**	**1.38**	**0.00**	**0.00**	**0.08**	**0.15**	**2.54**	**0.00**	**1.00**	**5.46**
Morgan	Collision	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
	Contact	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	**0.08**
	Grounding	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00	0.00	**0.08**
	Other	0.15	1.92	0.00	0.00	0.00	0.00	2.08	0.00	0.69	**4.85**
	Total	**0.15**	**1.92**	**0.00**	**0.00**	**0.00**	**0.00**	**2.15**	**0.00**	**0.77**	**5.00**
Morecambe	Collision	0.00	0.08	0.00	0.00	0.00	0.00	0.15	0.00	0.15	**0.38**
	Contact	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.15	**0.15**
	Grounding	0.00	0.08	0.00	0.00	0.00	0.00	0.08	0.00	0.00	**0.15**
	Other	0.08	0.62	0.00	0.00	0.00	0.08	2.31	0.00	0.31	**3.38**
	Total	**0.08**	**0.77**	**0.00**	**0.00**	**0.00**	**0.08**	**2.54**	**0.00**	**0.62**	**4.08**

6.3.3 Consequences of Collision

International studies have explored the consequences of collision between large vessels. The European Maritime Safety Agency (EMSA) (2015) collision risk model developed for their FSA based on historical incidents estimated that 33% of struck roll-on/roll-off passenger (RoPax) vessels would result in water ingress and 14% of those would result in sinking (joint probability of 4.6%). The Maritime Safety Committee (MSC) 85-17-2 FSA gives probabilities of 16% of collisions being a serious casualty of which 50% of struck vessels would flood, of which 22% would sink and a further 50% split between gradual sinking or rapid capsize (joint probability of the latter being 0.8%).

Analysis of MAIB data suggests that approximately 1% of collisions would result in loss of life. However, it is likely as most collisions occur within ports and harbours, vessels are navigating at slower speeds than they may do in open sea. Furthermore, there are relatively few incidents in UK waters of significant loss of life following collisions or allisions involving large commercial shipping or ferries. Collisions between commercial vessels, even at speed, often result in only damage and no pollution or injuries (MAIB 7/2018, 28/2015, 3/2017, 15/2013).

Several consultees noted that a collision between a large commercial ship or ferry with a small craft such as fishing boat would likely to result in the loss of the small craft and multiple fatalities (7/2007, 10/2015). However, a more likely outcome is serious damage to the small craft and either no or minor injuries/pollution (MAIB 4/2019, 16/2015, 20/2011, 17/2011).

During the hazard workshop, some consultees, in particular the IOMSPC, made reference to the highly fragile nature of the Manannan high speed ferry's structural integrity, having been designed for high-speed transit and therefore with aluminium build. Therefore, any collision involving this vessel could have a larger potential consequence than other vessel types.

6.3.4 Consequences of Allision

Given the infrequency at which vessels have collided with wind turbines, there is some uncertainty to the degree of damage that would result from an allision. The degree of damage depends on the vessel characteristics, the type of allision (at speed or drifting), angle of allision (broadside or headon) and the engineering of the wind turbine. Several academic studies using finite element modelling have sought to explore this, including Biehl and Lehmann (2006), VINDPILOT (2008), Dai et al. (2013), Moulas et al. (2017) and Presencia and Shafiee (2018).

These studies suggest that:

- Ship allisions, even at low speeds, can cause significant damage to wind turbines including deformation and buckling
- Some studies of in-field construction/maintenance vessels (up to 4,000 tons), with allisions at high speeds, did not result in wind turbine collapse
- Modelling of allisions with large commercial ships could result in holing of the vessels hull and cargo release

- Larger vessels (30,000 Dead Weight Tonnes DWT) alliding with the turbine might typically result in the tower collapsing away from the vessel.
- However, some studies suggested that large commercial ships could result in the tower collapsing towards the vessel, with the damage likely to penetrate the deck.

To better understand the potential consequences of ship allision with wind turbines, **Table 19** presents some case studies of past incidents and the resulting impacts to people, property and the environment. It can be concluded that where incidents have occurred, they have been at low speed, involve in-field project vessels and typically result in only minor damage or injuries. However, it is feasible that a serious allision with an offshore wind farm might result in turbine collapse, holing and eventual flooding of a vessel and potential loss of life.

Table 19: Case studies of allision.

Date	Site	Vessel	Description
31 January 2022	Hollandse Kust Zuid	Julietta D – 190m 24,196 Gross Tonnes (GT) Bulk Carrier	Disabled vessel in a storm struck the foundation of a substation jacket that result in minor damage to both the vessel and jacket. There were no injuries or pollution.
23 April 2020	Borkrum Riffgrund	Njord Forseti – 24m 137 GT	Vessel skipper not keeping proper lookout collided with wind turbine at speed. Vessel suffered significant structural damage.
10 April 2018	AOWF (Baltic)	Vos Stone – 80m 4,956 GT Offshore Supply Vessel	Construction vessel casting off from a wind turbine lost control and was forced against the wind turbine due to adverse weather. Resulted in 3 minor injuries, dry dock to the vessel and minor damage to platform. There was no pollution.
21 November 2012	Sheringham Shoal	Island Panther – 17m 22 GT CTV	CTV made heavy contact with unlit transition piece. Resulted in 5 injuries and damage to the vessels bow.
23 April 2020	Borkum Riffgrund 1 (Germany)	Njord Forseti – 26m CTV	CTV made heavy contact with wind turbine. Resulted in three injuries (one seriously) and significant flooding of CTV through 0.5m crack in bow.
14 August 2014	Walney	OMS Pollux – Stand By Safety Vessel	Whilst conducting inspection work, the vessel collided with a turbine that resulted in no injuries, and minor leaking of marine gas.
06 October 2006	Scroby Sands	Jack up	Large jackup barge collided with turbine resulting in damage to a turbine blade.

7. FUTURE CASE TRAFFIC PROFILE

This section presents the predicted future case traffic profile within the CRNRA study area for commercial, ferries, oil and gas, fishing and recreational vessel traffic.

7.1 FUTURE CASE (WITHOUT PROJECTS)

7.1.1 Commercial Traffic

DfT data on UK port trade is presented in **Figure 38** and **Figure 39** and show a decline in port freight in 2020 at both the national and port level, respectively. The DfT report that UK ports were affected by measures to prevent and reduce the global spread of Covid-19 throughout 2020, as well as the UK exiting the EU at the end of 2020. The DfT report a 9% decrease in tonnage handled by UK ports in 2020 compared to 2019. However, given the lifting of COVID-19 related restrictions, it is anticipated that port freight will continue to return to pre-pandemic levels.

Port freight activity at the Port of Liverpool steadily increased between 2014 and 2019, before undergoing a significant reduction in 2020, likely due to pandemic related restrictions. It should be noted that an increase in tonnage does not necessarily correlate with an increase in vessels. New build vessels are often larger, capable of carrying more cargo, and ports such as Liverpool have invested in shoreside infrastructure to better handle these larger vessels.

Figure 40 shows projected freight traffic into UK major ports, produced by the DfT in 2019. Overall, port traffic is forecast to remain relatively flat in the short term but grow in the long term, with tonnage 39% higher in 2050 compared to 2016. This equates to approximately a 15% increase in national freight tonnage by 2035.

The long-term growth in port traffic is driven by increases in unitised freight traffic, which compensates for decreases in other freight in the short term. Liquid bulk traffic (principally crude oil) has the largest forecasted decreases, continuing a historical trend. Similarly, general cargo is forecast to decrease, in line with the historic decreasing trend, which is likely driven by increased containerisation of goods. Dry bulk traffic is forecast to have a relatively large decrease in the short term, driven primarily by demand for coal being projected to fall. In the long term, dry bulk traffic is forecast to increase, with other dry bulk, the largest category, continuing to increase as it has done historically (principally biomass). Motor vehicles, twenty-foot equivalent unit (TEU) forecast for lift-on/lift-off (Lo-Lo) and the unit forecast for roll-on/roll-off (Ro-Ro) are all forecast to grow strongly, driven by economic growth.

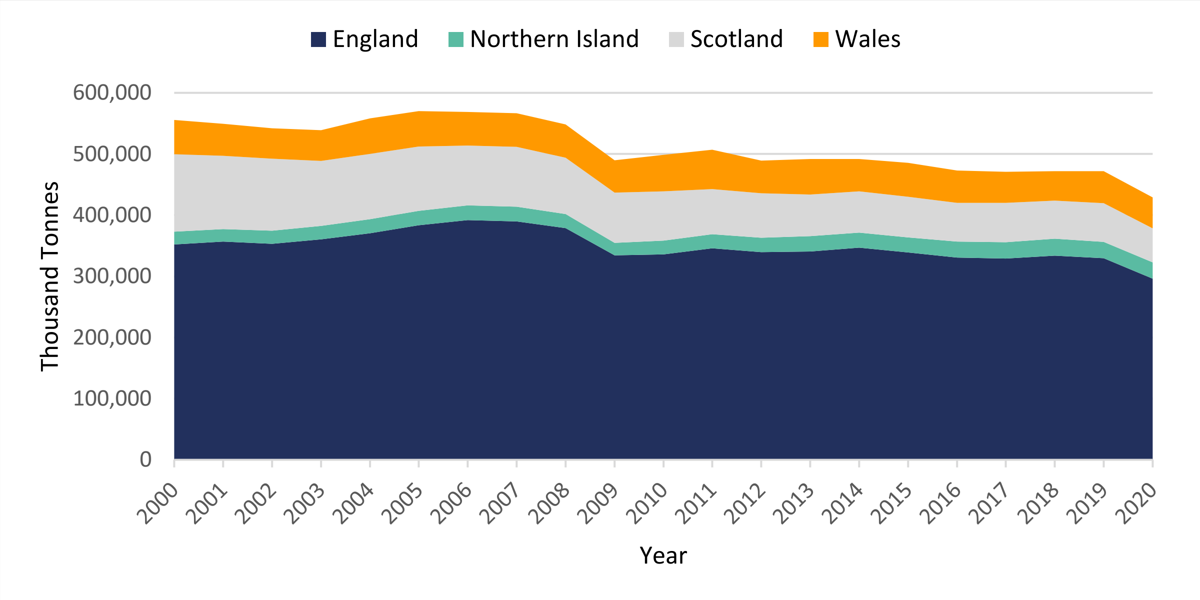


Figure 38 UK major port freight.

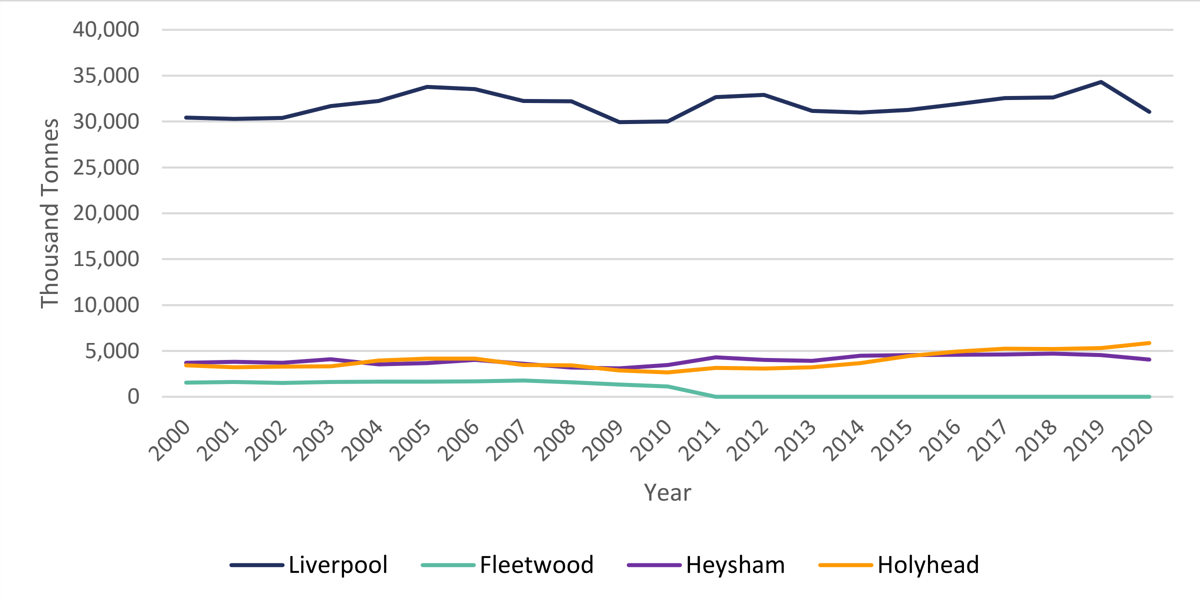


Figure 39 Port freight for UK major ports (Fleetwood ferry service closed at the end of 2010).

It is also noted that the Douglas Harbour Master Plan (2017) considers the potential for development of a day-call cruise ship berth, which might increase the number of cruise ship calls to the Isle of Man[2].

Other future changes that might occur by 2035 could include the increased operation of Autonomous vessels within UK waters. During the course of the NRA, autonomous or remote-controlled survey vessels were active within the array areas and no incidents were recorded.

[2] https://www.gov.im/media/1360794/harbours-strategy-technical-information-gd2018-0012.pdf.

Regulatory bodies have insisted that any introduction of autonomous vessels into UK waters would have equivalent safety standards as conventional crewed vessels.

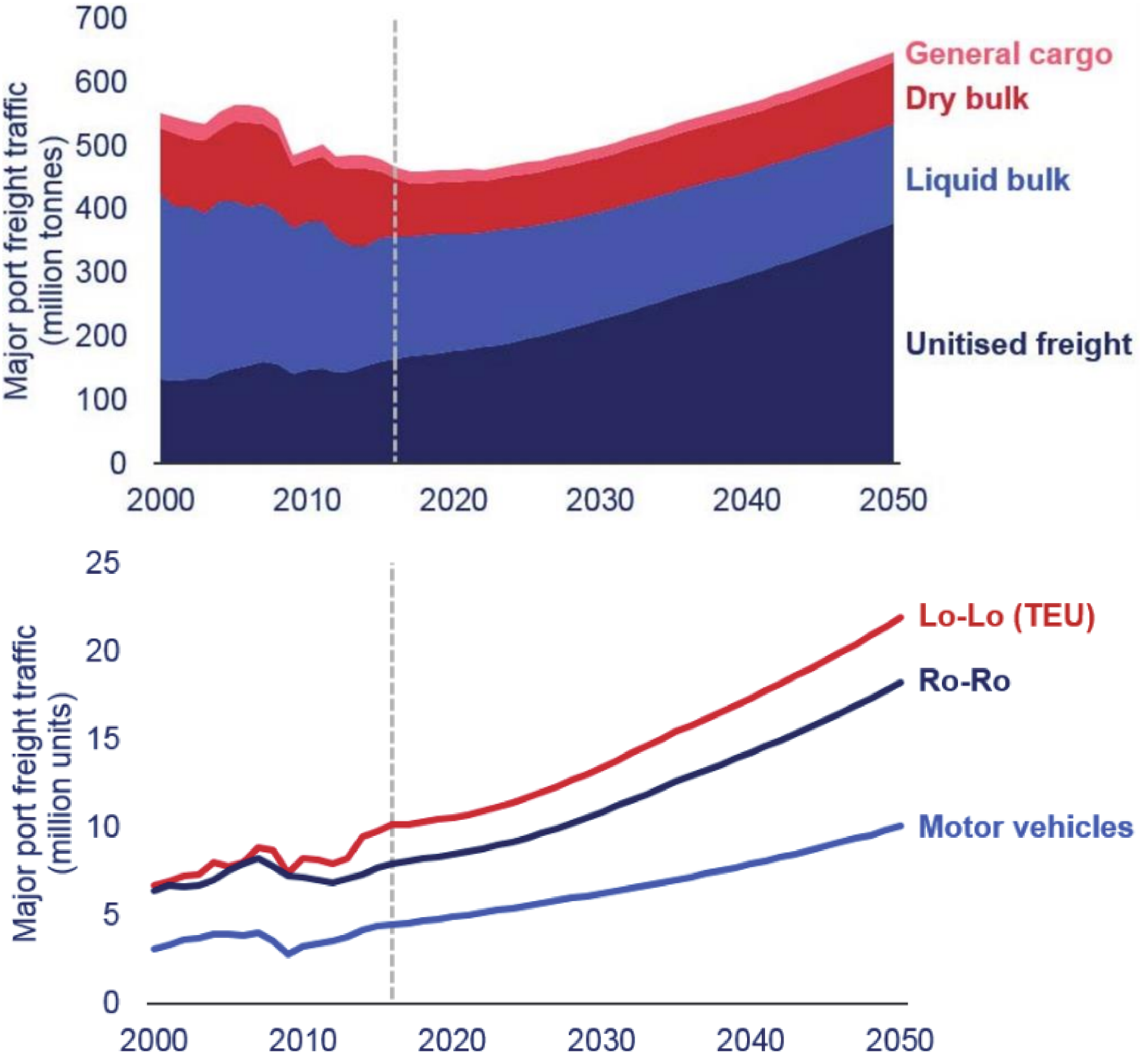


Figure 40: UK port freight projections (DfT, 2019).

7.1.2 Ferries

Freight and passenger ferries account for a large proportion of vessel movements within the CRNRA study area. These routes are subject to change both in terms of schedule, vessels and the addition of new routes in order to meet market demand. For example, between the 2019 AIS analysis and the 2022 NRA, Stena replaced several of their ferries with the new E-flex class. During consultation, each operator was asked on any potential future changes, noting that these were subject to change.

Seatruck have showed significant growth in demand, in 2018, Seatruck reported a 30% increase in volumes since 2015, with a 10% increase in 2017 alone[3]. The increase in

[3] https://www.seatruckferries.com/news/seatruck-surge-continues.

unaccompanied trailer volumes between 2007 and 2018 was reportedly 250%[4]. A €100 million investment by Seatruck in 2018 was announced to increase capacity on the Warrenpoint to Heysham route by 30%.

Both of the IoMSPC vessels are twenty years old and will require replacement before 2035. The Ben-my-Chree will be replaced by the Manxman, currently undergoing sea trials before being introduced in 2023. Consultation with IoMSPC determined that it is reasonable to assume that the Ben-my-Chree and Manxman will have similar handling and endurance capabilities. The Manannan is due for replacement before 31 December 2026[5]. This may be replaced by either a new fast craft or a fast conventional ferry.

Trends for passenger numbers are shown in **Figure 41** and show a gradual increase in passenger numbers across most routes (noting the exception of those figures impacted by COVID-19). Predicting how this trend may influence vessel schedules and routes is full of uncertainty. Therefore, in the absence of definitive information, an assumption is made that vessel routes and schedules will be similar in 2035 as to the existing basecase.

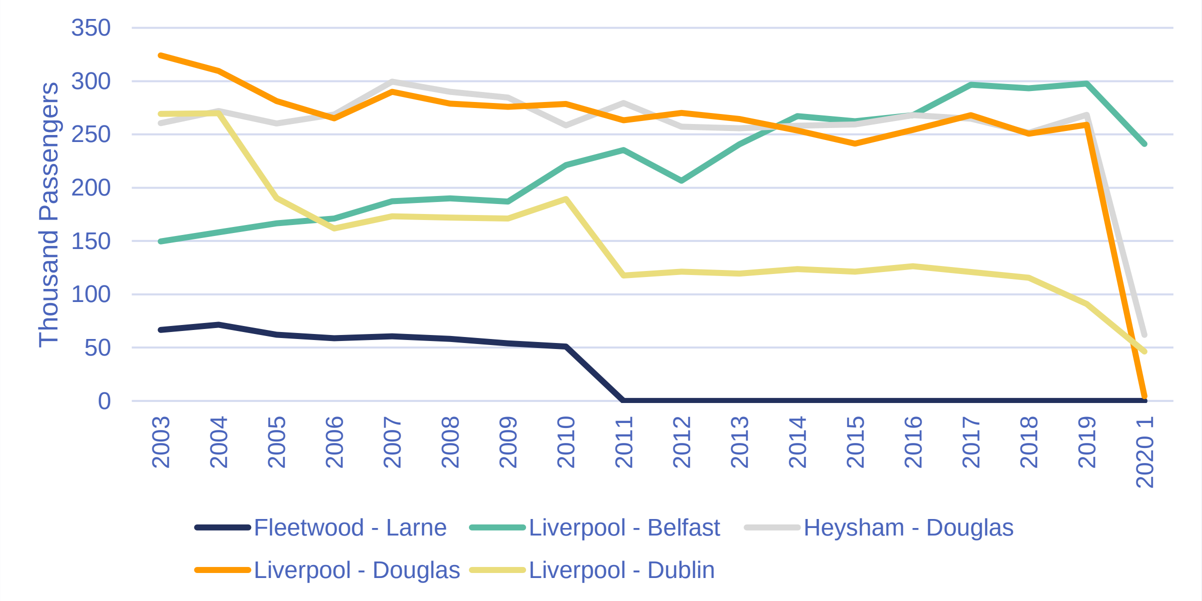


Figure 41 Passenger numbers (Fleetwood ferry service closed at the end of 2010). 2020 figures heavily impacted by COVID-19.

7.1.3 Oil and Gas

Irish Sea oil and gas platforms are reaching end of life and it is understood that some platforms may be decommissioned. Details of which platforms and when have not been fully ascertained by the Project team. It is assumed that:

- Millom West (Harbour Energy) will be decommissioned between quarter 3 2022 to quarter 4 2025

[4] https://www.seatruckferries.com/news/seatruck-boost-capacity-driver-shortages-fuel-unaccompanied-trailer-growth.
[5] https://www.tynwald.org.im/business/opqp/sittings/20182021/2019-GD-0009.pdf.

- The South Morecambe gas field platforms are expected to cease production in 2027 (+/-2 years)). The field includes the platforms DP3, DP4, DP6, DP8 and CPP1 and associated cable, pipeline and umbilical infrastructure. It is understood that DP3 and DP4 were removed in 2021 and decommissioning of CA1 is also scheduled to complete in 2027 onwards.

A related question to Round 4 North Sea and Irish Sea developments is whether oil and gas vessels would navigate through or around an offshore wind farm. It is noted that the International Guidance for Offshore Marine Operations (GOMO) Section 8.15 recommends that courses are planned so that, where practical, the vessel passes at the distance of at least one nm from each facility. However, the familiarity and manoeuvrability of offshore supply ships or Emergency Rescue and Recovery Vessels (ERRVs) may facilitate navigation within large offshore wind farms. This assessment has assumed that there is sufficient space, in suitable conditions, for in-field navigation to take place.

7.1.4 Fishing Activity

There is limited information available for future fishing vessel activity on which reliable assumptions can be made. Fishing within the Irish Sea is demonstrably important for both the Isle of Man and UK fisheries. However, fishing activity in the area is not anticipated to change significantly by 2035, with both local and foreign vessels continuing fishing activity in the area.

Further detail on this is provided in the individual Project commercial fishing chapters.

7.1.5 Recreational Activity

The RYA Water Sports Participation Survey conducted in 2019 found that the proportion of adults participating in boating activities has fluctuated between 6% and 8% between 2002 and 2018. Between 2008 and 2018, the proportion participating in yacht cruising, motor boating and power boating have remained consistent at 0.8%, 1.1% and 0.7% respectively. More recent data published in the 2021 Water Sports Participation Survey is significantly influenced by COVID-19 with a significant variation between 2021 and 2022 due to national/local lockdowns.

Therefore, it is unlikely that there will be a significant change in the number of recreational users due to macro trends.

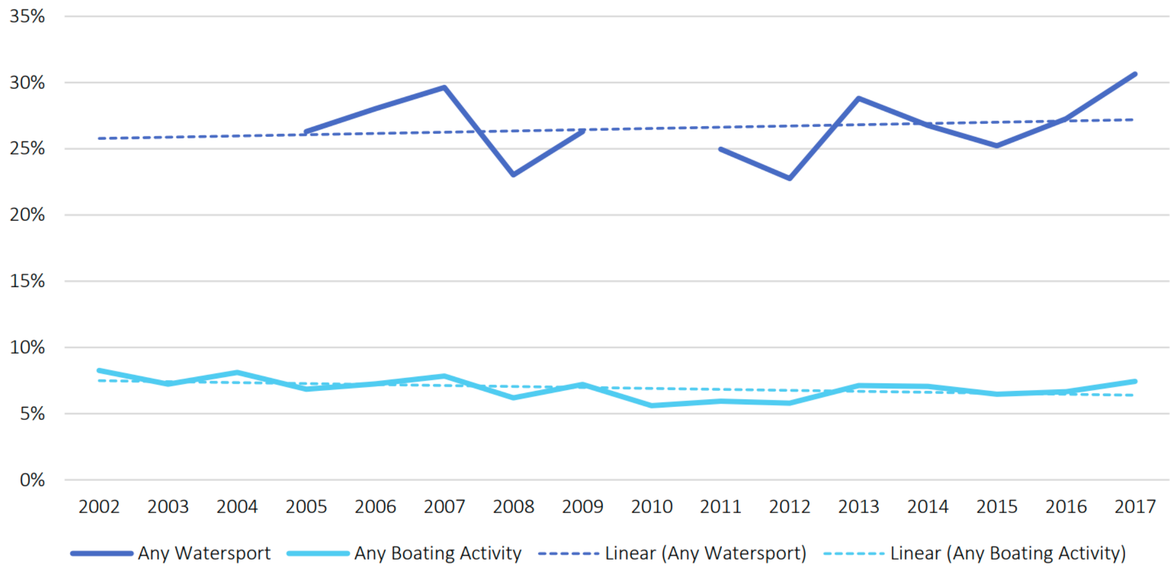


Figure 42: RYA boating participation survey.

7.2 PROJECT VESSEL MOVEMENTS

The operations and maintenance bases for each of the Projects is not yet known, therefore, assumptions have been made in the MDS as follows in order to provide a basis of where transits will be placed across the CRNRA study area:

- **Morgan** – 2,351 vessel movements per year from northwest England
- **Mona -** 2,351 vessel movements per year from North Wales or Northwest England
- **Morecambe** – 776 vessel movements per year from northwest England.

7.3 REALISTIC TRAFFIC SCENARIOS

Given the results of this analysis and the traffic surveys, the following realistic traffic scenarios shown in **Table 20** are envisaged for the seven areas in which distinct hazards and impacts are identified (excluding the internal array areas).

Table 20: Realistic traffic scenarios.

Corridor	Scenario	Potential Traffic Situation Encountered by a Transiting Vessel	Justification
Mona-Morgan	Reasonable Day to Day Situation (<50% transits)	2 ferries 1 fishing vessel	Ferries: Reasonable likelihood of meeting another ferry (Seatruck/IoMSPC/Stena) between Mona-Morgan. Potential for up to 3 ferries to converge on corridor. Commercial: Anticipated to take TSS and pass Southwest of Mona Array Area. Some small general cargo <150m may occasionally navigate between Project Array Areas, but infrequently. Tug and Service: Repositioning of standby vessels possible. Fishing: Occasional fishing around Project Array Areas. Radar survey recorded up to 2 fishing boats during summer survey in Project Array Areas. Recreational: Radar surveys showed relatively little recreational in central Irish Sea. Up to 2 recreational craft crossing through site per day from summer surveys (noting negligible during winter survey). Project Vessels: Unlikely to pass through Mona-Morgan corridor.
	Unlikely but Occasional Situation (<10% transits)	2 ferries 1 tug and service 1 fishing vessel	
	Reasonable Worst Credible (<1% transits)	3 ferries 1 commercial vessel 1 tug and service vessel 2 fishing vessels 2 recreational vessels	
Mona Morecambe	Reasonable Day to Day Situation (<50% transits)	2 ferries 1 Tug and Service (stationary) vessel 1 Fishing vessel	Ferries: Reasonable likelihood of meeting another ferry (IoMSPC/Stena) between Mona-Morecambe. Reasonable potential for up to 2 ferries to converge on corridor. Commercial: Anticipated to take TSS and pass southwest of Mona Array Area. Some small general cargo <150m may occasionally navigate between Project Array Areas, but infrequently. Tug and Service: Repositioning of standby vessels possible and loitering around existing Hamilton/Conwy fields southeast of Mona Array Area.
	Unlikely but Occasional Situation (<10% transits)	2 ferries 1 Commercial vessel 2 Tug and Service (stationary) vessels 1 Fishing vessel 1 Recreational vessel	

Corridor	Scenario	Potential Traffic Situation Encountered by a Transiting Vessel	Justification
	Reasonable Worst Credible (<1% transits)	3 ferries 2 commercial vessel 2 tug and Service (stationary) vessels 2 fishing vessels 2 recreational vessels	Fishing: Occasional fishing around Project Array Areas. Radar survey recorded up to 2 fishing boats during summer survey in Project Array Areas. Recreational: Radar surveys showed relatively little recreational in central Irish Sea. Up to 2 recreational craft crossing through site per day from summer surveys (noting negligible during winter survey). Project Vessels: Unlikely to pass through Mona-Morecambe corridor.
Morgan Walney	Reasonable Day to Day Situation (<50% transits)	1 ferry 1 tug and service (stationary) vessel 1 fishing vessel	Ferries: Unlikely to meet another ferry (IoMSPC vs Stena), given Stena's infrequent transit to E of IoM. Commercial: AIS analysis showed minimal passage to west of Walney (less than once per day). Tug and Service: Repositioning of standby vessels possible and loitering around existing Millom Field. Fishing: Occasional fishing around Project Array Areas. Radar survey recorded up to 2 fishing boats during summer survey in Project Array Areas. Significantly greater density within IoM waters to northwest of Morgan Array Area. Recreational: Radar surveys showed relatively little recreational in central Irish Sea. Up to 2 recreational craft crossing through site per day from summer surveys (noting negligible during winter survey). Project Vessels: Morgan Project CTVs likely to cross corridor or transit through it, generally together or in a convoy. Likely that passage does not coincide with this activity.
	Unlikely but Occasional Situation (<10% transits)	2 ferries 1 tug and service (stationary) vessel 1 fishing vessel 1 recreational vessel	
	Reasonable Worst Credible (<1% transits)	2 ferries 1 commercial vessel 1 tug and service (stationary) vessel 2 fishing vessels 2 recreational vessels 6 Project vessel crossings	
East Morecambe	Reasonable Day to Day Situation (<50% transits)	No traffic	Ferries: Current adverse weather passage plans can take ferries through the Morecambe Array Area (once or twice a year), unlikely to continue with Project Array Area in place. Commercial: AIS analysis showed minimal passage to east of Morecambe Array Area. Considered less likely in future case given reduced searoom. Tug and Service: Repositioning of standby vessels possible from Morecambe fields.
	Unlikely but Occasional Situation (<10% transits)	1 fishing vessel 1 recreational vessel 1 tug and service vessel 2 Project vessel crossings	

Corridor	Scenario	Potential Traffic Situation Encountered by a Transiting Vessel	Justification
	Reasonable Worst Credible (<1% transits)	1 tug and service vessel 2 fishing vessels 2 recreational vessels 2 Project vessel crossings	Fishing: Occasional fishing around Project Array Areas. Radar survey recorded up to 2 fishing boats during summer survey in Project Array Areas. Significantly greater density within Isle of Man waters to northwest of Morgan Array Area. Recreational: Radar surveys showed relatively little recreational in central Irish Sea. Up to 2 recreational craft crossing through site per day from summer surveys (noting negligible during winter survey). Project Vessels: Morecambe CTVs likely to cross to east. Likely that passage does not coincide with this activity.
South Mona	Reasonable Day to Day Situation (<50% transits)	2 ferries 3 commercial vessels 1 service vessel 1 fishing vessel	Ferries: Confluence of Stena/P&O routes, likely to meet another ferry, albeit separated between routes from Anglesey/IoM. Commercial: Major shipping route through TSSs. Likely to meet multiple ships. Tug and Service: Movement of tug and service craft into Liverpool or between the oil and gas fields may be encountered. Fishing: Occasional fishing around Project Array Areas. Radar survey recorded up to 2 fishing boats during summer survey in Project Array Areas. Recreational: Radar surveys showed relatively little recreational in central Irish Sea, concentrated inshore to south. Up to 2 recreational craft crossing through site per day from summer surveys (noting negligible during winter survey). Likely to keep clear of shipping lanes, and further inshore. Project Vessels: Mona CTVs likely to cross corridor or transit through it, generally together or in a convoy. Likely that passage does not coincide with this activity.
	Unlikely but Occasional Situation (<10% transits)	2 ferries 5 commercial vessels 1 tug and service vessel 1 fishing 1 recreational 6 Project vessel crossings	
	Reasonable Worst Credible (<1% transits)	3 ferries 8 commercial vessels 1 tug and service vessel 2 fishing vessels 2 recreational vessels 6 Project vessel crossings	

8. CUMULATIVE IMPACT ASSESSMENT

8.1 IMPACT IDENTIFICATION

Following consultation with stakeholders, analysis of data and a review of guidance, 11 potential impacts of the Project were identified on shipping and navigation, as relevant from the cumulative perspective for the CRNRA and are documented in **Table 21**.

Table 21: Impact identification.

ID	Impact	Description
1	Impact to recognised sea lanes essential to international navigation	The Projects could impede access into major international sea lanes.
2	Impact of arrays on ferry routeing	The Projects could necessitate deviations to ferry routeing increasing distances resulting in additional cost and time for the passage.
3	Impact of arrays on commercial vessel routeing	The Projects could adversely impact routeing of commercial vessels, making services unviable.
4	Impact of arrays on small craft routeing	The Projects could interfere with the activities and safety of small craft navigation such as cruising.
5	Impact of design on transit corridors	The Projects could result in corridors between them that fail to meet guidance of industry best practice.
6	Impact of arrays on collision risk	The Projects could increase the risk of collision between navigating vessels, such as through the creation of choke points or increased vessel movements.
7	Impact of arrays on allision risk	The presence of the Projects could increase the risk of allision or contact between navigating vessels and surface structures.
8	Impact of arrays on vessel emergency response	The Projects could adversely impact a vessels ability to respond to an emergency.
9	Impact of arrays on search and rescue	The Projects design could inhibit search and rescue access for vessels or aircraft during an emergency.
10	Impacts of arrays on oil and gas activities and safety	The Projects could disrupt or impede oil and gas activities or safety of installations or vessels.
11	Impact of arrays on communications, radar and positioning systems	The Projects infrastructure could interfere with shipboard or land-based equipment essential to communications or positioning.

Additional impacts have been identified that relate to the construction or operation of the windfarm as well as the activities of operations and maintenance vessels which are considered within the individual Project NRAs. Furthermore, three other impacts were identified by stakeholders, which are not considered within the scope of the NRA as described below:

- **Socio-economic effects due to disruption of ferry or commercial services**. Several stakeholders raised concerns on how cancellation or disruption to services as a result of increased steaming time could impact the Isle of Man through the transport of goods in a Just-In-Time economy, medical supplies and tourists or business travellers amongst others. This is considered separately within the PEIR chapters for each Project and will be assessed further, as required, within the Environmental Statement.

- **Environmental effects**. The presence of the offshore wind farm increases the travel distance of vessels which increases their fuel consumption and emissions of greenhouse gases. Measures such as the Energy Efficiency eXisting ship Index (EEXI) introduced by the IMO could therefore be impacted. This is considered separately within the PEIR chapters for each Project and will be assessed further, as required, within the Environmental Statement.
- **Optioneering for future routes**. The presence of the offshore wind farm reduces the opportunities for operators to develop new routes where market conditions allow, by increasing the transit distance and makes them less competitive. This is considered separately within the PEIR chapters for each Project and will be assessed further, as required, within the Environmental Statement.

8.2 IMPACT TO RECOGNISED SEA LANES ESSENTIAL TO INTERNATIONAL NAVIGATION

United Nations Convention on the Law of the Sea (UNCLOS) Article 60, NPS EN-3 and the Electricity Act 1989 recognise that Projects should not interfere with the use of recognised sea lanes essential to international navigation.

The TSS Liverpool Bay and TSS Off Skerries are promulgated and provide the only route for large ships into Liverpool so would meet the definitions as sea lanes essential to international navigation. The Mona Array Area is located immediately to the northwest of the Liverpool TSS at 1.7nm distance, albeit by extending the limits of the traffic lane westward, the lateral distance is 1.5nm. This is substantially further than the 0.5nm separation from Gwynt-y-Mor offshore wind farm.

Figure 43 identifies the 2019 vessel tracks navigating the TSS. With the Mona Array Area in place, the majority of tracks from the west Off Skerries TSS would pass clear to the southwest of Mona Array Area with no direct impact. For those arriving from the northwest, they would necessarily deviate to the southwest of Mona Array Area, but have continued access into Liverpool TSS (see **Section 8.3** and **8.4**). Therefore, given that the presence of the Project does not prevent access into Liverpool through the TSS, it is not considered that the requirements of safeguarding sea lanes essential to international navigation are breached. Passage adjacent to an offshore wind farm poses increased risk of collision or allision as described in the following sections.

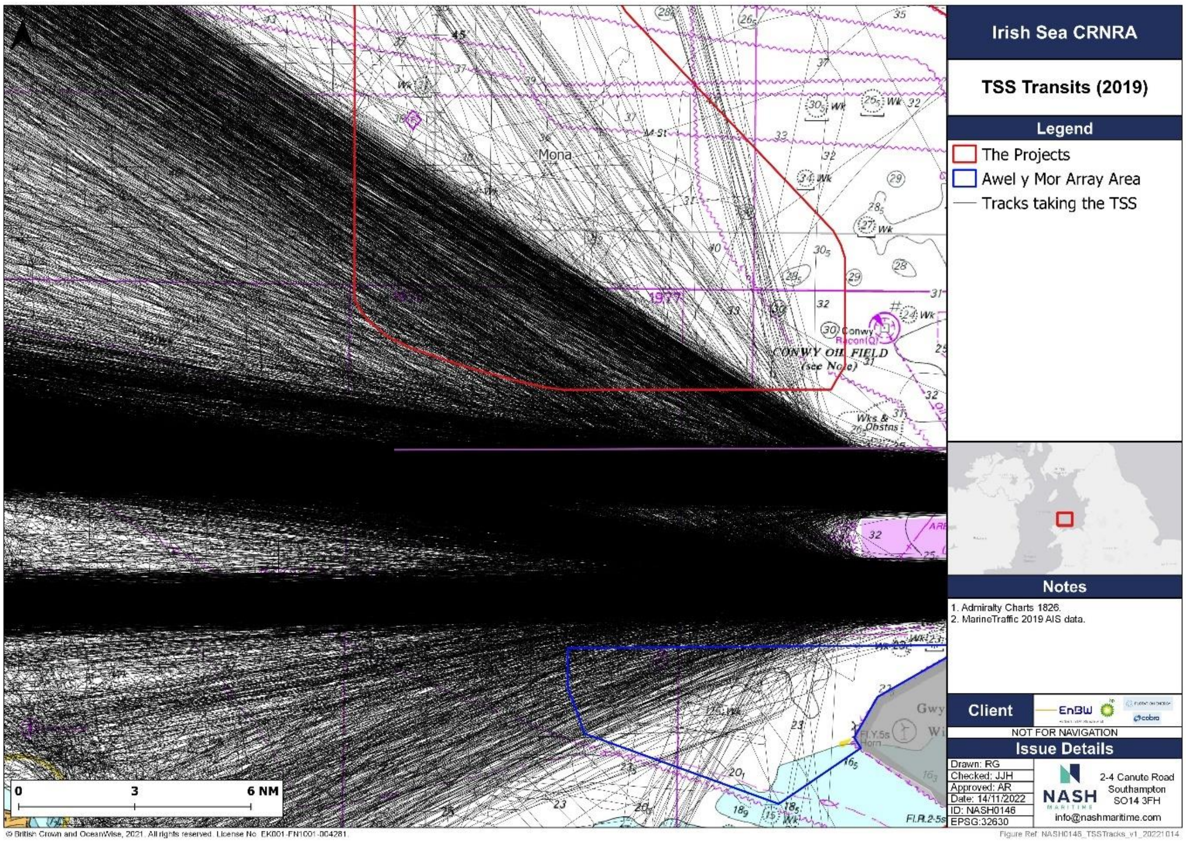


Figure 43: Tracks of vessels using Liverpool TSS.

During consultation, several stakeholders asserted that historic routes between two ports are necessarily "recognised sea lanes" and therefore could not be impacted. A review of UNCLOS Article 22 determines that: "*4. The coastal State shall clearly indicate such sea lanes and traffic separation schemes on charts to which due publicity shall be given*". Therefore, the onus is on the MCA to put forward a proposed sea lane to IMO who would formally designate it. Given that this has not occurred, and no such routes are indicated on charts, Article 60 and NPS EN-3 2.6.161 would not apply. Furthermore, given that alternative routes exist around the offshore wind farms, albeit at a greater transit distance (see **Section 8.3** and **8.4**), they do not provide unique access and so cannot be regarded as "essential". These principals set out in legal advice concerning the Thanet Extension offshore wind farm and were reaffirmed by the Examining Authority in their Recommendation Report[6]. In addition, it is notable that historic wind farms within the Irish Sea (such as West of Duddon Sands) have impacted upon these same routes, without being refused consent under the Electricity Act 1989 Section 36B.

[6] THANET EXTENSION OFFSHORE WIND FARM Examining Authority's Report of Findings and Conclusions and Recommendation to the Secretary of State for Business, Energy & Industrial Strategy.

8.3 IMPACT OF ARRAYS ON FERRY VESSEL ROUTEING

8.3.1 Introduction

offshore wind farms can impact on vessel routeing by creating an obstacle in otherwise navigable waters that requires a deviation of their route. For regular runners such as ferries, this has the potential to result in a significant increase in costs or make schedules unviable. Furthermore, impacts on routeing may result in increased risks, which are considered in **Sections 8.7** and **8.8**. During consultation, ferry operators raised several existing operational constraints which should be considered in conjunction with the increased distance to clear an offshore wind farm:

- **Schedules**: Existing schedules are developed to maintain consistent arrival and departure times per 24-hour period. This may not be achievable with increased transit time on some routes
- **Increased fuel**: Increased transit distance necessitates an increase in fuel burn which has a direct additional cost to operators. Furthermore, this would increase the environmental impact of their operations through increased emissions
- **Hours of Rest**: The Maritime Labour Convention requires ten hours of rest in any 24-hour period, in a maximum of two periods, of which at least six hours must be uninterrupted. Existing schedules enable this requirement to be met, but increased transit duration could make compliance with the convention impossible without compromising schedules or hiring additional crew
- **Safe Manning**: Navigation in narrow corridors between offshore wind farms could be treated as constrained navigation and require additional senior officer presence on the bridge for greater proportions of crossings
- **Reduced Vessel Speed**: Vessels operating in narrow corridors, performing additional turns or encountering other vessels more frequently may need to reduce speed, compounding any additional transit distance on vessel schedules
- **Turn-around times**: Turn around times within ports are constrained to enable safe loading and unloading. During busy periods, it may not be possible to reduce this duration to make up lost time due to increased transit duration
- **Berth/port constraints**: Several ports have clear operational constraints where delays might result in missing crucial arrival windows:
    - **Heysham** – Has a tight entrance, which in combination with strong tides and wind conditions, makes berthing challenging. The harbour is also dredged but

occasionally arrival at spring low tides is not achievable with sufficient under keel clearance, requiring amendments to timetables

- **Douglas** – Berthing in certain wind conditions is challenging and may result in cancellations
- **Warrenpoint** – Is also tidally constrained
- **Belfast** – There is a limitation on berths given the number of vessels operating on a route
- **Liverpool** – Constrained by lock timings and other vessel movements
- **Dublin** – Relocation of freight terminals further from the seaward entrance in 2022 would increase transit duration.

8.3.2 Ferry Routeing in Normal Conditions

Passenger or freight ferry services have been identified operating through the CRNRA study area(see **Section 6.2.2.2**). Therefore, the development of these areas would necessitate re-routeing of these ferry services. It is recognised that previous offshore wind projects in the Irish Sea (Barrow, Ormonde, Walney, West of Duddon Sands) have each impacted upon ferry routeing since 2004 (Anatec, 2016). Operators have necessarily had to adjust their passage plans to accommodate previous projects and the nature of these projects has not made any existing routes unviable.

Figure 45 shows the anticipated outline routes that operators would take were the Projects to be in place. These were developed following a review of the current passage plans provided by each operator and a review of the potential impacts of the array areas upon them. Each revised passage plan was developed by the NASH project team, including master mariners, and account for existing decision making principles (such as passing at least 1.5nm from a wind turbine) that were obtained during consultation with operators.

Based on these anticipated routes, **Table 22** summarises the additional transit distance and time as a result of clearing the Projects, given their average vessel speed taken from the 2019 AIS data. This analysis does not quantify any additional effects of the Projects, such as reducing speed in narrow corridors, reduced speed due to increased number of turns or slowing down during vessel encounters. Furthermore, the reduction in speed in adverse weather is discussed in **Section 8.3.3**. The key findings of this analysis are summarised within the following sections.

Stena routes:

- West of IoM: Crossings between Liverpool and Belfast have previously departed the River Mersey and not used the TSS Off Liverpool. A revised passage plan was developed which assumed these vessels would navigate between Mona and Morecambe Array Areas, pass between Mona and Morgan Array Areas before altering course to pass to the southwest of the Isle of Man. The additional distance and service speed would result in approximately seven minutes additional transit time

- East of IoM: Where the vessel chooses to pass to the east of the Isle of Man, they would need to pass either to the east or west of Morgan Array Areas (east of Morgan Array Area is shown in **Figure 45**). The additional distance and service speed would result in approximately 10 to 16 minutes of additional transit time dependent on which route through the Morecambe gas field was taken
- The advertised service is 8 hours, with AIS analysis suggesting that the average crossing duration (limited to the extent of the CRNRA study area) is 255 minutes. There is some variation in transit time but 85% of 2019 trips were within 25 minutes of the average
- 75% of Liverpool turnarounds were within 250-300 minutes and 75% of Belfast turn arounds were within 240-300 minutes (limited to Lagan/Mersey – Forecaster had shorter turnaround times
- Therefore, given the crossing duration of several hours, a natural variation in crossing of up to 25 minutes and natural variation in turn around times of up to 25 minutes, approximately ten minutes of additional transit time is not considered to render this service unviable but could increase pressures on the operator
- Stena operating between Heysham and Belfast is unaffected during normal conditions (transiting between West of Duddon Sands and Barrow).

The **IoMSPC** route between Heysham and Douglas:

- Would necessarily pass between Morgan and Walney Array Areas, with a small alteration of course to clear the north of the Morgan Array Area. The additional distance and service speed would result in less than four minutes additional transit time
- The advertised service is 3:45 hours, with AIS analysis suggesting that the average crossing duration is 180 minutes. There is some variation in transit time but 95% of 2019 trips were within 20 minutes of the average
- Heysham and Douglas turn around times vary, with 75% between 100 and 140 minutes (excluding overnight layovers)
- Therefore, given the crossing duration of several hours, a natural variation in crossing of up to 20 minutes and natural variation in turn around times of up to 20 minutes, four minutes of additional transit time is not considered to render this service unviable.

The **IoMSPC** route between Liverpool and Douglas:

- The route between Liverpool and Douglas would require a small alteration of course to pass between Mona and Morgan Array Areas, and along the west boundary of Morgan Array Area. The additional distance and service speed would result in less than two minutes additional transit time
- The advertised service is 2:45 hours, with AIS analysis suggesting that the average crossing duration is 136 minutes. There is some variation in transit time but 90% of 2019 trips were within 15 minutes of the average
- Both Liverpool and Douglas turnaround times vary, with 75% between 70 to 110 minutes and 60 to 100 minutes respectively
- Therefore, given the crossing duration of several hours, a natural variation in crossing of up to 15 minutes and natural variation in turnaround times of up to 20 minutes, two minutes of additional transit time is not considered to render this service unviable.

Seatruck routes between Heysham and Ireland:

- Both routes would pass between Mona and Morgan Array Areas, requiring minor alterations of course (amended waypoints) to clear both Projects. The Liverpool route is unaffected by the Projects. The additional distance and service speed would result in less than two minutes additional transit time
- The advertised service is 8 hours, with AIS analysis suggesting that the average crossing duration (limited to the extent of the CRNRA study area) is 257 minutes for Heysham to Warrenpoint and 279 minutes for Heysham to Dublin. There is a large variation in transit time with 70% of 2019 trips were within 25 minutes of the average for Heysham to Warrenpoint and 39% within 20 minutes of the average for Heysham to Dublin
- There was considerable variation in turnaround times in Heysham, with 75% between 240 to 290 minutes for Heysham to Warrenpoint, and 7% within 160 to 260 minutes for Heysham to Dublin
- Therefore, given the crossing duration of several hours, a natural variation in crossing of up to 25 minutes and natural variation in turnaround times of up to 40 minutes, two minutes of additional transit time is not considered to render these services unviable.

P&O routes are not directly affected by the Projects.

Figure 44 summarises the results of modelling of the aforementioned ferry routes to determine the number of crossings per day through each offshore wind farm corridor, given their existing timetables and 2019 metocean conditions. During peak weekdays up to 16 ferries might cross between Mona and Morgan Array Areas (IoMSPC, Stena and Seatruck). The Morgan-Walney corridor is limited to the IoMSPC Heysham-Douglas route and occasional Stena transits and therefore would rarely exceed six per day. The Mona-Morecambe corridor includes both IoMSPC Liverpool-Douglas transits and Stena Liverpool-Belfast transits and therefore would reach ten per day during summer but up to six per day during the winter.

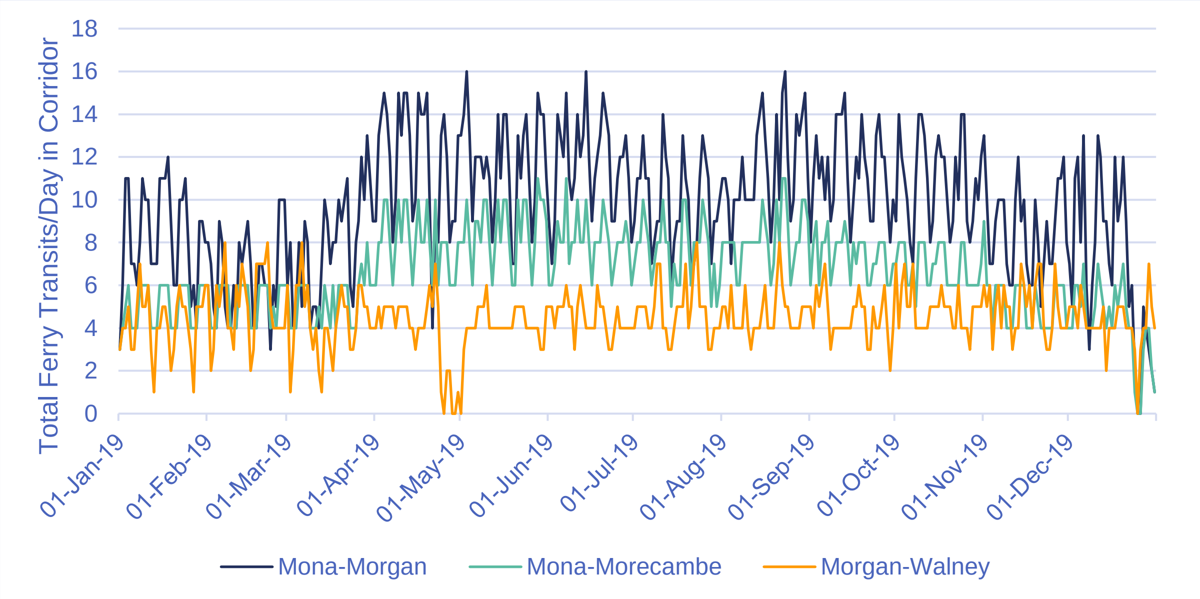


Figure 44: Predicted total daily ferry crossings per corridor.

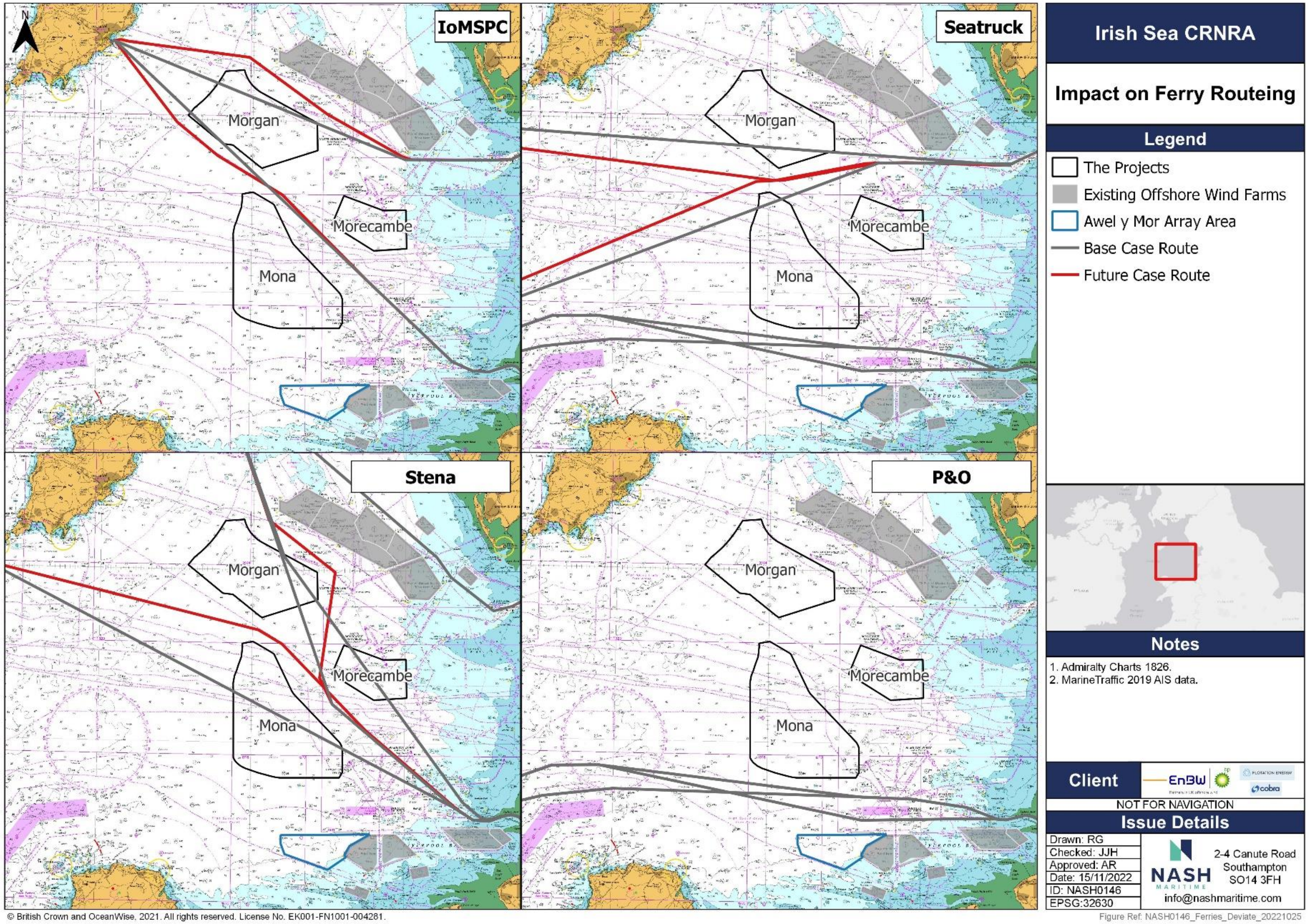


Figure 45: Impact on ferry routeing.

Table 22: Impact on vessel routeing in normal conditions.

<table>
<tr><th>Operator</th><th>Route</th><th>Example Vessels (2019 to 2022)</th><th>Approximate Annual Crossings (2019)</th><th>Baseline Distance (nm)</th><th>Baseline Time (Minutes)</th><th>Service Speed (Knots)</th><th>Project Distance</th><th>Additional Project Time (Minutes)</th></tr>
<tr><td rowspan="3">IoMSPC</td><td>HEY – DOUG</td><td>Ben-my-Chree</td><td>1,286</td><td>60.1</td><td>225</td><td>17.2</td><td>61.1</td><td>+3.5</td></tr>
<tr><td>LIV – DOUG</td><td>Manannan</td><td>628</td><td>71.5</td><td>165.0</td><td>28.8</td><td>71.9</td><td>+0.8</td></tr>
<tr><td>LIV – DOUG</td><td>Ben-my-Chree</td><td>46</td><td>71.5</td><td>165.0</td><td>17.2</td><td>71.9</td><td>+1.4</td></tr>
<tr><td rowspan="4">Stena</td><td>LIV – BEL W</td><td rowspan="3">Stena Edda
Stena Embla
Stena Mersey
Stena Horizon
Stena Lagan
Stena Forecaster
Stena Forerunner</td><td>1,442</td><td>142.3</td><td rowspan="3">480.0</td><td rowspan="3">18.7</td><td>144.4</td><td>+6.7</td></tr>
<tr><td>LIV – BEL E
(E of Calder)</td><td>153</td><td>141.7</td><td rowspan="2">146.6</td><td>+15.7</td></tr>
<tr><td>LIV – BEL E
(W of Calder)</td><td>200</td><td>143.6</td><td>+9.6</td></tr>
<tr><td>HEY – BEL</td><td>Stena Hibernia
Stena Scotia</td><td>1,150</td><td colspan="5">No change</td></tr>
<tr><td rowspan="3">Seatruck</td><td>HEY – WAR</td><td>Seatruck Performance
Seatruck Precision</td><td>967</td><td>100.2</td><td>480.0</td><td>15.4</td><td>100.7</td><td>+1.9</td></tr>
<tr><td>HEY – DUB</td><td>Seatruck Pace
Seatruck Panorama</td><td>523</td><td>107.0</td><td>480.0</td><td>15</td><td>107.4</td><td>+1.6</td></tr>
<tr><td>LIV-DUB</td><td>Seatruck Pace
Seatruck Power
Seatruck Panorama
Seatruck Progress</td><td>1,800</td><td colspan="5" rowspan="2">No change</td></tr>
<tr><td>P&O</td><td>LIV-DUB</td><td>Mistral
Norbay
Norbank</td><td>1,600</td></tr>
</table>

8.3.3 Ferry Routeing in Adverse Weather

Section 8.3.2 has been limited to an assessment of routeing in normal weather conditions. Where significant adverse weather is encountered, ferries may take less direct routes to take advantage of lees from land masses, avoiding dangerous sea states or minimising the motions onboard. **Figure 46** shows anticipated adverse weather routeing with and without the Projects in situ. The 2019 AIS data has been used to estimate the transit speeds and decision making in adverse weather (**Table 23**). Each revised passage plan was developed by the NASH project team, including master mariners, and account for existing decision-making principles and passage plans where provided by operators (such as passing at least 1.5nm from a wind turbine) that were obtained during consultation with operators.

Stena Heysham to Belfast route may choose not to transit between West of Duddon Sands and Barrow and pass to the west of West of Duddon Sands. Within the 2019 data, vessels choosing to do so incurred an additional 67 minutes of transit time. With the Project Array Areas in place, and were the corridor between Morgan and Walney not deemed navigable in adverse weather, they pass to the west of Morgan Array Area before proceeding north (to the east of Isle of Man). This is estimated to incur a further increase in transit times by 52 minutes of transit, a total delay of at least 119 minutes to the normal route. Alternatively, vessels may elect to continue further west and pass to the east of Isle of Man (this is not shown in **Figure 46** as the existing datasets show a dominance of adverse weather routing to the east of Isle of Man).

Stena Liverpool to Belfast routes in adverse weather for transits to the west of Isle of Man tend to trend to the southwest, towards the prevailing conditions. Within the 2019 data, this accounted for an additional 13 to 68 minutes in additional distance and reduced speed. In order to fully clear the Mona Array Area further to the southwest, this would require a further increase in transit times by 24 minutes, although would take advantage of greater shelter from the Welsh coast, a total delay of at least 38 minutes relative to the normal route. In adverse weather, the 2019 data suggests routes to the east of the Isle of Man are used and an updated passage plan is shown in **Figure 46** on this basis with the Project Array Areas in place (passing between Morecambe/Mona and Morgan/Mona Array Areas) although if the corridors between the Project Array Areas are not considered navigable in adverse weather then they may elect to navigate using the west of Isle of Man route described above.

IoMSPC Heysham and Douglas adverse weather routeing accounts for an additional 10 to 23 minutes of journey time, as identified within the 2019 AIS data. Whilst the corridor between Walney and Morgan Array Areas may be sufficient for safe transit, a conservative assumption (informed by bridge navigation simulation) has been made that vessels would choose to pass between Mona and Morgan Array Areas, before transiting to the west of Morgan Array Area. This would necessitate a further increase in transit times by 17 minutes in journey times, a total delay of at least 27 minutes to the normal route.

IoMSPC Liverpool and Douglas adverse weather routeing accounts for an additional 10 to 33 minutes of journey time, as identified within the 2019 AIS data. These transits tend to trend to the southwest and therefore it has been assumed that vessels would pass to the south and west of Mona Array Area. This would necessitate a further increase in transit times by 27 minutes in journey times, a total delay of at least 37 minutes to the normal route, although would take advantage of greater shelter from the Welsh coast. It should be noted during the bridge navigation simulation it was verified that the Mannanan is more sensitive to adverse weather conditions than conventional ro-ro ferries and therefore may be more likely to take adverse weather routes and be impacted by the presence of the Projects.

Seatruck adverse weather routeing was generally limited within the vicinity of the Project Array Areas. Within the 2019 AIS data, tracks diverged approximately where the Mona and Morgan corridors are located. Therefore, the impact of the Project Array Areas on adverse weather routeing is negligible.

The increase in delays during adverse weather has several implications for the vessel schedules that could increase the number of cancellations. This includes hours of rest requirements for the bridge teams and schedule/turn around constraints described above.

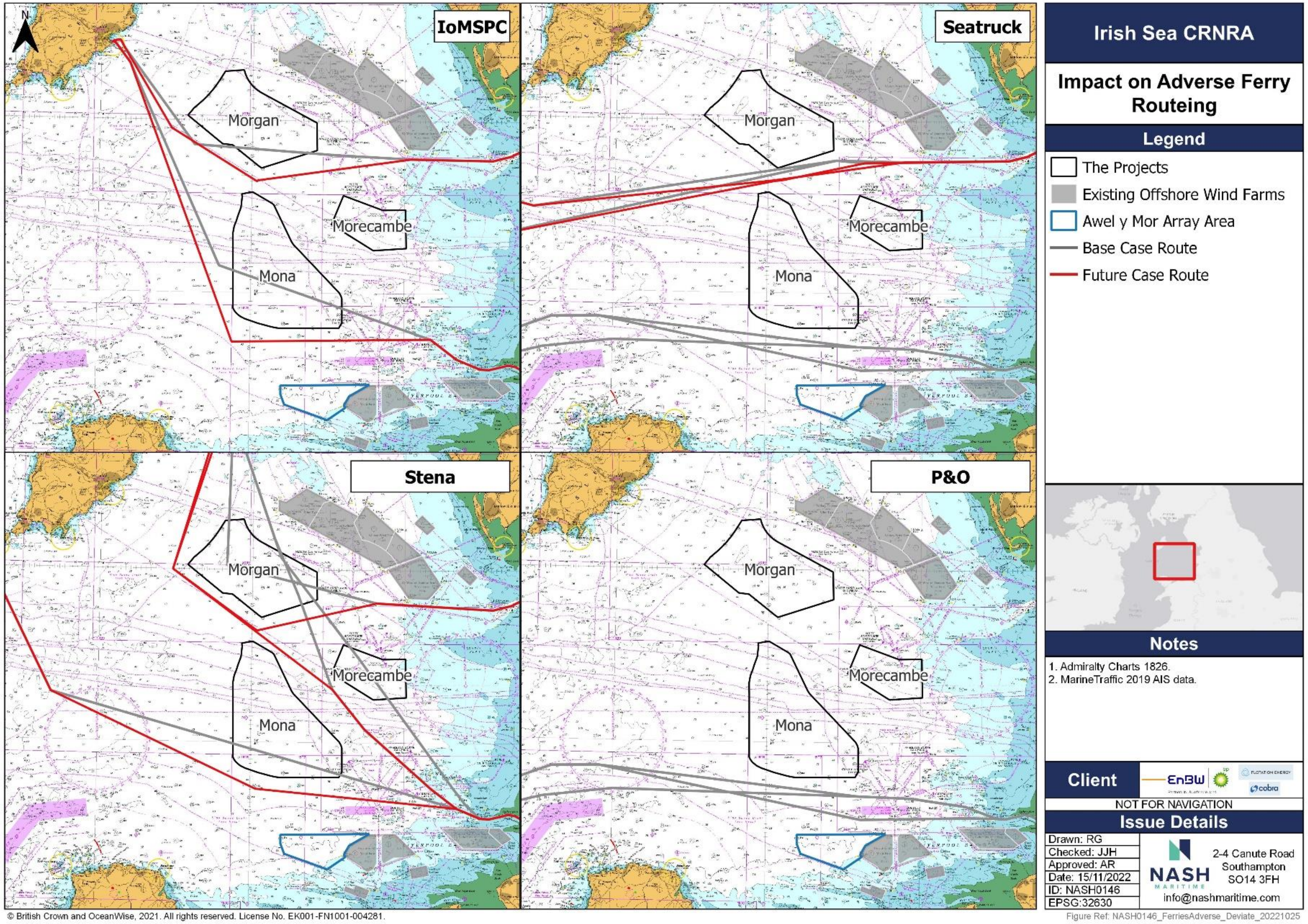


Figure 46: Impact on ferry routes in adverse weather.

Table 23: Number of non-typical vessel transits (outside 95th/99th percentiles) and increased transit duration.

Operator	Route	Example Vessels (2019 to 2022)	Approximate Annual Crossings	Baseline Distance (nm)	Baseline Time (Minutes)	Total Delay Basecase (Minutes)	Project Distance	Additional Project Delays (Minutes)	Total Delay with Projects Will be at Least (Minutes)
IoMSPC	HEY – DOUG	Ben-my-Chree	17	63.5	213-226	+10 to +23	66.9	+17	+27
	LIV – DOUG	Manannan	34	73.5	168-191	+10 to +33	79.4	+27	+37
Stena	LIV – BEL W	Stena Edda Stena Embla Stena Mersey Stena Horizon Stena Lagan Stena Forecaster Stena Forerunner	20	144.4	418-495	+13 to +68	145.9	+24	+38
	LIV – BEL E (W of Calder)		13	141.0	439-460	+0 to +29	152.2	+46	+46
	HEY – BEL	Stena Hibernia Stena Scotia	24	135.3	511	+67	149.1	+52	+119
Seatruck	HEY – WAR	Seatruck Performance Seatruck Precision	44	124.6	476	+27	124.4	+0	+27
	HEY – DUB	Seatruck Pace Seatruck Panorama	27	128.0	505	+28	127.9	+0	+28

During consultation, it was described that the conditions in which ferries would either take adverse weather routes or be cancelled is dependent upon several factors including route, vessel, wind/wave directions, wind speed and wave height. In some instances the bridge team may make decisions on adverse weather routing during passage, making adjustments to parameters such as heading and speed in order to optimise the vessel to conditions and, for example, maintain vessel motions. Therefore, it is not possible to fully quantitatively compare the effects of the Project boundaries on adverse weather routeing. Based on analysis of the conditions in which such routes are taken, the following thresholds have been estimated for which ferries would be impacted:

- IoMSPC Heysham-Douglas (Ben-my-Chree) – Impacted at 2m Hs and cancelled at 3m Hs
- IoMSPC Liverpool-Douglas (Manannan) – Impacted at 1.6m Hs and cancelled at 2m Hs (note that analysis is limited to April-October conditions when high speed services are operating)
- Stena Liverpool-Belfast (E. Isle of Man) – impacted at 2.2m Hs and cancelled at 3.4m Hs
- Remaining Stena and Seatruck routes – impacted at 2.4m Hs and cancelled at 3.4m Hs.

Given the thresholds estimated above, analysis of the Met Office's 1988 to 2021 North West Shelf Model was used to determine the frequency at which these conditions were exceeded in a typical year, but also the years in which they were both most and least exceeded (see **Figure 47**. The results show that the IoMSPC routes are most susceptible to adverse weather routeing and cancellations, compared with the Stena and Seatruck vessels and routes. In particular, the Manannan service is significantly more likely to be cancelled than other ferry services.

Figure 47: Estimated frequency of adverse weather impacts (top) and cancellations (bottom) per route from analysis of 1988 to 2021 North West Shelf MetOffice Model.

Based on the frequency at which adverse weather might be expected (as described in **Figure 47**) and the annual number of ferry trips, the basecase number of cancellations can be estimated. A review of the schedules of these services and constraints in adverse weather events, has identified that were the ferries required to take the lengthier routes around the Project boundaries identified in **Figure 46,** it may result in:

- Loss of one in four crossings due to Projects during adverse weather: Heysham-Douglas and Liverpool-Douglas
- Loss of one in three crossings due to Projects during adverse weather: Liverpool-Belfast, Heysham-Belfast
- Loss of no services due to Projects during adverse weather: Heysham to Warrenpoint, Heysham to Dublin.

Therefore, **Figure 48** increases the estimated base case cancellations by these ratios to provide an initial estimate of the increase in ferry cancellations in adverse weather due to the Project boundaries.

Figure 48: Estimated impact on cancellation frequency.

8.3.4 Summary

Section 8.2 has described how the Projects might impact upon ferry operations and routeing in both normal conditions and adverse weather. Whilst the impacts vary by operator, the results suggest that in normal conditions the additional transit duration is not likely to significantly impact upon ferry operations. However, in adverse weather, the reduced sea room and increased duration of journey, particularly if vessels elect to deviate around all three wind farms, could necessitate additional operational constraints and could result in cancellations to some services.

8.4 IMPACT OF ARRAYS ON COMMERCIAL VESSEL ROUTEING

8.4.1 Introduction

offshore wind farms can impact on vessel routeing by creating an obstruction in otherwise navigable waters that requires a deviation of their route. For commercial vessels this has the potential to result in a significant increase in costs or make schedules unviable. Furthermore, impacts on routeing may result in increased risks, which are considered in **Sections 8.5** and **8.7**.

8.4.2 Commercial Shipping Routeing in Normal Conditions

Figure 49 and **Figure 50** show the anticipated changes in commercial ship routeing. **Table 24** shows the increase distance transited for each of the identified routes in order to clear the Project Array Areas. Each revised passage plan was developed by the NASH project team, including master mariners, and account for existing decision making principals (such as passing at least 1.5nm from a wind turbine).

The most significant shipping routes in the CRNRA study area (less than one vessel per day) are between Off Skerries TSS and Liverpool Bay TSS. These are relatively unaffected by the Projects with no additional transit duration. The routes from the west of the Isle of Man and Liverpool Bay TSS would necessitate a minor deviation around the southwest corner of Mona Array Area, however this would be less than 0.5nm.

Less trafficked routes are more dispersed within the CRNRA study area and therefore greater deviations are encountered. The most impacted route is between Off Skerries TSS and Heysham with an additional 5.9nm of steaming above 51.7nm within the CRNRA study area. However, less than one vessel per week utilises this route. The majority of other effected routes are of similarly low intensity and typically are routeing through the Mona and Morgan corridor or deviating to the southwest of Mona Array Area. Some routes have minor reductions in distance where less direct routes routinely used to avoid traffic or weather are no longer possible. Furthermore, this necessitates greater course changes to pass between the Project Array Areas, or as is the case for Route 15a, necessitates not utilising the Liverpool TSS when they previous would have.

Given the low intensity of the most impacted routes, their greater distance travelled and the lower criticality of their schedules, provided the corridors between the Projects are safe, these impacts are unlikely to make their operations unviable.

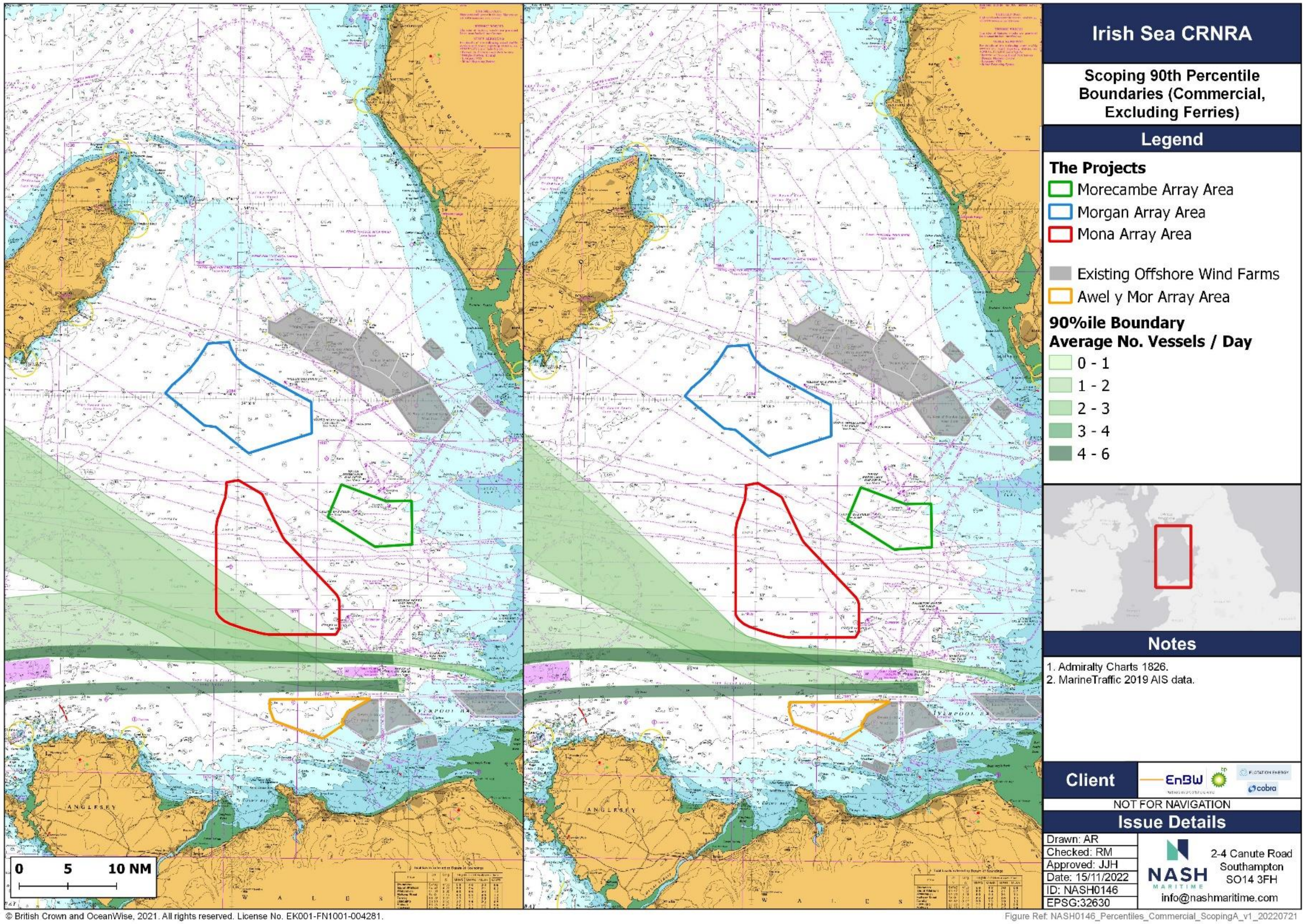


Figure 49: Change in commercial shipping routes with Projects Array Areas (>1/day).

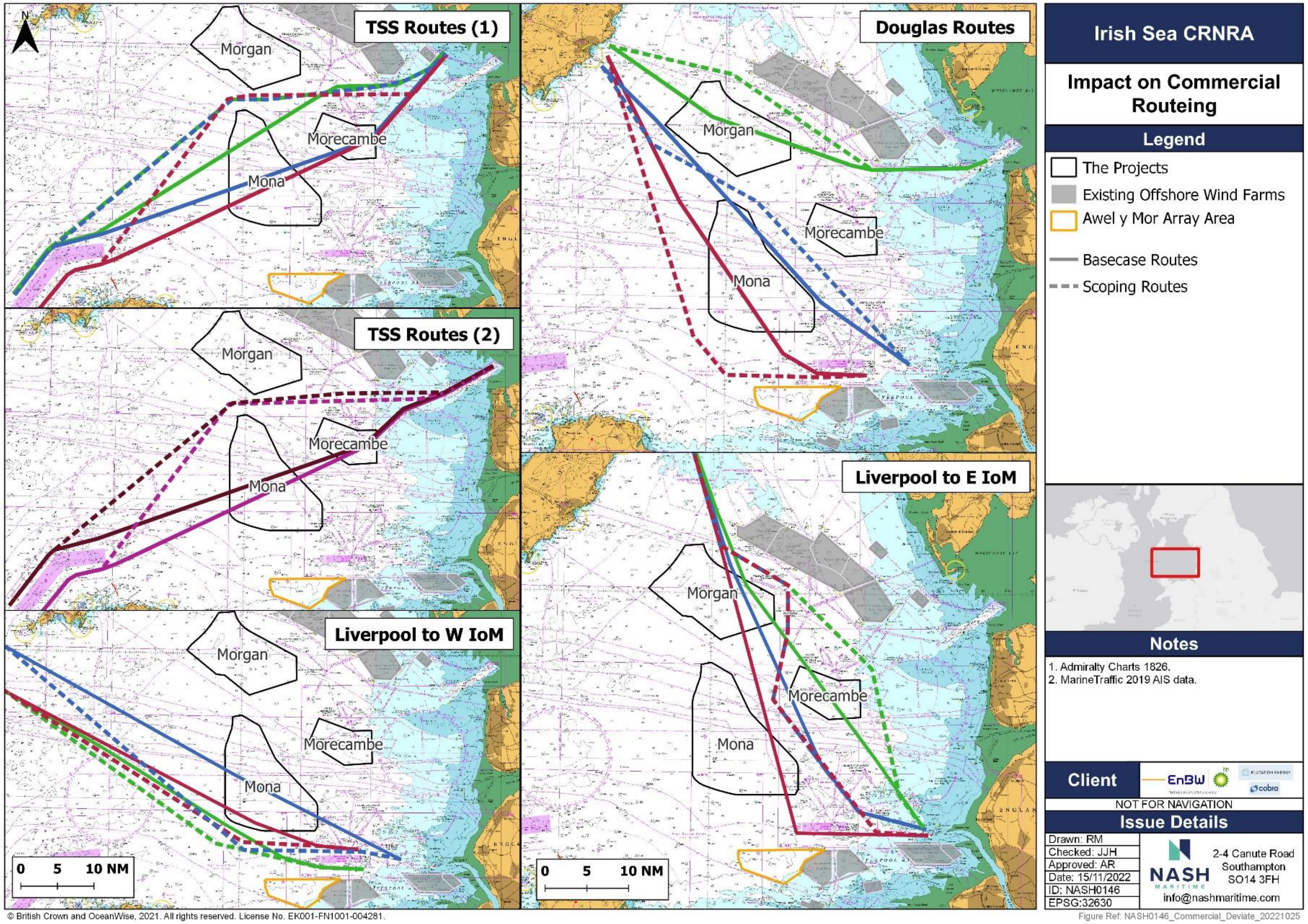


Figure 50: Change in commercial shipping routes with Projects Array Areas (<1/day).

Table 24: Increase in distance for impacted routes with Project Array Areas in Place.

ID	Route	Approximate Annual Crossings (2019)	Baseline Distance (nm)	Future Case Distance	Additional Future Case Distance (nm)	Total Additional Distance per Year (nm)
2	W IoM to Liverpool TSS (east)	525	55.1	55.7	0.6	332.5
6	Off Skerries TSS to Heysham (east)	23	71.2	76.3	5.1	117.3
7a	Off Skerries TSS to Barrow (west) – North	10	69.0	70.3	1.3	13.0
7b	Off Skerries TSS to Barrow (west) - South	17	69.4	70.9	1.5	25.5
8	Heysham to Off Skerries TSS (west)	18	73.9	77.5	3.6	64.8
11	Liverpool TSS to Irish Sea (west)	45	49.2	49.3	0.1	3.1
12	Liverpool TSS to Irish Sea (west)	410	50.08	50.13	0.05	19.9
13	Liverpool TSS to W IoM (west)	704	53.0	54.0	1.0	704.1
15a	Liverpool to E IoM - west	17	77.6	75.8	-1.8	-30.3
15b	Liverpool to E IoM - central	113	70.5	74.7	4.1	465.7
15c	Liverpool to E IoM - east	20	68.0	70.4	2.4	48.7
16	Douglas to Heysham	93	48.7	48.9	0.2	20.8
18	Liverpool to west IoM	128	61.0	64.1	3.0	386.6
19	Douglas to Liverpool TSS (east)	16	51.7	57.6	5.9	94.2
21	Off Skerries TSS to Solway Firth	48	74.6	71.4	-3.2	-154.1
22	Douglas to Liverpool TSS	20	51.1	51.8	0.6	12.4
24	Off Skerries TSS to Barrow (east)	23	66.9	71.6	4.7	108.1
Total						2,186.1

8.4.3 Commercial Shipping Routeing in Adverse Weather

Analysis of adverse weather routeing in **Section 6.2.5.1** during 2019 named storms did not identify any particular changes to typical routes. There was a greater demand for the anchorages along the Welsh coast, and no discernible impacts of the Projects are identified for the availability of anchorages for vessels to seek shelter in adverse weather. Some vessels were recorded loitering both to the west and within the Projects, likely riding the conditions before they could berth. There is sufficient clear sea room to the west of the Projects for this practice to continue.

8.4.4 Adverse Weather Pilotage

Section 6.2.6 highlighted that during strong northwesterlies, pilots may be overcarried or boarded at Douglas on the Isle of Man using the lee of the island. There is 12nm clear searoom between Morgan Array Area and Douglas, and therefore these operations would not be directly impacted during disembarkation or embarkation. However, it was noted that the Projects can impact these activities in two ways.

Firstly, this activity can result in convoys of multiple commercial vessels navigating between Douglas and Liverpool. This has a significant, short-term increase in density and collision risk, particularly where they are routed through corridors. The 2019 AIS data indicated that half of the identified transits navigated through the Liverpool Bay TSS, and therefore would naturally pass to the west of Mona Array Area. It is reasonable to assume that not all of these convoys would pass between the Project Array Areas, and therefore, the increased collision risk within the corridors would be manageable.

Secondly, if commercial vessels were to navigate through the TSS and to the west of Mona Array Area, this would increase their transit distance by approximately 7nm which would equate to an additional transit time of approximately 30 minutes. This may have commercial impacts on the ports provision of pilots, albeit this occurs relatively infrequently and the requirement for pilots to transfer between Douglas and Liverpool (before or after the pilotage movement) would be a more significant constraint on time.

8.4.5 Summary

Commercial shipping routes are concentrated into the Port of Liverpool, and therefore minor deviations around the Mona Array Area are required. Minor routes with fewer than three vessels per week would have greater deviations, but provided the corridors between Projects were safe, this is not considered to make such operations unviable.

8.5 IMPACT OF ARRAYS ON SMALL CRAFT ROUTEING

The analysis of recreational vessel transits presented in **Section 6.2.2.4** identified relatively few cruising routes passing across the CRNRA study area, most are concentrated near shore and clear of the Projects Array Areas. During consultation with the RYA, it was noted that recent evidence from AIS data suggests that yachts avoid transiting through an offshore wind farm less than previously thought based on responses to surveys. This may increase the number of recreational craft navigating through a corridor, albeit that the density of recreational traffic near to the Projects is low.

A number of commercial fisheries operate within the CRNRA study area, with boats based across Welsh, English, Scottish and Isle of Man harbours, as well as several internationally based vessels. Fishing boats operating in the CRNRA study area of greater than 10m in length are generally small enough to transit through the Array Areas when on passage to fishing grounds, as evidenced by both their existing passages between turbines within the Irish Sea and the wide spacing for the proposed Projects. However, to some extent the presence of the Projects might displace their activities into adjacent corridors that increases the risk of collision. This is referred to as Spatial Squeeze, for which the National Federation of Fishermen’s Organisations (NFFO) and Scottish Fishermen’s Federation recently published a report (NFFO, 2020).

Vessels operating between operations and maintenance bases and oil and gas platforms may pass near to or adjacent to the Project Array Areas. In most cases, with the exception of where decommissioning activities will take place, there is at least one nautical mile of suitable clearance between turbines and platforms such that the Projects do not impede this activity.

8.6 TRANSIT CORRIDORS ADJACENT TO OFFSHORE WIND FARM'S

8.6.1 Introduction

In this section, the safety aspect of navigating through the resultant corridors between Mona, Morgan and Morecambe Array Areas is reviewed.

Given the routeing assumptions identified in **Section 8.3** and **8.4**, **Table 25** and **Figure 51** shows anticipated number of vessels navigating through each of the key corridors. Small craft estimates are determined based on the MGN654 traffic surveys undertaken for each Project, the actual numbers of vessels varies depending on time of day and season. Project vessel numbers are worst credible assumptions based on the MDS and potential operations and maintenance bases.

Table 25: Predicted traffic numbers per CRNRA corridors (*Manannan operates April to October, ** Estimates based on radar traffic surveys, ***Estimates based on worst case MDS).

Study area	Season	Passenger/ Year (2019 Per Day)	Commercial/ Year (Per Day)	Small Craft Per Day**	Project Per Day***	Total Per Day
Mona-Morgan Corridor	Annual	3,826 (Average: 10, Max:16)	214 (0.58)	0 to 1 recreational vessels 0 to 2 fishing vessels 0 to 1 service vessels	0	11 to 21
	*April to October**	*Average: 11.2*				
Mona-Morecambe Corridor	Annual	2,454 (Average: 6.7, Max:11)	307 (0.84)	0 to 2 recreational vessels 0 to 2 fishing vessels 0 to 1 service vessels	0	8 to 17
	*April to October**	*Average: 7.8*				
Morgan-Walney Corridor	Annual	1,766 (Average: 5, Max:8)	229 (0.63)	0 to 2 recreational vessels 0 to 2 fishing vessels 0 to 1 service vessels	6	12 to 20
South of Mona	Annual	4,062 (Average: 11.1)	6193 (16.9)	0 to 2 recreational vessels 0 to 2 fishing vessels 0 to 1 service vessels	6	34 to 39
East of Morecambe	Annual	14 (Average: 0.04)	32 (0.09)	0 to 2 recreational vessels 0 to 2 fishing vessels 1 to 2 service vessels	2	3 to 8

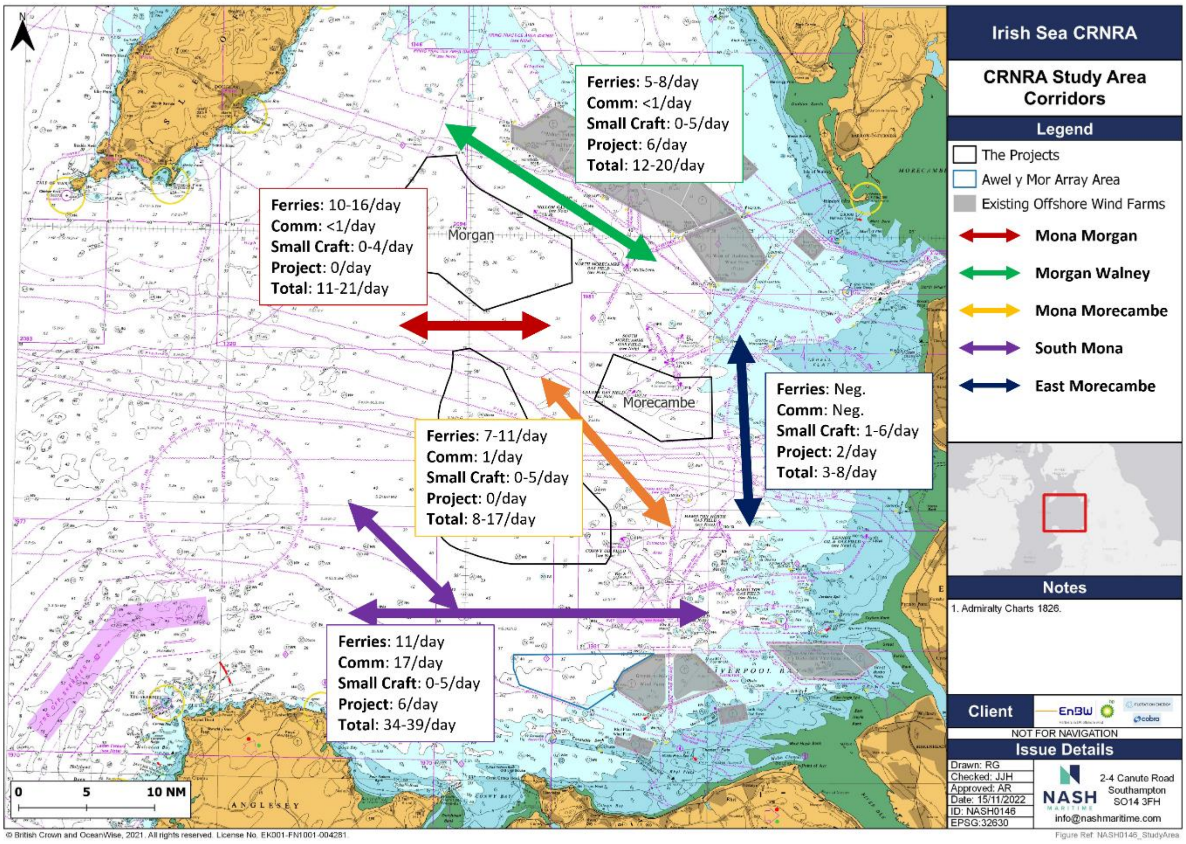


Figure 51: Predicted movement numbers per corridor.

8.6.2 Application of Guidance

Two principal guidance documents describe how corridors between offshore wind farms should be developed (see **Figure 52**). Firstly, MGN654 proposes a 20 degree rule, namely that during transit in adverse weather conditions, vessels could be deviated by up to 20 degrees from their route. Therefore, a corridor of 10nm in length would require a width of at least 3.6nm.

Secondly, the World Association for Waterborne Transport Infrastructure (PIANC) WG161 guidance stipulates a corridor should consist of:

- A traffic lane that is between 4x ship lengths and 8x ship lengths depending on traffic volume
- Sufficient space to perform a round turn in an emergency manoeuvre which is given as 6x ship lengths plus 0.3nm
- 500m safety zones from the wind turbines.

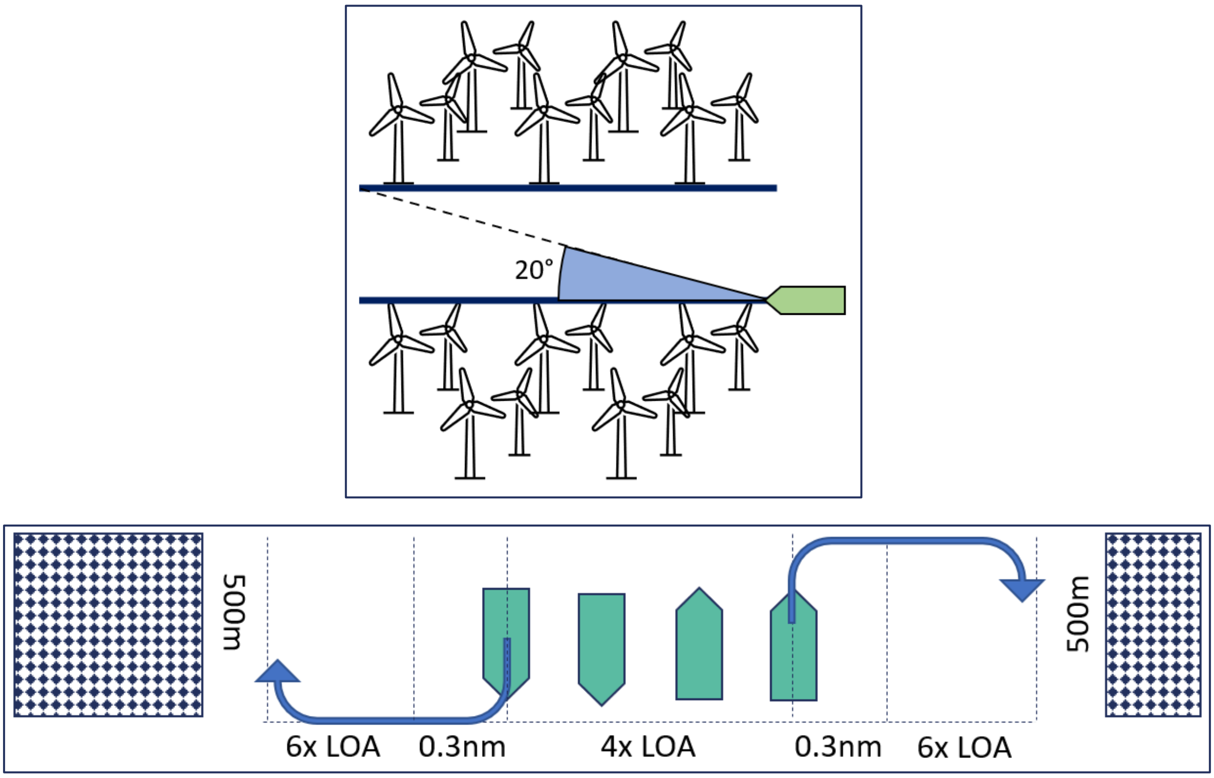


Figure 52: Comparison of MGN654 (top) and PIANC WG161 (bottom) guidance.

Table 26 compares the corridors between Mona, Morgan and Morecambe Array Areas with MGN654 and PIANC guidance documents described above. **Figure 53** visualises the PIANC guidance for 200m and 300m length design vessels applied to each offshore wind farm.

All three corridors comply with the 20 degree rule recommended by the MCAs MGN654 and the PIANC guidance for 200m design vessels, given the volume of traffic. Whilst the average vessel size for both Mona-Morgan and Mona-Morecambe are 150m, on some occasions vessels up to 300m transit. For Mona-Morecambe, 51 vessels over 200m were recorded in 2019 that might take this corridor (1.8%). For Mona-Morgan, only 8 (0.2%) were greater than 200m. If the PIANC guidance is applied for 300m design vessels, the Mona-Morgan corridor is not of sufficient width to comply. Furthermore, sensitivity analysis was undertaken to increase the number of vessels from the <4,400 to >4,400 categories in the PIANC guidance, which requires a greater traffic lane width. This change also exceeds the required width of the Mona-Morgan corridor. Both the Morgan-Walney and Mona-Morecambe corridors meet guidance even with increased vessel numbers and design vessel size.

It should be noted that the guidance likely envisages straight corridors between Project Array Areas, with parallel turbine boundaries. It is noted that this is not the case for Morgan-Walney, with a northern tip to Morgan Array Area which reduces the effective width at the entry/exit of the corridor and increases the navigating challenge. Therefore, additional consideration should be given to whether this section of the corridor is of sufficient width through risk assessment (**Section 9**) and analysis (**Section 8.7**).

Table 26: Comparison of CRNRA corridors with guidance (green = complies, orange=does not comply).

Corridor	Width	Length	MGN654 Degrees	Transits/ Year	Average Vessel	Max Vessel	PIANC 200m Target	PIANC 200m Target (> Vessel Numbers)	PIANC 300m Target
Morgan-Walney	4.2nm	10.4nm	22	1,995	120m	195m	2.9nm	3.1nm	3.73nm
Mona-Morgan	3nm	3.9nm	37.5	4,040	149m	296m	2.9nm	3.1nm	3.73nm
Mona-Morecambe	4.9nm	8.2nm	31	2,761	157m	296m	2.9nm	3.1nm	3.73nm

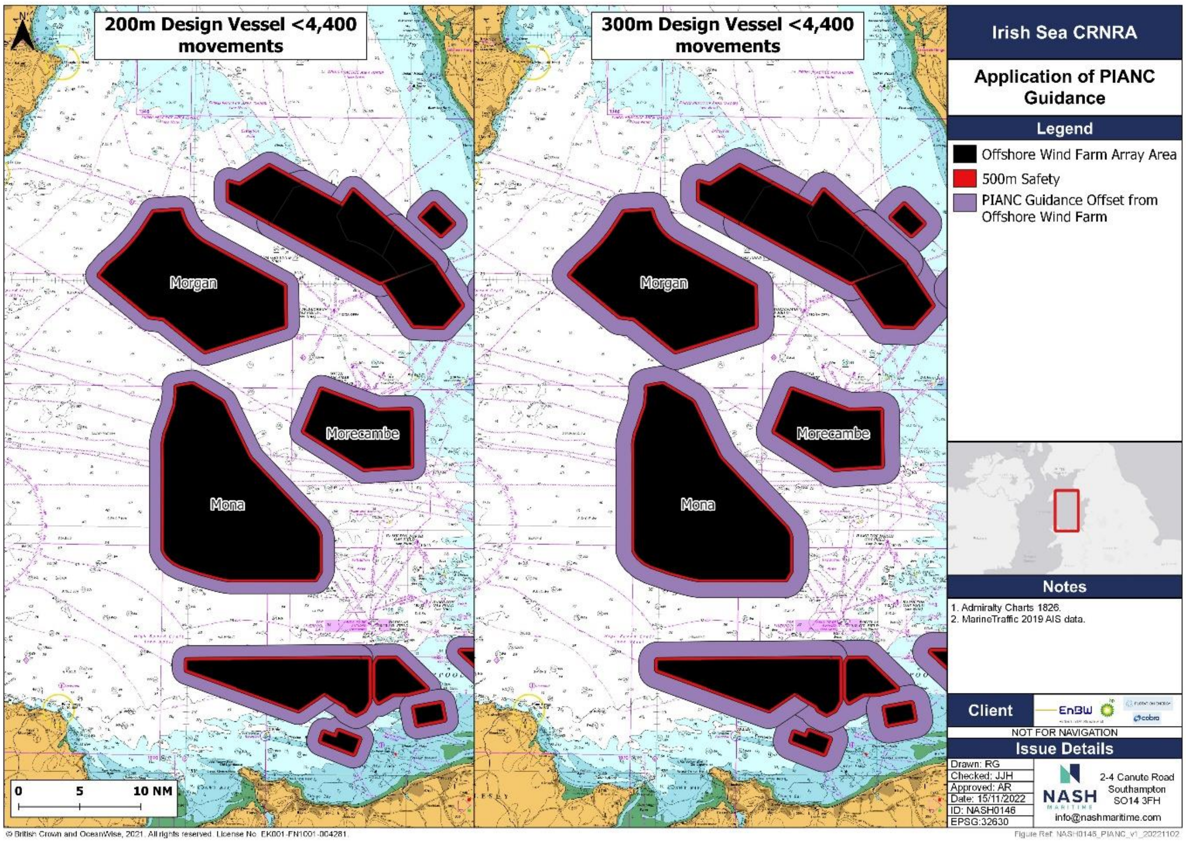
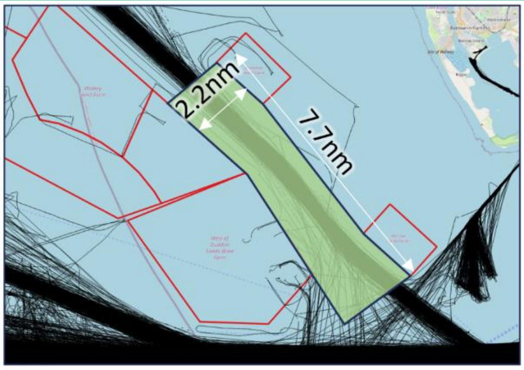
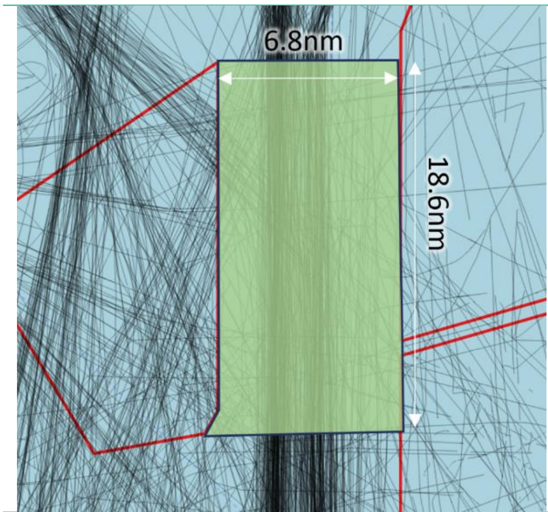
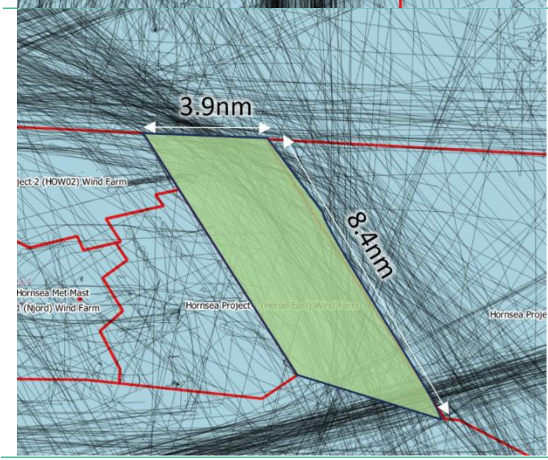


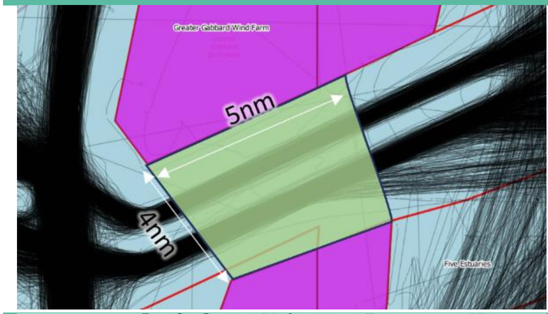
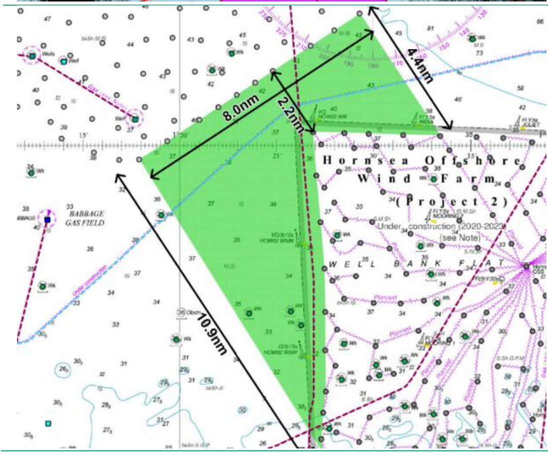
Figure 53: Comparison of PIANC guidance for safety buffers for 200m (left) and 300m (right) design vessels.

8.6.3 Historical Precedent within the UK

To further test the feasibility of the resultant corridors, a review of historical precedent elsewhere in the UK has been undertaken (see **Table 27**). Whilst the specific situation, geometry and traffic numbers of each are different and case dependent, the Hornsea Zone corridors in particular have similarities in dimensions and traffic volume.

Table 27: UK corridors between offshore wind farms.

Corridor	Description
	**Name**: Ormonde/Barrow-Walney/West of Duddon Sands **Dimensions**: 2.2nm by 7.7nm. **Approximate** Transits/Year: 1,333 **Average Vessel Size**: 125m **Maximum Vessel Size**: 142.5m Corridor is marked by a series of cardinal marks approximately600m from the wind turbines. Route is principally used by Stena Ferries between Heysham and Belfast (approximately three per day). Some commercial traffic but less than 100m in length (less than one per day). Most recreational and fishing on transit (and higher density inshore to east of Ormonde/Barrow). Significant CTVs crossing corridor from Barrow to offshore wind farms.
	**Name**: Vanguard-Boreas **Dimensions**: 6.8nm by 18.6nm. **Approximate Transits/Year**: 4,745 **Average Vessel Size**: 155m **Maximum Vessel Size**: 399m Proposed corridor between the Vanguard and Boreas sites. This corridor safeguards the existing Deep Water Route via DR1 light-buoy used by large commercial shipping.
	**Name**: Hornsea Three-Hornsea One **Dimensions**: 3.9nm by 8.4nm **Approximate Transits/Year**: 1,716 **Average Vessel Size**: 133m **Maximum Vessel Size**: 333m Proposed corridor between Hornsea One and Hornsea Three. This corridor enables the regular freight services between the UK and Europe to continue.

Corridor	Description
	**Name**: Galloper-Greater Gabbard **Dimensions**: 4 nm by 5 nm **Approximate Transits/Year**: 5,851 **Average Vessel Size**: 182m **Maximum Vessel Size**: 400m Corridor exists on the east arm of the Sunk TSS and therefore traffic is bound by Rule 10 of the COLREGs, with Cardinal Marks providing a safe buffer from the offshore wind farms.
	**Name**: Hornsea Four-Hornsea Two **Dimensions**: 2.2 nm (at narrowest) by 8 nm. **Approximate Transits/Year**: 2,190 **Average Vessel Size**: 165m **Maximum Vessel Size**: Unknown Gap between Hornsea Two and Hornsea Four has a minimum corridor width of 2.2nm, including a DFDS regular service. During consultation and the hazard workshop, it was considered by both commercial and regulatory consultees that the gap was sufficient for the frequency and types of vessels navigating this corridor. *Image source: Hornsea Four Application.*

8.6.4 Summary

The principal corridors created between Mona-Morgan, Mona-Morecambe and Morgan-Walney Array Areas have been tested against guidance. The following findings are reached:

- The corridor between Mona and Morecambe Array Areas is of sufficient width and design that it meets the relevant guidance
- The corridor between Morgan and Walney Array Areas, whilst it technically meets the guidance, could be argued to not be applicable where there is a change of course required given the shape of the northern portion of Morgan Array Area
- The Mona-Morgan corridor is marginal, with additional width required to facilitate greater vessel numbers or larger vessels.

8.7 IMPACT OF CORRIDORS ON COLLISION RISK

8.7.1 Introduction

The presence of the Project Arrays Areas could potentially alter existing shipping routes and create pinch points or hot spots where vessels may encounter one another at a closer distance or more frequently. This has the potential to increase the collision risk between vessels.

8.7.2 Commercial Vessel and Ferry Meeting Situations within Corridors

A key factor in the risk of collision is the frequency at which two vessels would meet in the same corridor at the same time. By modelling how vessel routes may change with the Project Array Areas, and taking into account vessel timetables, the concurrent frequency of two commercial vessels meeting can be calculated. For example, were a vessel to depart Liverpool, the presence of the Mona Array Area could require a deviation to the south through the TSS, resulting in new meeting situations which would not have previously occurred.

The analysis is conducted for the waters between the three Project Array Areas, as shown in **Figure 54.** Given the low proportion of fishing and recreational vessels which carry AIS, only cargo, tankers and passenger vessels (including ferries) have been included in this analysis. Furthermore, as this analysis focusses on ship routes, non-direct transits such as loitering or pilot boarding have not been captured.

All commercial vessel tracks within the 2019 AIS data were processed and deviated around the Project Array Areas. For every minute of the year, a count was performed of the number of vessels present in each region. Over the total year, the percentage of time in which zero, one, two or more vessels were counted is then given.

Figure 55 compares the resulting frequencies. For the corridor between Mona and Morgan Array Areas, no commercial vessels are predicted for 62.5% of the time and 31.4% of the time only one vessel would navigate this corridor. Therefore, for the remaining 6% of the year would two or more vessels be within this corridor. There is and 0.5% and 0.03% probability of three and four vessels respectively meeting. This corridor is 16.4nm in length and notable for the multiple directions at which ferries and commercial shipping might approach and depart this gap increasing the complexity of a vessel encounter. However, the density of traffic is relatively low and therefore the likelihood of multiple commercial vessels converging at this location is low but will occasionally occur.

For the corridor between Morgan and Walney Array Areas, no commercial vessels are predicted for 69.1% of the time and 27.2% of the time would one vessel navigate this corridor. Therefore, 3.7% of the time would two or more vessels be within this corridor. There is 0.24% probability of three vessels and less than 0.01% of four vessels meeting. The corridor between Morgan and Walney Array Areas is 22nm in length and is likely to be used mostly by Stena and IoMSPC ferries, with some small commercial vessels. Based on the 2019 analysis of their timetables, and the predicted routeing impacts as a result of the Projects, the analysis suggests a low probability of two vessels meeting within this corridor.

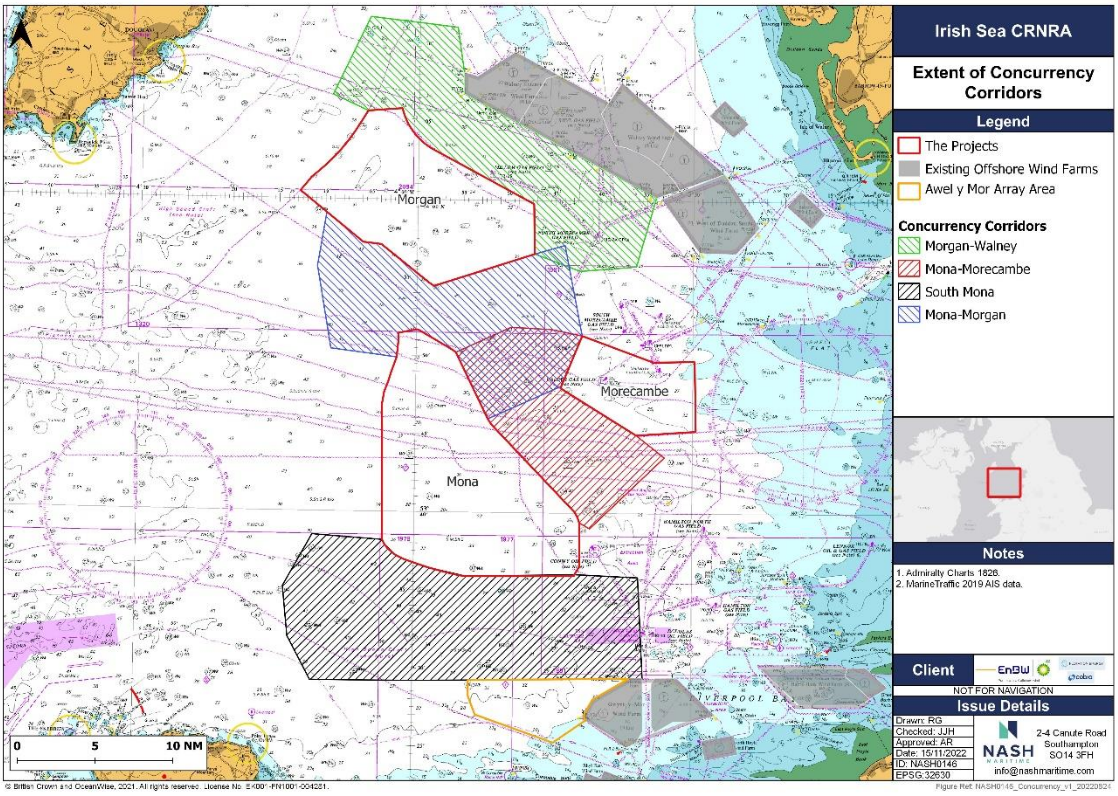


Figure 54: Corridor regions assessed for concurrency.

For the corridor between Mona and Morecambe Array Areas, no commercial vessels are predicted for 89.7% of the time and 16.9% of the time would one vessel navigate this corridor. Therefore, 1.45% of the time would two or more vessels be within this corridor. There is 0.06% probability of three vessels and less than 0.01% of four vessels meeting. This corridor is likely to be used mostly by Stena and IoMSPC ferries departing Liverpool and transiting north or northwest, with some small commercial vessels. Based on the 2019 analysis of their timetables, and the predicted routeing impacts as a result of the Projects, the analysis suggests a low probability of two vessels meeting within this corridor. This would be greater in summer due to the seasonal nature of the ferry timetables.

For the corridor with the TSS south of Mona Array Areas, this consists of a busier route with the main approaches to Liverpool for traffic using the TSS and passing to the west of the Isle of Man. No commercial vessels are predicted for 16.9% of the time and 28.3% of the time would one vessel navigate this gap. Therefore, 54.8% of the time would two or more vessels be within this corridor. This corridor is 22.6nm in length and includes separation of traffic with a TSS. The Project boundaries result in vessel traffic approaching Liverpool from the west of the Isle of Man entering this corridor earlier. Therefore, whilst the absolute numbers of commercial vessels in this region does not increase, they would spend longer transiting within the TSS and its approaches, potentially encountering more traffic.

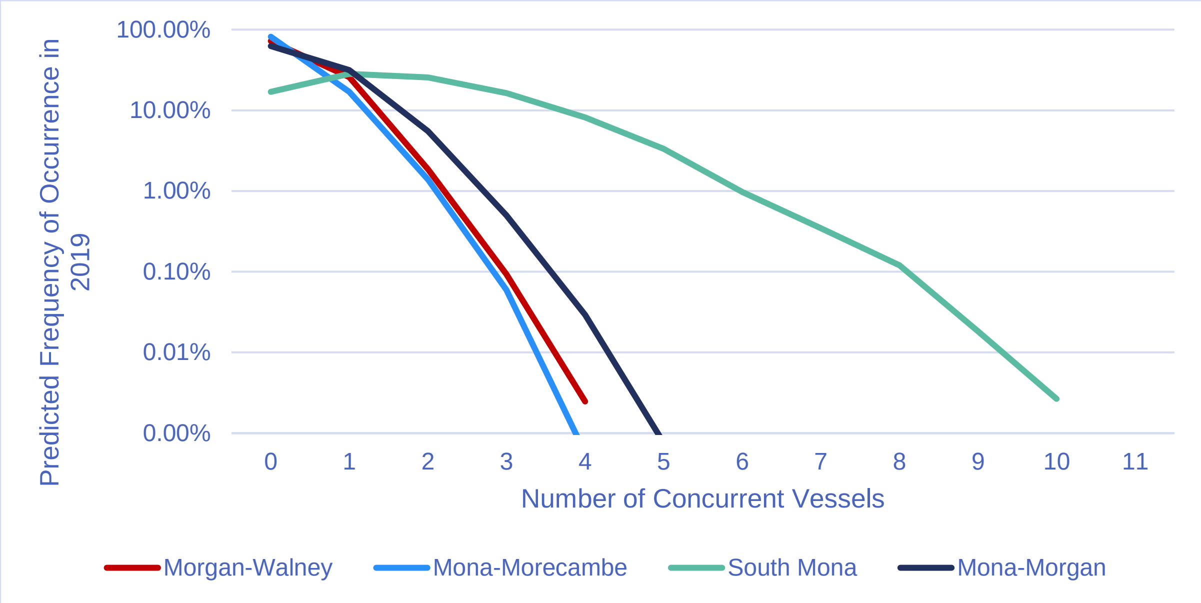


Figure 55: Predicted frequency of concurrent activity of cargo, tanker and passenger vessels in selected corridors (logarithmic scale).

8.7.3 Small Craft Meeting Situations within Corridors

The routes to be taken by operations and maintenance vessels are not known and therefore assumptions have been made for each of the Projects. A clear additional risk of the Projects are the additional vessel movements supporting operations and maintenance and their interaction with other traffic. In particular, it is likely that multiple CTVs will cross corridors between the Projects and interact with other passing traffic, including ferries and fishing boats. Additional risk controls should be identified to deconflict CTV movements with other passing traffic, such as through passage planning.

Section 6.2.2.4 identified several offshore cruising routes which intersect the array boundaries. Historical evidence has suggested that recreational cruising vessels may choose to navigate through an offshore wind farm, and there are no restrictions on their ability to do so. The RYA has suggested during consultation that more recent data gathering has identified that cruising routes have changed to pass around offshore wind farms, suggesting a reluctance by some yachtsman to navigate between the turbines. Much of this evidence has been collected from earlier Round 1 and 2 offshore wind farms, where turbines were generally closer together. The greater turbine spacing for Round 4 projects may promote greater navigation through these Project Array Areas.

Where yachts choose to navigate through the offshore wind farm, there is a risk of colliding with other craft, due in part to the reduced sea room between rows of turbines. This is partly exacerbated by the greater difficulty in visually, or through radar, identifying other craft once within an offshore wind farm. Where yachts choose to navigate parallel to an offshore wind farm, they may do so within a corridor which is created between the three Projects. This waterway is shared with large commercial operators and therefore there is a greater risk of collision. The vessel traffic surveys identified relatively few offshore cruising vessels navigating between Ireland, the UK and Isle of Man. On most days of radar collection, no recreational craft were observed, even in summer. Therefore, it would be reasonable to conclude that the increase in risk of collision would be minor.

Large parts of the Irish Sea are regularly fished (see **Section 6.2.2.5**). In particular, the region to the northwest of the Morgan Array Areas was identified during the summer traffic surveys as an area of high fishing intensity, albeit this is largely clear of the Morgan-Walney corridor. The offshore wind farm could increase the risk of allision due to their proximity or result in offsetting their activities into corridors between Project Array Areas which increases the risk of collision. Given the PDEs and proposed turbine spacing (**Section 4**), it is assumed that some fishing activities could continue to take place within the offshore wind farm.

8.7.4 Impacts of Projects on Visual Navigation and Collision Avoidance

MGN654 notes that an offshore wind farm could block or hinder the view of other vessels or any navigational feature such as the coastline or AtoNs. This may result in “blind spots” between vessels which could increase the risk of collision by reducing the capability for early and effective collision avoidance.

Firstly, each individual wind turbine is approximately 10m in diameter and whilst vessels transit past the site, any two vessels may come in and out of visibility temporarily. Furthermore, there may be challenges identifying the vessels through radar (see **Section 8.11**) and targets would be visually less distinct amongst the turbines. Assuming that most prudent mariners would pass more than one nm from the boundary of an offshore wind farm, the likely meeting situations are described in **Figure 56**. For a small craft, such as fishing boat or yacht transiting at 6kts, from emergence from the offshore wind farm, it would take 10 minutes for the CPA to reach 0m (a collision). For a high-speed craft such as CTV, transiting at 25kts, this is less than 3 minutes. The latter vessel type are highly likely to carry AIS which will improve their visibility to other vessels. This would provide some opportunity to avoid a collision, however, would be significantly reduced beyond what would be the case pre-construction in open sea. Such challenges currently exist for the established Irish Sea offshore wind farms but are being successfully managed with no reported collisions as a direct result of reduced visibility of emerging vessels.

Secondly, the geometries of the offshore wind farms would reduce the visible appreciation of other vessels, particularly where routes converge or the corners of sites. For example, two vessels proceeding north to the west and east of Mona Array Area to pass between Mona and Morgan Array Areas would not have visual sight of one another until potentially within the constrained corridor (**Figure 57**). The COLREGs describe obligations for collision avoidance and the appreciation of navigational lights (port/starboard) are necessary in determining the correct response to crossing, overtaking and head-on situations. However, larger vessels would be identifiable from AIS and therefore passing arrangements could be agreed.

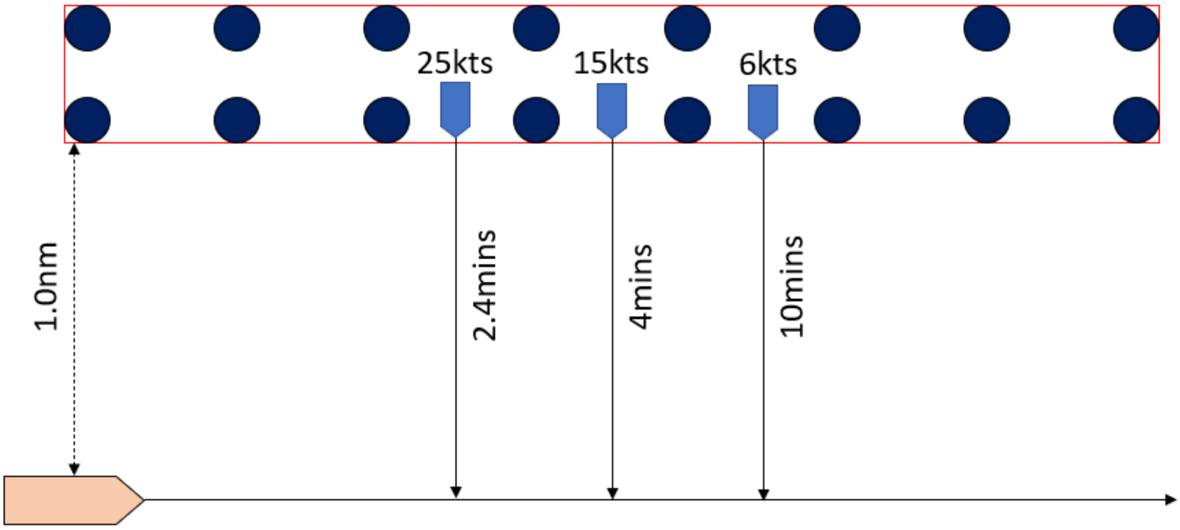


Figure 56: Calculated meeting times for vessels emerging from offshore wind farms.

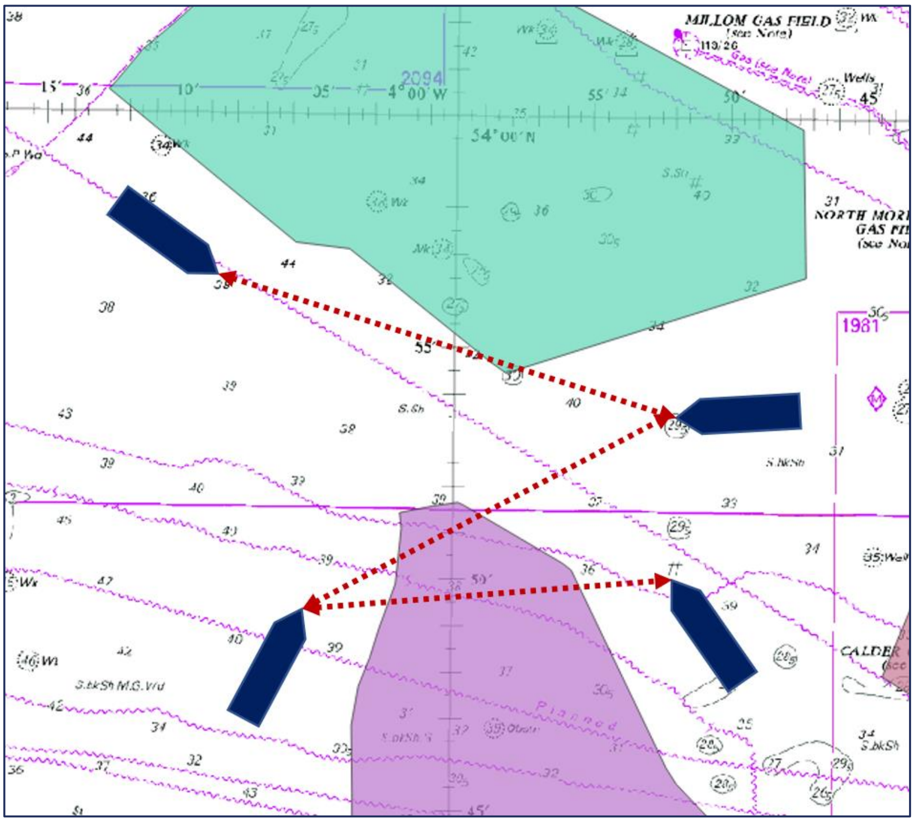


Figure 57: Schematic of obscured vessels passing offshore wind farms (not to scale).

Thirdly, concerns were raised by stakeholders about collision appreciation during night navigation, particularly as a result of vessel navigational lights lost amongst the turbine backscatter. Rule 22 of the COLREGs describe the minimum visibility of lights with vessels under 12m requiring masthead/sternlights of greater than 2nm and for vessels over 12m (but less than 50m) having 5nm and 2nm respectively. Therefore, it is reasonable that vessels within an offshore wind farm that would have previously been visible to passing vessels may be obscured or would be less prominent amongst the offshore wind farm lighting. In particular, masthead lights for approaching vessels may be less conspicuous amongst white AtoNs fixed to the wind turbines, and this may to some extent contribute to an increase risk of collision. Such impacts have been successfully managed at existing offshore wind farms, elsewhere in the UK, with similar passing vessel numbers and vessels would still be identifiable through other means.

8.7.5 Vessel Interaction in the Approaches to Liverpool

A review of vessel traffic and the impacts on ship routes noted that crossing situations can develop between southeast bound traffic to the Liverpool TSS and westbound vessels departing the TSS (see **Figure 58**). In such circumstances, the COLREGs dictate that the give way vessel is the one navigating west out of the TSS and should turn to starboard to avoid the vessels approaching from the Isle of Man. The presence of the Project Array Areas reduces this capability, particularly those vessels who have positioned themselves to the north of the TSS lane in preparation for heading northwest once clear of the Project Array Area. As a result, the vessel has no option but to reduce speed and wait for the southeast bound vessel to cross ahead. Analysis demonstrates that these circumstances might reasonably happen frequently and would be exacerbated with multiple vessels.

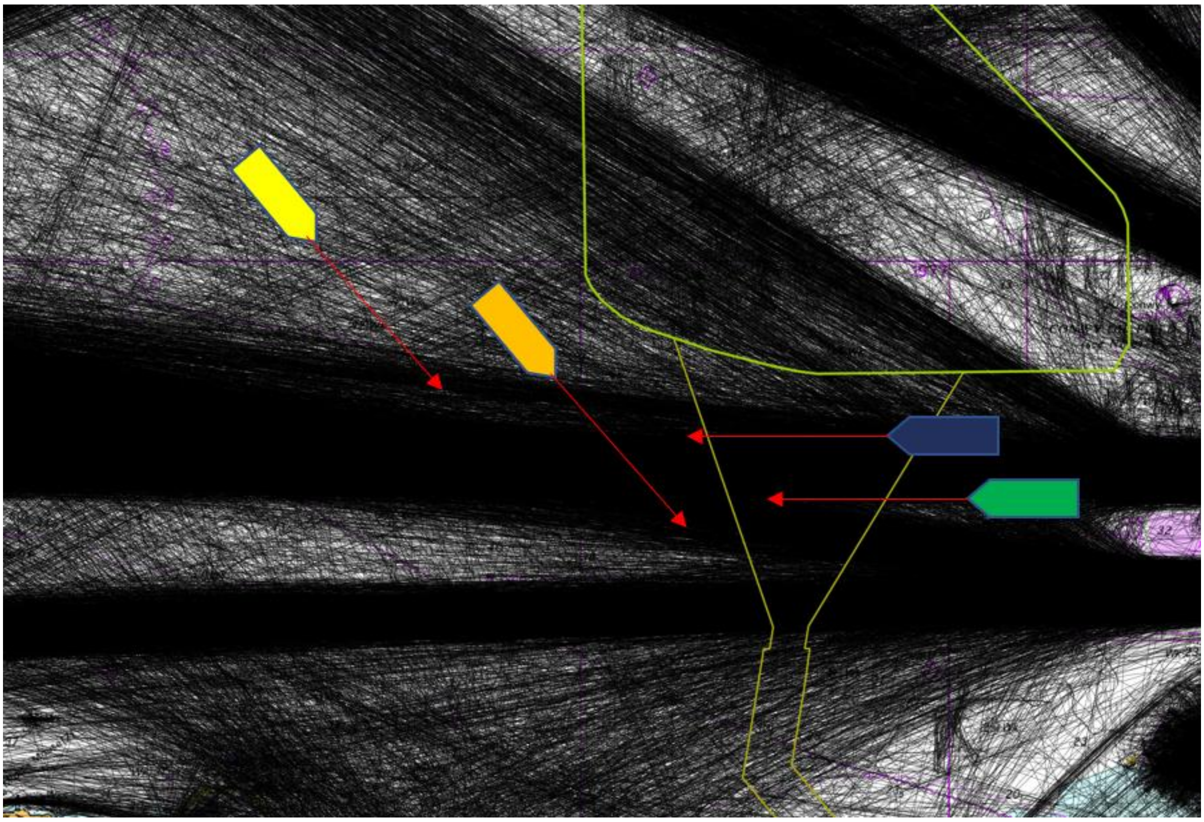


Figure 58: Impact of Mona Array Area on collision situations in the approaches to Liverpool.

8.7.6 Summary

Section 8.7 has considered how the Projects could increase the risk of collision between navigating vessels. The results suggest that whilst this would be the case for all vessel users, the greatest increase would be the result of CTVs operating between the operations and maintenance base and the offshore wind farm. Other vessel types such as ferries and commercial shipping would experience an increase in collision risk, concentrated within the corridors. Furthermore, the analysis highlighted that the greatest risk of an incident both before and after the offshore wind farm developments was in the approaches to Liverpool.

8.8 IMPACTS OF ARRAY ON ALLISION RISK

The presence of new infrastructure in an area can increase the risk that a vessel may be involved in an allision with it. This risk is present for both vessels transiting within the windfarm site and adjacent to it. There are several means by which this might reasonably occur. It should be noted that the spacing between turbines is likely to be approximately 1km and therefore in all such cases, there is the potential for a large vessel to enter the array area in an emergency without contacting a turbine.

Firstly, during mechanical breakdown such as steering or engine failure a vessel may become disabled and drift towards the turbines. For a vessel in the centre of a 4nm corridor, this would allow a two nm drift before an allision would occur. High side vessels such as ferries could drift in excess of two knots and therefore there would be less than an hour to take action. This could include conducting repairs or deploying an anchor. Such hazards exist for vessel routes adjacent to pre-existing offshore wind farms such as Walney, West of Duddon Sands and Gwynt-y-Mor amongst others.

Secondly, due to human error with vessels failing to appreciate the available sea room in proximity to the wind turbines due to fatigue or failing to keep a proper lookout. For larger vessels, and in particular ferries who would have significant experience of operating these routes, this is less likely that might be the case for smaller craft. Allisions between small craft such as yachts and fishing boats with wind turbines is known to occur on other project sites, with these vessel types potentially less familiar with the hazards. Whilst the Projects per se do not necessarily increase the risk of human error, the greater number of turbines provide more obstacles for which an allision could occur.

Thirdly, avoidance of other vessels in collision situations could result in ships taking manoeuvres which place them in close proximity to wind turbines. This is discussed above.

The safety of navigating within the offshore wind farm is challenging due to the significant number of structures. Historical incident analysis at other projects suggests that an allision between a CTV and a wind turbine occurs approximately once every ten years (see **Section 6.3**). Given the greater frequency of movements due to the larger size of Round 4 projects, this is estimated to increase.

Section 6.2.2.4 identified several offshore cruising routes which intersect the array boundaries. Historical evidence has suggested that recreational cruising vessels may choose to navigate through an offshore wind farm, and there are no restrictions on their ability to do so. The RYA has suggested during consultation that more recent data gathering has identified that cruising routes have changed to pass parallel to offshore wind farms, suggesting a reluctance by some yachtsman to navigate between the turbines. Much of this evidence has been collected from earlier Round 1 and 2 offshore wind farms, where turbines were generally closer together. The greater turbine spacing for Round 4 projects may promote greater navigation through these Projects.

Large parts of the Irish Sea are regularly fished (see **Section 6.2.2.5**). In particular, the region to the northwest of the Morgan Array Area was identified during the summer traffic surveys as an area of high fishing intensity, albeit this is largely clear of the Morgan-Walney corridor. The offshore wind farm could increase the risk of allision due to their proximity or result in offsetting their activities into corridors between projects which increases the risk of collision. Given the PDEs and proposed turbine spacing (**Section 4**), it is assumed that some fishing activities could continue to take place within the offshore wind farm.

8.9 IMPACTS OF ARRAY ON VESSEL EMERGENCY RESPONSE

Impacts of the offshore wind farms on vessel emergency response were identified amongst consultees, such as the ability to manage cargo shift scenarios, fire or man overboard situations.

8.9.1 Vessel Rolling and Cargo Shift

During adverse weather, with large waves and strong winds, vessels can roll so excessively as to cause cargo to break free from its securing's and injuries to passenger or crew. This is particularly the case when the seas are directly on the vessel's beam, hence the requirement for variation in vessel course observed in **Section 6.2.4.2** to mitigate the ship's heading to the seas. With the Projects in place, corridors are formed between them that constrict the capability for vessels to alter course to safely manage this.

The Navigation Simulations (see **Section 3.3.5**) tested the safety of transits in adverse weather through each of the corridors. It was noted that the prevailing southwesterlies necessitated near beam on navigation across the conditions given the orientation of the Morgan-Walney and Mona-Morecambe corridors in southeast/northwest directions. As a result, in several runs Marginal or Fail scores were reached due to excessive rolling, exceeding 20 degrees. This was considered to be both uncomfortable and hazardous to passengers, but also have the potential to shift cargo and cause damage. Given this conclusion, it would be reasonable to expect ferries to take a more circuitous route around the offshore wind farms rather than through the corridors, as described in **Section 8.3**. However, in marginal conditions where a master does not choose to take an adverse weather route, were the conditions to deteriorate within the corridor, there is little opportunity for the master to mitigate those conditions. Therefore, as excessive roll starts to be experienced, the master may for instance turn into wind, but in doing so will increase the risk of allision with the offshore wind farm.

Cargo shift situations have occurred within the CRNRA study area, most notably the ro-ro cargo vessel Riverdance in January 2008. This occurred in adverse weather and resulted in the grounding on the Shell Flats and total constructive loss but without injuries.

8.9.2 Responding to Vessel Emergencies

Emergencies on board, particularly fire or a man overboard, require immediate action by the bridge teams. For example, during fire, it may be necessary to turn the vessel into the wind such that the smoke does not blow across the passenger decks. Consultation has identified that these incidents infrequently occur on board ferries in the CRNRA study area (in the order of less than once a year). Whilst the Projects do not necessarily impact upon the likelihood that fire may occur, their presence constricts the searoom to perform these manoeuvres, and may increase the resulting consequences. The likelihood of these incidents occurring, and it occurring during a temporary transit of the corridor, is unlikely. The ability to hold a heading may be hampered in adverse weather conditions such as a large sea state or wind speed. Furthermore, whilst the searoom is reduced, at least several nm would exist to undertake some degree of mitigation, greater than vessels would have available elsewhere such as the approaches to ports for example.

8.10 IMPACTS OF PROJECTS ON SEARCH AND RESCUE

In the unlikely event of an incident, SAR assets are required to access the site or surrounding area without risk to themselves. In particular, wind turbines can pose a hazard to SAR helicopters and therefore the design of the wind farm should be such to enable helicopter access and therefore safeguard HM Coastguard obligations to SAR within the UK Search and Rescue Region. An ERCOP is required to facilitate information sharing regarding the offshore wind farm and SAR organisations. The principals of SAR access for offshore wind farms are contained in MGN654 Annex 5, and can be summarised as:

- **Lines of Orientation** – developers should maintain two lines of orientation unless a safety case is produced, and additional mitigation is proposed, that one line of orientation is tolerable. This allows multiple directions for aircraft entry and improves access, whilst a linear regular grid is both more efficient and safer for conducting SAR
- **SAR Lanes** – to be of sufficient width to enable safe transit of an SAR helicopter between the turbines. MGN654 Annex 5 recommends turbine spacing (blade tips to blade tips) of greater than 500m
- **Helicopter Refuge Areas** – in larger developments (>10nm width), a refuge area clear of turbines may be required to enable aircrews to reorientate themselves and change direction safely
- **Turbine Preparation** – to support winching of a casualty, the wind turbine needs to be configured to a specific position as requested by the SAR crew. This might include rotating the nacelle to 90 degrees from the wind, and both locking and positioning the blades to facilitate SAR access (e.g. Y configuration - see MGN654 Annex 5).

Several trials have been conducted by HMCG and MCA in SAR at offshore wind farms (see MCA, 2005; 2019). They found that searching within an offshore wind farm is more complex than in open sea and there may be a delay for entry into an offshore wind farm whilst the crew familiarise themselves with the site and layouts. During poor visibility, the importance of linear SAR lanes of sufficient width was identified as of great importance. When transiting through an offshore wind farm, all communications and navigation equipment was reported to be operated successfully with wind turbines identifiable through radar. Unfamiliarity with transiting and winching in vicinity of wind turbines results in slower speeds and delays which increases fuel consumption and may make searches less effective. Concerns have also been raised regarding visual identification of casualties as wind turbines block the view, particularly during rough weather.

The spacing between turbines is aimed at 1000 metres and therefore there would be sufficient space for SAR helicopter access through the sites. The project design should also enable surface SAR assets (such as RNLI lifeboats) to safely navigate through the site and between the wind turbines. The DCO would typically stipulate that the MMO, in consultation with the MCA and Trinity House, must agree to the design layout in order to ensure that access of SAR assets is not compromised.

Specific effects to SAR are further assessed within the individual Project NRAs.

8.11 IMPACTS OF ARRAY ON OIL AND GAS ACTIVITIES AND SAFETY

In addition to the risk of a vessel coming into contact with a wind turbine, is the increased risk of coming into contact with oil and gas infrastructure. The key platforms for which this may be the case are:

- **North Morecambe gas field** – the existing HEY-DOUG route passes between 0.4nm to the north of this platform already. The presence of the Morgan Array Area would necessitate vessels passing further to the north to clear the Morgan Array Area. Furthermore, the routes to the west from Heysham would need to pass further south to clear the Morgan Array Area. Therefore, the risk of allision is likely reduced
- **South Morecambe gas field** – all existing routes from Heysham pass clear to the north of this field. The presence of the Morgan Array Area may constrict traffic further south that increases the risk of allision
- **Conwy gas field** – the presence of Mona Array Area would necessitate traffic to pass well clear of this platform in the future
- **Hamilton North gas field** – existing traffic routes clear these platforms, the presence of Morecambe and Mona Array Areas would likely have little impact on vessel routeing passed these platforms.

Whilst there is significant uncertainty regarding timescales, it is likely that several of these platforms will be decommissioned prior to the 2035 scenario and therefore the risk will be removed.

A contact between a ferry or other large vessel and a platform carries the potential for a far greater consequence that with a wind turbine. Some platforms are manned which increases the potential for loss of life but also the potential pollution outcomes.

8.12 IMPACTS OF PROJECTS ON COMMUNICATIONS, RADAR AND POSITIONING SYSTEMS

MGN654 notes that an offshore wind farm may have adverse effects on the equipment used for navigation, collision avoidance or communications. A significant body of work has been conducted to examine these impacts on detail, and reference is made to the following studies:

- QinetiQ (2004). Results of the electromagnetic investigations and assessments of marine radar, communications and positioning systems undertaken at the North Hoyle wind farm by QinetiQ and the MCA
- BWEA (2007). Investigation of Technical and Operational Effects on Marine Radar Close to Kentish Flats Offshore Wind Farm
- Ocean Studies Board's Division on Earth and Life Studies (2022). Wind Turbine Generator Impacts to Marine Vessel Radar.

Table 28 provides a summary of these potential impacts, with further consideration of the impacts on marine radar explored in **Section 8.12**.

Table 28: Summary of impacts on equipment.

Impact on	Overview
Very High Frequency (VHF) Radio	VHF is essential for the communication between vessels and shore. VHF radio waves could be blocked or interfered with by the presence of turbines. The 2004 QinetiQ study found no noticeable effect on VHF communications both ship-shore and ship-ship within or adjacent to the wind farm. A trial aboard SAR helicopters (MCA, 2005) also determined no significant impact on VHF direction finding capabilities. **Therefore, no significant impact on VHF communications is anticipated**.
AIS	AIS enhances the identification between vessels for collision avoidance. AIS signal could be blocked or interfered with by the presence of turbines. The QinetiQ study found no noticeable effect on AIS reception. **Therefore, no significant impact on VHF communications is anticipated.**
Global Navigation Satellite System (GNSS)	GNSS (such as GPS) is used for satellite positioning systems and navigation. Satellite reception could be impacted by the presence of turbines. The QinetiQ study found no noticeable effect on GPS reception, even in very close proximity to the wind turbines. **Therefore, no significant impact on GPS is anticipated.**
Shore Radar	Similar to marine radars, shore radars could be impacted by the wind turbines. Morgan, Mona and Morecambe Array Areas are well clear of any ports and harbours, and any VTS coverage. **Therefore, no significant impact on shore radar for managing navigational safety is anticipated.**
Noise	The sound generated by the turbines could mask navigational sound signals from vessels or AtoNs. Whilst turbines make an audible sound whilst rotating, the low density of shipping and distance to other navigational marks makes this potential impact negligible. Furthermore, maritime regulations for audibility of a ship's whistle are well in excess of the typical wind turbine sound emissions even at very close range. **Therefore, no significant impact on navigation safety from increased noise is anticipated.**

Impact on	Overview
Compass	Compasses are used for vessel navigation. These are potentially impacted by electromagnetic interference from the wind turbines or cables. The degree of this impact is related to the depth of water, cable design and alignment with the earth's magnetic field. Whilst this has impact has not been directly observed in studies, it is possible that small vessel compasses could be impacted near to cable landfall. However, it is considered likely that small craft would navigate visually near to cable landfall and therefore the impact on navigation safety is reduced. **Therefore, no significant impact on navigation safety from electromagnetic interference is anticipated.**

8.12.1 Marine Radar

Marine radar is used for both collision avoidance and vessel navigation. Wind turbines, like other structures, can result in spurious returns such as side lobes, echoes, reflections and blanketing. These effects were studied extensively in both the QinetiQ (2004) and British Wind Energy Association (BWEA) (2006) studies. Both studies determined that the reduced capability to track small vessels within offshore wind farms and the risk of losing acquired targets should be considered by mariners navigating adjacent to offshore wind farms. Some of these effects can also be mitigated by careful adjustment of radar controls, such as Gain.

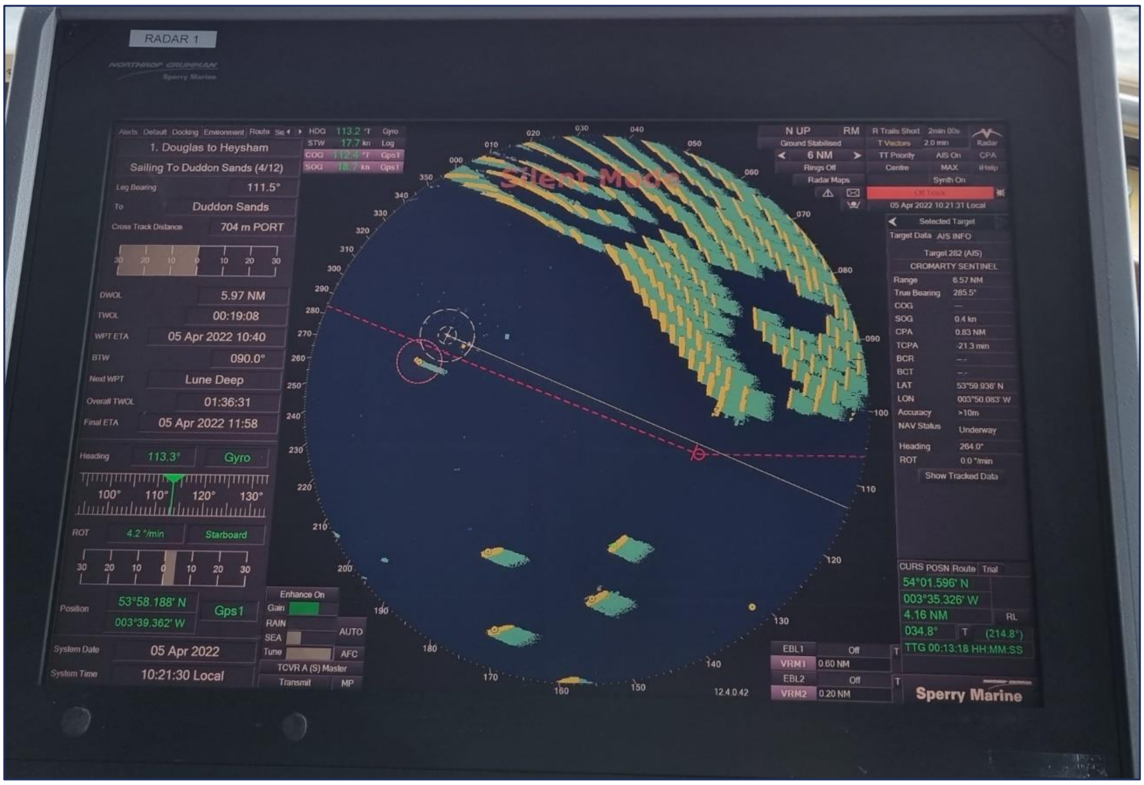


Figure 59: Radar screen of the Ben-my-Chree (Source: NASH 05 April 2022).

Based on this, the MCA developed a shipping route template (MGN654) that placed the extent of these effects at 1.5nm, increasing as the vessels transit closer to the turbines. Intolerable impacts may be experienced up to 0.5nm from the offshore wind farm. Historical evidence suggests that most vessels pass more than 0.5nm from an offshore wind farm and therefore these effects are lessened.

Figure 60 shows how the Project Array Areas relate to the region of potential radar effects. It is notable that passage through the Mona-Morgan corridor would not be possible without experiencing some degree of radar interference. This could have impacts on the ability to determine a collision situation. Analysis of historical vessel traffic throughout this NRA demonstrates that vessels routinely pass within 1nm of offshore wind farms, particularly West of Duddon Sands, Gwynt-y-Mor and Burbo Bank. Therefore, these effects are already encountered and should be well understood by bridge teams.

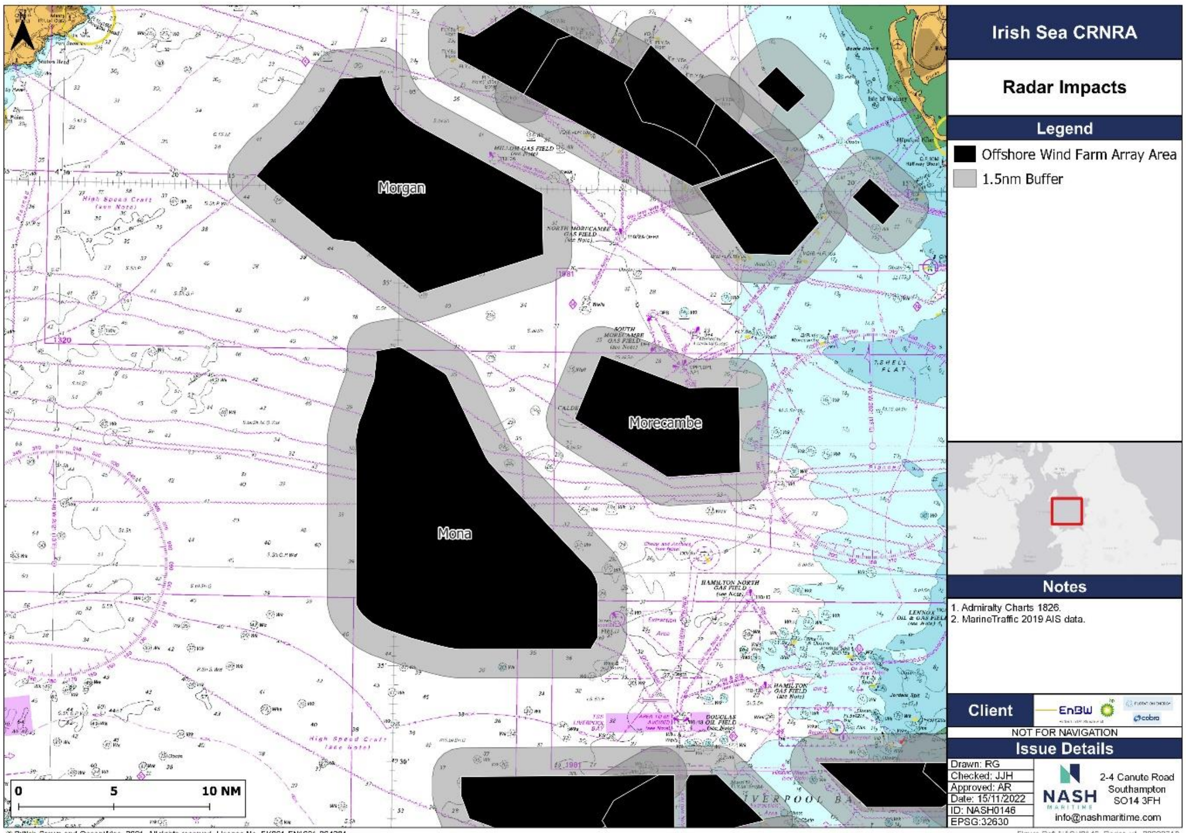


Figure 60: MGN654 radar impacts.

8.12.2 Shore Based Radar

The Project Array Areas are outside of the port limits, VTS and pilotage areas and therefore whilst shore-based radar may have partial coverage of the sites, it would not be actively monitored. Therefore, the presence of the Projects would not compromise vessel traffic monitoring obligations.

9. CUMULATIVE NAVIGATION RISK ASSESSMENT

9.1 INTRODUCTION

The NRA has been produced in accordance with MGN654 and follows the IMO's FSA (IMO, 2018). The MGN654 requires that the NRA contain a hazard log of shipping and navigation hazards caused or changed by the project which includes an assessment of risk with embedded controls in place (those controls designed and included in the project which are commonly accepted as industry good practise - see **Section 4** for a list of embedded risk controls), and an assessment of risk for the project with possible additional risk controls in place if they are warranted (**Section 9.7**).

At Preliminary Environmental Information Report (PEIR) stage of the EIA process the assessment of risk with possible additional controls in place is not undertaken as the need for, and design of additional risk control measures has yet to be defined. It is anticipated that additional risk controls are committed to as part of the final Environmental Statement which is submitted at DCO application. These will be reviewed with stakeholders to ensure they are appropriate and adequate for reducing risks to ALARP prior to Application.

The development of the NRA, hazard log and associated risk scoring process is based on the following data, analysis, modelling and expertise of the project team:

- Projects description (see **Section 4**)
- Overview of baseline environment (see **Section 5**)
- Description of existing marine activities (see **Section 6**)
- Future case vessel traffic profiles (see **Section 7**)
- Potential impact assessment (see **Section 8**).

In addition to above a key component of the NRA is engagement with regulators and local stakeholders to confirm baseline shipping and navigation characteristics and elicit judgement on the levels of navigation risk with the project in place.

The following sections outline the:

- Overarching methodology of the risk assessment;
- Details of the hazard workshop;
- Process of hazard identification;
- Embedded (or designed in) risk controls measures;
- Results of the assessment of risk with the embedded risk controls in place; and
- Possible additional risk control measures which may reduce risk to acceptable levels.

The risk assessment methodology follows the IMO FSA and is based on the principles set out in IALA Guidelines 1018 and 1138 which are endorsed by the IMO in SN.1/Circ.296 in

December 2010 and is as shown in **Figure 1**. The methodology also closely follows MCA MGN654 guidance.

Navigation hazards are identified through consultation and data analysis, before being assessed in terms of their likelihood and consequence of risk. A risk matrix is then utilised to identify the significance of each hazard with possible additional risk controls identified based on the resultant risk score to reduce the risks to acceptable levels.

A description of the FSA process is as follows:

- **FSA Step 1: HAZID**: The project team identifies navigation hazards related to defined and agreed assessment parameters, such as geographic areas, marine operation, or vessel type. This is achieved using a suite of quantitative (e.g., statistical vessel traffic analysis) and qualitative (e.g. consultation with stakeholders) techniques which enables an evidentially robust identification of navigation hazards
- **FSA Step 2: Risk Analysis**: A detailed investigation of the causes, including the initiating events, and consequences of the hazards identified in Step 1 is undertaken. This is completed using a risk matrix, and enables ranking of hazards based on navigation risk, and a determination of hazard acceptability tolerability. This process allows attention to be focused upon higher-risk hazards enabling identification and evaluation of factors which influence the level of risk
- **FSA Step 3 & 4: Risk Controls**: The identification of existing risk controls measures (which are assumed to be embedded in the assessment of navigation risk), and the identification of possible additional risk controls, not currently in place for the assessment parameters is undertaken. Possible additional risk control measures are identified based on prioritising mitigation of higher-risk hazards. During this stage risk control measures may be grouped into a defined and thought-out risk mitigation strategy
- **FSA Step 5: Findings**: The assessment findings are developed and documented into a technical report and then presented to the relevant decision makers in an auditable and traceable manner. The findings are based upon a comparison and a ranking of all hazards and their underlying causes; the comparison and ranking of possible additional risk control options as a function of associated costs and benefits; and the identification of those options which mitigate hazards to acceptable or ALARP.

9.2 SCORING CRITERIA

Having identified all relevant impacts and hazards as a result of a project, a hazard log is constructed as described in MGN654 Annex 1 (Annex D). Whilst there is no generally accepted standard for risk matrices, the following is proposed as suitable for the project, meets IMO and IALA guidance, and is consistent with industry best practice.

Each hazard was scored for the likelihood of occurrence (**Table 30**) and expected consequence (**Table 29**) for two scenarios, the "realistic most likely" and "realistic worst credible". Severity of consequence with each hazard under both scenarios is considered in terms of damage to:

- **People** – hazards may result in injuries or fatalities
- **Property** – hazards may result in damage or loss of vessels or structures
- **Environment** – hazards may result in environmental pollution such as oil spills
- **Commercial and Reputation** – hazards may result in loss of economic output, impact on vessel routes, interruption of supply/generation capacity and adverse media coverage.

This NRA, in considering and assessing navigation risk, assumes that vessels will be compliant with international (e.g. Convention on the International Regulations for Preventing Collisions at Sea (COLREGS) and Standards of Training, Certification and Watchkeeping for Seafarers (STCW)), and National regulations and Guidance (e.g. UK Merchant Shipping Act 1995, and MCA Marine Guidance Notes) regulations.

Table 29: Severity of consequence categories and criteria.

Rank	Definition	Description			
		People	Property	Environment	Commercial and Reputation
1	Negligible	Minor injury.	Less than £10,0000	Minor spill no assistance required.	Minimal impact on activities.
2	Minor	Multiple minor injuries.	£10,000-£100,000	Tier 1 Local assistance required	Local negative publicity. Short term loss of revenue or interruption of services to ports/offshore wind farm/oil and gas/ferries and other marine users.
3	Moderate	Multiple major injuries.	£100,000-£1million	Tier 2 Limited external assistance required	Widespread negative publicity. Temporary suspension of activities to ports/offshore wind farm/oil and gas/ferries and other marine users.
4	Serious	Fatality.	£1million-£10million	Tier 2 Regional assistance required	National negative publicity. Prolonged closure or restrictions to ports/offshore wind farm/oil and gas/ferries and other marine users.
5	Major	Multiple fatalities.	>£10million	Tier 3 National assistance required	International negative publicity. Serious and long-term disruption to ports/offshore wind farm/oil and gas/ferries and other marine users.

Table 30: Frequency of occurrence criteria.

Rank	Definition	Description	Definition
1	Remote	Remote probability of occurrence at project site and few examples in wider industry.	<1 occurrence per 1,000 years
2	Extremely unlikely	Extremely unlikely to occur at project site and has rarely occurred in wider industry.	1 per 100 – 1,000 years
3	Unlikely	Unlikely to occur at project site during project lifecycle and has occurred at other offshore wind farms.	1 per 10 – 100 years
4	Reasonably probable	May occur once or more during offshore wind farm lifecycle.	1 per 1 – 10 years
5	Frequent	Likely to occur multiple times during offshore wind farm lifecycle.	Yearly

9.3 RISK MATRIX

The combination of the frequency and consequence scores are then combined to produce a risk score (**Table 31**).

The assessment of risk is calculated eight times for each identified hazard; four times for the “realistic most likely” occurrence for each consequence category and four times for the “realistic worst credible” outcome for each consequence category. An overall risk score is then calculated using an averaging function weighted to the highest risk score for the “realistic most likely” and the highest risk score for the “realistic worst credible”. The weighted averaging calculation is an average of:

- Average of all the “realistic most likely” risk scores
- Average all the “realistic worst credible” risk scores
- Highest individual score from the “realistic most likely” scores
- Highest individual score from the “realistic worst credible” scores.

The tolerability of hazard risk scores with regards to significance and acceptability with or without further action are shown in **Table 32.**

The assessment criteria, including frequency and consequence bandings, are consistent with previous offshore wind farm NRAs submitted and approved by the MCA. Furthermore, reference has been made to Intolerable/ALARP/Negligible bandings defined in IMO FSA studies, such as the FSA for RoPax Vessels (MSC 85 INF3).

For example, a fatality every 10 years, or multiple fatalities every 100 years within the RoPax FSA was defined as the threshold between Unacceptable and ALARP, this translates to a score between 12 and –16, and 10 and 15 respectively on the risk matrix. Similarly, the same study determined that a fatality every 1,000 years, or multiple fatalities every 10,000 years was defined as the threshold between ALARP and Negligible, this translates to a score between four and –eight, and five and ten respectively on the risk matrix. The risk matrix presented in **Table 31** is therefore consistent with the FSA for RoPax Vessels (MSC 85 INF3).

Hazards are then defined as either Broadly Acceptable, with existing (embedded) mitigation, or Unacceptable. MGN654 Annex 1 states that where risks are scored as Medium Risk, *"Further risk control options must be considered to the point where further risk control is grossly disproportionate (i.e. the ALARP principle) and an ALARP justification and declaration made*." Therefore, hazards scored as Medium Risk can only be Tolerable if ALARP is met.

Table 31: Risk matrix.

Risk Matrix							
Severity of consequences	Major	5	5	10	15	20	25
	Serious	4	4	8	12	16	20
	Moderate	3	3	6	9	12	15
	Minor	2	2	4	6	8	10
	Negligible	1	1	2	3	4	5
			1	2	3	4	5
			Remote	Extremely unlikely	Unlikely	Reasonably probable	Frequent
			Likelihood of Occurrence				

Table 32: Tolerability and risk ratings.

Hazard Risk Score	Hazard Risk Rating	Tolerability	Description
0 - 4	Negligible Risk	Broadly Acceptable	Generally regarded as not significant and adequately mitigated. Additional risk reduction should be implemented if reasonably practicable and proportionate
4.1 - 6	Low Risk		
6.1 - 12	Medium Risk	Tolerable (if ALARP)	Generally regarded as within a zone where the risk may be tolerable in consideration of the project. Requirement to properly assess risks, regularly review and implement risk controls to maintain risks to within ALARP where possible.
12.1 - 20	High Risk	Unacceptable	Generally regarded as significant and unacceptable for project to proceed without further review.
20.1 - 25	Extreme Risk		

9.4 HAZARD WORKSHOP

A hazard workshop was held in Liverpool on the 10 October 2022 to review the navigational hazards of the three Projects. It was attended by representatives from ferry operators, regulators, commercial bodies, oil and gas, ports, fishing community and recreational users.

The hazard workshop process was undertaken as follows:

- Development of a draft or initial hazard log by the NASH project team
- Identification of shipping and navigation stakeholders, made up of statutory regulators and local users and determination of workshop dates to maximise attendance
- Provision of detailed pre-read information related to the Projects, baseline vessel traffic and an assessment of likely changes brought about by the Projects
- A pre-hazard workshop webinar to review the collated data, NRA methodology and the draft hazard log (conducted on 3 October 2022)
- The hazard workshop with all invited attendees to review and update hazard identification, hazard characteristics, hazard risk scoring and key impacts for individual stakeholder organisations
- Finalisation of hazard risk scores based on the findings of the hazard workshop, particularly individual stakeholder hazard scoring.

As part of the pre-read pack, copies of the draft risk assessment produced by the Project team were provided to each stakeholder, who was invited to review and pre-score the assessment.

At the workshop, the pre-read material was re-summarised at a high level before stakeholders were invited to describe their key concerns regarding the Projects. The key navigation themes are summarised in **Table 33.**

Table 33: Key CRNRA stakeholder navigational concerns.

Organisation	Key Navigation Themes
Cruising Association	• AIS data – assumption that most cruising vessels have AIS – underrepresents recreational craft activity • Vessel deliveries at beginning/end of season (e.g. May, September/October) – different routes compared to peak season routes • Long voyage times – small tidal window and significant weather constraints (wind/waves) • Make rules clearer to recreational users – regarding sailing in/around windfarms.
Department of Infrastructure (IOM)	• offshore wind farm and extraction site will be impacted, especially for adverse weather routing • Lifeline services and routes must be able to function as they currently do - time impacts and routing impacts. • Economic, social and environmental impacts all must be considered • Emphasis on time constraints to economic impacts – shipping routes especially have tight turn arounds in IoM. • Safety is no. 1!
Harbour Energy	• Number of assets in area • Increase in large vessels navigating in close proximity to oil and gas infrastructure.
Isle of Man Steam Packet Company Limited	• Long established service – lifeline to IoM including passenger and freight • Direct route is essential – ships designed for these routes. Diverting may impact route timings • Concerns about environmental impacts (e.g. higher fuel consumption if diverted routes are longer). Companies must comply with environmental goals – concerns about meeting these • Concerned about safety of navigation (e.g. meeting COLREGs, obligations under SOLAS) • Must fully consider adverse weather conditions and the hazards associated with this • SAR procedures in and around offshore wind farms.
Maritime and Coastguard Agency	• Obligation to listen to other stakeholders and address concerns • Focus on making Projects navigationally safe • Corridors are a big concern with focus on pinch points • SAR chapter will be NRA – will address SAR concerns and procedures.
Peel Ports	• Traffic from northwest and piloted vessels from Douglas • Responsibility for approaches – focus on increase of risk to navigation, especially around pinch points • Direct risk to ports – pollution from grounding/contact • Concerned about environmental risk from increased fuel consumption.

Organisation	Key Navigation Themes
Royal Yachting Association	• AIS data concerns. (previously found) fewer than 10% of recreational vessels have AIS • Intense levels of activity in August – should be captured in vessel traffic analysis • Concerned about busy pinch points • Safety zones – how is this controlled? How will this information be shared to mariners so that they are aware of requirements?
Seatruck Ferries	• Established schedule that depends on tides and lock systems – tight turn arounds. Extended routes will greatly impact this • Extended route will have economic and environmental impact • Pinch points (e.g. meeting recreational vessels in limited space) • Obscuring radar, navigational marks/looking towards land and recreational/fishing craft (without AIS). Worse in adverse weather conditions • Night-time navigation must be significantly considered in NRA.
Spirit Energy	• Multiple assets in area (designed in 1970s) • Concerns about large vessels near infrastructure – large amounts of traffic displaced towards platforms • Collision detection times – ability to evacuate (>100 people) • Ability to continue to service infrastructure and decommission platforms.
Stena Line	• Five large ferries operate through the CRNRA study area (two transits a day) • Increase crossing time – will cause significant concerns – timing constraints and environmental impacts • Safety aspect – funnelling of traffic into tighter area. Reducing searoom leading to increased hazards • Operators to consider level of risk.
Tom Watson	• Whole area is a fishing ground – Significant density of fishing vessels – lanes between wind farms and within offshore wind farms • Scalloping, trawling and potting (only large vessels have mandatory AIS) • Southwest and Belgian beam trawlers in Morecambe Array Area.
UK Chamber of Shipping	• Displacement, reduced searoom and collision risk • SAR considerations in/around offshore wind farms • Irish Sea becoming an increasingly busy area – multiple develops, nearing saturation point? – Emphasis on the importance of marine spatial planning • Environmental concerns – adhering to EEXI • Input of tanker/cargo operators • Isle of Man offshore wind farm included in NRA – should consider how it impacts navigation corridors in conjunction with the Projects.

From the key navigation themes, the NRA team identified eight hazards to focus the hazard workshop discussions. These generally related to collisions between ferries and other ships as well as collisions with small craft, although other hazards such as allisions were also discussed.

For each hazard, stakeholders were provided an opportunity to discuss the hazards in small groups and provide scorings, and then a discussion was held in the wider room about the variation in scoring for each hazard and where differences lay. A summary was held at the end of the day to discuss the key impacts identified and some potential mitigation options.

A full summary of the workshop is available in **Appendix B**.

During the hazard workshop, consensus was not reached on several hazards, with a range of scores provided between the Project teams and amongst stakeholders. The findings of the workshop were therefore considered with the analysis and wider assessment undertaken by the NASH Project team to derive a finalised risk assessment.

9.5 HAZARD IDENTIFICATION

An NRA should consider all identified hazards of the Projects on shipping and navigation receptors. In developing the hazard log, consideration was given to project phases, areas, hazard types and vessel types. However, for the purposes of the CRNRA, the objective was to focus on cumulative impacts and therefore the assessment was prioritised the assessment of risk associated with hazards located within the corridors between the Projects, rather than hazards associated with individual Project, which are considered in the individual NRA for each Project.

In total four hazard types were assessed for the CRNRA including:

- **Collision** - Collision between two vessels underway (also includes striking of an anchored or moored vessel)
- **Allision** - Vessel makes contact with Fixed or Floating Object (e.g. wind turbines/substation etc.). A separate hazard was included following the hazard workshop for oil and gas allisions
- **Grounding** - Vessel makes contact with the seabed/shoreline or underwater assets
- **Vessel motions** – Vessel experiences a dangerous degree of roll or other motions that cause damage to cargo or injuries.

For the purposes of the CRNRA, the following vessel types were identified.

Table 34: Vessel types within CRNRA.

Vessel #	Vessel Types/Receptors	Includes
1	Ferry or Passenger Vessel	Passenger Ferry Freight Ferry Cruise Ship
2	Cargo Vessel or Tanker	Cargo (Container, Bulk, Reefer, General etc.) Tanker (Oil, Chemical etc.)
3	Tug and Service Vessels	Tugs Offshore Supply Ships Standby Rescue Vessels Pilot Boats Non-Project CTVs Other Service Vessels
4	Fishing	Trawlers Fishing Boats
5	Recreational	Yachts Pleasure Boats
6	Small Project Vessels	CTVs Survey Vessels Workboats

Finally, seven areas were identified that largely relate to the corridors between offshore wind farms (see **Figure 61**).

Table 35: CRNRA areas.

Area #	Areas	Detail
1	Mona-Morgan	Route between Mona and Morgan Array Areas and between all three Projects
2	Morgan-Walney	Route between Morgan-Walney
3	Mona-Morecambe	Route between Mona and Morecambe Array Areas
4	South of Mona	Route south of Mona Array Area (incl. TSS)
5	East of Morecambe	Route east of Morecambe Array Area
6	Within offshore wind farms	Navigation within Mona, Morgan or Morecambe Array Areas
7	Operations and Maintenance Base	Route between Projects and an unspecified operations and maintenance base.

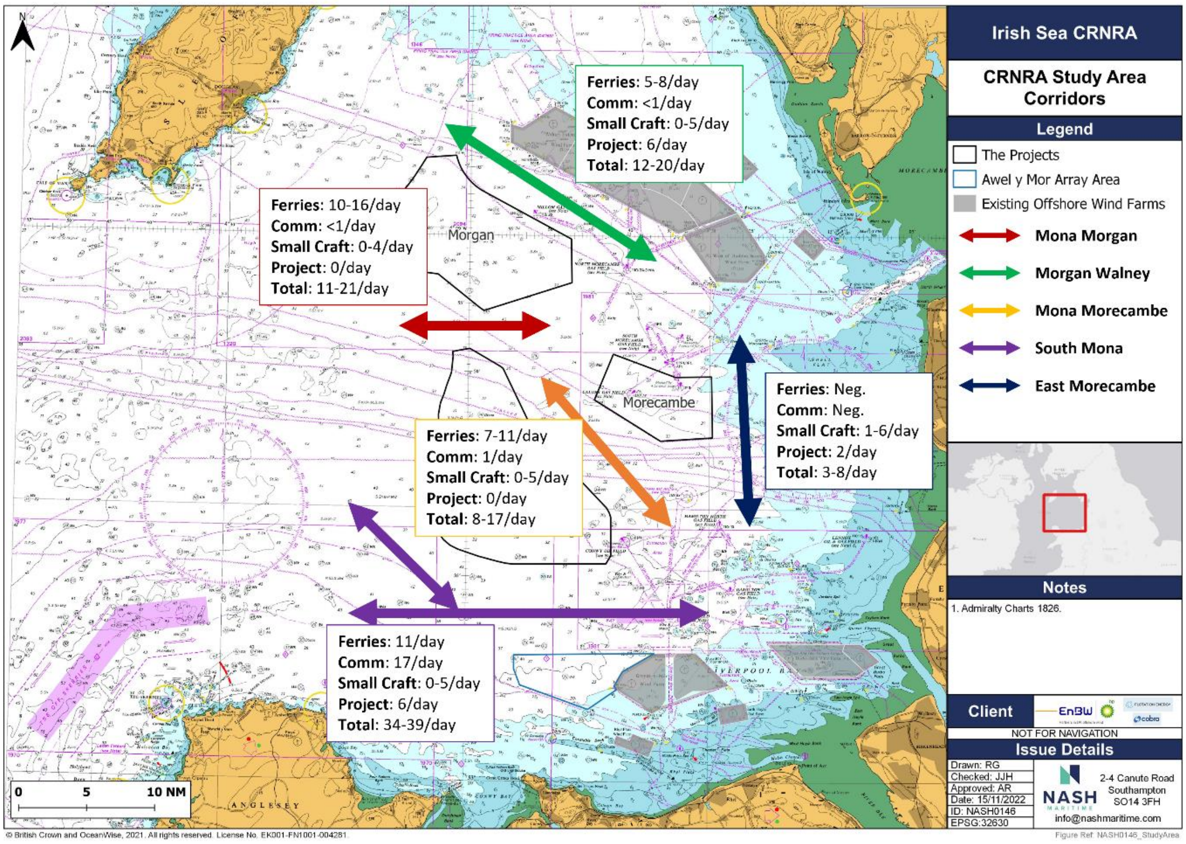


Figure 61: NRA hazard areas.

Based on the vessel type, hazard types and hazard area a total of 56 individual hazards were identified. Other hazards and project phases are considered within the respective individual NRAs.

9.6 RESULTS

The results of the NRA, based on the approach as identified above shows that in total (**Table 36)** describes the top ten hazards identified in the NRA :

- Five hazards were assessed as High Risk – Unacceptable
- Forty two hazards were assessed as Medium Risk – Tolerable (if ALARP)
- Nine hazards were assessed as Low Risk – Broadly Acceptable.

A full hazard log is available in **Appendix A**.

Table 36: Top 10 hazards.

ID	Rank	Area	Hazard Title	Baseline Risk	
				Score	Rating
10	1	Mona-Morgan	Collision - Ferry/Passenger ICW. Cargo/Tanker or Ferry/Passenger	13.1	High Risk - Unacceptable
28	1	South-Mona	Collision - Ferry/Passenger ICW. Cargo/Tanker or Ferry/Passenger	13.1	High Risk - Unacceptable
12	3	Mona-Morgan	Collision - Ferry/Passenger or Cargo/Tanker ICW. Small Craft	12.3	High Risk - Unacceptable
3	3	Morgan-Walney	Collision - Ferry/Passenger or Cargo/Tanker ICW. Small Craft	12.3	High Risk - Unacceptable
30	3	South-Mona	Collision - Ferry/Passenger or Cargo/Tanker ICW. Small Craft	12.3	High Risk - Unacceptable
21	6	Mona-Morecambe	Collision - Ferry/Passenger or Cargo/Tanker ICW. Small Craft	10.9	Medium Risk - Tolerable (if ALARP)
23	7	Mona-Morecambe	Allision - Ferry/Passenger	10.4	Medium Risk - Tolerable (if ALARP)
5	7	Morgan-Walney	Allision - Ferry/Passenger	10.4	Medium Risk - Tolerable (if ALARP)
14	7	Mona-Morgan	Allision - Ferry/Passenger	10.4	Medium Risk - Tolerable (if ALARP)
29	10	South-Mona	Collision - Cargo/Tanker ICW. Cargo/Tanker	10.3	Medium Risk - Tolerable (if ALARP)

The joint highest hazard relates to a collision between a Ferry/Passenger vessel with another Cargo/Tanker or Ferry/Passenger in the Mona-Morgan corridor. The Mona and Morgan corridor would be used by a number of ferry operators and includes commercial routes into Heysham, Liverpool and Douglas (see **Section 8.3** and **8.4**), albeit the numbers for both would equate to less than one an hour (**Section 8.6**), however regular meeting situations were considered a realistic scenario. It was widely agreed with stakeholders that the distance between the Mona and Morgan Array Areas was of insufficient width to enable effective collision avoidance, particularly given the convergence of ships from multiple directions (**Section 8.7**). Furthermore, the consequences of collisions involving ferries could result in multiple loss of life consequences, and that the "most likely" consequences could involve multiple major injuries (see **Section 6.3.3**).

Further, it was asserted during the hazard workshop by the IoMSPC that its vessel the Manannan (a high speed craft) had a low survivability in a collision event given its speed and design. However, as this accounts for only a single vessel, that predominantly deployed seasonally in summer months, a realistic "most likely" scenario would be for a conventional ferry to be involved in the collision. As a result, this hazard was assessed as High Risk – Unacceptable.

A similar collision scenario, but to the south of Mona Array Area, was similarly scored High Risk as the joint highest hazard. As noted in **Section 8.2** and **Section 8.7.5**, the proximity of the Mona Array Area to the westbound lane of the Liverpool TSS was likely to cause challenges complying with COLREGs collision avoidance for southeast bound traffic from the Isle of Man and increase close quarters encounters and congestion.

As demonstrated in **Section 7.3** multi vessel situations with four or more vessels are a daily occurrence and it is possible, but unlikely, that up to 20 vessels could be navigating south of Mona Array Area at any one time. These vessels include ferries and large commercial ships travelling in excess of 20 knots and therefore there was a relatively high potential for injuries and major damage were a collision to occur. This also accounts for the 10th highest hazard, albeit for cargo/tanker in collision with cargo/tanker, which has a lower potential loss of life.

The 3rd to 5th scoring hazards all relate to a Ferry/Passenger or a Cargo/Tanker in collision with a small craft such as a fishing, recreational or CTV. The creation of corridors between Projects, transited by large vessels with the potential also for small fishing boats and other small vessels within them, reduces the ability to avoid a collision. Furthermore, emergence of small craft from the offshore wind farms with possible radar interference or visual obscuration could exacerbate these risks (**Section 8.7.4**), particularly Project CTVs which may be operating at higher speeds.

The absolute numbers of small craft within these corridors could not be fully quantified at the time of the assessment, but realistic scenarios based on the data analysis were presented in **Section 7.3** and a precautionary basis taken to the assessment. The variation was not such that the likelihood scores could be differentiated between these corridors. Some stakeholders asserted that any such collision might involve loss of life, however, comparative historical incidents suggest this is unlikely, with multiple injuries a more credible outcome (**Section 6.3.3**). The loss of the small craft with multiple loss of life was agreed as a "worst credible" outcome. As a result of stakeholder feedback at the hazard workshop, these hazards were assessed as High Risk – Unacceptable. When scored within the Mona-Morecambe corridor which is notably wider, this hazard was considered Medium Risk.

An allision between a Ferry/Passenger vessel with a wind turbine was scored as a Medium Risk. The corridors between the offshore wind farm vary in shape and length (**Section 8.6**) and there is the potential for a vessel to become disabled within this corridor and therefore have an allision if corrective action cannot be taken in time. Ferries do have high redundancy and reliability and therefore likelihood of such failure would be low. Furthermore, the avoidance of other small craft could exacerbate this risk. In addition, there would be sufficient space between wind turbines in an emergency to enter the offshore wind farm without necessarily contacting with a turbine. There are few historical examples of ship allisions with turbines (**Section 6.3.4**), and none involving existing offshore wind farms in the CRNRA study area, however, the historical data, research and stakeholder responses suggested these may be less severe than a collision. Multiple injuries, damage and minor pollution would be a "most likely" outcome but a "worst credible" result could include severe damage to the ferry with fatalities and the collapse of a wind turbine. Whilst the Mona-Morgan corridor is relatively shorter in length comparted tot eh other corridors, the narrow and potentially congested nature increases the likelihood of allisions due to collision avoidance from vessels converging from multiple headings.

9.6.1 Risk by Hazard

Collision – Ferry/Passenger or Cargo/Tanker in collision with (ICW). Small Craft

The assessment identified that a collision between a Ferry/Passenger and another small craft was the most significant cumulative hazard across multiple offshore wind farm corridors (see **Section 9.6**). This is partly a reflection of the high potential consequence of such a collision, particularly where the ship is travelling at full speed with the loss of the small craft with multiple fatalities a realistic worst credible outcome, albeit the potential for pollution and damage is inherently less than for larger vessels.

The likelihood of occurrence varies between the range of small craft being considered (principally fishing, recreational or CTV) and the spatial and temporal distribution of these vessels were subject to much discussion during the hazard workshop. During the hazard workshop, there was also discussion regarding the extent of consequence for a most likely outcome, and the relevant draft hazard scores were increased to reflect multiple major injuries and significant damage as a hazard outcome. The presence of the offshore wind farms may also constrain both the searoom for small craft to navigate, concentrating them within the corridors (see **Section 8.5**), and also the ability for collision avoidance manoeuvres.

Table 37: Collision – Ferry/Passenger or Cargo/Tanker ICW. Small Craft.

ID	Baseline Rank	Area	Hazard Title	Baseline Risk	
				Score	Rating
12	3	Mona-Morgan	Collision - Ferry/Passenger or Cargo/Tanker ICW. Small Craft	12.3	High Risk - Unacceptable
3	3	Morgan-Walney	Collision - Ferry/Passenger or Cargo/Tanker ICW. Small Craft	12.3	High Risk - Unacceptable
30	3	South-Mona	Collision - Ferry/Passenger or Cargo/Tanker ICW. Small Craft	12.3	High Risk - Unacceptable
21	6	Mona-Morecambe	Collision - Ferry/Passenger or Cargo/Tanker ICW. Small Craft	10.9	Medium Risk - Tolerable (if ALARP)
38	51	East Morecambe	Collision - Ferry/Passenger or Cargo/Tanker ICW. Small Craft	5.1	Low Risk - Broadly Acceptable

Collision - Ferry/Passenger ICW. Cargo/Tanker or Ferry/Passenger

Collisions involving large ships can have catastrophic consequences in terms of damage, loss of life or pollution. Realistic "most likely" consequences of collisions at speed between a ferry and another large vessel could include multiple major injuries amongst passengers, damage to both vessels and the potential for minor pollution.

The Projects sit adjacent to several major ports, including Liverpool with cruise ships, container ships and tankers up to 400m in length regularly transiting through the CRNRA study area (**Section 6.2**). Development of future case routeing patterns suggest that most commercial ships would route southwest of Mona Array Area and therefore avoid the key corridors (**Section 8.4**).

However, it is likely that ferries would route between the Projects and therefore realistic meeting situations could be envisaged (see **Section 8.3**). The assessment considers this most likely between Mona and Morgan Array Areas and to the southwest of Mona Array Area, and therefore High Risk scores are achieved. Some stakeholders asserted that these risks were also High within other corridors. However, analysis undertaken as part of this assessment demonstrate that other corridors have lower vessel numbers and lower potential meeting situations (**Section 8.7**) and are therefore scored as Medium Risk.

Table 38: Collision – Ferry/Passenger ICW. Cargo/Tanker or Ferry/Passenger.

ID	Baseline Rank	Area	Hazard Title	Baseline Risk	
				Score	Rating
10	1	Mona-Morgan	Collision - Ferry/Passenger ICW. Cargo/Tanker or Ferry/Passenger	13.1	High Risk - Unacceptable
28	1	South-Mona	Collision - Ferry/Passenger ICW. Cargo/Tanker or Ferry/Passenger	13.1	High Risk - Unacceptable
19	12	Mona-Morecambe	Collision - Ferry/Passenger ICW. Cargo/Tanker or Ferry/Passenger	9.2	Medium Risk - Tolerable (if ALARP)
1	12	Morgan-Walney	Collision - Ferry/Passenger ICW. Cargo/Tanker or Ferry/Passenger	9.2	Medium Risk - Tolerable (if ALARP)

Collision – Cargo/Tanker ICW. Cargo/Tanker

Collisions involving Cargo and Tanker vessels were scored as Low Risk – Broadly Acceptable in all corridors, with the exception of South of Mona Array Area. Vessel traffic analysis (**Section 6.2.2**) and predicted impacts on commercial routes (**Section 8.4**) clearly identifies that the majority of cargo vessels and tankers will pass to the southwest of Mona Array Area and therefore clear of the corridors, reducing the likelihood of an allision. Collisions involving large ships could result in significant damage, pollution and loss of life. Tankers up to 300m are known to transit through the CRNRA study area and therefore major pollution incidents could occur in a realistic "worst case" scenario.

Consultees identified infrequent periods when vessels leaving Liverpool would undertake pilotage transfers at Douglas, taking advantage of shelter in strong northwesterlies (**Section 6.2.6**). At present, many of these vessels take the TSS west of Liverpool and would naturally route clear of any corridors, this may continue in the future. The exception is the Medium Risk scoring of collision South-Mona, due to the significant number of vessel movements in the approaches to Liverpool. Furthermore, **Section 8.2** and **8.7.5** demonstrate that there is limited space to comply with COLREGs when vessel traffic routes from the northwest and joins east-west traffic between Liverpool TSS and Off Skerries TSS.

Table 39: Collision – Cargo/Tanker ICW. Cargo/Tanker.

ID	Baseline Rank	Area	Hazard Title	Baseline Risk	
				Score	Rating
29	10	South-Mona	Collision - Cargo/Tanker ICW. Cargo/Tanker	10.3	Medium Risk - Tolerable (if ALARP)
11	47	Mona-Morgan	Collision - Cargo/Tanker ICW. Cargo/Tanker	5.1	Low Risk - Broadly Acceptable
37	47	East Morecambe	Collision - Cargo/Tanker ICW. Cargo/Tanker	5.1	Low Risk - Broadly Acceptable
20	47	Mona-Morecambe	Collision - Cargo/Tanker ICW. Cargo/Tanker	5.1	Low Risk - Broadly Acceptable
2	47	Morgan-Walney	Collision - Cargo/Tanker ICW. Cargo/Tanker	5.1	Low Risk - Broadly Acceptable

Collision – Small Craft ICW. Small Craft

The risk of collision between small craft were scored as Medium Risk across all corridors assessed within the NRA. These include fishing boats, recreational craft, tug and service or CTVs. The presence of the Projects could increase the likelihood of this occurrence by concentrating or offsetting small craft traffic into more dense areas (**Section 8.5**). Collisions involving small craft occur routinely throughout the UK and it is rare that a fatality occurs (see **Section 6.3.3**), however, this is still considered a realistic worst-case scenario. The nature of small craft are that the potential for damage and pollution is inherently lower than for other large vessels, and the scoring reflects this.

Allision – Ferry/Passenger

All allisions involving a ferry/passenger vessel were scored as Medium Risks. Whilst navigating within these corridors there is the potential for a vessel to become disabled within this corridor and have an allision if corrective action cannot be taken. Furthermore, the avoidance of other small craft could exacerbate this risk. These ferries have high redundancy and reliability and therefore such failure would be low. In addition, there would be sufficient space between wind turbines in an emergency to enter the offshore wind farm without contacting with a turbine. There are few historical examples of ship allisions with turbines (**Section 6.3.4**), however, the historical data, research and stakeholder responses suggested these may be less severe than a collision. Multiple injuries, damage and minor pollution would be a most likely outcome but a worst credible result would include severe damage to the ferry with fatalities and the collapse of a wind turbine.

Table 40: Collision – Small Craft ICW. Small Craft.

ID	Baseline Rank	Area	Hazard Title	Baseline Risk	
				Score	Rating
45	31	Within offshore wind farms	Collision - Small Craft ICW. Small Craft	7.5	Medium Risk - Tolerable (if ALARP)
39	31	East Morecambe	Collision - Small Craft ICW. Small Craft	7.5	Medium Risk - Tolerable (if ALARP)
22	31	Mona-Morecambe	Collision - Small Craft ICW. Small Craft	7.5	Medium Risk - Tolerable (if ALARP)
4	31	Morgan-Walney	Collision - Small Craft ICW. Small Craft	7.5	Medium Risk - Tolerable (if ALARP)
31	31	South-Mona	Collision - Small Craft ICW. Small Craft	7.5	Medium Risk - Tolerable (if ALARP)
13	42	Mona-Morgan	Collision - Small Craft ICW. Small Craft	6.6	Medium Risk - Tolerable (if ALARP)

Table 41: Allision – Ferry/Passenger.

ID	Baseline Rank	Area	Hazard Title	Baseline Risk	
				Score	Rating
23	7	Mona-Morecambe	Allision - Ferry/Passenger	10.4	Medium Risk - Tolerable (if ALARP)
5	7	Morgan-Walney	Allision - Ferry/Passenger	10.4	Medium Risk - Tolerable (if ALARP)
14	7	Mona-Morgan	Allision - Ferry/Passenger	10.4	Medium Risk - Tolerable (if ALARP)
32	14	South-Mona	Allision - Ferry/Passenger	8.9	Medium Risk - Tolerable (if ALARP)

Allision – Fishing/Recreational/Tug/Service

The allisions of small craft including fishing, recreational and tug/service vessels was consistently scored as Medium Risk across all locations and is consistent with the majority of stakeholder feedback. Within the central Irish Sea, there are relatively few recreational routes (**Section 6.2.2.4**), but fishing, and tug and service activity can be prolific. The proposed spacing between turbines is greater than in existing projects and there is an expectation that small craft will continue to be able to both transit and fish within the boundaries of the offshore wind farm. This close navigation raises the likelihood of allision due to human error or mechanical failure. Such incidents have occurred within the UK, but resulted in only minor damage and injuries, but a worst credible potential for a fatality exists.

Table 42: Allision – Fishing/Recreational/Tug and Service.

ID	Baseline Rank	Area	Hazard Title	Baseline Risk	
				Score	Rating
7	16	Morgan-Walney	Allision - Tug/Service & Small Project Vessels	8.6	Medium Risk - Tolerable (if ALARP)
46	16	Within offshore wind farms	Allision - Tug/Service & Small Project Vessels	8.6	Medium Risk - Tolerable (if ALARP)
42	19	East Morecambe	Allision - Fishing	7.6	Medium Risk - Tolerable (if ALARP)
43	19	East Morecambe	Allision - Recreational	7.6	Medium Risk - Tolerable (if ALARP)
41	19	East Morecambe	Allision - Tug/Service & Small Project Vessels	7.6	Medium Risk - Tolerable (if ALARP)
25	19	Mona-Morecambe	Allision - Tug/Service & Small Project Vessels	7.6	Medium Risk - Tolerable (if ALARP)
16	19	Mona-Morgan	Allision - Tug/Service & Small Project Vessels	7.6	Medium Risk - Tolerable (if ALARP)
8	19	Morgan-Walney	Allision - Fishing	7.6	Medium Risk - Tolerable (if ALARP)
9	19	Morgan-Walney	Allision - Recreational	7.6	Medium Risk - Tolerable (if ALARP)
35	19	South-Mona	Allision - Fishing	7.6	Medium Risk - Tolerable (if ALARP)
36	19	South-Mona	Allision - Recreational	7.6	Medium Risk - Tolerable (if ALARP)
34	19	South-Mona	Allision - Tug/Service & Small Project Vessels	7.6	Medium Risk - Tolerable (if ALARP)
47	19	Within offshore wind farms	Allision - Fishing	7.6	Medium Risk - Tolerable (if ALARP)
48	19	Within offshore wind farms	Allision - Recreational	7.6	Medium Risk - Tolerable (if ALARP)
26	36	Mona-Morecambe	Allision - Fishing	6.7	Medium Risk - Tolerable (if ALARP)
27	36	Mona-Morecambe	Allision - Recreational	6.7	Medium Risk - Tolerable (if ALARP)
17	36	Mona-Morgan	Allision - Fishing	6.7	Medium Risk - Tolerable (if ALARP)
18	36	Mona-Morgan	Allision - Recreational	6.7	Medium Risk - Tolerable (if ALARP)

Allision – Cargo/Tanker

Allision hazards involving cargo and tanker were scored as Medium Risk– Tolerable (if ALARP) in all corridors, with the exception of South of Mona Array Area. Vessel traffic analysis (**Section 6.2.2**) and predicted impacts on commercial routes (**Section 8.4**) clearly identifies that the majority of cargo and tankers will pass to the southwest of Mona Array Area and therefore clear of the corridors, reducing the likelihood of an allision.

Any allision between a ship and a wind turbine would likely result in minor damage to the vessel and the turbine, as has occurred (**Section 6.3.4**) in the historical incident record. More significant damage, including pollution and fatalities are less likely to occur but are a realistic worst credible outcome.

Consultees identified infrequent periods when vessels leaving Liverpool would undertake pilotage transfers at Douglas, taking advantage of shelter in strong northwesterlies (**Section 6.2.6**). At present, many of these vessels take the TSS west of Liverpool and would naturally route clear of any corridors, this may continue in the future. The exception, is the Medium Risk scoring of allision South-Mona, due to the proximity at which a large number of ships transit to the southwest face of the Mona Array Area. Collision avoidance situations or mechanical failure could result in vessels leaving the shipping route and striking a turbine.

Table 43: Allision – Cargo/Tanker.

ID	Baseline Rank	Area	Hazard Title	Baseline Risk	
				Score	Rating
33	11	South-Mona	Allision - Cargo/Tanker	9.9	Medium Risk - Tolerable (if ALARP)
24	44	Mona-Morecambe	Allision - Cargo/Tanker	6.3	Medium Risk - Tolerable (if ALARP)
15	44	Mona-Morgan	Allision - Cargo/Tanker	6.3	Medium Risk - Tolerable (if ALARP)
6	44	Morgan-Walney	Allision - Cargo/Tanker	6.3	Medium Risk - Tolerable (if ALARP)
40	52	East Morecambe	Allision - Cargo/Tanker	4.9	Low Risk - Broadly Acceptable

Allision (Oil and Gas) – Cargo/Tanker or Ferry/Passenger

Following the hazard workshop, a separate hazard concerning allision of a large ship with oil and gas infrastructure was added. **Section 8.11** notes that there are multiple platforms which are currently exposed to the risk of contact by passing vessels and controls exist to manage it. The Projects were assessed to have a minimal effect on changing this risk, given their geometries in relation to vessel routes and the infrastructure anticipated to be in place for the assessed situation. Allisions with platforms carry a higher potential consequence, particularly where they are manned.

Table 44: Allision (Oil and Gas) – Cargo/Tanker or Ferry/Passenger.

ID	Baseline Rank	Area	Hazard Title	Baseline Risk	
				Score	Rating
53	19	Morgan-Walney	Allision (Oil and Gas) - Cargo/Tanker or Ferry/Passenger	7.9	Medium Risk - Tolerable (if ALARP)

Vessel Motions – Cargo/Tanker or Ferry/Passenger

As described in **Section 8.3**, during adverse weather, ferries will route to maintain a comfortable heading relative to the conditions and take advantage of any available lee from the shore. Several of the corridors are perpendicular to the prevailing conditions and of a width/length ratio that sufficient heading choice flexibility is not available and therefore any ships within these corridors must proceed with the seas beam on, which is not considered seamanlike in adverse weather.

This may result in cargo shift occurrence that causes minor injuries and property damage. On occasions, cargo shift can be more significant and a fatality with significant damage to the vessel is possible. Of the three corridors, the orientation and exposure of the Morgan-Walney corridor was assessed to be the most constrained (primarily due to its length/width ratio) and likely to result in excessive motions. All three of these hazards were assessed to lie within the Medium Risk category. Whilst it is likely that in extreme conditions, masters would choose to route around the Projects and avoid these corridors (or for example navigate through Mona-Morgan rather than Morgan-Walney due to greater flexibility for heading), in marginal conditions, they may be committed to such passage but unable to weather route. This may result in cargo shift occurrence that causes minor injuries and property damage.

Table 45: Vessel Motions – Cargo/Tanker or Ferry/Passenger.

ID	Baseline Rank	Area	Hazard Title	Baseline Risk	
				Score	Rating
54	32	Morgan-Walney	Adverse Vessel Motions - Cargo/Tanker or Ferry/Passenger	7.5	Medium Risk - Tolerable (if ALARP)
56	32	Mona-Morecambe	Adverse Vessel Motions - Cargo/Tanker or Ferry/Passenger	7.5	Medium Risk - Tolerable (if ALARP)
55	32	Mona-Morgan	Adverse Vessel Motions - Cargo/Tanker or Ferry/Passenger	7.5	Medium Risk - Tolerable (if ALARP)

Groundings – Cargo/Tanker

Two grounding hazards were identified, namely for a commercial ship passing East of Morecambe Array Area or a small Project vessel on an operations and maintenance route. Groundings typically have lower potential consequence than collision or allisions, particularly on softer seabed. However, the constructive loss of a vessel and even a fatality is a reasonable worst credible outcome. In general, it is unlikely than many large ships would route east of Morecambe Array Area, and those that do so would be of small size and there would be sufficient water depth for safe navigation. Both are scored lower than other hazards described above but within the Medium Risk category.

Table 46: Grounding –Cargo/Tanker.

ID	Baseline Rank	Area	Hazard Title	Baseline Risk	
				Score	Rating
44	43	East Morecambe	Grounding - Cargo/Tanker	6.5	Medium Risk - Tolerable (if ALARP)

Incidents involving Small Project Vessels

The operations and maintenance route used by vessels is not yet known for all three Projects, however, assumptions are made that the route is likely to cross the various shipping routes and corridors between Projects, often in high numbers. Therefore, there is a risk of collision between Project vessels, namely CTVs, and other navigating vessels. This is exacerbated where they may emerge from within an offshore wind farm at high speed, on a boundary that is immediately adjacent to a shipping route. CTVs carry multiple persons and a realistic worst credible hazard outcome could involve multiple loss of life. Furthermore, given the high transit speeds, even most likely outcomes could result in multiple major injuries.

Consultees referred to previous near misses occurring with Irish Sea offshore wind farm CTVs, although no collision has been reported/documented. Furthermore, allision or grounding of these vessels, particularly within the operations and maintenance base, occurs for other UK offshore wind farms and therefore is reasonably probable to occur in the CRNRA study area, albeit likely to have a lower consequence. Assumptions regarding CTV movements and risk profile will be reviewed following finalisation of the proposed passage plans.

Table 47: Incidents involving Small Project Vessels.

ID	Baseline Rank	Area	Hazard Title	Baseline Risk	
				Score	Rating
49	15	Operations and Base	Collision - Small Project Vessels ICW. Cargo/Tanker or Ferry/Passenger	8.8	Medium Risk - Tolerable (if ALARP)
50	18	Operations and M Base	Collision - Small Project Vessels ICW. Small Craft	8.4	Medium Risk - Tolerable (if ALARP)
51	36	Operations and Base	Allision - Small Project Vessel	6.7	Medium Risk - Tolerable (if ALARP)
52	36	Operations and Base	Grounding - Small Project Vessel	6.7	Medium Risk - Tolerable (if ALARP)

9.6.2 Risk by Corridor

Mona-Morgan

The Mona-Morgan corridor was identified during the NRA and the hazard workshop as the most constrained corridor. The 3nm width between Mona and Morgan Array Areas, with in excess of 4,000 commercial vessel movements per year (**Section 8.6**), was not considered of sufficient width for safe navigation. Meeting situations between vessels would therefore be reasonably likely to occur, increasing the risk of collision or allision (**Section 8.7**). In addition, there was evidence that fishing activity would likely take place between the two Projects, constraining navigation further. Therefore, collision hazards were scored as High Risk. The risks of Allision were scored less highly due to the lower potential for high consequence outcomes.

Table 48: Mona-Morgan corridor risk scores.

ID	Baseline Rank	Area	Hazard Title	Baseline Risk	
				Score	Rating
10	1	Mona-Morgan	Collision - Ferry/Passenger ICW. Cargo/Tanker or Ferry/Passenger	13.1	High Risk - Unacceptable
12	3	Mona-Morgan	Collision - Ferry/Passenger or Cargo/Tanker ICW. Small Craft	12.3	High Risk - Unacceptable
14	7	Mona-Morgan	Allision - Ferry/Passenger	10.4	Medium Risk - Tolerable (if ALARP)
16	19	Mona-Morgan	Allision - Tug/Service & Small Project Vessels	7.6	Medium Risk - Tolerable (if ALARP)
55	32	Mona-Morgan	Adverse Vessel Motions - Cargo/Tanker or Ferry/Passenger	7.5	Medium Risk - Tolerable (if ALARP)
17	36	Mona-Morgan	Allision - Fishing	6.7	Medium Risk - Tolerable (if ALARP)
18	36	Mona-Morgan	Allision - Recreational	6.7	Medium Risk - Tolerable (if ALARP)
13	42	Mona-Morgan	Collision - Small Craft ICW. Small Craft	6.6	Medium Risk - Tolerable (if ALARP)
15	44	Mona-Morgan	Allision - Cargo/Tanker	6.3	Medium Risk - Tolerable (if ALARP)
11	47	Mona-Morgan	Collision - Cargo/Tanker ICW. Cargo/Tanker	5.1	Low Risk - Broadly Acceptable

Morgan-Walney

The Morgan-Walney corridor would be formed as a result of the Morgan Array Area in isolation, however, the presence of Mona and Morecambe Array Areas may exacerbate risk by altering the routeing decisions taken by vessels. In particular, the passages of the IoMSPC and Stena ferries through a narrow channel with significant fishing activity, oil and gas and some recreational craft increases the risk of small craft collision, which was scored as High Risk.

The relatively long length of the corridor increases the exposure both to allision and vessel motions (through reduced opportunity to amend heading) aboard ferries transiting it, particularly during adverse weather. The greater density of small craft traffic results in increased risks to fishing, recreational and tug/service vessels operating in the area, both in terms of collision and allision.

Whilst some stakeholders asserted that the risk of collision between two large vessels within this corridor was also high, the analysis undertaken suggests that very few ships would take this corridor that were not from the two ferry companies (**Section 8.7**). Estimated numbers of commercial ships taking this corridor, other than ferries, were anticipated to be one every two days (**Section 8.6**). As a result, these hazard scores have not been elevated as highly.

Table 49: Morgan-Walney corridor risk scores.

ID	Baseline Rank	Area	Hazard Title	Baseline Risk	
				Score	Rating
3	3	Morgan-Walney	Collision - Ferry/Passenger or Cargo/Tanker ICW. Small Craft	12.3	High Risk - Unacceptable
5	7	Morgan-Walney	Allision - Ferry/Passenger	10.4	Medium Risk - Tolerable (if ALARP)
1	12	Morgan-Walney	Collision - Ferry/Passenger ICW. Cargo/Tanker or Ferry/Passenger	9.2	Medium Risk - Tolerable (if ALARP)
7	16	Morgan-Walney	Allision - Tug/Service & Small Project Vessels	8.6	Medium Risk - Tolerable (if ALARP)
8	19	Morgan-Walney	Allision - Fishing	7.6	Medium Risk - Tolerable (if ALARP)
9	19	Morgan-Walney	Allision - Recreational	7.6	Medium Risk - Tolerable (if ALARP)
53	19	Morgan-Walney	Allision (Oil and Gas) - Cargo/Tanker or Ferry/Passenger	7.9	Medium Risk - Tolerable (if ALARP)
4	31	Morgan-Walney	Collision - Small Craft ICW. Small Craft	7.5	Medium Risk - Tolerable (if ALARP)
54	32	Morgan-Walney	Adverse Vessel Motions - Cargo/Tanker or Ferry/Passenger	7.5	Medium Risk - Tolerable (if ALARP)
6	44	Morgan-Walney	Allision - Cargo/Tanker	6.3	Medium Risk - Tolerable (if ALARP)
2	47	Morgan-Walney	Collision - Cargo/Tanker ICW. Cargo/Tanker	5.1	Low Risk - Broadly Acceptable

Mona-Morecambe

The Mona-Morecambe corridor is the widest of the three principal corridors in the cumulative scenario at 4.9nm (see **Section 8.6**). The risk of collision is therefore less than with the other corridors. Other collisions and allisions are generally lower than other corridors given its more favourable geometry.

During the hazard workshop, there was debate as to the likelihood that cargo and tanker vessels would navigate between Mona and Morecambe Array Areas. At present, a minority of small vessels do not transit through the TSS when navigating west (approximately one per day), and the presence of the Projects could make this more attractive rather than navigating through the TSS. The NRA assumes that those vessels would continue to do so, but their relatively low numbers reduce the likelihood that they would be involved in an incident.

Table 50: Mona-Morecambe corridor risk scores.

ID	Baseline Rank	Area	Hazard Title	Baseline Risk	
				Score	Rating
21	6	Mona-Morecambe	Collision - Ferry/Passenger or Cargo/Tanker ICW. Small Craft	10.9	Medium Risk - Tolerable (if ALARP)
23	7	Mona-Morecambe	Allision - Ferry/Passenger	10.4	Medium Risk - Tolerable (if ALARP)
19	12	Mona-Morecambe	Collision - Ferry/Passenger ICW. Cargo/Tanker or Ferry/Passenger	9.2	Medium Risk - Tolerable (if ALARP)
25	19	Mona-Morecambe	Allision - Tug/Service & Small Project Vessels	7.6	Medium Risk - Tolerable (if ALARP)
22	31	Mona-Morecambe	Collision - Small Craft ICW. Small Craft	7.5	Medium Risk - Tolerable (if ALARP)
56	32	Mona-Morecambe	Adverse Vessel Motions - Cargo/Tanker or Ferry/Passenger	7.5	Medium Risk - Tolerable (if ALARP)
26	36	Mona-Morecambe	Allision - Fishing	6.7	Medium Risk - Tolerable (if ALARP)
27	36	Mona-Morecambe	Allision - Recreational	6.7	Medium Risk - Tolerable (if ALARP)
24	44	Mona-Morecambe	Allision - Cargo/Tanker	6.3	Medium Risk - Tolerable (if ALARP)
20	47	Mona-Morecambe	Collision - Cargo/Tanker ICW. Cargo/Tanker	5.1	Low Risk - Broadly Acceptable

South-Mona

The South Mona Array Area region, formed due to the presence of Mona Array Area compressing traffic to the southwest in the approaches to Liverpool, achieved two High Risk and several Medium Risk scores. The High risk hazards relates to collisions between large commercial ships and small craft and interaction between large vessels to the southwest of Mona Array Area.

Presently, small craft could navigate to the north of the shipping lanes, avoiding the higher vessel density and the offshore wind farms to the south. Whilst small craft could continue to navigate through an offshore wind farm, the presence of Mona Array Area would likely offset fishing, recreational and tug/service craft further south and towards the TSS in the approaches to Liverpool, increasing interaction and the risk of collision (see **Section 8.5**). Other hazards such as allision and collision scores involving commercial ships are relatively high, albeit this reflects the greater density of traffic in this area than elsewhere within the Irish Sea, and therefore the risk scores were likely elevated in the basecase. The presence of the Projects would change the interaction between larger ships, particularly westbound traffic from

Liverpool TSS with traffic approaching from the northwest from the Isle of Man (see **Section 8.7**).

Table 51: South Mona corridors risk scores.

ID	Baseline Rank	Area	Hazard Title	Baseline Risk	
				Score	Rating
28	1	South-Mona	Collision - Ferry/Passenger ICW. Cargo/Tanker or Ferry/Passenger	13.1	High Risk - Unacceptable
30	3	South-Mona	Collision - Ferry/Passenger or Cargo/Tanker ICW. Small Craft	12.3	High Risk - Unacceptable
29	10	South-Mona	Collision - Cargo/Tanker ICW. Cargo/Tanker	10.3	Medium Risk - Tolerable (if ALARP)
33	11	South-Mona	Allision - Cargo/Tanker	9.9	Medium Risk - Tolerable (if ALARP)
32	14	South-Mona	Allision - Ferry/Passenger	8.9	Medium Risk - Tolerable (if ALARP)
35	19	South-Mona	Allision - Fishing	7.6	Medium Risk - Tolerable (if ALARP)
36	19	South-Mona	Allision - Recreational	7.6	Medium Risk - Tolerable (if ALARP)
34	19	South-Mona	Allision - Tug/Service & Small Project Vessels	7.6	Medium Risk - Tolerable (if ALARP)
31	31	South-Mona	Collision - Small Craft ICW. Small Craft	7.5	Medium Risk - Tolerable (if ALARP)

East-Morecambe

The route to the east of Morecambe Array Area was identified as having relatively low traffic numbers (**Section 8.6**) and therefore the presence of the Morecambe Array Area is not considered to significantly increase the risk profile. Given the greater propensity for small craft traffic, these hazards are scored more highly, but all falling within the Medium Risk/Low Risk categories. It may be the case that the presence of the other Projects, increases the likelihood that small general cargo ships and small craft route further east rather than navigating between the arrays, although this should not appreciably increase the risk scores.

Table 52: East Morecambe risk scores.

ID	Baseline Rank	Area	Hazard Title	Baseline Risk	
				Score	Rating
42	19	East Morecambe	Allision - Fishing	7.6	Medium Risk - Tolerable (if ALARP)
43	19	East Morecambe	Allision - Recreational	7.6	Medium Risk - Tolerable (if ALARP)

ID	Baseline Rank	Area	Hazard Title	Baseline Risk	
				Score	Rating
41	19	East Morecambe	Allision - Tug/Service & Small Project Vessels	7.6	Medium Risk - Tolerable (if ALARP)
39	31	East Morecambe	Collision - Small Craft ICW. Small Craft	7.5	Medium Risk - Tolerable (if ALARP)
44	43	East Morecambe	Grounding - Cargo/Tanker	6.5	Medium Risk - Tolerable (if ALARP)
37	47	East Morecambe	Collision - Cargo/Tanker ICW. Cargo/Tanker	5.1	Low Risk - Broadly Acceptable
38	51	East Morecambe	Collision - Ferry/Passenger or Cargo/Tanker ICW. Small Craft	5.1	Low Risk - Broadly Acceptable
40	52	East Morecambe	Allision - Cargo/Tanker	4.9	Low Risk - Broadly Acceptable

9.7 POTENTIAL ADDITIONAL RISK CONTROLS OPTIONS

During the hazard workshop a number of potential, additional risk control options were identified which could reduce the risk scores further. These are summarised below in **Table 53**.

Table 53: Potential additional risk control options.

ID	Title	Description
1	Layout Design	To increase manoeuvring space and reduce impact on operators, revision of Project boundaries could include: • Increase in sea room between Morgan and Mona Array Areas • Realignment of northern corner of the Morgan Array Area to maintain parallel boundaries to Morgan-Walney corridor and improve navigability and line of sight (visual and radar) for vessels entering and departing the corridor • Realignment of Morecambe Array Area west boundary extent to minimise course changes (and deviation distance) for vessels navigating north-south through Mona-Morecambe and then Morgan-Walney • Realignment of Mona Array Area northeast boundary to enable direct passage between Mona-Morecambe-Morgan for traffic passing Liverpool-Douglas • Realignment south boundary of Mona Array area to increase distance form TSS and passing distance of traffic from offshore wind farm.
2	Ship Routeing	Inclusion of ship routeing schemes to organise vessel traffic, such as: • Extension of Liverpool Bay TSS to the west, enabling direct route for traffic from West of Isle of Man to the TSS, clearing Mona Array Area • Recommended routeing schemes introduced (starboard side channel navigation) in some of the corridors between offshore wind farms.
3	Site Layout	Two lines of orientation to support internal navigation (and reduce likelihood of small traffic displacement into the corridors/areas outside of the offshore wind farm's) and SAR.

ID	Title	Description
4	CTV Passage Planning	Develop coordinated passage plans for CTVs that minimises impact on other traffic, could include: • Specified crossing points (e.g. Morgan-Walney corridor • Crossing protocols to be established prior to crossing corridors • Dissemination of information and liaison with regular runners and ferry services • Restricted visibility and night time protocols.
5	Continued Engagement	Maintain the MNEF to facilitate information sharing and management/identification of additional risk controls: • Identify near misses and investigate incidents, disseminating learnings • Coordinate construction activities.
6	Reporting Notification	Consider reporting procedures for vessels entering corridors between offshore wind farms. VHF Channel 16 broadcasts of vessel details and direction of travels.
7	Master Training	Provision of enhanced master and bridge team training, such as bridge navigation simulator sessions, for safe navigation within the offshore wind farm corridors and wider CRNRA study area.
8	Construction scheduling	Managing construction activities to deconflict with other marine activities.

9.8 SUMMARY

The NRA has identified several risks which are unacceptable with existing mitigation in place. These particularly relate to the risk of collision between large commercial vessels and with small craft in the corridors between the offshore wind farms or adjacent to the site. The presence of unacceptable risks to navigational safety therefore fails requirements stated in both NPS EN-3 2.6.165 and MGN654 Annex 1 and require mitigation.

Possible additional risk control options were identified to reduce these risks to Broadly Acceptable or Tolerable if ALARP. These additional controls are conceptual only at this stage and have not been implemented for assessment within the PEIR. Therefore, it is not possible to state that those hazards scored as Medium Risk are Tolerable as they cannot be considered ALARP until all appropriate risk control options are tested. It is noted that significant additional work is ongoing to define these risk controls to address the risks highlighted within this CRNRA. The Projects have committed to exploring these additional risk controls through further studies and engagement with stakeholders to ensure they are appropriate and adequate for reducing risks to ALARP prior to Application for their respective DCOs. Appropriate risk controls will then be secured through the DCO or marine licences.

10. CONCLUSIONS AND RECOMMENDATIONS

10.1 CONCLUSIONS

1. A cumulative assessment has been conducted on a collaborative basis between the Mona, Morgan and Morecambe offshore wind farm Projects
2. The CRNRA has been conducted in compliance with all relevant legislation, policy and guidance (**Section 2/3**)
3. The three Projects would account for up to 254 additional wind turbines and 10 substations, developed across a sizeable proportion of the Irish Sea (**Section 4**). These might necessitate at least 5,000 additional vessel movements per year during the operational phases of the Projects
4. The CRNRA study area includes numerous AtoNs, pilot stations, ports and harbours, anchorages and two TSSs (**Section 5.1/5.2**). Furthermore, there are extensive existing activities including oil and gas, offshore wind and aggregate extraction
5. The CRNRA study area has predominately southwesterly wind and wave conditions (**Section 5.3**). Annual adverse weather events can exceed 4.2m significant wave height and 50 knots. Reduced visibility might occur up to 24 days/year dependent on location within the CRNRA study area
6. SAR facilities, including RNLI stations and helicopter stations are located immediately adjacent to the CRNRA study area throughout the Welsh, English and Isle of Man coastlines (**Section 5.4**)
7. Analysis of historical vessel traffic data (**Section 6.2**) identified:
    a. Commercial cargo and tanker shipping predominately passes into the Port of Liverpool from the northwest or west. This includes deep draught vessels over 300m in length. Some smaller vessels may pass between other ports across the CRNRA study area, but at far fewer transits
    b. There is significant passenger vessel activity across the CRNRA study area, including ferry services between Liverpool, Heysham and Douglas with the island of Ireland. Cruise ship transits also occur, to a lesser extent, between Douglas and Liverpool
    c. Recreational vessel traffic is concentrated inshore, particularly along the Welsh coast and the Isle of Man. Cruising routes exist between Liverpool and Douglas, Heysham and the Welsh coast, and the Welsh Coast and Douglas
    d. There is static and mobile gear across the CRNRA study area, including both local and international based boats
    e. Service vessels associated with existing offshore wind farms and oil and gas infrastructure account for a large proportion of vessel movements within the CRNRA study area
    f. Analysis of adverse weather routeing demonstrates that vessels may deviate from their usual routes frequently throughout the year (**Section 6.2.5**)

g. Anchorages exist to the east of Anglesey and adjacent to the approaches to Liverpool (**Section 6.2.6**). There is evidence of loitering by commercial ships between the Welsh coast and the Isle of Man.

8. Analysis of historical incident data identified that the majority of incidents within the CRNRA study area occurred inshore, and adjacent to the approaches to the key ports (**Section 6.3**). There were few collisions in vicinity of the Project sites and were largely mechanical failure. Analysis of incidents at other offshore wind farms around the UK show that most accidents involve project vessels contacting wind turbines or having incidents in transit between the arrays and operations and maintenance base

9. An assessment of the future traffic profile within the CRNRA study area (**Section 7**) determined that an increase in commercial vessel numbers of 15% by 2035 would be a reasonable assumption. There was little evidence of large changes to recreational or fishing vessel numbers. It is anticipated that oil and gas decommissioning would reduce vessel numbers, although there is uncertainty around the timing at which this would occur

10. An assessment of the impacts of the Projects on recognised sea lanes essential to international navigation determined that access to the TSSs in the CRNRA study area would be maintained

11. An assessment of the impacts of the Projects on ferry vessel routeing determined that:

    a. There would be necessary deviation of Stena, Isle of Man Steam Packet and Seatruck routes around the arrays

    b. This deviation in normal conditions would be less than ten minutes, and even less for most routes. Existing passages are up to eight hours (dependent on route), with existing services having significant variation in turnaround times and transit times of greater than 25 minutes. The increase associated with the Projects is unlikely to have significant schedule impacts but could increase pressures on operators

    c. During adverse weather, the assessment determined that several corridors between Projects would likely not be considered safe to navigate by vessel masters, and a more circuitous route required avoiding some or all of the corridors. This would increase the schedule impacts by between 15 and 60 minutes (dependent on route). This is likely to result in increased cancellations of services as existing timetables would not be viable

    d. The presence of the Projects may necessitate additional watchkeeping requirements to ensure safe navigation within the corridors.

12. An assessment of the impacts of the Projects on commercial ship routeing determined that the principal shipping routes into Liverpool would necessitate a deviation to the southwest of Mona Array Area, but this was not so significant to threaten the viability of Liverpool as a port. Less trafficked routes into Heysham and Douglas would necessitate minor deviations, which are unlikely to make such services unviable

13. An assessment of the impacts of the Projects on small craft routeing determined that there is sufficient spacing between turbines across all three offshore wind farms to

facilitate safe navigation for fishing and recreational craft. There may be some effect of offsetting these vessels into adjacent channels where vessel choose not to do so

14. The principal corridors between the Projects were reviewed in context of guidance and UK precedents. The Morgan-Walney, Mona-Morgan and Mona-Morecambe meet both MCA and PIANC guidance. However, were the vessel numbers between Mona-Morgan to increase, or vessels to be larger, it would fail the PIANC guidance. Projects elsewhere in the North Sea have proposed corridors which are comparable in geometries to those between the three Projects
15. An assessment of the impacts of the Projects on collision and allision risk determined that:
    a. With the exception of the waters south of Mona Array Area, it is unlikely that multiple large commercial vessels would be concurrently navigating (<10% likelihood of 2 or more vessels)
    b. The arrays lie adjacent to commercial shipping and ferry routes and therefore there is the potential for vessels to emerge undetected from the offshore wind farms at speed with limited opportunity for collision avoidance
    c. The corridors are likely to contain multiple small craft at times which are at risk of collision with other passing vessels
    d. The Mona-Morgan corridor is at the confluence of meeting scenarios between vessels from multiple directions, with limited visibility and a relatively reduced searoom to comply with COLREGs
    e. The Mona Array Area reduces the capability for westbound vessels out of Liverpool TSS to comply with COLREGs obligations for vessels crossing southeast from the northwest.
16. The orientation and width of the corridors variously reduce the capability of vessels to respond to an emergency by altering their heading, such as during a fire or cargo shift incident
17. The layouts of the Projects will be further assessed to ensure compliance with obligations for continued access for SAR assets
18. The layout of the Projects, in relation to shipping routes, and accounting for decommissioning activities, would not substantially increase the risk to oil and gas activities
19. An assessment of the impacts of the Projects on communications, radar and positioning systems determined that most impacts are negligible. Impacts to radar are inherent when navigating adjacent to offshore wind farms. It is likely that such effects will be experienced for vessels navigating all three Projects
20. A risk assessment was undertaken, supported through a hazard workshop attended by representatives from ferry operators, regulators, commercial bodies, oil and gas, ports, fishing community and recreational users. The risk assessment, with embedded risk controls concluded that:
    a. Fifty six hazards were identified, split across different hazard types, vessel types and areas

b. Five hazards were assessed as being High Risk – Unacceptable. These include the risk of collision between Ferry/Passenger and a Ferry/Passenger or Cargo/Tanker between Mona and Morgan Array Areas or South Mona Array Area. Secondly, collisions involving Ferry/Passenger or Cargo/Tanker and small craft throughout the CRNRA study area

c. Forty two of the hazards were assessed as Medium Risk. The highest of these are represented by collisions and allisions involving Ferry/Passenger vessels and between large ships and small craft, often in the Morgan-Walney, Mona-Morgan and South Mona Array Areas

d. Whilst additional risk control measures are identified, these are conceptual only at this stage and have not been implemented for assessment within the PEIR. Therefore, it is not possible to state that those hazards scored as Medium Risk are Tolerable as they cannot be considered ALARP until all appropriate risk control options are tested.

10.2 ADDITIONAL POSSIBLE RISK CONTROLS

The assessment has concluded that the cumulative effect on navigation safety would result in an increase in navigational risk to unacceptable levels. Therefore, to address these hazards, the following possible risk controls have been identified:

1. Layout boundaries are reviewed to improve the geometry and, where relevant, increase the corridor widths to ensure safe navigation and collision avoidance
2. Engagement with both regulators and stakeholders to develop a safety case to support introduction of, or changes to existing, ship routeing measures
3. Commitment to design for two lines of orientation to improve internal navigation within the offshore wind farms
4. Development of coordinated passage plans for Project vessels, including crossing points, passing arrangements and reporting procedures, to be disseminated to regular runners and ferry services
5. Continued engagement with local stakeholders to promulgate Project activities and identify any concerns or near misses
6. Review feasibility of reporting arrangements for vessel navigation within key Project corridors
7. Develop procedure for regular liaison with fishing and recreational user groups to promote safe navigation around or through Projects, and deconflict any areas of increased risk
8. Undertake enhanced master training, such as through simulators, to improve the skills and familiarity of regular runner bridge teams navigating within Project corridors.

Furthermore, it is recommended that the CRNRA is revised to include the Isle of Man offshore wind farm once more information is available.

10.3 SUMMARY

In summary, the findings of this CRNRA are that the cumulative effects for the Mona, Morgan and Morecambe Projects would result in hazards with unacceptable navigational risk scores and therefore additional risk control options are required.

Some appropriate additional controls have been identified but have not been implemented for assessment within the PEIR. The Projects have committed to exploring these additional risk controls through further studies and engagement with stakeholders to ensure they are appropriate and adequate for reducing risks to ALARP prior to Application for their respective DCO or marine licences.

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Appendix A
Hazard Log

ID	Haz. Rank	Area	Hazard Title	Possible Causes	Embedded Risk Controls	Realistic Most Likely Scenario	Realistic Most Likely Scores: People	Property	Environment	Business	Frequency	Realistic Worst Credible Scenario	Realistic Worst Credible Scores: People	Property	Environment	Business	Frequency	Risk Score	Risk Rating
1	12	Morgan-Walney	Collision - Ferry/Passenger ICW. Cargo/Tanker or Ferry/Passenger	Reduced Searoom Between offshore wind farms; Human Error/Poor Seamanship; Failure to Comply with COLREGs; Fatigue; Radar Interference from wind turbines; Mechanical Failure; Adverse Weather; Avoidance of Small Craft; Reduced Visibility;	Notice to Mariners; Site Marking and Charting; ERCOP; Layout Plan and Lines of Orientation.	Multiple major injuries; Moderate damage to vessel; Minor pollution; Widespread adverse publicity; Short term interruption to ferry services.	3	3	2	3	3	Significant loss of life; Constructive Loss; Serious pollution (Tier 2); International adverse publicity. Ferry out of service.	5	5	4	5	2	9.2	Medium Risk - Tolerable (if ALARP)
2	47	Morgan-Walney	Collision - Cargo/Tanker ICW. Cargo/Tanker	Reduced Searoom Between offshore wind farms; Human Error/Poor Seamanship; Failure to Comply with COLREGs; Fatigue; Radar Interference from wind turbines; Mechanical Failure; Adverse Weather; Avoidance of Small Craft; Reduced Visibility;	Notice to Mariners; Site Marking and Charting; ERCOP; Layout Plan and Lines of Orientation.	Multiple minor injuries; Moderate damage to vessel; Minor pollution; Widespread adverse publicity; Vessel requires drydock.	2	3	2	3	2	Single fatalities; Constructive Loss; Major pollution incident (Tier 3); National adverse publicity.	4	5	5	4	1	5.1	Low Risk - Broadly Acceptable
3	3	Morgan-Walney	Collision - Ferry/Passenger or Cargo/Tanker ICW. Small Craft	Reduced Searoom Between offshore wind farms; Increased Project Vessel Movements; Human Error/Poor Seamanship; Failure to Comply with COLREGs; Fatigue; Radar Interference from wind turbines; Mechanical Failure; Adverse Weather; Avoidance of Small Craft; Reduced Visibility;	Notice to Mariners; Site Marking and Charting; ERCOP; Incident Investigation and Reporting; Layout Plan and Lines of Orientation; Marine Operating Guidelines; Vessel Standards; Training; Compliance of Project Vessels; Vessel Traffic Monitoring.	Multiple major injuries; Moderate damage to vessel; Minor pollution; Widespread adverse publicity; Short term interruption to ferry services.	3	3	2	3	4	Multiple fatalities; Loss of small craft; Moderate pollution incident (Tier 2); National adverse publicity.	5	3	3	4	3	12.3	High Risk - Unacceptable
4	31	Morgan-Walney	Collision - Small Craft ICW. Small Craft	Reduced Searoom Between offshore wind farms; Increased Project Vessel Movements; Human Error/Poor Seamanship; Fatigue; Radar Interference from wind turbines; Mechanical Failure; Adverse Weather; Avoidance of Small Craft; Reduced Visibility;	Notice to Mariners; Site Marking and Charting; ERCOP; Periodic Exercises; Incident Investigation and Reporting; Layout Plan and Lines of Orientation; Marine Operating Guidelines; Vessel Standards; Training; Compliance of Project Vessels; Vessel Traffic Monitoring.	Multiple minor injuries; Moderate damage to small craft; No pollution; Minor adverse publicity.	2	2	1	2	4	Single fatalities; Loss of small craft; Moderate pollution incident (Tier 2); National adverse publicity.	4	3	3	4	2	7.5	Medium Risk - Tolerable (if ALARP)
5	7	Morgan-Walney	Allision - Ferry/Passenger	Presence of wind turbines; Reduced Searoom Between offshore wind farms; Increased Project Vessel Movements; Human Error/Poor Seamanship; AtoNs Failure; Fatigue; Radar Interference from wind turbines; Mechanical Failure; Adverse Weather; Avoidance of Small Craft; Reduced Visibility;	Notice to Mariners; Site Marking and Charting; Safety Zones; ERCOP; Periodic Exercises; Incident Investigation and Reporting; Aids to Navigation; Air Draught Clearance; Layout Plan and Lines of Orientation; Vessel Traffic Monitoring.	Multiple major injuries; Moderate damage to vessel; Minor pollution; Widespread adverse publicity; Repairs to wind turbines; Short term interruption to ferry services.	3	3	2	3	4	Multiple fatalities; Serious damage to vessel; Serious pollution (Tier 2); International adverse publicity; Loss of wind turbines; Ferry out of service.	5	4	3	5	2	10.4	Medium Risk - Tolerable (if ALARP)

ID	Haz. Rank	Area	Hazard Title	Possible Causes	Embedded Risk Controls	Realistic Most Likely Scenario	Realistic Most Likely Scores: People	Property	Environment	Business	Frequency	Realistic Worst Credible Scenario	Realistic Worst Credible Scores: People	Property	Environment	Business	Frequency	Risk Score	Risk Rating
6	44	Morgan-Walney	Allision - Cargo/Tanker	Presence of wind turbines; Reduced Searoom Between offshore wind farms; Increased Project Vessel Movements; Human Error/Poor Seamanship; AtoNs Failure; Fatigue; Radar Interference from wind turbines; Mechanical Failure; Adverse Weather; Avoidance of Small Craft; Reduced Visibility;	Notice to Mariners; Site Marking and Charting; Safety Zones; ERCOP; Periodic Exercises; Incident Investigation and Reporting; Aids to Navigation; Air Draught Clearance; Layout Plan and Lines of Orientation; Vessel Traffic Monitoring.	Multiple minor injuries; Moderate damage to vessel; No pollution; Widespread adverse publicity; Repairs to wind turbines.	2	3	1	3	3	Single fatalities; Drydock required; Serious pollution incident (Tier 2); National adverse publicity; Loss of wind turbines.	4	4	4	5	1	6.3	Medium Risk - Tolerable (if ALARP)
7	16	Morgan-Walney	Allision - Tug/Service & Small Project Vessels	Presence of wind turbines; Reduced Searoom Between offshore wind farms; Increased Project Vessel Movements; Human Error/Poor Seamanship; AtoNs Failure; Fatigue; Radar Interference from wind turbines; Mechanical Failure; Adverse Weather; Avoidance of Small Craft; Reduced Visibility;	Notice to Mariners; Site Marking and Charting; Safety Zones; ERCOP; Periodic Exercises; Incident Investigation and Reporting; Aids to Navigation; Air Draught Clearance; Layout Plan and Lines of Orientation; Marine Operating Guidelines; Vessel Standards; Training; Compliance of Project Vessels.	Multiple minor injuries; Moderate damage to small craft; No pollution; Minor adverse publicity; Repairs to wind turbines.	2	2	1	2	5	Single fatalities; Loss of small craft; Moderate pollution incident (Tier 2); National adverse publicity; Repairs to wind turbines.	4	4	3	4	2	8.6	Medium Risk - Tolerable (if ALARP)
8	19	Morgan-Walney	Allision - Fishing	Presence of wind turbines; Reduced Searoom Between offshore wind farms; Increased Project Vessel Movements; Human Error/Poor Seamanship; AtoNs Failure; Fatigue; Radar Interference from wind turbines; Mechanical Failure; Adverse Weather; Avoidance of Small Craft; Reduced Visibility;	Notice to Mariners; Site Marking and Charting; Safety Zones; Fishing Liaison Plan; ERCOP; Periodic Exercises; Incident Investigation and Reporting; Aids to Navigation; Air Draught Clearance; Layout Plan and Lines of Orientation.	Multiple minor injuries; Moderate damage to small craft; No pollution; Minor adverse publicity; Repairs to wind turbines.	2	2	1	2	4	Single fatalities; Loss of small craft; Moderate pollution incident (Tier 2); National adverse publicity; Repairs to wind turbines.	4	4	3	4	2	7.6	Medium Risk - Tolerable (if ALARP)
9	19	Morgan-Walney	Allision - Recreational	Presence of wind turbines; Reduced Searoom Between offshore wind farms; Increased Project Vessel Movements; Human Error/Poor Seamanship; AtoNs Failure; Fatigue; Radar Interference from wind turbines; Mechanical Failure; Adverse Weather; Avoidance of Small Craft; Reduced Visibility;	Notice to Mariners; Site Marking and Charting; Safety Zones; ERCOP; Periodic Exercises; Incident Investigation and Reporting; Aids to Navigation; Air Draught Clearance; Layout Plan and Lines of Orientation.	Multiple minor injuries; Moderate damage to small craft; No pollution; Minor adverse publicity; Repairs to wind turbines.	2	2	1	2	4	Single fatalities; Loss of small craft; Moderate pollution incident (Tier 2); National adverse publicity; Repairs to wind turbines.	4	4	3	4	2	7.6	Medium Risk - Tolerable (if ALARP)
10	1	Mona-Morgan	Collision - Ferry/Passenger ICW. Cargo/Tanker or Ferry/Passenger	Reduced Searoom Between offshore wind farms; Human Error/Poor Seamanship; Failure to Comply with COLREGs; Fatigue; Radar Interference from wind turbines; Mechanical Failure; Adverse Weather; Avoidance of Small Craft; Reduced Visibility;	Notice to Mariners; Site Marking and Charting; ERCOP; Layout Plan and Lines of Orientation.	Multiple major injuries; Moderate damage to vessel; Minor pollution; Widespread adverse publicity; Short term interruption to ferry services.	3	3	2	3	4	Significant loss of life; Constructive Loss; Serious pollution (Tier 2); International adverse publicity. Ferry out of service.	5	5	4	5	3	13.1	High Risk - Unacceptable

ID	Haz. Rank	Area	Hazard Title	Possible Causes	Embedded Risk Controls	Realistic Most Likely Scenario	Realistic Most Likely Scores: People	Property	Environment	Business	Frequency	Realistic Worst Credible Scenario	Realistic Worst Credible Scores: People	Property	Environment	Business	Frequency	Risk Score	Risk Rating
11	47	Mona-Morgan	Collision - Cargo/Tanker ICW. Cargo/Tanker	Reduced Searoom Between offshore wind farms; Human Error/Poor Seamanship; Failure to Comply with COLREGs; Fatigue; Radar Interference from wind turbines; Mechanical Failure; Adverse Weather; Avoidance of Small Craft; Reduced Visibility;	Notice to Mariners; Site Marking and Charting; ERCOP; Layout Plan and Lines of Orientation.	Multiple minor injuries; Moderate damage to vessel; Minor pollution; Widespread adverse publicity; Vessel requires drydock.	2	3	2	3	2	Single fatalities; Constructive Loss; Major pollution incident (Tier 3); National adverse publicity.	4	5	5	4	1	5.1	Low Risk - Broadly Acceptable
12	3	Mona-Morgan	Collision - Ferry/Passenger or Cargo/Tanker ICW. Small Craft	Reduced Searoom Between offshore wind farms; Increased Project Vessel Movements; Human Error/Poor Seamanship; Failure to Comply with COLREGs; Fatigue; Radar Interference from wind turbines; Mechanical Failure; Adverse Weather; Avoidance of Small Craft; Reduced Visibility;	Notice to Mariners; Site Marking and Charting; ERCOP; Incident Investigation and Reporting; Layout Plan and Lines of Orientation; Marine Operating Guidelines; Vessel Standards; Training; Compliance of Project Vessels; Vessel Traffic Monitoring.	Multiple major injuries; Moderate damage to vessel; Minor pollution; Widespread adverse publicity; Short term interruption to ferry services.	3	3	2	3	4	Multiple fatalities; Loss of small craft; Moderate pollution incident (Tier 2); National adverse publicity.	5	3	3	4	3	12.3	High Risk - Unacceptable
13	42	Mona-Morgan	Collision - Small Craft ICW. Small Craft	Reduced Searoom Between offshore wind farms; Increased Project Vessel Movements; Human Error/Poor Seamanship; Fatigue; Radar Interference from wind turbines; Mechanical Failure; Adverse Weather; Avoidance of Small Craft; Reduced Visibility;	Notice to Mariners; Site Marking and Charting; ERCOP; Periodic Exercises; Incident Investigation and Reporting; Layout Plan and Lines of Orientation; Marine Operating Guidelines; Vessel Standards; Training; Compliance of Project Vessels; Vessel Traffic Monitoring.	Multiple minor injuries; Moderate damage to small craft; No pollution; Minor adverse publicity.	2	2	1	2	3	Single fatalities; Loss of small craft; Moderate pollution incident (Tier 2); National adverse publicity.	4	3	3	4	2	6.6	Medium Risk - Tolerable (if ALARP)
14	7	Mona-Morgan	Allision - Ferry/Passenger	Presence of wind turbines; Reduced Searoom Between offshore wind farms; Increased Project Vessel Movements; Human Error/Poor Seamanship; AtoNs Failure; Fatigue; Radar Interference from wind turbines; Mechanical Failure; Adverse Weather; Avoidance of Small Craft; Reduced Visibility;	Notice to Mariners; Site Marking and Charting; Safety Zones; ERCOP; Periodic Exercises; Incident Investigation and Reporting; Aids to Navigation; Air Draught Clearance; Layout Plan and Lines of Orientation; Vessel Traffic Monitoring.	Multiple major injuries; Moderate damage to vessel; Minor pollution; Widespread adverse publicity; Repairs to wind turbines; Short term interruption to ferry services.	3	3	2	3	4	Multiple fatalities; Serious damage to vessel; Serious pollution (Tier 2); International adverse publicity; Loss of wind turbines; Ferry out of service.	5	4	3	5	2	10.4	Medium Risk - Tolerable (if ALARP)
15	44	Mona-Morgan	Allision - Cargo/Tanker	Presence of wind turbines; Reduced Searoom Between offshore wind farms; Increased Project Vessel Movements; Human Error/Poor Seamanship; AtoNs Failure; Fatigue; Radar Interference from wind turbines; Mechanical Failure; Adverse Weather; Avoidance of Small Craft; Reduced Visibility;	Notice to Mariners; Site Marking and Charting; Safety Zones; ERCOP; Periodic Exercises; Incident Investigation and Reporting; Aids to Navigation; Air Draught Clearance; Layout Plan and Lines of Orientation; Vessel Traffic Monitoring.	Multiple minor injuries; Moderate damage to vessel; No pollution; Widespread adverse publicity; Repairs to wind turbines.	2	3	1	3	3	Single fatalities; Drydock required; Serious pollution incident (Tier 2); National adverse publicity; Loss of wind turbines.	4	4	4	5	1	6.3	Medium Risk - Tolerable (if ALARP)

ID	Haz. Rank	Area	Hazard Title	Possible Causes	Embedded Risk Controls	Realistic Most Likely Scenario	Realistic Most Likely Scores: People	Property	Environment	Business	Frequency	Realistic Worst Credible Scenario	Realistic Worst Credible Scores: People	Property	Environment	Business	Frequency	Risk Score	Risk Rating
16	19	Mona-Morgan	Allision - Tug/Service & Small Project Vessels	Presence of wind turbines; Reduced Searoom Between offshore wind farms; Increased Project Vessel Movements; Human Error/Poor Seamanship; AtoNs Failure; Fatigue; Radar Interference from wind turbines; Mechanical Failure; Adverse Weather; Avoidance of Small Craft; Reduced Visibility;	Notice to Mariners; Site Marking and Charting; Safety Zones; ERCOP; Periodic Exercises; Incident Investigation and Reporting; Aids to Navigation; Air Draught Clearance; Layout Plan and Lines of Orientation; Marine Operating Guidelines; Vessel Standards; Training; Compliance of Project Vessels.	Multiple minor injuries; Moderate damage to small craft; No pollution; Minor adverse publicity; Repairs to wind turbines.	2	2	1	2	4	Single fatalities; Loss of small craft; Moderate pollution incident (Tier 2); National adverse publicity; Repairs to wind turbines.	4	4	3	4	2	7.6	Medium Risk - Tolerable (if ALARP)
17	36	Mona-Morgan	Allision - Fishing	Presence of wind turbines; Reduced Searoom Between offshore wind farms; Increased Project Vessel Movements; Human Error/Poor Seamanship; AtoNs Failure; Fatigue; Radar Interference from wind turbines; Mechanical Failure; Adverse Weather; Avoidance of Small Craft; Reduced Visibility;	Notice to Mariners; Site Marking and Charting; Safety Zones; Fishing Liaison Plan; ERCOP; Periodic Exercises; Incident Investigation and Reporting; Aids to Navigation; Air Draught Clearance; Layout Plan and Lines of Orientation.	Multiple minor injuries; Moderate damage to small craft; No pollution; Minor adverse publicity; Repairs to wind turbines.	2	2	1	2	3	Single fatalities; Loss of small craft; Moderate pollution incident (Tier 2); National adverse publicity; Repairs to wind turbines.	4	4	3	4	2	6.7	Medium Risk - Tolerable (if ALARP)
18	36	Mona-Morgan	Allision - Recreational	Presence of wind turbines; Reduced Searoom Between offshore wind farms; Increased Project Vessel Movements; Human Error/Poor Seamanship; AtoNs Failure; Fatigue; Radar Interference from wind turbines; Mechanical Failure; Adverse Weather; Avoidance of Small Craft; Reduced Visibility;	Notice to Mariners; Site Marking and Charting; Safety Zones; ERCOP; Periodic Exercises; Incident Investigation and Reporting; Aids to Navigation; Air Draught Clearance; Layout Plan and Lines of Orientation.	Multiple minor injuries; Moderate damage to small craft; No pollution; Minor adverse publicity; Repairs to wind turbines.	2	2	1	2	3	Single fatalities; Loss of small craft; Moderate pollution incident (Tier 2); National adverse publicity; Repairs to wind turbines.	4	4	3	4	2	6.7	Medium Risk - Tolerable (if ALARP)
19	12	Mona-Morecambe	Collision - Ferry/Passenger ICW. Cargo/Tanker or Ferry/Passenger	Reduced Searoom Between offshore wind farms; Human Error/Poor Seamanship; Failure to Comply with COLREGs; Fatigue; Radar Interference from wind turbines; Mechanical Failure; Adverse Weather; Avoidance of Small Craft; Reduced Visibility;	Notice to Mariners; Site Marking and Charting; ERCOP; Layout Plan and Lines of Orientation.	Multiple major injuries; Moderate damage to vessel; Minor pollution; Widespread adverse publicity; Short term interruption to ferry services.	3	3	2	3	3	Significant loss of life; Constructive Loss; Serious pollution (Tier 2); International adverse publicity. Ferry out of service.	5	5	4	5	2	9.2	Medium Risk - Tolerable (if ALARP)
20	47	Mona-Morecambe	Collision - Cargo/Tanker ICW. Cargo/Tanker	Reduced Searoom Between offshore wind farms; Human Error/Poor Seamanship; Failure to Comply with COLREGs; Fatigue; Radar Interference from wind turbines; Mechanical Failure; Adverse Weather; Avoidance of Small Craft; Reduced Visibility;	Notice to Mariners; Site Marking and Charting; ERCOP; Layout Plan and Lines of Orientation.	Multiple minor injuries; Moderate damage to vessel; Minor pollution; Widespread adverse publicity; Vessel requires drydock.	2	3	2	3	2	Single fatalities; Constructive Loss; Major pollution incident (Tier 3); National adverse publicity.	4	5	5	4	1	5.1	Low Risk - Broadly Acceptable

							Realistic Most Likely Scores						Realistic Worst Credible Scores						
ID	Haz. Rank	Area	Hazard Title	Possible Causes	Embedded Risk Controls	Realistic Most Likely Scenario	People	Property	Environment	Business	Frequency	Realistic Worst Credible Scenario	People	Property	Environment	Business	Frequency	Risk Score	Risk Rating
21	6	Mona-Morecambe	Collision - Ferry/Passenger or Cargo/Tanker ICW. Small Craft	Reduced Searoom Between offshore wind farms; Increased Project Vessel Movements; Human Error/Poor Seamanship; Failure to Comply with COLREGs; Fatigue; Radar Interference from wind turbines; Mechanical Failure; Adverse Weather; Avoidance of Small Craft; Reduced Visibility;	Notice to Mariners; Site Marking and Charting; ERCOP; Incident Investigation and Reporting; Layout Plan and Lines of Orientation; Marine Operating Guidelines; Vessel Standards; Training; Compliance of Project Vessels; Vessel Traffic Monitoring.	Multiple major injuries; Moderate damage to vessel; Minor pollution; Widespread adverse publicity; Short term interruption to ferry services.	3	3	2	3	3	Multiple fatalities; Loss of small craft; Moderate pollution incident (Tier 2); National adverse publicity.	5	3	3	4	3	10.9	Medium Risk - Tolerable (if ALARP)
22	31	Mona-Morecambe	Collision - Small Craft ICW. Small Craft	Reduced Searoom Between offshore wind farms; Increased Project Vessel Movements; Human Error/Poor Seamanship; Fatigue; Radar Interference from wind turbines; Mechanical Failure; Adverse Weather; Avoidance of Small Craft; Reduced Visibility;	Notice to Mariners; Site Marking and Charting; ERCOP; Periodic Exercises; Incident Investigation and Reporting; Layout Plan and Lines of Orientation; Marine Operating Guidelines; Vessel Standards; Training; Compliance of Project Vessels; Vessel Traffic Monitoring.	Multiple minor injuries; Moderate damage to small craft; No pollution; Minor adverse publicity.	2	2	1	2	4	Single fatalities; Loss of small craft; Moderate pollution incident (Tier 2); National adverse publicity.	4	3	3	4	2	7.5	Medium Risk - Tolerable (if ALARP)
23	7	Mona-Morecambe	Allision - Ferry/Passenger	Presence of wind turbines; Reduced Searoom Between offshore wind farms; Increased Project Vessel Movements; Human Error/Poor Seamanship; AtoNs Failure; Fatigue; Radar Interference from wind turbines; Mechanical Failure; Adverse Weather; Avoidance of Small Craft; Reduced Visibility;	Notice to Mariners; Site Marking and Charting; Safety Zones; ERCOP; Periodic Exercises; Incident Investigation and Reporting; Aids to Navigation; Air Draught Clearance; Layout Plan and Lines of Orientation; Vessel Traffic Monitoring.	Multiple major injuries; Moderate damage to vessel; Minor pollution; Widespread adverse publicity; Repairs to wind turbines; Short term interruption to ferry services.	3	3	2	3	4	Multiple fatalities; Serious damage to vessel; Serious pollution (Tier 2); International adverse publicity; Loss of wind turbines; Ferry out of service.	5	4	3	5	2	10.4	Medium Risk - Tolerable (if ALARP)
24	44	Mona-Morecambe	Allision - Cargo/Tanker	Presence of wind turbines; Reduced Searoom Between offshore wind farms; Increased Project Vessel Movements; Human Error/Poor Seamanship; AtoNs Failure; Fatigue; Radar Interference from wind turbines; Mechanical Failure; Adverse Weather; Avoidance of Small Craft; Reduced Visibility;	Notice to Mariners; Site Marking and Charting; Safety Zones; ERCOP; Periodic Exercises; Incident Investigation and Reporting; Aids to Navigation; Air Draught Clearance; Layout Plan and Lines of Orientation; Vessel Traffic Monitoring.	Multiple minor injuries; Moderate damage to vessel; No pollution; Widespread adverse publicity; Repairs to wind turbines.	2	3	1	3	3	Single fatalities; Drydock required; Serious pollution incident (Tier 2); National adverse publicity; Loss of wind turbines.	4	4	4	5	1	6.3	Medium Risk - Tolerable (if ALARP)
25	19	Mona-Morecambe	Allision - Tug/Service & Small Project Vessels	Presence of wind turbines; Reduced Searoom Between offshore wind farms; Increased Project Vessel Movements; Human Error/Poor Seamanship; AtoNs Failure; Fatigue; Radar Interference from wind turbines; Mechanical Failure; Adverse Weather; Avoidance of Small Craft; Reduced Visibility;	Notice to Mariners; Site Marking and Charting; Safety Zones; ERCOP; Periodic Exercises; Incident Investigation and Reporting; Aids to Navigation; Air Draught Clearance; Layout Plan and Lines of Orientation; Marine Operating Guidelines; Vessel Standards;	Multiple minor injuries; Moderate damage to small craft; No pollution; Minor adverse publicity; Repairs to wind turbines.	2	2	1	2	4	Single fatalities; Loss of small craft; Moderate pollution incident (Tier 2); National adverse publicity; Repairs to wind turbines.	4	4	3	4	2	7.6	Medium Risk - Tolerable (if ALARP)

ID	Haz. Rank	Area	Hazard Title	Possible Causes	Embedded Risk Controls	Realistic Most Likely Scenario	Realistic Most Likely Scores: People	Property	Environment	Business	Frequency	Realistic Worst Credible Scenario	Realistic Worst Credible Scores: People	Property	Environment	Business	Frequency	Risk Score	Risk Rating
					Training; Compliance of Project Vessels.														
26	36	Mona-Morecambe	Allision - Fishing	Presence of wind turbines; Reduced Searoom Between offshore wind farms; Increased Project Vessel Movements; Human Error/Poor Seamanship; AtoNs Failure; Fatigue; Radar Interference from wind turbines; Mechanical Failure; Adverse Weather; Avoidance of Small Craft; Reduced Visibility;	Notice to Mariners; Site Marking and Charting; Safety Zones; Fishing Liaison Plan; ERCOP; Periodic Exercises; Incident Investigation and Reporting; Aids to Navigation; Air Draught Clearance; Layout Plan and Lines of Orientation.	Multiple minor injuries; Moderate damage to small craft; No pollution; Minor adverse publicity; Repairs to wind turbines.	2	2	1	2	3	Single fatalities; Loss of small craft; Moderate pollution incident (Tier 2); National adverse publicity; Repairs to wind turbines.	4	4	3	4	2	6.7	Medium Risk - Tolerable (if ALARP)
27	36	Mona-Morecambe	Allision - Recreational	Presence of wind turbines; Reduced Searoom Between offshore wind farms; Increased Project Vessel Movements; Human Error/Poor Seamanship; AtoNs Failure; Fatigue; Radar Interference from wind turbines; Mechanical Failure; Adverse Weather; Avoidance of Small Craft; Reduced Visibility;	Notice to Mariners; Site Marking and Charting; Safety Zones; ERCOP; Periodic Exercises; Incident Investigation and Reporting; Aids to Navigation; Air Draught Clearance; Layout Plan and Lines of Orientation.	Multiple minor injuries; Moderate damage to small craft; No pollution; Minor adverse publicity; Repairs to wind turbines.	2	2	1	2	3	Single fatalities; Loss of small craft; Moderate pollution incident (Tier 2); National adverse publicity; Repairs to wind turbines.	4	4	3	4	2	6.7	Medium Risk - Tolerable (if ALARP)
28	1	South-Mona	Collision - Ferry/Passenger ICW. Cargo/Tanker or Ferry/Passenger	Reduced Searoom Between offshore wind farms; Human Error/Poor Seamanship; Failure to Comply with COLREGs; Fatigue; Radar Interference from wind turbines; Mechanical Failure; Adverse Weather; Avoidance of Small Craft; Reduced Visibility;	Notice to Mariners; Site Marking and Charting; ERCOP; Layout Plan and Lines of Orientation.	Multiple major injuries; Moderate damage to vessel; Minor pollution; Widespread adverse publicity; Short term interruption to ferry services.	3	3	2	3	4	Significant loss of life; Constructive Loss; Serious pollution (Tier 2); International adverse publicity. Ferry out of service.	5	5	4	5	3	13.1	High Risk - Unacceptable
29	10	South-Mona	Collision - Cargo/Tanker ICW. Cargo/Tanker	Reduced Searoom Between offshore wind farms; Human Error/Poor Seamanship; Failure to Comply with COLREGs; Fatigue; Radar Interference from wind turbines; Mechanical Failure; Adverse Weather; Avoidance of Small Craft; Reduced Visibility;	Notice to Mariners; Site Marking and Charting; ERCOP; Layout Plan and Lines of Orientation.	Multiple minor injuries; Moderate damage to vessel; Minor pollution; Widespread adverse publicity; Vessel requires drydock.	2	3	2	3	4	Single fatalities; Constructive Loss; Major pollution incident (Tier 3); National adverse publicity.	4	5	5	4	2	10.3	Medium Risk - Tolerable (if ALARP)
30	3	South-Mona	Collision - Ferry/Passenger or Cargo/Tanker ICW. Small Craft	Reduced Searoom Between offshore wind farms; Increased Project Vessel Movements; Human Error/Poor Seamanship; Failure to Comply with COLREGs; Fatigue; Radar Interference from wind turbines; Mechanical Failure; Adverse Weather; Avoidance of Small Craft; Reduced Visibility;	Notice to Mariners; Site Marking and Charting; ERCOP; Incident Investigation and Reporting; Layout Plan and Lines of Orientation; Marine Operating Guidelines; Vessel Standards; Training; Compliance of Project Vessels; Vessel Traffic Monitoring.	Multiple major injuries; Moderate damage to vessel; Minor pollution; Widespread adverse publicity; Short term interruption to ferry services.	3	3	2	3	4	Multiple fatalities; Loss of small craft; Moderate pollution incident (Tier 2); National adverse publicity.	5	3	3	4	3	12.3	High Risk - Unacceptable

							Realistic Most Likely Scores						Realistic Worst Credible Scores						
ID	Haz. Rank	Area	Hazard Title	Possible Causes	Embedded Risk Controls	Realistic Most Likely Scenario	People	Property	Environment	Business	Frequency	Realistic Worst Credible Scenario	People	Property	Environment	Business	Frequency	Risk Score	Risk Rating
31	31	South-Mona	Collision - Small Craft ICW. Small Craft	Reduced Searoom Between offshore wind farms; Increased Project Vessel Movements; Human Error/Poor Seamanship; Fatigue; Radar Interference from wind turbines; Mechanical Failure; Adverse Weather; Avoidance of Small Craft; Reduced Visibility;	Notice to Mariners; Site Marking and Charting; ERCOP; Periodic Exercises; Incident Investigation and Reporting; Layout Plan and Lines of Orientation; Marine Operating Guidelines; Vessel Standards; Training; Compliance of Project Vessels; Vessel Traffic Monitoring.	Multiple minor injuries; Moderate damage to small craft; No pollution; Minor adverse publicity.	2	2	1	2	4	Single fatalities; Loss of small craft; Moderate pollution incident (Tier 2); National adverse publicity.	4	3	3	4	2	7.5	Medium Risk - Tolerable (if ALARP)
32	14	South-Mona	Allision - Ferry/Passenger	Presence of wind turbines; Reduced Searoom Between offshore wind farms; Increased Project Vessel Movements; Human Error/Poor Seamanship; AtoNs Failure; Fatigue; Radar Interference from wind turbines; Mechanical Failure; Adverse Weather; Avoidance of Small Craft; Reduced Visibility;	Notice to Mariners; Site Marking and Charting; Safety Zones; ERCOP; Periodic Exercises; Incident Investigation and Reporting; Aids to Navigation; Air Draught Clearance; Layout Plan and Lines of Orientation; Vessel Traffic Monitoring.	Multiple major injuries; Moderate damage to vessel; Minor pollution; Widespread adverse publicity; Repairs to wind turbines; Short term interruption to ferry services.	3	3	2	3	3	Multiple fatalities; Serious damage to vessel; Serious pollution (Tier 2); International adverse publicity; Loss of wind turbines; Ferry out of service.	5	4	3	5	2	8.9	Medium Risk - Tolerable (if ALARP)
33	11	South-Mona	Allision - Cargo/Tanker	Presence of wind turbines; Reduced Searoom Between offshore wind farms; Increased Project Vessel Movements; Human Error/Poor Seamanship; AtoNs Failure; Fatigue; Radar Interference from wind turbines; Mechanical Failure; Adverse Weather; Avoidance of Small Craft; Reduced Visibility;	Notice to Mariners; Site Marking and Charting; Safety Zones; ERCOP; Periodic Exercises; Incident Investigation and Reporting; Aids to Navigation; Air Draught Clearance; Layout Plan and Lines of Orientation; Vessel Traffic Monitoring.	Multiple minor injuries; Moderate damage to vessel; No pollution; Widespread adverse publicity; Repairs to wind turbines.	2	3	1	3	4	Single fatalities; Drydock required; Serious pollution incident (Tier 2); National adverse publicity; Loss of wind turbines.	4	4	4	5	2	9.9	Medium Risk - Tolerable (if ALARP)
34	19	South-Mona	Allision - Tug/Service & Small Project Vessels	Presence of wind turbines; Reduced Searoom Between offshore wind farms; Increased Project Vessel Movements; Human Error/Poor Seamanship; AtoNs Failure; Fatigue; Radar Interference from wind turbines; Mechanical Failure; Adverse Weather; Avoidance of Small Craft; Reduced Visibility;	Notice to Mariners; Site Marking and Charting; Safety Zones; ERCOP; Periodic Exercises; Incident Investigation and Reporting; Aids to Navigation; Air Draught Clearance; Layout Plan and Lines of Orientation; Marine Operating Guidelines; Vessel Standards; Training; Compliance of Project Vessels.	Multiple minor injuries; Moderate damage to small craft; No pollution; Minor adverse publicity; Repairs to wind turbines.	2	2	1	2	4	Single fatalities; Loss of small craft; Moderate pollution incident (Tier 2); National adverse publicity; Repairs to wind turbines.	4	4	3	4	2	7.6	Medium Risk - Tolerable (if ALARP)

							Realistic Most Likely Scores						Realistic Worst Credible Scores						
ID	Haz. Rank	Area	Hazard Title	Possible Causes	Embedded Risk Controls	Realistic Most Likely Scenario	People	Property	Environment	Business	Frequency	Realistic Worst Credible Scenario	People	Property	Environment	Business	Frequency	Risk Score	Risk Rating
35	19	South-Mona	Allision - Fishing	Presence of wind turbines; Reduced Searoom Between offshore wind farms; Increased Project Vessel Movements; Human Error/Poor Seamanship; AtoNs Failure; Fatigue; Radar Interference from wind turbines; Mechanical Failure; Adverse Weather; Avoidance of Small Craft; Reduced Visibility;	Notice to Mariners; Site Marking and Charting; Safety Zones; Fishing Liaison Plan; ERCOP; Periodic Exercises; Incident Investigation and Reporting; Aids to Navigation; Air Draught Clearance; Layout Plan and Lines of Orientation.	Multiple minor injuries; Moderate damage to small craft; No pollution; Minor adverse publicity; Repairs to wind turbines.	2	2	1	2	4	Single fatalities; Loss of small craft; Moderate pollution incident (Tier 2); National adverse publicity; Repairs to wind turbines.	4	4	3	4	2	7.6	Medium Risk - Tolerable (if ALARP)
36	19	South-Mona	Allision - Recreational	Presence of wind turbines; Reduced Searoom Between offshore wind farms; Increased Project Vessel Movements; Human Error/Poor Seamanship; AtoNs Failure; Fatigue; Radar Interference from wind turbines; Mechanical Failure; Adverse Weather; Avoidance of Small Craft; Reduced Visibility;	Notice to Mariners; Site Marking and Charting; Safety Zones; ERCOP; Periodic Exercises; Incident Investigation and Reporting; Aids to Navigation; Air Draught Clearance; Layout Plan and Lines of Orientation.	Multiple minor injuries; Moderate damage to small craft; No pollution; Minor adverse publicity; Repairs to wind turbines.	2	2	1	2	4	Single fatalities; Loss of small craft; Moderate pollution incident (Tier 2); National adverse publicity; Repairs to wind turbines.	4	4	3	4	2	7.6	Medium Risk - Tolerable (if ALARP)
37	47	East Morecambe	Collision - Cargo/Tanker ICW. Cargo/Tanker	Reduced Searoom Between offshore wind farms; Human Error/Poor Seamanship; Failure to Comply with COLREGs; Fatigue; Radar Interference from wind turbines; Mechanical Failure; Adverse Weather; Avoidance of Small Craft; Reduced Visibility;	Notice to Mariners; Site Marking and Charting; ERCOP; Layout Plan and Lines of Orientation.	Multiple minor injuries; Moderate damage to vessel; Minor pollution; Widespread adverse publicity; Vessel requires drydock.	2	3	2	3	2	Single fatalities; Constructive Loss; Major pollution incident (Tier 3); National adverse publicity.	4	5	5	4	1	5.1	Low Risk - Broadly Acceptable
38	51	East Morecambe	Collision - Ferry/Passenger or Cargo/Tanker ICW. Small Craft	Reduced Searoom Between offshore wind farms; Increased Project Vessel Movements; Human Error/Poor Seamanship; Failure to Comply with COLREGs; Fatigue; Radar Interference from wind turbines; Mechanical Failure; Adverse Weather; Avoidance of Small Craft; Reduced Visibility;	Notice to Mariners; Site Marking and Charting; ERCOP; Incident Investigation and Reporting; Layout Plan and Lines of Orientation. Marine Operating Guidelines; Vessel Standards; Training; Compliance of Project Vessels; Vessel Traffic Monitoring.	Multiple major injuries; Moderate damage to vessel; Minor pollution; Widespread adverse publicity; Short term interruption to ferry services.	3	3	2	3	2	Multiple fatalities; Loss of small craft; Moderate pollution incident (Tier 2); National adverse publicity.	5	3	3	4	1	5.1	Low Risk - Broadly Acceptable
39	31	East Morecambe	Collision - Small Craft ICW. Small Craft	Reduced Searoom Between offshore wind farms; Increased Project Vessel Movements; Human Error/Poor Seamanship; Fatigue; Radar Interference from wind turbines; Mechanical Failure; Adverse Weather; Avoidance of Small Craft; Reduced Visibility;	Notice to Mariners; Site Marking and Charting; ERCOP; Periodic Exercises; Incident Investigation and Reporting; Layout Plan and Lines of Orientation. Marine Operating Guidelines; Vessel Standards; Training; Compliance of Project Vessels; Vessel Traffic Monitoring.	Multiple minor injuries; Moderate damage to small craft; No pollution; Minor adverse publicity.	2	2	1	2	4	Single fatalities; Loss of small craft; Moderate pollution incident (Tier 2); National adverse publicity.	4	3	3	4	2	7.5	Medium Risk - Tolerable (if ALARP)

ID	Haz. Rank	Area	Hazard Title	Possible Causes	Embedded Risk Controls	Realistic Most Likely Scenario	Realistic Most Likely Scores: People	Property	Environment	Business	Frequency	Realistic Worst Credible Scenario	Realistic Worst Credible Scores: People	Property	Environment	Business	Frequency	Risk Score	Risk Rating
40	52	East Morecambe	Allision - Cargo/Tanker	Presence of wind turbines; Reduced Searoom Between offshore wind farms; Increased Project Vessel Movements; Human Error/Poor Seamanship; AtoNs Failure; Fatigue; Radar Interference from wind turbines; Mechanical Failure; Adverse Weather; Avoidance of Small Craft; Reduced Visibility;	Notice to Mariners; Site Marking and Charting; Safety Zones; ERCOP; Periodic Exercises; Incident Investigation and Reporting; Aids to Navigation; Air Draught Clearance; Layout Plan and Lines of Orientation; Vessel Traffic Monitoring.	Multiple minor injuries; Moderate damage to vessel; No pollution; Widespread adverse publicity; Repairs to wind turbines.	2	3	1	3	2	Single fatalities; Drydock required; Serious pollution incident (Tier 2); National adverse publicity; Loss of wind turbines.	4	4	4	5	1	4.9	Low Risk - Broadly Acceptable
41	19	East Morecambe	Allision - Tug/Service & Small Project Vessels	Presence of wind turbines; Reduced Searoom Between offshore wind farms; Increased Project Vessel Movements; Human Error/Poor Seamanship; AtoNs Failure; Fatigue; Radar Interference from wind turbines; Mechanical Failure; Adverse Weather; Avoidance of Small Craft; Reduced Visibility;	Notice to Mariners; Site Marking and Charting; Safety Zones; ERCOP; Periodic Exercises; Incident Investigation and Reporting; Aids to Navigation; Air Draught Clearance; Layout Plan and Lines of Orientation; Marine Operating Guidelines; Vessel Standards; Training; Compliance of Project Vessels.	Multiple minor injuries; Moderate damage to small craft; No pollution; Minor adverse publicity; Repairs to wind turbines.	2	2	1	2	4	Single fatalities; Loss of small craft; Moderate pollution incident (Tier 2); National adverse publicity; Repairs to wind turbines.	4	4	3	4	2	7.6	Medium Risk - Tolerable (if ALARP)
42	19	East Morecambe	Allision - Fishing	Presence of wind turbines; Reduced Searoom Between offshore wind farms; Increased Project Vessel Movements; Human Error/Poor Seamanship; AtoNs Failure; Fatigue; Radar Interference from wind turbines; Mechanical Failure; Adverse Weather; Avoidance of Small Craft; Reduced Visibility;	Notice to Mariners; Site Marking and Charting; Safety Zones; Fishing Liaison Plan; ERCOP; Periodic Exercises; Incident Investigation and Reporting; Aids to Navigation; Air Draught Clearance; Layout Plan and Lines of Orientation.	Multiple minor injuries; Moderate damage to small craft; No pollution; Minor adverse publicity; Repairs to wind turbines.	2	2	1	2	4	Single fatalities; Loss of small craft; Moderate pollution incident (Tier 2); National adverse publicity; Repairs to wind turbines.	4	4	3	4	2	7.6	Medium Risk - Tolerable (if ALARP)
43	19	East Morecambe	Allision - Recreational	Presence of wind turbines; Reduced Searoom Between offshore wind farms; Increased Project Vessel Movements; Human Error/Poor Seamanship; AtoNs Failure; Fatigue; Radar Interference from wind turbines; Mechanical Failure; Adverse Weather; Avoidance of Small Craft; Reduced Visibility;	Notice to Mariners; Site Marking and Charting; Safety Zones; ERCOP; Periodic Exercises; Incident Investigation and Reporting; Aids to Navigation; Air Draught Clearance; Layout Plan and Lines of Orientation.	Multiple minor injuries; Moderate damage to small craft; No pollution; Minor adverse publicity; Repairs to wind turbines.	2	2	1	2	4	Single fatalities; Loss of small craft; Moderate pollution incident (Tier 2); National adverse publicity; Repairs to wind turbines.	4	4	3	4	2	7.6	Medium Risk - Tolerable (if ALARP)

ID	Haz. Rank	Area	Hazard Title	Possible Causes	Embedded Risk Controls	Realistic Most Likely Scenario	Realistic Most Likely Scores: People	Property	Environment	Business	Frequency	Realistic Worst Credible Scenario	Realistic Worst Credible Scores: People	Property	Environment	Business	Frequency	Risk Score	Risk Rating
44	43	East Morecambe	Grounding - Cargo/Tanker	Presence of wind turbines; Reduced Searoom Between offshore wind farms; Increased Project Vessel Movements; Human Error/Poor Seamanship; AtoNs Failure; Fatigue; Radar Interference from wind turbines; Mechanical Failure; Adverse Weather; Avoidance of Small Craft; Reduced Visibility;	Notice to Mariners; Site Marking and Charting; Safety Zones; ERCOP; Periodic Exercises; Incident Investigation and Reporting; Aids to Navigation; Air Draught Clearance; Layout Plan and Lines of Orientation.	Multiple minor injuries; Minor damage to vessel; No pollution; Minor adverse publicity.	2	2	1	1	3	Single fatalities; Serious damage to vessel; Moderate pollution incident (Tier 2); National adverse publicity.	4	4	3	4	2	6.5	Medium Risk - Tolerable (if ALARP)
45	31	Within offshore wind farms	Collision - Small Craft ICW. Small Craft	Reduced Searoom Between offshore wind farms; Increased Project Vessel Movements; Human Error/Poor Seamanship; Fatigue; Radar Interference from wind turbines; Mechanical Failure; Adverse Weather; Avoidance of Small Craft; Reduced Visibility;	Notice to Mariners; Site Marking and Charting; ERCOP; Periodic Exercises; Incident Investigation and Reporting; Layout Plan and Lines of Orientation; Marine Operating Guidelines; Vessel Standards; Training; Compliance of Project Vessels; Vessel Traffic Monitoring.	Multiple minor injuries; Moderate damage to small craft; No pollution; Minor adverse publicity.	2	2	1	2	4	Single fatalities; Loss of small craft; Moderate pollution incident (Tier 2); National adverse publicity.	4	3	3	4	2	7.5	Medium Risk - Tolerable (if ALARP)
46	16	Within offshore wind farms	Allision - Tug/Service & Small Project Vessels	Presence of wind turbines; Reduced Searoom Between offshore wind farms; Increased Project Vessel Movements; Human Error/Poor Seamanship; AtoNs Failure; Fatigue; Radar Interference from wind turbines; Mechanical Failure; Adverse Weather; Avoidance of Small Craft; Reduced Visibility;	Notice to Mariners; Site Marking and Charting; Safety Zones; ERCOP; Periodic Exercises; Incident Investigation and Reporting; Aids to Navigation; Air Draught Clearance; Layout Plan and Lines of Orientation; Marine Operating Guidelines; Vessel Standards; Training; Compliance of Project Vessels.	Multiple minor injuries; Moderate damage to small craft; No pollution; Minor adverse publicity; Repairs to wind turbines.	2	2	1	2	5	Single fatalities; Loss of small craft; Moderate pollution incident (Tier 2); National adverse publicity; Repairs to wind turbines.	4	4	3	4	2	8.6	Medium Risk - Tolerable (if ALARP)
47	19	Within offshore wind farms	Allision - Fishing	Presence of wind turbines; Reduced Searoom Between offshore wind farms; Increased Project Vessel Movements; Human Error/Poor Seamanship; AtoNs Failure; Fatigue; Radar Interference from wind turbines; Mechanical Failure; Adverse Weather; Avoidance of Small Craft; Reduced Visibility;	Notice to Mariners; Site Marking and Charting; Safety Zones; Fishing Liaison Plan; ERCOP; Periodic Exercises; Incident Investigation and Reporting; Aids to Navigation; Air Draught Clearance; Layout Plan and Lines of Orientation.	Multiple minor injuries; Moderate damage to small craft; No pollution; Minor adverse publicity; Repairs to wind turbines.	2	2	1	2	4	Single fatalities; Loss of small craft; Moderate pollution incident (Tier 2); National adverse publicity; Repairs to wind turbines.	4	4	3	4	2	7.6	Medium Risk - Tolerable (if ALARP)
48	19	Within offshore wind farms	Allision - Recreational	Presence of wind turbines; Reduced Searoom Between offshore wind farms; Increased Project Vessel Movements; Human Error/Poor Seamanship; AtoNs Failure; Fatigue; Radar Interference from wind turbines; Mechanical Failure;	Notice to Mariners; Site Marking and Charting; Safety Zones; ERCOP; Periodic Exercises; Incident Investigation and Reporting; Aids to Navigation; Air Draught Clearance;	Multiple minor injuries; Moderate damage to small craft; No pollution; Minor adverse publicity; Repairs to wind turbines.	2	2	1	2	4	Single fatalities; Loss of small craft; Moderate pollution incident (Tier 2); National adverse publicity; Repairs to wind turbines.	4	4	3	4	2	7.6	Medium Risk - Tolerable (if ALARP)

ID	Haz. Rank	Area	Hazard Title	Possible Causes	Embedded Risk Controls	Realistic Most Likely Scenario	Realistic Most Likely Scores: People	Property	Environment	Business	Frequency	Realistic Worst Credible Scenario	Realistic Worst Credible Scores: People	Property	Environment	Business	Frequency	Risk Score	Risk Rating
				Adverse Weather; Avoidance of Small Craft; Reduced Visibility;	Layout Plan and Lines of Orientation.														
49	15	Operations and Maintenance Base	Collision - Small Project Vessels ICW. Cargo/Tanker or Ferry/Passenger	Increased Project Vessel Movements; Human Error/Poor Seamanship; Failure to Comply with COLREGs; Fatigue; Mechanical Failure; Adverse Weather; Avoidance of Small Craft; Reduced Visibility;	Notice to Mariners; ERCOP; Incident Investigation and Reporting; Marine Operating Guidelines; Vessel Standards; Training; Compliance of Project Vessels; Vessel Traffic Monitoring.	Multiple major injuries; Moderate damage to vessel; Minor pollution; Widespread adverse publicity; Short term interruption to ferry services.	3	3	2	3	3	Multiple fatalities; Loss of small craft; Moderate pollution incident (Tier 2); National adverse publicity.	5	4	3	4	2	8.8	Medium Risk - Tolerable (if ALARP)
50	18	Operations and Maintenance Base	Collision - Small Project Vessels ICW. Small Craft	Increased Project Vessel Movements; Human Error/Poor Seamanship; Fatigue; Mechanical Failure; Adverse Weather; Avoidance of Small Craft; Reduced Visibility;	Notice to Mariners; ERCOP; Periodic Exercises; Incident Investigation and Reporting; Marine Operating Guidelines; Vessel Standards; Training; Compliance of Project Vessels; Vessel Traffic Monitoring.	Multiple minor injuries; Moderate damage to small craft; No pollution; Minor adverse publicity.	2	2	1	2	3	Single fatalities; Loss of small craft; Moderate pollution incident (Tier 2); National adverse publicity.	4	3	3	4	3	8.4	Medium Risk - Tolerable (if ALARP)
51	36	Operations and Maintenance Base	Allision - Small Project Vessel	Increased Project Vessel Movements; Human Error/Poor Seamanship; Fatigue; Mechanical Failure; Adverse Weather; Avoidance of Small Craft; Reduced Visibility;	Notice to Mariners; ERCOP; Periodic Exercises; Incident Investigation and Reporting; Marine Operating Guidelines; Vessel Standards; Training; Compliance of Project Vessels.	Multiple minor injuries; Moderate damage to small craft; No pollution; Minor adverse publicity.	2	2	1	2	3	Single fatalities; Loss of small craft; Moderate pollution incident (Tier 2); National adverse publicity.	4	4	3	4	2	6.7	Medium Risk - Tolerable (if ALARP)
52	36	Operations and Maintenance Base	Grounding - Small Project Vessel	Increased Project Vessel Movements; Human Error/Poor Seamanship; Fatigue; Mechanical Failure; Adverse Weather; Avoidance of Small Craft; Reduced Visibility;	Notice to Mariners; ERCOP; Periodic Exercises; Incident Investigation and Reporting; Marine Operating Guidelines; Vessel Standards; Training; Compliance of Project Vessels.	Multiple minor injuries; Moderate damage to small craft; No pollution; Minor adverse publicity.	2	2	1	2	3	Single fatalities; Loss of small craft; Moderate pollution incident (Tier 2); National adverse publicity.	4	4	3	4	2	6.7	Medium Risk - Tolerable (if ALARP)
53	19	Morgan-Walney	Allision (Oil and Gas) - Cargo/Tanker or Ferry/Passenger	Reduced Searoom Between offshore wind farms; Human Error/Poor Seamanship; Failure to Comply with COLREGs; Fatigue; Radar Interference from wind turbines; Mechanical Failure; Adverse Weather; Avoidance of Small Craft; Reduced Visibility;	Notice to Mariners; Site Marking and Charting; ERCOP; Layout Plan and Lines of Orientation.	Multiple major injuries; Moderate damage to vessel; Moderate pollution (Tier 2); Widespread adverse publicity; Short term interruption to ferry services.	3	3	3	3	2	Significant loss of life; Constructive Loss; Serious pollution (Tier 2); International adverse publicity. Ferry out of service.	5	5	4	5	2	7.9	Medium Risk - Tolerable (if ALARP)
54	32	Morgan-Walney	Adverse Vessel Motions - Cargo/Tanker or Ferry/Passenger	Reduced Searoom Between offshore wind farms; Human Error/Poor Seamanship; Adverse Weather; Avoidance of Other Traffic;	Notice to Mariners; Site Marking and Charting; ERCOP.	Minor injuries; Minor damage to vessel - some damage to cargo; No pollution; Short term interruption to ferry services.	2	3	1	2	3	Single fatality; Major damage; Minor pollution; National adverse publicity; Ferry out of service.	4	4	2	4	2	7.5	Medium Risk - Tolerable (if ALARP)
55	32	Mona-Morgan	Adverse Vessel Motions - Cargo/Tanker or Ferry/Passenger	Reduced Searoom Between offshore wind farms; Human Error/Poor Seamanship; Adverse Weather; Avoidance of Other Traffic;	Notice to Mariners; Site Marking and Charting; ERCOP.	Minor injuries; Minor damage to vessel - some damage to cargo; No pollution;	2	3	1	2	3	Single fatality; Major damage; Minor pollution; National adverse publicity; Ferry out of service.	4	4	2	4	2	7.5	Medium Risk - Tolerable (if ALARP)

ID	Haz. Rank	Area	Hazard Title	Possible Causes	Embedded Risk Controls	Realistic Most Likely Scenario	Realistic Most Likely Scores: People	Property	Environment	Business	Frequency	Realistic Worst Credible Scenario	Realistic Worst Credible Scores: People	Property	Environment	Business	Frequency	Risk Score	Risk Rating
						Short term interruption to ferry services.													
56	32	Mona-Morecambe	Adverse Vessel Motions - Cargo/Tanker or Ferry/Passenger	Reduced Searoom Between offshore wind farms; Human Error/Poor Seamanship; Adverse Weather; Avoidance of Other Traffic;	Notice to Mariners; Site Marking and Charting; ERCOP.	Minor injuries; Minor damage to vessel - some damage to cargo; No pollution; Short term interruption to ferry services.	2	3	1	2	3	Single fatality; Major damage; Minor pollution; National adverse publicity; Ferry out of service.	4	4	2	4	2	7.5	Medium Risk - Tolerable (if ALARP)

Appendix B
Hazard Workshop Summary

Hazard workshop process:

The hazard workshop process was as follows:

1) **Pre-read material**: Pre-read material issued to stakeholders containing detailed Project information.
2) **Pre-hazard workshop seminar**: Pre-hazard workshop webinar held to discuss pre-read material and familiarise stakeholders with CRNRA and hazard log methodology.
3) **Draft hazard log**: Draft hazard log issued to stakeholders for score updates and comments.
4) **Hazard workshop**; Stakeholder hazard workshop held in-person.

Pre-read material:

Prior to the hazard workshop, all stakeholder organisations were provided with a pre-read pack that contained a detailed summary of the:

- Data collected and bridge simulation overview.
- Existing marine environment and maritime activities in the Irish Sea (including detailed vessel traffic analysis).
- Project descriptions and assumptions.
- Potential impacts of the Projects on the existing environment.
- CRNRA requirements and methodology.

Pre-hazard workshop webinar:

On the 03 October 2022, one week prior to the in-person hazard workshop, a webinar was undertaken, to discuss the pre-read material and familiarise stakeholders with the risk assessment methodology and draft hazard log spreadsheet that was to be used by stakeholder organisations in the hazard workshop.

Draft hazard log:

On the 04 October 2022, following the webinar, each stakeholder organisation was issued a copy of the draft hazard log spreadsheet. Stakeholders were invited to review and re-score each hazard as they saw fit prior to the hazard workshop. Stakeholders were encouraged to add a description to the comments section of their adjusted hazard scores to clarify their reasoning and aid discussion in the hazard workshop.

Hazard workshop:

A hazard workshop was held on 10 October 2022 at the Holiday Inn Liverpool.

The agenda was as follows:

- 09:00 - 09:30 Coffee
- 09:30 - 10:30 MNEF
- 10:30 - 10:45 Introductions
- 10:45 - 11:00 Aims and Objectives
- 11:00 - 11:15 Coffee Break
- 11:15 - 11:30 Supporting Studies and Data
- 11:30 - 11:45 Workshop Methodology Recap

- 11:45 - 12:30 Key Navigation Themes/Discussion
- 12:30 - 13:15 Lunch
- 13:15 - 15:00 Hazard Scoring Session 1 (Priority Hazards)
- 15:00 - 15:15 Coffee Break
- 15:15 - 17:00 Hazard Scoring Session 2 (Priority Hazards)
- 17:00 - 17:30 Summary
- 17:30 - 18:00 Run Over Time.

The details the organisations and representatives that attended the workshop are shown below.

Hazard workshop attendees [HOLD – confirm inclusion of named individuals].

Organisation	Attendee	Role
RPS	Miriam Knollys	Principal Environmental Consultant
Royal Haskoning DHV	Rebecca Worbey	Senior Environmental Consultant (Marine)
Flotation Energy	Kristine Wood	Communications Manager
bp and EnBW	Gero Vella Lucy Harper John Davies	Project Development Manager Consenting Lead Master
Cruising Association	Nigel Robinson	Representative
IoM Department of Infrastructure	Emma Rowan	Isle of Man Government
Harbour Energy	Alex Morton	Marine and Aviation Global Technical Authority
IoM Steam Packet Company	Robert Hunter Capt Jonathan Palmer Capt Chris Kelly Capt Kane Taha	Marine Manager Master Master Operations Manager
Maritime Coastguard Agency	Nick Salter Vaughan Jackson	Offshore Renewables Lead, Marine Licensing and Consenting
Peel Ports	Neill Sumner	Deputy Harbour Master/Marine Operations Manager
Royal Yachting Association	Phil Horton	Environment and Sustainability Manager
Seatruck Ferries	Matt Henderson	Fleet Training Superintendent
Spirit Energy	Denis Utisch	
Stena Line	Michael Proctor	Safety & Security Superintendent, Deputy CSO, DP Ports (PMSC)
Tom Watson	Tom Watson	
UK Chamber of Shipping	Robert Merrylees	Policy Manager (Safety & Nautical) & Analyst
Kirkcudbright	Douggie White (online)	
NASH Maritime	Jamie Holmes Ed Rogers Claire Conning Sam Anderson Brown	Project Director (Morgan and Mona) Project Director (Morecambe) Maritime Consultant Principal Maritime Consultant

At the workshop, the pre-read material was reviewed at a high level before stakeholders were invited to describe their key concerns regarding the Projects.

From these key navigational concerns, the NRA team identified eight hazards to focus the hazard workshop discussions around. For each hazard, stakeholders were provided an opportunity to discuss the hazard in small groups and update their scorings in their copy of the draft risk assessment spreadsheet.

These scores were then updated (live) within the summary spreadsheet (presented to the room) which contained the draft project teams scores alongside all attending stakeholder organisation scores.

A discussion was then held across the wider room about the variation in scoring for each hazard and where differences lay. Once each hazard discussion had come to a close, the summary spreadsheet was 'locked' to capture the concluding scores of the discussion. Stakeholders were encouraged to fill out the comments section of each hazard post workshop to provide a higher level of description regarding their scores.

At the end of the day, a summary was held to discuss the key impacts identified and some potential mitigation options.

Results

The baseline hazard scores and comments for the eight hazards discussed in the workshop are as follows:

During the hazard workshop, consensus was not reached on a number of hazards, with a range of scores between the project team and stakeholders. Therefore, the findings of the workshop were considered with the analysis and wider assessment undertaken by the Project team to derive the final risk assessment described in the CRNRA (see **Appendix A**).

Hazard ID:	**3**
Hazard Title:	**Collision - Commercial Ship vs Small Craft**
Area:	**Morgan-Walney**

Possible Causes	Applied Mitigation	Realistic Most Likely Scenario	Realistic Worst Credible Scenario
Reduced Searoom Between offshore wind farms; Increased Project Vessel Movements; Human Error/Poor Seamanship; Failure to Comply with COLREGs; Fatigue; Radar Interference from wind turbines; Mechanical Failure; Adverse Weather; Avoidance of Small Craft; Reduced Visibility;	Notice to Mariners; Site Marking and Charting; ERCOP; Incident Investigation and Reporting; Layout Plan and Lines of Orientation; Marine Operating Guidelines; Vessel Standards; Training; Compliance of Project Vessels; Vessel Traffic Monitoring.	Multiple minor injuries; Moderate damage to small craft; No pollution; Minor adverse publicity.	Single fatalities; Loss of small craft; Moderate pollution incident (Tier 2); National adverse publicity.

Organisation	Baseline Risk Rank	Realistic Most Likely Scores					Realistic Worst Credible Scores					Baseline Risk Score	Baseline Risk Rating	Notes
		People	Property	Environment	Business	Frequency	People	Property	Environment	Business	Frequency			
Draft Scores	**2**	2	3	1	2	**4**	4	3	3	4	**3**	**10.6**	**Medium Risk - Tolerable (if ALARP)**	
Cruising Association	**2**	2	3	1	2	**4**	4	3	3	4	**3**	**10.6**	**Medium Risk - Tolerable (if ALARP)**	
Department of Infrastructure (IoM)	**2**	4	3	2	3	**4**	5	3	3	4	**3**	**13.6**	**High Risk - Unacceptable**	Based on discussions with IOMSPC, this reflects their concerns in respect of this hazard on their vessels and routes. Consideration needs to be given to the different types of vessels and the impact of collision on both, as passenger ferries.
Harbour Energy	**2**	2	3	1	2	**4**	4	3	3	4	**3**	**10.6**	**Medium Risk - Tolerable (if ALARP)**	
IoMSPC	**2**	4	3	2	3	**4**	5	3	3	4	**3**	**13.6**	**High Risk - Unacceptable**	fast craft high speed collision increases risk of fatality.
MCA	**2**	3	3	1	3	**4**	5	4	4	4	**3**	**12.4**	**High Risk - Unacceptable**	Compliance with corridor guidance would be required.
Peel Ports	**2**	2	3	1	2	**4**	4	3	3	4	**3**	**10.6**	**Medium Risk - Tolerable (if ALARP)**	
RYA	**1**	2	2	1	2	**4**	5	3	3	4	**4**	**12.5**	**High Risk - Unacceptable**	Changes in discussion within the workshop. CA, RYA, Spirit, Harbour Energy. Cost for realistic most likely lower to match typical boat costs. Worst case more likely as small boats not visible and being forced into narrow channel with larger ships, especially if single line of orientation agreed. Also likely to have multiple deaths on sinking.
Seatruck Ferries	**2**	4	3	2	3	**4**	5	3	3	4	**3**	**13.6**	**High Risk - Unacceptable**	High potential for loss of property and life, Difficult to detect small craft. potential for environmental damage. Damage to business thorugh bad press through media/loss of revenue etc.
Spirit Energy	**17**	2	3	1	2	**4**	4	3	3	4	**3**	**10.6**	**Medium Risk - Tolerable (if ALARP)**	
Stena Line	**2**	4	3	2	3	**4**	5	3	3	4	**3**	**13.6**	**High Risk - Unacceptable**	
Tom Watson	**2**	2	3	1	2	**4**	4	3	3	4	**3**	**10.6**	**Medium Risk - Tolerable (if ALARP)**	
UK Chamber of Shipping	**3**	3	3	2	3	**4**	5	4	3	4	**3**	**12.5**	**High Risk - Unacceptable**	
Final Scores	**3**	3	3	2	3	**4**	5	3	3	4	**3**	**12.3**	**High Risk - Unacceptable**	

Hazard ID:	**5**
Hazard Title:	**Allision-Ferry**
Area:	**Morgan-Walney**

Possible Causes	Applied Mitigation	Realistic Most Likely Scenario	Realistic Worst Credible Scenario
Presence of wind turbines; Reduced Searoom Between offshore wind farms; Increased Project Vessel Movements; Human Error/Poor Seamanship; AtoNs Failure; Fatigue; Radar Interference from wind turbines; Mechanical Failure; Adverse Weather; Avoidance of Small Craft; Reduced Visibility;	Notice to Mariners; Site Marking and Charting; Safety Zones; ERCOP; Periodic Exercises; Incident Investigation and Reporting; Aids to Navigation; Air Draught Clearance; Layout Plan and Lines of Orientation; Vessel Traffic Monitoring.	Multiple minor injuries; Superficial damage to vessel; No pollution; Widespread adverse publicity; Repairs to wind turbines; Short term interruption to ferry services.	Significant loss of life; Constructive Loss; Serious pollution (Tier 2); International adverse publicity; Loss of wind turbines; Ferry out of service.

Organisation	Baseline Risk Rank	Realistic Most Likely Scores					Realistic Worst Credible Scores					Baseline Risk Score	Baseline Risk Rating	Notes
		People	Property	Environment	Business	Frequency	People	Property	Environment	Business	Frequency			
Draft Scores	**7**	2	2	1	3	**4**	5	4	3	5	**2**	**9.6**	Medium Risk - Tolerable (if ALARP)	
Cruising Association	**7**	2	2	1	3	**4**	5	4	3	5	**2**	**9.6**	Medium Risk - Tolerable (if ALARP)	
Department of Infrastructure (IoM)	**7**	2	2	1	3	**4**	5	4	3	5	**2**	**9.6**	Medium Risk - Tolerable (if ALARP)	Nothing further to add to scoring/comments received from IOMSPC reflecting their analysis of this hazard, taking into account its vessels (particularly the impact on the fast craft).
Harbour Energy	**7**	2	2	1	3	**4**	5	4	3	5	**2**	**9.6**	Medium Risk - Tolerable (if ALARP)	
IoMSPC	**4**	3	4	2	4	**4**	5	5	4	5	**2**	**12.1**	High Risk - Unacceptable	high speed craft collision at full speed, aluminium hull.
MCA	**6**	2	3	1	3	**4**	5	4	3	5	**2**	**9.9**	Medium Risk - Tolerable (if ALARP)	
Peel Ports	**7**	2	2	1	3	**4**	5	4	3	5	**2**	**9.6**	Medium Risk - Tolerable (if ALARP)	
RYA	**4**	2	2	1	3	**4**	5	5	4	4	**3**	**12.1**	High Risk - Unacceptable	Changes in discussion within the workshop. CA, RYA, Spirit, Harbour Energy. Increased impacts and frequency in realistic worst case scenario, Note: substation in Walney is on sea side of array, not in the centre.
Seatruck Ferries	**5**	2	2	2	3	**4**	4	4	4	5	**3**	**12.2**	High Risk - Unacceptable	considering weather (high seas, strong wind) resulting in multiple strikes with fixed objects.
Spirit Energy	**1**	5	5	4	5	**3**	5	5	4	5	**3**	**14.6**	High Risk - Unacceptable	
Stena Line	**5**	2	2	1	3	**4**	4	4	3	5	**3**	**11.8**	Medium Risk - Tolerable (if ALARP)	
Tom Watson	**7**	2	2	1	3	**4**	5	4	3	5	**2**	**9.6**	Medium Risk - Tolerable (if ALARP)	
UK Chamber of Shipping	**4**	2	3	1	3	**4**	5	4	3	5	**3**	**12.2**	High Risk - Unacceptable	
Final Scores	**7**	3	3	2	3	**4**	5	4	3	5	**2**	**10.4**	Medium Risk - Tolerable (if ALARP)	

Hazard ID:	**10**
Hazard Title:	**Collision-Ferry vs Other Large Vessel**
Area:	**Mona-Morgan**

Possible Causes	Applied Mitigation	Realistic Most Likely Scenario	Realistic Worst Credible Scenario
Reduced Searoom Between offshore wind farms; Human Error/Poor Seamanship; Failure to Comply with COLREGs; Fatigue; Radar Interference from wind turbines; Mechanical Failure; Adverse Weather; Avoidance of Small Craft; Reduced Visibility;	Notice to Mariners; Site Marking and Charting; ERCOP; Layout Plan and Lines of Orientation.	Multiple minor injuries; Superficial damage to vessel; No pollution; Widespread adverse publicity; Short term interruption to ferry services.	Significant loss of life; Constructive Loss; Serious pollution (Tier 2); International adverse publicity. Ferry out of service.

Organisation	Baseline Risk Rank	Realistic Most Likely Scores					Realistic Worst Credible Scores					Baseline Risk Score	Baseline Risk Rating	Notes
		People	Property	Environment	Business	Frequency	People	Property	Environment	Business	Frequency			
Draft Scores	**1**	2	2	1	3	**4**	5	5	4	5	**3**	**12.3**	**High Risk - Unacceptable**	
Cruising Association	**1**	2	2	1	3	**4**	5	5	4	5	**3**	**12.3**	**High Risk - Unacceptable**	
Department of Infrastructure (IoM)	**1**	3	4	3	4	**4**	5	5	4	5	**3**	**14.8**	**High Risk - Unacceptable**	Based on discussions with IOMSPC, this reflects their concerns in respect of this hazard on their vessels and routes. Consideration needs to be given to the different types of vessels and the impact of collision on both, as passenger ferries. Should also include that superficial damage to boats is unlikely as specified in the realistic most likely scores. Could also include reference to night time sailing.
Harbour Energy	**1**	2	2	1	3	**4**	5	5	4	5	**3**	**12.3**	**High Risk - Unacceptable**	
IoMSPC	**1**	3	4	3	4	**4**	5	5	4	5	**3**	**14.8**	**High Risk - Unacceptable**	worst case scenario concerning fast craft collision, agree with IOM DOI conclusion.
MCA	**1**	2	3	1	3	**4**	5	5	4	5	**3**	**12.6**	**High Risk - Unacceptable**	ERCoP is not a preventative measure Layout plan and lines of orientation is only valid if there are multiple lines of orientation - is there a commitment for multiple?
Peel Ports	**1**	2	2	1	3	**4**	5	5	4	5	**3**	**12.3**	**High Risk - Unacceptable**	
RYA	**1**	4	4	1	3	**4**	5	5	4	5	**2**	**11.9**	**Medium Risk - Tolerable (if ALARP)**	Changes in discussion within the workshop. CA, RYA, Spirit, Harbour Energy. Increased realistic most likely scores due to significant damage likely in any collision at speed. Reduced likelihood of catastrophic event to 2 from 3.
Seatruck Ferries	**1**	3	4	3	4	**4**	5	5	4	5	**3**	**14.8**	**High Risk - Unacceptable**	
Spirit Energy	**1**	2	2	1	3	**4**	5	5	4	5	**3**	**12.3**	**High Risk - Unacceptable**	
Stena Line	**1**	3	4	3	4	**4**	5	5	4	5	**3**	**14.8**	**High Risk - Unacceptable**	
Tom Watson	**1**	2	2	1	3	**4**	5	5	4	5	**3**	**12.3**	**High Risk - Unacceptable**	
UK Chamber of Shipping	**2**	2	3	1	3	**4**	5	5	4	5	**3**	**12.6**	**High Risk - Unacceptable**	
Final Scores	**1**	3	3	2	3	**4**	5	5	4	5	**3**	13.1	High Risk - Unacceptable	

Hazard ID:	**11**
Hazard Title:	**Collision - Commercial Ship vs Commercial Ship (excluding Ferries)**
Area:	**Mona-Morgan**

Possible Causes	Applied Mitigation	Realistic Most Likely Scenario	Realistic Worst Credible Scenario
Reduced Searoom Between offshore wind farms; Human Error/Poor Seamanship; Failure to Comply with COLREGs; Fatigue; Radar Interference from wind turbines; Mechanical Failure; Adverse Weather; Avoidance of Small Craft; Reduced Visibility;	Notice to Mariners; Site Marking and Charting; ERCOP; Layout Plan and Lines of Orientation.	Multiple minor injuries; Suiperficial damage to vessel; No pollution; Minor adverse publicity; Vessel requires drydock.	Single fatalities; Constructive Loss; Major pollution incident (Tier 3); International adverse publicity.

Organisation	Baseline Risk Rank	Realistic Most Likely Scores					Realistic Worst Credible Scores					Baseline Risk Score	Baseline Risk Rating	Notes
		People	Property	Environment	Business	Frequency	People	Property	Environment	Business	Frequency			
Draft Scores	**48**	2	2	1	2	**2**	4	5	5	4	**1**	4.3	Low Risk - Broadly Acceptable	
Cruising Association	**39**	2	1	1	2	**2**	4	5	5	4	**2**	6.5	Medium Risk - Tolerable (if ALARP)	
Department of Infrastructure (IoM)	**4**	2	3	3	4	**3**	4	5	5	5	**3**	12.6	High Risk - Unacceptable	Following discussions with IOMSPC, Stena and Seatruck.
Harbour Energy	**43**	2	4	1	4	**1**	5	5	3	4	**2**	6.3	Medium Risk - Tolerable (if ALARP)	
IoMSPC	**4**	2	3	3	4	**3**	4	5	5	5	**3**	12.6	High Risk - Unacceptable	
MCA	**25**	2	4	2	3	**2**	4	5	5	4	**2**	8.1	Medium Risk - Tolerable (if ALARP)	
Peel Ports	**48**	2	2	1	2	**2**	4	5	5	4	**1**	4.3	Low Risk - Broadly Acceptable	
RYA	**48**	2	2	1	2	**2**	4	5	5	4	**1**	4.3	Low Risk - Broadly Acceptable	
Seatruck Ferries	**5**	2	3	3	4	**3**	4	5	5	5	**3**	12.6	High Risk - Unacceptable	
Spirit Energy	**43**	2	4	1	4	**1**	5	5	3	4	**2**	6.3	Medium Risk - Tolerable (if ALARP)	
Stena Line	**4**	2	3	3	4	**3**	4	5	5	5	**3**	12.6	High Risk - Unacceptable	
Tom Watson	**43**	2	4	1	4	**1**	5	5	3	4	**2**	6.3	Medium Risk - Tolerable (if ALARP)	
UK Chamber of Shipping	**24**	2	3	2	4	**2**	4	5	5	5	**2**	8.3	Medium Risk - Tolerable (if ALARP)	
Final Scores	**47**	2	3	2	3	2	**4**	5	5	4	**1**	**5.1**	**Low Risk - Broadly Acceptable**	

NASH MARITIME

Hazard ID:	12
Hazard Title:	Collision - Commercial Ship vs Small Craft
Area:	Mona-Morgan

Possible Causes	Applied Mitigation	Realistic Most Likely Scenario	Realistic Worst Credible Scenario
Reduced Searoom Between offshore wind farms; Increased Project Vessel Movements; Human Error/Poor Seamanship; Failure to Comply with COLREGs; Fatigue; Radar Interference from wind turbines; Mechanical Failure; Adverse Weather; Avoidance of Small Craft; Reduced Visibility;	Notice to Mariners; Site Marking and Charting; ERCOP; Incident Investigation and Reporting; Layout Plan and Lines of Orientation; Marine Operating Guidelines; Vessel Standards; Training; Compliance of Project Vessels; Vessel Traffic Monitoring.	Multiple minor injuries; Moderate damage to small craft; No pollution; Minor adverse publicity.	Single fatalities; Loss of small craft; Moderate pollution incident (Tier 2); National adverse publicity.

Organisation	Baseline Risk Rank	Realistic Most Likely Scores					Realistic Worst Credible Scores					Baseline Risk Score	Baseline Risk Rating	Notes
		People	Property	Environment	Business	Frequency	People	Property	Environment	Business	Frequency			
Draft Scores	2	2	3	1	2	4	4	3	3	4	3	10.6	Medium Risk - Tolerable (if ALARP)	
Cruising Association	2	2	3	1	2	4	4	3	3	4	3	10.6	Medium Risk - Tolerable (if ALARP)	
Department of Infrastructure (IoM)	2	4	3	2	3	4	5	3	3	4	3	13.6	High Risk - Unacceptable	Based on discussions with IOMSPC, this reflects their concerns in respect of this hazard on their vessels and routes. Consideration needs to be given to the different types of vessels and the impact of collision on both, as passenger ferries.
Harbour Energy	2	2	3	1	2	4	4	3	3	4	3	10.6	Medium Risk - Tolerable (if ALARP)	
IoMSPC	2	4	3	2	3	4	5	3	3	4	3	13.6	High Risk - Unacceptable	fast craft high speed collision increases risk of fatality, reduced capability of SAR rescue increases risk of fatality (casualty in the water or board).
MCA	1	3	3	2	3	4	5	4	4	4	3	12.7	High Risk - Unacceptable	
Peel Ports	5	2	2	1	2	4	5	3	3	4	3	10.3	Medium Risk - Tolerable (if ALARP)	RML - minor damage, RWC - single fatalities unlikely, BRS reduces, DIM not uniform in hazards.
RYA	1	2	2	1	2	4	5	3	3	4	4	12.5	High Risk - Unacceptable	Changes in discussion within the workshop. CA, RYA, Spirit, Harbour Energy. Cost for realistic most likely lower to match typical boat costs. Worst case more likely as small boats not visible and being forced into narrow channel with larger ships, especially if single line of orientation agreed. Also likely to have multiple deaths on sinking.
Seatruck Ferries	2	4	3	2	3	4	5	3	3	4	3	13.6	High Risk - Unacceptable	
Spirit Energy	17	2	3	1	2	4	4	3	3	4	3	10.6	Medium Risk - Tolerable (if ALARP)	
Stena Line	2	4	3	2	3	4	5	3	3	4	3	13.6	High Risk - Unacceptable	
Tom Watson	2	2	3	1	2	4	4	3	3	4	3	10.6	Medium Risk - Tolerable (if ALARP)	
UK Chamber of Shipping	3	3	3	2	3	4	5	4	3	4	3	12.5	High Risk - Unacceptable	
Final Scores	3	3	3	2	3	4	5	3	3	4	3	12.3	High Risk - Unacceptable	

Hazard ID:	**14**
Hazard Title:	**Allision - Ferry**
Area:	**Mona-Morgan**

Possible Causes	Applied Mitigation	Realistic Most Likely Scenario	Realistic Worst Credible Scenario
Presence of wind turbines; Reduced Searoom Between offshore wind farms; Increased Project Vessel Movements; Human Error/Poor Seamanship; AtoNs Failure; Fatigue; Radar Interference from wind turbines; Mechanical Failure; Adverse Weather; Avoidance of Small Craft; Reduced Visibility;	Notice to Mariners; Site Marking and Charting; Safety Zones; ERCOP; Periodic Exercises; Incident Investigation and Reporting; Aids to Navigation; Air Draught Clearance; Layout Plan and Lines of Orientation; Vessel Traffic Monitoring.	Multiple minor injuries; Superficial damage to vessel; No pollution; Widespread adverse publicity; Repairs to wind turbines; Short term interruption to ferry services.	Significant loss of life; Constructive Loss; Serious pollution (Tier 2); International adverse publicity; Loss of wind turbines; Ferry out of service.

Organisation	Baseline Risk Rank	Realistic Most Likely Scores					Realistic Worst Credible Scores					Baseline Risk Score	Baseline Risk Rating	Notes
		People	Property	Environment	Business	Frequency	People	Property	Environment	Business	Frequency			
Draft Scores	**21**	2	2	1	3	**3**	5	4	3	5	**2**	**8.4**	Medium Risk - Tolerable (if ALARP)	
Cruising Association	**20**	2	2	1	3	**3**	5	4	3	5	**2**	**8.4**	Medium Risk - Tolerable (if ALARP)	
Department of Infrastructure (IoM)	**21**	2	2	1	3	**3**	5	4	3	5	**2**	**8.4**	Medium Risk - Tolerable (if ALARP)	Nothing further to add to scoring/comments received from IOMSPC reflecting their analysis of this hazard, taking into account its vessels (particularly the impact on the fast craft).
Harbour Energy	**21**	2	2	1	3	**3**	5	4	3	5	**2**	**8.4**	Medium Risk - Tolerable (if ALARP)	
IoMSPC	**4**	3	4	2	4	**4**	5	5	4	5	**2**	**12.1**	High Risk - Unacceptable	high speed craft collision at full speed, aluminium hull.
MCA	**1**	2	4	2	3	**4**	5	4	3	5	**3**	**13.7**	High Risk - Unacceptable	
Peel Ports	**21**	2	2	1	3	**3**	5	4	3	5	**2**	**8.4**	Medium Risk - Tolerable (if ALARP)	
RYA	**6**	2	2	1	3	**4**	5	4	3	4	**3**	**11.8**	Medium Risk - Tolerable (if ALARP)	Changes in discussion within the workshop. CA, RYA, Spirit, Harbour Energy. Increased frequency & reduced business impact in realistic worst credible score. Matched frequency in most likely to previously considered ID 23. Still medium risk as a result.
Seatruck Ferries	**6**	2	2	1	3	**4**	4	4	4	5	**3**	**11.9**	Medium Risk - Tolerable (if ALARP)	
Spirit Energy	**5**	2	2	1	4	**3**	5	4	3	4	**3**	**11.4**	Medium Risk - Tolerable (if ALARP)	
Stena Line	**5**	2	2	1	3	**4**	4	4	3	5	**3**	**11.8**	Medium Risk - Tolerable (if ALARP)	
Tom Watson	**21**	2	2	1	3	**3**	5	4	3	5	**2**	**8.4**	Medium Risk - Tolerable (if ALARP)	
UK Chamber of Shipping	**4**	2	3	1	3	**4**	5	4	3	5	**3**	**12.2**	High Risk - Unacceptable	
Final Scores	**7**	3	3	2	3	**4**	5	4	3	5	**2**	**10.4**	Medium Risk - Tolerable (if ALARP)	

Hazard ID:	**21**
Hazard Title:	**Collision - Commercial Ship vs Small Craft**
Area:	**Mona-Morecambe**

Possible Causes	Applied Mitigation	Realistic Most Likely Scenario	Realistic Worst Credible Scenario
Reduced Searoom Between offshore wind farms; Increased Project Vessel Movements; Human Error/Poor Seamanship; Failure to Comply with COLREGs; Fatigue; Radar Interference from wind turbines; Mechanical Failure; Adverse Weather; Avoidance of Small Craft; Reduced Visibility;	Notice to Mariners; Site Marking and Charting; ERCOP; Incident Investigation and Reporting; Layout Plan and Lines of Orientation; Marine Operating Guidelines; Vessel Standards; Training; Compliance of Project Vessels; Vessel Traffic Monitoring.	Multiple minor injuries; Moderate damage to small craft; No pollution; Minor adverse publicity.	Single fatalities; Loss of small craft; Moderate pollution incident (Tier 2); National adverse publicity.

Organisation	Baseline Risk Rank	Realistic Most Likely Scores					Realistic Worst Credible Scores					Baseline Risk Score	Baseline Risk Rating	Notes
		People	Property	Environment	Business	Frequency	People	Property	Environment	Business	Frequency			
Draft Scores	**2**	2	3	1	2	**4**	4	3	3	4	**3**	**10.6**	Medium Risk - Tolerable (if ALARP)	
Cruising Association	**2**	2	3	1	2	**4**	4	3	3	4	**3**	**10.6**	Medium Risk - Tolerable (if ALARP)	
Department of Infrastructure (IoM)	**2**	4	3	2	3	**4**	5	3	3	4	**3**	**13.6**	High Risk - Unacceptable	Based on discussions with IOMSPC, this reflects their concerns in respect of this hazard on their vessels and routes. Consideration needs to be given to the different types of vessels and the impact of collision on both, as passenger ferries.
Harbour Energy	**2**	2	3	1	2	**4**	4	3	3	4	**3**	**10.6**	Medium Risk - Tolerable (if ALARP)	
IoMSPC	**2**	4	3	2	3	**4**	5	3	3	4	**3**	**13.6**	High Risk - Unacceptable	fast craft high speed collision increases risk of fatality, reduced capability of SAR rescue increases risk of fatality (casualty in the water or board).
MCA	**1**	3	3	2	3	**4**	5	4	4	4	**3**	**12.7**	High Risk - Unacceptable	
Peel Ports	**5**	2	2	1	2	**4**	5	3	3	4	**3**	**10.3**	Medium Risk - Tolerable (if ALARP)	RML - minor damage, RWC - single fatalities unlikely, BRS reduces, DIM not uniform in hazards.
RYA	**1**	2	2	1	2	**4**	5	3	3	4	**4**	**12.5**	High Risk - Unacceptable	Changes in discussion within the workshop. CA, RYA, Spirit, Harbour Energy. Cost for realistic most likely lower to match typical boat costs. Worst case more likely as small boats not visible and being forced into narrow channel with larger ships, especially if single line of orientation agreed. Also likely to have multiple deaths on sinking.
Seatruck Ferries	**2**	4	3	2	3	**4**	5	3	3	4	**3**	**13.6**	High Risk - Unacceptable	
Spirit Energy	**17**	2	3	1	2	**4**	4	3	3	4	**3**	**10.6**	Medium Risk - Tolerable (if ALARP)	
Stena Line	**2**	4	3	2	3	**4**	5	3	3	4	**3**	**13.6**	High Risk - Unacceptable	
Tom Watson	**2**	2	3	1	2	**4**	4	3	3	4	**3**	**10.6**	Medium Risk - Tolerable (if ALARP)	
UK Chamber of Shipping	**3**	3	3	2	3	**4**	5	4	3	4	**3**	**12.5**	High Risk - Unacceptable	
Final Scores	**6**	3	3	2	3	**3**	5	3	3	4	**3**	**10.9**	Medium Risk - Tolerable (if ALARP)	

Hazard ID:	**23**
Hazard Title:	**Allision - Ferry**
Area:	**Mona-Morecambe**

Possible Causes	Applied Mitigation	Realistic Most Likely Scenario	Realistic Worst Credible Scenario
Presence of wind turbines; Reduced Searoom Between offshore wind farms; Increased Project Vessel Movements; Human Error/Poor Seamanship; AtoNs Failure; Fatigue; Radar Interference from wind turbines; Mechanical Failure; Adverse Weather; Avoidance of Small Craft; Reduced Visibility;	Notice to Mariners; Site Marking and Charting; Safety Zones; ERCOP; Periodic Exercises; Incident Investigation and Reporting; Aids to Navigation; Air Draught Clearance; Layout Plan and Lines of Orientation; Vessel Traffic Monitoring.	Multiple minor injuries; Superficial damage to vessel; No pollution; Widespread adverse publicity; Repairs to wind turbines; Short term interruption to ferry services.	Significant loss of life; Constructive Loss; Serious pollution (Tier 2); International adverse publicity; Loss of wind turbines; Ferry out of service.

Organisation	Baseline Risk Rank	Realistic Most Likely Scores					Realistic Worst Credible Scores					Baseline Risk Score	Baseline Risk Rating	Notes
		People	Property	Environment	Business	Frequency	People	Property	Environment	Business	Frequency			
Draft Scores	**7**	2	2	1	3	**4**	5	4	3	5	**2**	**9.6**	Medium Risk - Tolerable (if ALARP)	
Cruising Association	**7**	2	2	1	3	**4**	5	4	3	5	**2**	**9.6**	Medium Risk - Tolerable (if ALARP)	
Department of Infrastructure (IoM)	**7**	2	2	1	3	**4**	5	4	3	5	**2**	**9.6**	Medium Risk - Tolerable (if ALARP)	Nothing further to add to scoring/comments received from IOMSPC reflecting their analysis of this hazard, taking into account its vessels (particularly the impact on the fast craft).
Harbour Energy	**7**	2	2	1	3	**4**	5	4	3	5	**2**	**9.6**	Medium Risk - Tolerable (if ALARP)	
IoMSPC	**8**	3	4	2	4	**3**	5	5	4	5	**2**	**10.3**	Medium Risk - Tolerable (if ALARP)	high speed craft collision at full speed, aluminium hull.
MCA	**19**	2	3	1	3	**3**	5	4	3	5	**2**	**8.6**	Medium Risk - Tolerable (if ALARP)	
Peel Ports	**7**	2	2	1	3	**4**	5	4	3	5	**2**	**9.6**	Medium Risk - Tolerable (if ALARP)	
RYA	**6**	2	2	1	3	**4**	5	4	3	4	**3**	**11.8**	Medium Risk - Tolerable (if ALARP)	Changes in discussion within the workshop. CA, RYA, Spirit, Harbour Energy. Increased frequency in realistic worst credible score. Still medium risk as a result.
Seatruck Ferries	**9**	2	2	2	3	**4**	4	4	4	5	**2**	**9.9**	Medium Risk - Tolerable (if ALARP)	
Spirit Energy	**1**	5	5	4	5	**3**	5	5	4	5	**3**	**14.6**	High Risk - Unacceptable	allision between ferry and Oil and Gas infrastructure.
Stena Line	**5**	2	2	1	3	**4**	4	4	3	5	**3**	**11.8**	Medium Risk - Tolerable (if ALARP)	
Tom Watson	**7**	2	2	1	3	**4**	5	4	3	5	**2**	**9.6**	Medium Risk - Tolerable (if ALARP)	
UK Chamber of Shipping	**9**	2	3	1	3	**4**	5	4	3	5	**2**	**9.9**	Medium Risk - Tolerable (if ALARP)	
Final Scores	**7**	3	3	2	3	**4**	5	4	3	5	**2**	**10.4**	Medium Risk - Tolerable (if ALARP)	

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