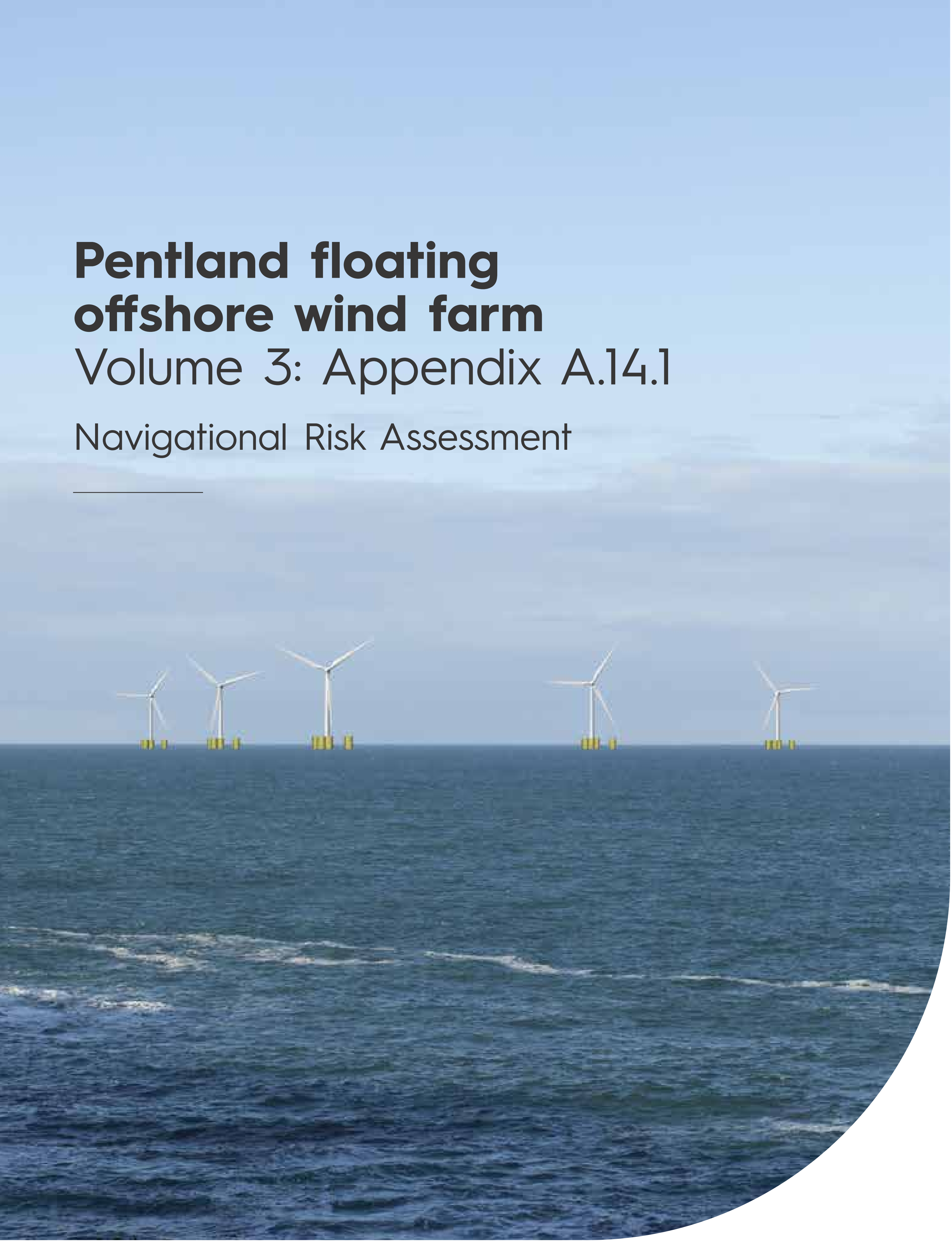
Pentland floating offshore wind farm
Volume 3: Appendix A.14.1

Navigational Risk Assessment



OFFSHORE EIAR (VOLUME 3): TECHNICAL APPENDICES

APPENDIX 14.1: NAVIGATIONAL RISK ASSESSMENT

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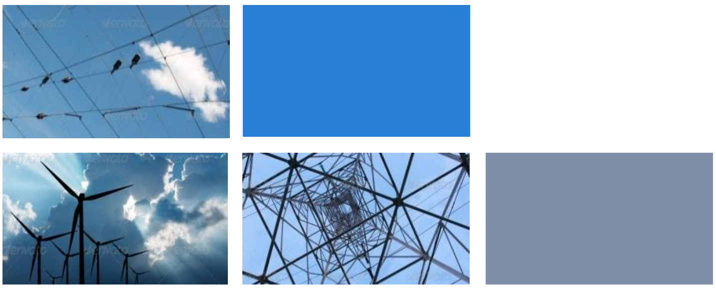

Pentland Floating Offshore Wind Farm Navigational Risk Assessment

(Appendix 14.1 to Offshore EIA Report)

Prepared by	Anatec Limited
Presented to	Highland Wind Limited
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Abbreviations Table

Abbreviation	Definition
AIS	Automatic Identification System
ALARP	As Low As Reasonably Practicable
ARPA	Automatic Radar Plotting Aid
AtoN	Aid to Navigation
BWEA	British Wind Energy Association
CAST	Coastguard Agreement on Salvage and Towage
CaP	Cable Plan
CBA	Cost Benefit Analysis
CBRA	Cable Burial Risk Assessment
CCC	Clyde Cruising Club
CHIRP	Confidential Human Factors Incident Reporting Programme
COLREGs	Convention on International Regulations for Preventing Collisions at Sea
DF	Direction Finding
DGC	Defence Geographic Centre
DSC	Digital Selective Calling
DSLP	Design, Specification and Layout Plan
DfT	Department for Transport
dB	Decibel
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
ERCoP	Emergency Response Cooperation Plan
ESCA	European Subsea Cables Association
ETV	Emergency Towing Vessel
FSA	Formal Safety Assessment
GPS	Global Positioning System
GT	Gross Tonnage
IMCA	International Marine Contractors Association

Abbreviation	Definition
IMO	International Maritime Organization
JRCC	Joint Rescue Co-ordination Centre
KIS-ORCA	Kingfisher Information Service – Offshore Renewable & Cable Awareness
kHz	Kilohertz
km	Kilometre(s)
LOA	Length Overall
MAIB	Marine Accident Investigation Branch
MCA	Maritime and Coastguard Agency
MDA	Managed Danger Area
MDS	Maximum Design Scenario
MEHRA	Marine Environmental High Risk Area
MEPC	Marine Environment Protection Committee
MGN	Marine Guidance Note
MOD	Ministry of Defence
MRCC	Maritime Rescue Co-ordination Centre
MS-LOT	Marine Scotland – Licensing Operations Team
MW	Megawatt
m	Metre(s)
NAVTEX	Navigational Telex
NLB	Northern Lighthouse Board
nm	Nautical Mile(s)
NRA	Navigational Risk Assessment
NSP	Navigational Safety Plan
O&M	Operation and Maintenance
ODAS	Ocean Data Acquisition System
OOW	Officer of the Watch
OREI	Offshore Renewable Energy Installation
OWF	Offshore Wind Farm
PFOWF	Pentland Floating Offshore Wind Farm

Abbreviation	Definition
PLL	Potential Loss of Life
QHSE	Quality, Health, Safety and Environment
RNLI	Royal National Lifeboat Institution
Racon	Radar Beacon
Ro-ro	Roll on / roll off
RYA	Royal Yachting Association
RYAS	Royal Yachting Association Scotland
SAR	Search and Rescue
SMS	Safety Management System
SONAR	Sound Navigation and Ranging
UK	United Kingdom
UKHO	United Kingdom Hydrographic Office
USA	United States of America
VHF	Very High Frequency
VMP	Vessel Management Plan
WGS84	World Geodetic System 1984
WTG	Wind Turbine Generator

1 Introduction

1.1 Background

1. Anatec was commissioned by Highland Wind Limited to undertake a Navigational Risk Assessment (NRA) for the proposed Pentland Floating Offshore Wind Farm (PFOWF) Array and Offshore Export Cable Corridor, henceforth referred to collectively as 'the Offshore Development'. The NRA presents information on the Offshore Development relative to the existing and estimated future navigational activity and forms the technical appendix to Chapter 14: Shipping and Navigation of the Environmental Impact Assessment Report (EIAR).

1.2 NRA Overview

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

   - Outline of the methodology applied in the NRA;
   - Summary of consultation undertaken with relevant shipping and navigation stakeholders to date;
   - Lessons learnt from previous Offshore Wind Farm (OWF) developments;
   - Summary of the description of the Offshore Development relevant to shipping and navigation;
   - Baseline characterisation of the existing environment including:
     - Key navigational features;
     - Meteorological and oceanographic conditions;
     - Vessel traffic movements;
     - Emergency response resources; and
     - Historical maritime incidents.
   - Discussion of potential hazards on navigation, communication and position fixing equipment;
   - Cumulative overview;
   - Future case vessel traffic characterisation;
   - Collision and allision risk modelling;
   - Hazard identification;
   - Outline of embedded mitigation measures; and
   - Outline of through life safety management features.

3. The NRA aims to screen the potential hazards and determine which should be taken forward to the impact assessment undertaken in Chapter 14: Shipping and Navigation. Potential hazards are considered for the construction, operation and maintenance (O&M), and decommissioning phases.

2 Guidance and Legislation

2.1 Legislation and Policy

4. Under the EIA Directive (2011/92/European Union (EU) as amended by Directive 2014/52/EU) (which remains applicable following the United Kingdom's (UK) EU Exit), an EIA Report is required to support the application for the Section 36 consent for the Offshore Development. As part of the EIA Report, the MCA require that an NRA is undertaken in order to "*inform the shipping and navigation chapter of the EIA Report*" (MCA, 2021).

2.2 Primary Guidance

5. The primary guidance documents used to inform the NRA are the following:

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

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

7. The MCA require that their methodology be used as a template for preparing NRAs. The methodology forms Annex 1 of MGN 654, the *Methodology for Assessing the Marine Navigational Safety & Emergency Response Risks for OREIs.* It is centred on risk management and requires a submission that shows that sufficient controls are, or will be, in place for the assessed risk to be judged as broadly acceptable or tolerable with mitigation (see Section 3). Both Chapter 14: Shipping and Navigation and the NRA identify base case and future case levels of risk, and assess what measures are required to ensure the future case remains broadly acceptable, or at most, tolerable with mitigation.

8. This NRA is fully compliant with MGN 654 and its annexes including Annex 1 on the risk assessment methodology. This is demonstrated by the completed MGN 654 checklist presented in Appendix A.

9. Annex 5 of MGN 654 also contains the Search and Rescue (SAR) checklist which will be completed as part of the mitigation measures embedded for the Offshore Development.

10. In line with industry standard approach for marine risk assessment and as required under MGN 654, the IMO FSA approach has been used for risk assessment. Further detail on the use of the IMO FSA process is included in Section 3.1 and Section 3.2.

2.3 Other Guidance

11. Other guidance documents used during the assessment include:

- *MGN 372 (Merchant and Fishing) Offshore Renewable Energy Installations (OREI): Guidance to mariners Operating in the vicinity of UK OREIs* (MCA, 2008);
- *International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) Guidance RO139 / G1162 The Marking of Offshore Man-Made Structures* (IALA, 2021); and
- *The Royal Yachting Association's (RYA) Position on Offshore Renewable Energy Developments: Paper 1 (of 4) – Wind Energy* (RYA, 2019a).
- *Regulatory Expectations on Moorings for Floating Wind and Marine Devices* (Health and Safety Executive (HSE) and MCA, 2017).

3 Navigational Risk Assessment Methodology

3.1 Formal Safety Assessment Methodology

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

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

13. Regarding commercial fishing vessels, the methodology and assessment has been applied to hazards considering fishing vessels in transit (i.e., where gear is not deployed). A separate methodology and assessment has been applied in Offshore EIAR (Volume 2): Chapter 13: Commercial Fisheries, to consider the hazards relating directly to commercial fishing activity (as opposed to fishing vessels in transit) including impacts of a commercial nature.

3.2 Formal Safety Assessment Process

14. The IMO FSA process (IMO, 2018) as approved by the IMO in 2018 under Maritime Safety Committee – Marine Environment Protection Committee (MEPC).2/circ. 12/Rev.2 have been applied in the impact assessment, set out in both the NRA and Offshore EIAR (Volume 2): Chapter 14: Shipping and Navigation.

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

- **Step 1** – Identification of hazards (a list is produced of hazards prioritised by risk level specific to the problem under review);
- **Step 2** – risk analysis (investigation of the causes and initiating events and consequences of the more important hazards identified in Step 1);
- **Step 3** – risk control options (identification of measures to control and reduce the identified hazards);
- **Step 4** – CBA (identification and comparison of the benefits and costs associated with the risk control options identified in step 3); and

- **Step 5** – recommendations for decision-making (defining of recommendations based upon the outputs of Steps 1 to 4).

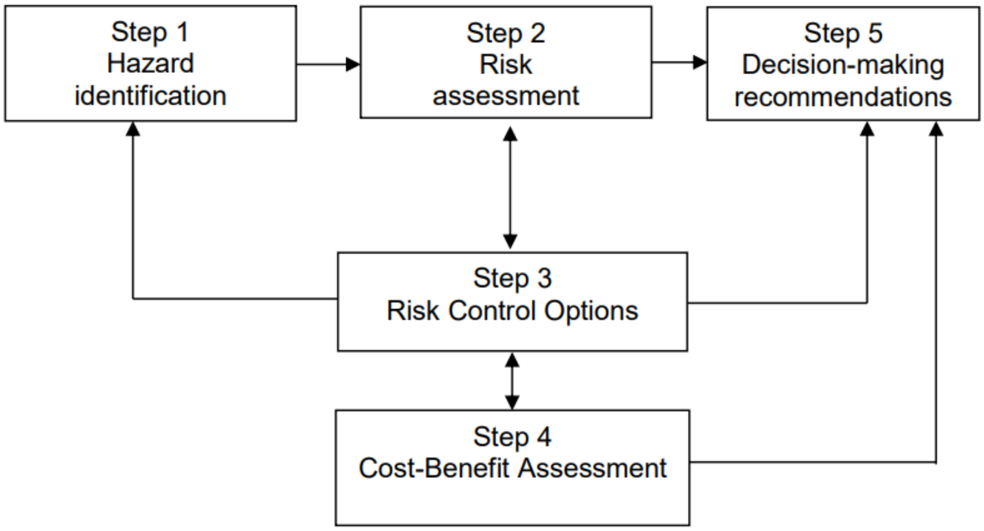

Figure 3.1 Flow Chart of the FSA Methodology (IMO, 2018)

3.3 Hazard Workshop Methodology

16. A key tool used in the NRA process is the Hazard Workshop which ensures that all risks are identified and qualified in discussion with the relevant consultees. Table 3.1 and Table 3.2 define the severity of consequence and the frequency of occurrence rankings which have been used to assess the impacts discussed in the Hazard Log (see Appendix B, completed based upon the outputs of the Hazard Workshop).

Table 3.1 Severity of Consequences

Rank	Description	Definition			
		People	Property	Environment	Business
1	Negligible	No perceptible impact.	No perceptible impact.	No perceptible impact.	No perceptible impact.
2	Minor	Slight injury(s).	Minor damage to property i.e., superficial damage.	Tier 1 local assistance required.	Minor reputation impact – limited to users.
3	Moderate	Multiple minor or single serious injury.	Damage not critical to operations.	Tier 2 limited external assistance required.	Local reputation impacts.

Rank	Description	Definition			
		People	Property	Environment	Business
4	Serious	Multiple serious injury or single fatality.	Damage resulting in critical impact on operations.	Tier 2 regional assistance required.	National reputation impacts.
5	Major	More than one fatality.	Total loss of property.	Tier 3 national assistance required.	International reputation impacts.

Table 3.2 Frequency of Occurrence Ranking Definitions

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

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

Table 3.3 Tolerability Matrix and Risk Rankings

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

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

18. Once identified, the tolerability of a hazard is assessed to ensure it is ALARP. Further risk control measures may be needed to further mitigate a hazard in accordance with the ALARP principles. It is noted that Unacceptable risks are not considered to be ALARP.

3.4 Methodology for Assessing Cumulative Effects

19. All hazards which are identified and assessed in the FSA process are also assessed for potential cumulative effects taking into account other projects and proposed developments, noting that existing developments are assessed as part of the baseline environment, and therefore are not included in the cumulative assessment.

20. Cumulative developments to be considered within the NRA are limited to a 50 kilometre (km) Zone of Influence around the PFOWF Array Area and the Offshore Export Cable Corridor (the Offshore Development). This distance was deemed an appropriate radius as this captures local port and harbour developments, as well as offshore developments which have the potential to significantly alter traffic patterns in the area. It is expected that any routes affected by changes beyond 50 km, will have returned to their current positions under the influence of the established navigational features of the Pentland Firth and the north coastline of Scotland.

21. As many of the commercial vessels passing through the Pentland Firth are undertaking international voyages, such as between the United States of America (USA) and Europe, it is possible that port developments at much greater distances could affect the volume and composition of shipping passing through the Pentland Firth, however, it is not feasible to capture such potential effects in the NRA.

22. Finally, the Marine Scotland – Licensing Operations Team (MS-LOT) agreed that only those projects for which scoping had been submitted six months prior to the submission date of the EIAR need to be considered in terms of cumulative effects. This approach was shared and agreed with MS-LOT and agreement was confirmed via email on 6 December 2021. The approach to the cumulative assessment is set out in Offshore EIA (Volume 3) Appendix 6.1. The list of cumulative projects screened in to assessment was provided to MS-LOT and consultees and comments were received on 16 May 2022. These comments have been taken into account within this assessment. Therefore, the ScotWind sites N1, N2 and N3 were raised during consultation but as these had not yet been scoped, and there is a lack of data confidence about the project details, the potential cumulative effects have not been assessed. It is noted these projects will have to carry out their own cumulative assessments, including consideration of the Offshore Development where appropriate, as they are progressed.

4 Consultation

23. This section sets out the consultation undertaken which is of relevance to shipping and navigation for the Offshore Development as part of the NRA process. This process has considered consultation requirements and recommendations within Annex 1 of MGN 654 (MCA, 2021).

4.1 Scoping Opinion

24. Highland Wind Limited submitted a Scoping Report in December 2020 for the Offshore Development to MS-LOT and a subsequent Scoping Opinion was received from MS-LOT in September 2021. The relevant outputs to the NRA are summarised in Table 4.1, including a reference to where each point is addressed within the NRA.

25. It is noted that a Scoping Report Addendum was issued in December 2021, with a Scoping Opinion Addendum being received in May 2022. No additional issues relating to shipping and navigation were raised in the Scoping Opinion Addendum.

4.2 Key Stakeholder Meetings / Correspondence

26. Key shipping and navigation stakeholders have been consulted throughout the NRA process. The following stakeholders have been consulted directly in meetings, noting that due to restrictions incurred by the COVID-19 pandemic, all meetings (except the Hazard Workshop discussed in Section 4.4) to date have been conducted remotely:

- MCA;
- NLB
- UK Chamber of Shipping;
- Royal Yachting Association Scotland (RYAS);
- Cruising Association (CA);
- Orkney Harbour Authority;
- Scrabster Harbour; and
- Pentland Canoe Club.

27. It is noted that the MCA were also consulted earlier, during the preparation of the Scoping Report for the Offshore Development.

28. Additional consultation was undertaken, with local stakeholders, at the Hazard Workshop as discussed in Section 4.4.

29. Table 4.1 summarises the key points raised by the consultees during meetings held throughout the scoping and NRA process. A reference is given to where each point has been addressed in the NRA or EIAR, where applicable.

4.3 Regular Operators

30. Regular operators who were identified from the vessel traffic surveys or recommended during consultation were also provided with an overview of the Offshore Development and offered the opportunity to provide feedback. Specific questions were included to assist Regular Operators who wished to make a response, relating to changes in routeing or adverse weather routeing, and whether Regular Operators would choose to pass within the array. The Regular Operator letter is included in full in Appendix D. As only limited Regular Operators were identified, operators of particular vessels of interest, such as large cruise vessels, were also identified for contact.

31. The full list of Regular Operators and vessels of interest identified and contacted is provided below:

- B.O.T. Bröring Oil Transport;
- Bessie Ellen;
- Celebrity Cruises;
- Marella Cruises;
- Noble Caledonia;
- NorthLink Ferries;
- Intrada Ship Management;
- Scottish Sea Farms; and
- Thun Tankers.

32. In addition, the Regular Operator letter was sent to the UK Chamber of Shipping to distribute to any parties which they deemed relevant to the Project. UK Chamber of Shipping also assisted in the process of identifying regular operators using internal vessel movements data to which they had access for the Pentland Firth.

33. Responses were received from Marella Cruises and Celebrity Cruises, which are detailed in Table 4.1. None of the other regular operators contacted offered any response.

4.4 Hazard Workshop

34. A key part of the consultation undertaken was the Hazard Workshop. This is a meeting held between the Project and the national and local marine stakeholders to identify and discuss potential shipping and navigation hazards associated with the Project.

35. The Hazard Workshop was held on 25th November 2021, taking place in Scrabster with some of the attendees joining through Microsoft Teams. The participants were as follows:

- Scrabster Harbour;
- Pentland Firth Yacht Club;
- Orkney Fisheries Association;
- RNLI;
- Orkney Harbour Authority;

- UK Chamber of Shipping;
- NLB;
- RYA Scotland;
- Orkney Marinas;
- MCA; and
- Local Fishing Representative.

36. The key output of the Hazard Workshop is the hazard log, presented in Appendix B. The hazard log is a key input to the risk assessment undertaken in Offshore EIAR (Volume 2): Chapter 14: Shipping and Navigation. A summary of the key points raised is provided in Table 4.1.

4.5 Consultation Responses

37. Key points from the various responses received from stakeholders during consultation undertaken during the NRA process, including the Hazard Workshop, consultation meetings, Regular Operator correspondence and through the Scoping Opinion are presented in Table 4.1. A reference to where the point has been addressed within the NRA or the EIAR has also been included where appropriate.

Table 4.1 Summary of Key Points Raised During Consultation

Stakeholder	Date and Forum	Point Raised	Response and Where Addressed in the NRA
MCA	1st October 2020, meeting during Scoping stage	The potential hazard of fishing and recreational users being pushed further offshore may increase the number of encounters with larger commercial vessels, which should be considered within the NRA.	▪ Assessed at the Hazard Workshop (see Section 4.4) and included in the Hazard Log (see Appendix B). Vessel encounters have been discussed within Section 19.2.1. Increased collision risk has been assessed within the hazard assessment summarised in Section 21.
		An Emergency Response Cooperation Plan (ERCoP) will be required.	▪ Section 22 outlines the embedded mitigation measures. These include the production of an ERCoP as required under MGN 654.
		The NRA should be compliant with the MGN 543 or its successor, noting that the guidance is being reviewed currently.	▪ The NRA is compliant with MGN 654 (MCA, 2021) has since replaced MGN 543, as noted in Section 2.
		The Ministry of Defence (MoD) should be consulted, along with other miscellaneous sea users.	▪ A cross-section of sea users were invited to the Hazard Workshop including local fishing representatives and local RNLI representatives, as per Section 4. ▪ The MoD and Dounreay Site Restoration Ltd (DSRL) have been consulted elsewhere within the EIA process (see Chapter 4: Stakeholder Engagement and Chapter 15: Aviation and Radar).
MCA	6th September 2021,	Risk to passing vessels due to the mooring lines to be assessed as part of the NRA.	▪ Section 15 discusses the risks to surface navigation due to the reduction in under keel clearance. Under keel clearance

Stakeholder	Date and Forum	Point Raised	Response and Where Addressed in the NRA
	consultation meeting		hazards are assessed as part of the hazard assessment summarised in Section 22.
		Content with the NRA approach, data sources, planned consultation and draft list of hazards.	▪ Section 3 outlines the methodology followed when preparing the NRA. ▪ Section 4 summarises the consultation undertaken during the NRA process. ▪ Section 7 outlines the data source used to inform the NRA. ▪ Section 8 summarises the vessel traffic survey methodology. ▪ Section 20 presents the hazards considered within the NRA.
		Full Prototype certificate from Demonstrator Project may be applicable to the Offshore Development, however the MCA would need to consider their stance.	▪ The Demonstrator Project is no longer being progressed.
		Fishing interaction with mooring lines/cables to be addressed in commercial fisheries chapter.	▪ Fishing gear snagging is considered within Section 15 and in the impact assessment within Offshore EIAR (Volume 2): Chapter 14: Shipping and Navigation, but is assessed in greater detail in Offshore EIAR (Volume 2): Chapter 13: Commercial Fisheries.
		Emergency response to incidents to be addressed as part of the NRA.	▪ Section 11 outlines the availability of emergency response resources. ▪ Section 22 outlines the mitigations to be considered, including the production of an ERCoP post-consent under MGN 654 (MCA, 2021) requirements.

Stakeholder	Date and Forum	Point Raised	Response and Where Addressed in the NRA
			▪ Reduction of emergency response capability has been assessed in the hazard assessment summarised in Section 21.
NLB	21st September 2021, consultation meeting	Content with the approach to the NRA, the data sources, planned consultation and impacts presented.	▪ Section 3 outlines the methodology followed when preparing the NRA. ▪ Section 4 summarises the consultation undertaken during the NRA process. ▪ Section 7 outlines the data source used to inform the NRA. ▪ Section 8 summarises the vessel traffic survey methodology. ▪ Section 20 presents the hazards considered within the NRA.
		The Demonstrator Project would need a minimum of an AIS Aid to Navigation (AtoN), while Wind Turbine Generators (WTGs) in the Offshore Development would likely need appropriate lighting.	▪ The Demonstrator Project is no longer being progressed.
		All WTGs in the PFOWF Array Area may require lighting due to the low number of turbines.	▪ As per Section 22, lighting and marking requirements will be agreed with NLB post-consent and will be compliant with the guidance in IALA RO139 / G1162.
		If operational safety zones are implemented, then considerations must include the enforcement of the safety zones and the potential movement of structures.	▪ Operational safety zones are under consideration by the Offshore Development. If statutory operational safety zones are planned, further consultation will be held with stakeholders before making an application, which will be supported by risk-based justification. Offshore EIAR (Volume 2): Chapter 5: Project Description includes details on how

Stakeholder	Date and Forum	Point Raised	Response and Where Addressed in the NRA
			safety zones will relate to the potential excursion of the floating structures. Refer to Section 22 on Safety Zones as mitigation.
		NLB would be interested in attending the Hazard Workshop.	▪ NLB were invited to and attended the Hazard Workshop, see Section 4.4.
RYAS	22nd September 2021, consultation meeting	Recreational traffic in summer 2021 is estimated at between 40% and 50% of a typical year due to the impact of COVID.	▪ Section 13.2.5 discusses the recreational traffic in the area in 2021. ▪ Section 14 presents additional data from previous studies and additional data sources, including on recreational vessels. ▪ Recreational traffic, including data from previous studies has been used to inform the baseline characterisation in Section 14. It was found that while non-UK recreational vessels were largely missing from the summer 2021 data, an increase in UK-based recreational vessels has seen overall numbers of vessels remain similar. In addition, the RYA Coastal Atlas (RYA, 2019b) shows a very low density of recreational activity in proximity to the PFOWF Array Area. Comparison to historical data also showed that recreational traffic patterns were similar in 2012, 2019 and 2021 in terms of the routes followed by recreational vessels.

Stakeholder	Date and Forum	Point Raised	Response and Where Addressed in the NRA
		Scandinavian vessels were noted to be absent in the summer survey data, with COVID and/or Brexit being possible causes for this.	▪ Additional data from previous studies and additional data sources has been used to validate 2021 survey data, including on recreational vessels, within Section 14. As previously noted, the increase in UK-based vessels in 2021 has meant that similar numbers of recreational vessels were recorded within the Offshore Study Area in both 2019 and 2021. Comparison to historical data also showed that recreational traffic patterns were similar in 2012, 2019 and 2021 in terms of the routes followed by recreational vessels.
		Current edition of the UK Coastal Atlas of Recreational Boating is acceptable as a data source if an update is not published in time.	▪ The most recent RYA Coastal Atlas (RYA, 2019b) has been utilised in Section 14.4.
		CCC Sailing Directions were updated in 2020 and are a possible additional data source.	▪ CCC Sailing Directions (CCC, 2020) were included in the data sources reviewed to inform the baseline (see Section 7).
		Pentland Firth Yacht Club and MoD to be possibly added to the list of consultees.	▪ Pentland Firth Yacht Club were invited to the Hazard Workshop (see Section 4.4). ▪ The MoD have been consulted separately as part of the EIAR (see Offshore EIAR (Volume 2): Chapter 15 'Aviation and Radar').
		Stornoway to be added to possible list of consultees due to the expansion of their facilities potentially increasing the volume of traffic in the area.	▪ Stornoway marina expansion captured within the future case vessel traffic scenarios (see Section 18).

Stakeholder	Date and Forum	Point Raised	Response and Where Addressed in the NRA
		Most yachts/motor boats in the area would not have more than one engine, but that most vessels in the area would transit under sail. It was also noted that only experienced sailors are likely to pass around Cape Wrath.	▪ Noted within the impact assessment in Offshore EIAR (Volume 2): Chapter 14: Shipping and Navigation that single engine vessels are more susceptible to drifting, while experienced sailors are likely more competent course planners.
		Safety zones are only considered an effective mitigation measure if they are enforced.	▪ Operational safety zones are under consideration by the Offshore Development. If statutory operational safety zones are planned, further consultation will be held with stakeholders before making an application, which will be supported by risk-based justification. Offshore EIAR (Volume 2): Chapter 5: Project Description includes details on how safety zones will relate to the potential excursion of the floating structures. Refer to Section 22 on Safety Zones as mitigation.
		Pre- and post- COVID recreational vessel data from Orkney Marinas was provided for analysis.	▪ Discussion of the Orkney Marinas data has been presented in Section 14.6.
		Concerns were expressed over over-proliferation of Notices to Mariners, and that Kingfisher is now recommended as the most useful passage planning information source.	▪ Information will be promulgated via Notices to Mariners and Kingfisher Bulletins as per Section 22.

Stakeholder	Date and Forum	Point Raised	Response and Where Addressed in the NRA
UK Chamber of Shipping	27th September 2021, consultation meeting	Cable touch-down point being within the site would be beneficial in terms of navigational safety.	▪ Underwater profile of cables is discussed in Section 6.4 and assessed in Section 15, noting that the touch-down point of the cable is not yet known.
		Consultation with individual vessel owners recommended due to lack of Regular Operators.	▪ In addition to Regular Operators, vessel operators of interest such as cruise operators who had been recorded within the Offshore Study Area were contacted for comment on the proposed Offshore Development (see Section 4.3).
		Regular Operators to be researched fully once the winter survey has been conducted.	▪ Regular Operators were researched and contacted (see Section 4.3).
		Use of remote sensors was suggested to alert developers to any mooring failures.	▪ Remote sensors and regular visits to be used to monitor mooring. Monitoring of AIS is also a possibility to monitor any unusual excursions from structures, which may flag failures of the mooring system.
		Use of operational safety zones is not currently supported due to the fact no personnel are permanently on the turbines.	▪ Operational safety zones are under consideration by the Offshore Development. If statutory operational safety zones are planned, further consultation will be held with stakeholders before making an application, which will be supported by risk-based justification. Offshore EIAR (Volume 2): Chapter 5: Project Description includes details on how safety zones will relate to the potential excursion of the floating structures. Refer to Section 22 on Safety Zones as mitigation.

Stakeholder	Date and Forum	Point Raised	Response and Where Addressed in the NRA
MS-LOT	28th September 2021, Scoping Opinion	General comments on the EIAR approach and methodology were given, including the approach to the scoping of hazards and the inclusion of embedded mitigations.	▪ Section 3 outlines the IMO FSA methodology followed in the NRA. ▪ Section 22 outlines the embedded mitigations considered within the NRA. ▪ No hazards have been scoped out prior to the NRA.
		In relation to the assessment of the environmental baseline, the UK Coastal Atlas of Recreational Boating should be used to inform on the movements of recreational vessels.	▪ Section 7 outlines the data sources to be considered within the NRA. ▪ Data from the RYA Coastal Atlas (RYA, 2019b) is analysed in Section 14.4.
		Cumulative impacts on shipping routes should be considered.	▪ Section 3.4 outlines the methodology for selecting which projects require to be considered for cumulative effects. ▪ Section 17 outlines the cumulative effects anticipated due to the Offshore Development.
		A vessel traffic study should be carried out.	▪ Section 8 outlines the methodology used to conduct the vessel traffic survey. ▪ Section 13 highlights the key findings of the vessel traffic survey.
MCA	28th September 2021, Scoping Opinion	The EIAR should consider the impact on navigational issues including: ▪ Collision risk ▪ Navigational safety ▪ Visual intrusion and noise	▪ Section 19 presents the results of allision and collision risk modelling. ▪ Section 16 discusses the impact of the Offshore Development on navigational and communicational equipment.

Stakeholder	Date and Forum	Point Raised	Response and Where Addressed in the NRA
		▪ Risk management and emergency response ▪ Marking and lighting of site and information to mariners ▪ Effect on small craft navigational and communication equipment ▪ The risk to drifting recreational craft in adverse weather or tidal conditions The likely squeeze of small craft into the routes of larger commercial vessels.	▪ Section 11 outlines the emergency response resources which cover the Offshore Development. ▪ Section 22 presents the mitigations to be considered for the Offshore Development, including the production of post-consent documentation such as a Lighting and Marking Plan. ▪ An MGN checklist has been completed as part of the NRA and is included in Appendix A, to ensure that navigational issues have been comprehensively considered.
		The NRA should be produced in accordance with the most up to date guidance from the MCA.	▪ Section 2 presents the guidance and legislation considered when carrying out the NRA, including the use of MGN 654 (MCA, 2021).
		An MGN compliant survey should be carried out comprising at least 28 days of Automatic Identification System (AIS), radar and visual observation data.	▪ Section 8 presents the methodology used in carrying out the vessel traffic surveys, which are compliant with MGN 654 (MCA, 2021). ▪ Section 13 presents the key findings of the vessel traffic surveys.
		Consideration should be given to the impact on SAR resources. An ERCoP and SAR Checklist will be required in consultation with the MCA.	▪ Section 11 outlines the availability of SAR resources. ▪ Section 22 outlines the documents to be produced post-consent, including the ERCoP and SAR Checklist as required under MGN 654 (MCA, 2021).

Stakeholder	Date and Forum	Point Raised	Response and Where Addressed in the NRA
			▪ The impact on SAR resources has been considered within the hazard assessment summarised in Section 21.
		Hydrographic surveys should fulfil the International Hydrographic Organisation (IHO) Order 1a standard, with the final data being supplied as a digital full density data set and reported to the MCA Hydrography Manager.	▪ The Offshore Development will provide the data to the MCA in the required format at the required points in the application and post-consent process.
NLB	28th September 2021, Scoping Opinion	A Lighting and Marking Plan will be required to be agreed with the NLB, and should be in line with the latest guidance.	▪ Section 22 presents the mitigations to be considered for the Offshore Development, including the production of post-consent documentation such as a Lighting and Marking Plan.
RYA Scotland	28th September 2021, Scoping Opinion	The UK Coastal Atlas of Recreational Boating is considered as the best data source on recreational vessel movements.	▪ Section 7 outlines the data sources to be considered within the NRA. ▪ Data from the RYA Coastal Atlas (RYA, 2019b) is analysed in Section 14.4.
		Information on the Offshore Development should be distributed to mariners using Notices to Mariners and Kingfisher bulletins. Relevant Notices to Mariners should also be distributed at local marinas and harbours which local users may stop at. Finally, details of the Offshore Development should be provided to the Clyde Cruising Club (CCC) so that the relevant publications can be updated.	▪ Section 22 outlines the mitigations considered, which includes the promulgation of information.

Stakeholder	Date and Forum	Point Raised	Response and Where Addressed in the NRA
Cruising Association (CA)	30th September 2021, consultation meeting	Scandinavian recreational vessels are missing from the summer survey data due to the impacts of COVID.	▪ Additional data from previous studies and additional data sources has been used to validate 2021 survey data, including on recreational vessels, within Section 14. As previously noted, the increase in UK-based vessels in 2021 has meant that similar numbers of recreational vessels were recorded within the Offshore Study Area in both 2019 and 2021. Comparison to historical data also showed that recreational traffic patterns were similar in 2012, 2019 and 2021 in terms of the routes followed by recreational vessels.
		Round the World yacht races have passed through the Pentland twice in recent years, which would bring participants close to the site.	▪ Hazards to recreational vessels passing the PFOWF Array Area, such as those participating in races, are assessed in the hazard assessment summarised in Section 21.
		CCC Sailing Directions recommended as a useful data source.	▪ CCC Sailing Directions (CCC, 2020) were included in the data sources reviewed to inform the baseline (see Section 7).
		Cumulative impacts of proposed wind farm west of Orkney need to be considered.	▪ The parameters of the cumulative assessment are set out in Section 3.4, noting that the ScotWind sites were not scoped in time for inclusion in the cumulative assessment. It is noted that the proposed projects will have to carry out their own cumulative assessments, including consideration of the Offshore Development as appropriate.
		Using average vessel numbers may underestimate collision risk from wind farm vessels as there may be	▪ Point noted. There is no existing regular wind farm traffic in the area to be considered. Anticipated project vessel

Stakeholder	Date and Forum	Point Raised	Response and Where Addressed in the NRA
		bunching of vessels at particular times of the day, such as the morning and evening.	numbers are discussed in Section 6.6 and have been considered within the hazard assessment summarised in Section 21.
		Spacing of between 800 m and 1000 m would allow for transits through the array.	▪ The minimum WTG spacing within the array will be 800 m. Allision risk to vessels passing internally within the PFOWF Array Area are considered within the hazard assessment summarised in Section 21.
		100 m would be a reasonable minimum passing distance for recreational to a turbine.	▪ Noted within the hazard assessment summarised in Section 21.
		The prospect of 50 m operational safety zones would not pose problems as vessels would be prudent to remain outside this anyway.	▪ Noted that recreational vessels are likely pass beyond 50 m. Operational safety zones are under consideration by the Offshore Development. If statutory operational safety zones are planned, further consultation will be held with stakeholders before making an application, which will be supported by risk-based justification. Refer to Section 22 on Safety Zones as mitigation.
		The majority of vessels in the area will carry at least receive-only AIS as they are likely to be on longer distance transits.	▪ Noted and considered within the impact assessment. At least one WTG is likely to broadcast on AIS (depending on agreement with the NLB), so vessels being equipped with receive-only AIS are more likely to be aware of the Offshore Development.

Stakeholder	Date and Forum	Point Raised	Response and Where Addressed in the NRA
Scrabster Harbour	7th October 2021, consultation meeting	Consultation may be useful to identify the best route for the export cable, with local fisherman potentially able to identify areas of softer seabed.	▪ The Offshore Development will consider options for the cable route as discussed in Offshore EIAR (Volume 2): Chapter 5: Project Description. This includes the use of pre-lay surveys to identify suitable areas of seabed and any preparation work required.
		Scrabster Harbour provided statistics to help identify the impact of COVID-19 effects on vessel numbers.	▪ Analysis of Scrabster Harbour arrival statistics is presented in Section 14.5.
		Dredging tracks in the vicinity of Scrabster Harbour during the summer survey were related to the St Ola Pier development.	▪ n/a
		Fishing grounds close to the PFOWF Array Area are less heavily fished than they have been historically, but are still occasionally used by vessels transiting to Scrabster, or in adverse weather.	▪ Analysis of transiting fishing vessel traffic is presented in Section 13.2.4. ▪ Modelling of fishing vessel allision risk is presented in Section 19.3.4.
		RNLI and a local fishing representative to be invited to the Hazard Workshop.	▪ RNLI and local fishing representatives attended the Hazard Workshop (see Section 4.4).
		There is little angling and kayaking close to the site, with charity rowing teams generally staying farther inshore.	▪ Recreational traffic has been considered in the baseline characterisation within Section 13 and Section 14. Angling vessels were recorded during the vessel traffic surveys. Consultation on kayaking and canoeing indicated paddlers

Stakeholder	Date and Forum	Point Raised	Response and Where Addressed in the NRA
			will not routinely cross the Offshore Development and the most effective mitigation is promulgation of information
		Content with the list of potential hazards to be considered.	▪ Section 20 presents the hazards considered within the NRA.
RNLI	25th November 2021, Hazard Workshop	The incident data shared agreed with the RNLI representatives' experience of working in the area.	▪ Section 12 presents analysis of historical incident data, including historical RNLI data.
		The ETV *Ievoli Black* covers the area but the contract for the ETV will expire during the lifetime of the Project and may not be extended.	▪ Section 11 presents an overview of the emergency response resources available in the area. It is noted that while the ETV contract may not be renewed, additional emergency towing resources are available within Scapa Flow.
		The Project should keep the RNLI informed of construction and maintenance works and of any changes to the layout which may impact on emergency response.	▪ Section 22 details the mitigations to be considered, including promulgation of information. A SAR Checklist and ERCoP will be produced which will include appropriate communication with the MCA who in turn will liaise with other SAR responders.
Orkney Harbour Authority	25th November 2021, Hazard Workshop	The tugs in Scapa Flow are signed up to the MCA Coastguard Agreement on Salvage and Towage (CAST) and may be available for emergency response.	▪ Noted in the characterisation of the baseline within Section 11. The tugs may be called upon in the case of a drifting incident in order to prevent allision. The Coastguard ETV is also available (though its future is uncertain), while the RNLI are also capable of towing certain vessels (dependent on size).

Stakeholder	Date and Forum	Point Raised	Response and Where Addressed in the NRA
		A drifting incident involving a large commercial vessel would have catastrophic consequences and must be considered within the NRA.	▪ Drifting allision risk is considered using quantitative modelling within Section 19.3.3. This includes modelling the allision risk of commercial vessels using the main routes within the Offshore Study Area.
		Cumulative impacts from the various ScotWind sites should be addressed.	▪ The parameters of the cumulative assessment are set out in Section 3.4, noting that the ScotWind sites were not scoped in time for inclusion in the cumulative assessment. It is noted that the proposed projects will have to carry out their own cumulative assessments, including consideration of the Offshore Development as appropriate.
		Orkney Harbour has plans to upgrade their deep-water pier. Future fuels such as hydrogen may also lead to an increase in traffic.	▪ Future Case traffic scenarios are discussed in Section 18 and have been modelled for 10% and 20% increases to traffic levels within Section 19.
Orkney Marinas	25th November 2021, Hazard Workshop	Orkney Marinas are currently upgrading their capacity.	▪ Future Case traffic scenarios are discussed in Section 18 and have been modelled for 10% and 20% increases to traffic levels within Section 19.
Pentland Firth Yacht Club	25th November 2021, Hazard Workshop	Recreational vessels will likely pass inshore of the array to avoid encounters with larger commercial vessels. There is sufficient sea room and any increase in collision/grounding incidents is expected to be minor.	▪ Passing inshore will serve to separate traffic and therefore potentially decrease the rate of encounters and collision risk between small vessels and commercial vessels. Vessel displacement is assessed in the hazard assessment summarised in Section 21.

Stakeholder	Date and Forum	Point Raised	Response and Where Addressed in the NRA
		Plans should be made to alert of any wear and tear on the mooring lines to avoid any loss of station incidents, and emergency response and recovery plans made to limit the potential consequences of such an incident.	▪ Regular monitoring of mooring line condition, including by remote monitoring and regular visits is planned to reduce the risk of mooring line failures.
		Marking on Admiralty Charts, Kingfisher bulletins and Notices to Mariners would be effective forms of promulgation of information to ensure users are aware of the Offshore Development.	▪ Section 22 details the mitigations to be considered, including promulgation of information.
Scrabster Harbour	25th November 2021, Hazard Workshop	Scrabster Harbour are hoping to receive more cruise ships, and increased renewable energy traffic given the future projects planned in the area.	▪ Future Case traffic scenarios are discussed in Section 18 and consider future port developments at Scrabster.
		Distribution of information to local harbours would be useful as users often ask for advice when plotting their course through the area.	▪ Section 22 details the mitigations to be considered, including promulgation of information.
Local Fishing Representative	25th November 2021, Hazard Workshop	Fishing vessels would likely be comfortable passing through the array.	▪ Fishing vessel allision risk is considered in the quantitative modelling in Section 19.3.4, and assessed within the hazard assessment summarised in Section 21.
		Notices to Mariners, Kingfisher bulletins and marking on Admiralty Charts are important forms of promulgation of information.	▪ Section 22 details the mitigations to be considered, including promulgation of information.

Stakeholder	Date and Forum	Point Raised	Response and Where Addressed in the NRA
Orkney Fisheries Association	25th November 2021, Hazard Workshop	It was questioned whether a second Hazard Workshop would be carried out once further project details were confirmed.	▪ The Design Envelope approach assesses the worst-realistic case ensuring the as-built project will have no greater impact. A further Workshop would only be required if design parameters changed to be outside of the envelope.
		Kingfisher bulletins would be a useful resource to update to keep mariners informed.	▪ Section 22 details the mitigations to be considered, including promulgation of information and marking on Admiralty charts.
NLB	25th November 2021, Hazard Workshop	NLB will make final decision on the requirement for turbine(s) to broadcast on AIS in the full array.	▪ Section 22 details the mitigations to be considered, including the production of a Lighting and Marking Plan.
MCA	14th January 2022, meeting to discuss potential layouts, mooring lines and SAR access.	Third party vessels being unfamiliar with mooring line arrangements may impede emergency response.	▪ Section 22 details the mitigations to be considered, including promulgation of information and chart marking, which will inform users on the location and mooring line arrangements. An ERCoP will be produced in line with MGN 654 (MCA, 2021) which will provide details of the mooring line arrangements to assist in emergency response.
		The presence of an Emergency Towing Vessel (ETV) cannot be assumed for the lifetime of the Offshore Development, and the Project must be aware of the emergency response capability in the area.	▪ The potential removal of the ETV has been noted in the characterisation of the baseline within Section 11, and considered in the hazard assessment summarised in Section 21.

Stakeholder	Date and Forum	Point Raised	Response and Where Addressed in the NRA
		Alternative modes of access to the WTG should be included to facilitate emergency response and access in adverse weather.	▪ Section 22 details the mitigations to be considered, including the production of an ERCoP, and MGN 654 compliance. As per the requirements of MGN 654 (MCA, 2021) and the SAR Checklist, the Project will work with the MCA post consent to identify safe means of access in adverse weather.
		Lessons can be learnt from other early floating wind projects, including from Kincardine.	▪ Experience of traffic patterns around floating installations, including at Kincardine, have been considered in Section 5.
		Minimum width of SAR lane is 500 m and must consider the effect of mooring lines on the SAR lanes.	▪ The Design Specification and Layout Plan (DSLP) will be agreed in consultation with the MCA as per Section 22, and will consider the inclusion of SAR lanes as necessary as per the requirements of MGN 654 (MCA, 2021).
		WTG movement and nacelle movement should be considered as it may affect tip-to-tip separation and minimum blade clearance.	▪ Excursion of the floating structures and changes to tip-to-tip separation and minimum blade clearance caused by nacelle movement will be considered by the Offshore Development when agreeing the final layout with the MCA.
		Minimum blade clearance of 22 m must be maintained at all tidal states.	▪ Minimum blade clearance of 22 m above mean high water springs is required as per MGN 654, noting for floating foundations this will be calculated from the Mean sea level with degrees of motion considered. This requirement will be met as per Section 22. It is noted that the project Design Envelope includes a minimum 35 m blade clearance from Mean sea level.

Stakeholder	Date and Forum	Point Raised	Response and Where Addressed in the NRA
		WTG layouts which maintain east-west routes allowing passage for small vessels through the array are preferable, with fewer larger turbines considered preferable to the maximum number of turbines.	▪ Noted in the selection of the worst case design scenario captured in Section 6, noting that the worst case from a shipping and navigation perspective is the maximum number of turbines. Small vessels passing within the array have been considered within the quantitative modelling and the hazard assessment captured in Section 21. A minimum turbine spacing of 800 m is considered to allow for small vessels to pass within the array.
Marella Cruises	31st January 2022, Regular Operator email correspondence	Marella Cruises do not expect to return to UK waters within the next two years and therefore did not find it appropriate to comment.	▪ n/a
Celebrity Cruises	31st January 2022, Regular Operator email correspondence	Celebrity Cruises noted that their routes are well north of the PFOWF Array Area and did not anticipate any safety concerns due to the Offshore Development.	▪ n/a
Orkney Harbour Authority	12th April 2022, consultation meeting	The Scapa Flow tugs have not been requested for support under the MCA CAST agreement for several years, but that they would be available to support if not engaged in essential work. The tugs are capable of working in all weather.	▪ Noted in the characterisation of the baseline within Section 11. The tugs may be called upon in the case of a drifting incident in order to prevent allision. There is also an ETV present in the area should the tugs be otherwise engaged.

Stakeholder	Date and Forum	Point Raised	Response and Where Addressed in the NRA
		The Scapa Flow tugs are capable of towing large vessels, having towed VLCCs in the past	▪ Scapa Flow tugs are noted in the characterisation of the baseline within Section 11.
		The construction of a new Deepwater Quay is scheduled to be completed in by the end of 2026. The plans for a new hydrogen hub at the Flotta Terminal may also lead to an increase in the number of tankers in the area.	▪ Future case traffic scenarios are discussed in Section 18 and have been modelled for 10% and 20% increases to traffic levels within Section 19.
		The plans for a new hydrogen hub at the Flotta Terminal may also lead to an increase in the number of tankers in the area.	▪ Future case traffic scenarios are discussed in Section 18 and have been modelled for 10% and 20% increases to traffic levels within Section 19.
		There are plans to make use of the Lyness facilities for offshore maintenance activities, which may lead to an increase in vessel traffic in the area.	▪ Future case traffic scenarios are discussed in Section 18 and have been modelled for 10% and 20% increases to traffic levels within Section 19.
The Highland Council	Cumulative Project List	It was suggested the following projects are also included in the cumulative assessment: Space Hub Sutherland (in all chapters of the EIAR not just the SLVIA section).	▪ As described in Chapter 18: Other Users of the Marine Environment, the launch vehicles for the Space Hub Sutherland project (approximately 38 km southwest of the Offshore Site) will be between 7 degrees east of due North and 8 degrees west of due North. An overflight launch exclusion zone will be activated prior to and during launches that will be active for approximately six hours per launch, and there are expected to be approximately 12 launches per year. Whilst the launch exclusion zone is in operation, restrictions

Stakeholder	Date and Forum	Point Raised	Response and Where Addressed in the NRA
			will be placed on marine users, such as shipping and navigation users. ▪ Given the short duration of the of the launch exclusion zones, as well as the intervening distance between the Offshore Site and the Space Hub Sutherland Project, no cumulative impact with the Offshore Development with respect to shipping and navigation is anticipated.
Pentland Canoe Club	22nd May 2022, consultation meeting	Kayakers will not regularly be active within the PFOWF Array Area, as most kayakers will tend to remain within 1 to 1.5 km of the coast, unless crossing the Pentland Firth.	▪ Recreational traffic has been considered within the baseline summarised in Section 13, noting that no kayaks or canoes were recorded within the PFOWF Array Area during the site-specific surveys.
		Temporary impacts during the installation and maintenance of the Offshore Export Cable may occur as the timing of these works will overlap the main kayaking season, which runs from April to September. Two-way communication was agreed to be the best approach, including the use of emailing lists and social media to promulgate information to kayakers.	▪ Temporary displacement of vessels due to the presence of Offshore Development vessels has been considered within the hazard assessment in Section 21. Promulgation of information has been noted as an embedded mitigation measure in Section 22.

5 Lessons Learnt

38. There is considerable benefit for the Project in the sharing of lessons learnt within the offshore industry. The NRA, and subsequent impact assessment undertaken in Offshore EIAR (Volume 2): Chapter 14: Shipping and Navigation of the EIAR includes general consideration for lessons learnt and expert opinion from previous OWF developments and other sea users, capitalising upon the UK's position as a leading generator of offshore wind power.

39. Data sources for lessons learnt include the following:

- Sharing the Wind – Recreational Boating in the Offshore Wind Strategic Areas (RYA and Cruising Association (CA), 2004);
- Results of the Electromagnetic Investigations (MCA and QinetiQ, 2004);
- Offshore Wind and Marine Energy Health and Safety Guidelines (RenewableUK, 2014);
- OWF Helicopter SAR Trials Undertaken at the North Hoyle Wind Farm (MCA, 2005);
- Interference to Radar Imagery from OWFs (Port of London Authority (PLA), 2005); and
- Strategic Assessment of Impacts on Navigation of Shipping and Related Effects on Other Marine Activities Arising from the Development of OWFs in the UK Renewable Energy Zone (REZ) (Anatec & The Crown Estate (TCE), 2012).
- Industry-wide liaison with the operators of the existing floating projects off Scotland at Hywind and Kincardine.

40. In addition, Anatec have carried out research examining vessel behaviour around floating installations, particularly around chains and anchors and safety zones in the North Sea, using long-term AIS data. This study included the operational floating wind installations at Hywind and Kincardine, and showed that in general commercial vessels tend to avoid passing close to floating installations, while smaller fishing and recreational vessels occasionally passed closer. Fishing vessels tended to avoid actively fishing in the vicinity of mooring lines and anchors. The results of the research informed the consultation carried out during the NRA including on the potential benefits of operational safety zones.

6 Project Description

41. This section sets out the Offshore Development description in terms of the design envelope, including the identification of the Maximum Design Scenario (MDS) from a shipping and navigation perspective.

42. An overview of the Offshore Development is provided in Figure 6.1. This includes the PFOWF Array Area, within which WTGs, together with infrastructure such as mooring lines and floating foundations, will be installed, and the Offshore Export Cable Corridor, in which the offshore export cable(s) will be laid linking the array to the cable landfall site at Dounreay. It is noted that the PFOWF Array Area includes a 1 km (0.54 nm) setback from the southern side of the previously consented Dounreay Tri Footprint. Additionally, as discussed in Offshore EIAR (Volume 2): Chapter 3: Site Selection and Alternatives, the PFOWF Array Area has been reduced. This refinement reduces the PFOWF Array Area by 50% with the primary aim of decreasing the horizontal spread associated with the WTGs. The refinement of the PFOWF Array Area reduces the footprint available to locate the WTGs and associated offshore infrastructure by 50%. The smaller footprint benefits shipping and navigation users whilst reducing direct impacts on the seabed.

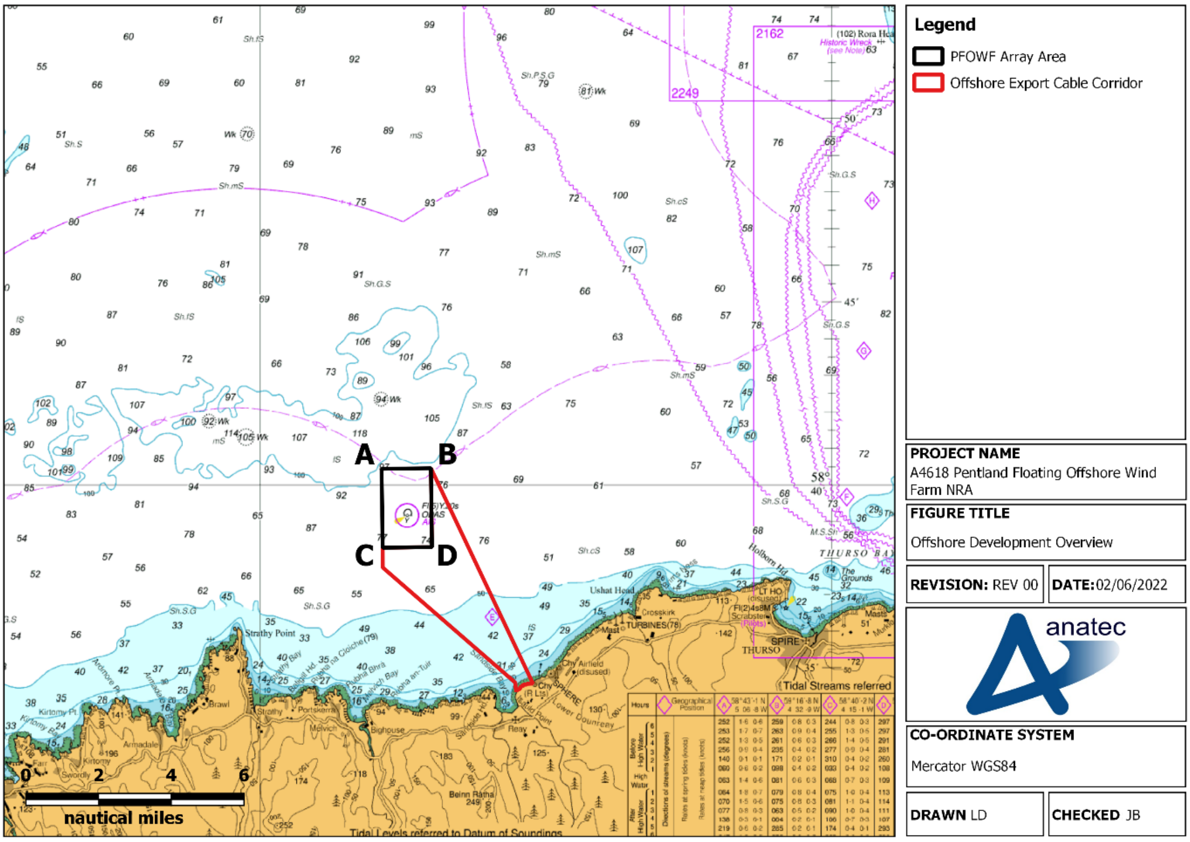

Figure 6.1 PFOWF Array Area and Offshore Export Cable Corridor

6.1 The Offshore Development

43. The PFOWF Array Area is located approximately 4 nautical miles (nm) off the north coast of Scotland, in the Pentland Firth, as show in Figure 6.1. The PFOWF Array Area covers an area of approximately 2.9 nm^2. The coordinates of the corners of the PFOWF Array Area are given in Table 6.1. Following this, the coordinates of the Offshore Export Cable Corridor are given in Table 6.2.

Table 6.1 PFOWF Array Area Coordinates (World Geodetic System 1984 (WGS84))

Point	Latitude	Longitude
A	58° 40’ 25.63” N	003° 53’ 36.02” W
B	58° 40’ 26.68” N	003° 51’ 00.85” W
C	58° 38’ 16.32” N	003° 53’ 32.72” W
D	58° 38’ 17.37” N	003° 50’ 57.70” W

Table 6.2 Offshore Export Cable Corridor Coordinates (WGS84)

Vertex ID	Latitude	Longitude
1	58° 34’ 27.08” N	003° 46’ 19.92” W
2	58° 34’ 25.10” N	003° 46’ 20.32” W
3	58° 34’ 23.66” N	003° 46’ 22.91” W
4	58° 34’ 23.77” N	003° 46’ 25.43” W
5	58° 34’ 21.11” N	003° 46’ 32.23” W
6	58° 34’ 19.52” N	003° 46’ 32.81” W
7	58° 34’ 31.98” N	003° 46’ 35.00” W
8	58° 34’ 32.84” N	003° 46’ 35.15” W
9	58° 34’ 34.72” N	003° 46’ 35.47” W
10	58° 37’ 43.79” N	003° 53’ 32.39” W
11	58° 38’ 16.33” N	003° 53’ 32.71” W
12	58° 38’ 17.38” N	003° 50’ 57.70” W
13	58° 40’ 26.69” N	003° 51’ 00.86” W
14	58° 34’ 32.99” N	003° 45’ 39.60” W
15	58° 34’ 27.70” N	003° 46’ 19.02” W

6.2 Surface Infrastructure

6.2.1 Layout

44. A final layout for the Offshore Development will not be confirmed until after the application has been submitted and determined. Following this, a final layout will be approved in consultation with MCA and NLB. Preliminary consultation has been undertaken with both the MCA and NLB as part of the NRA process, as discussed in Section 4.

45. A worst case from the project design envelope has been defined for the purposes of the collision and allision modelling undertaken within the NRA. This worst case is shown in Figure 6.2, and has been defined based on the following considerations:

- Maximum number of structures; and
- Maximum sea area occupied by the array.

46. The indicative minimum spacing between structures is 800 m, though it is noted that this is subject to change and will be confirmed following final layout and WTG selection in consultation with the MCA.

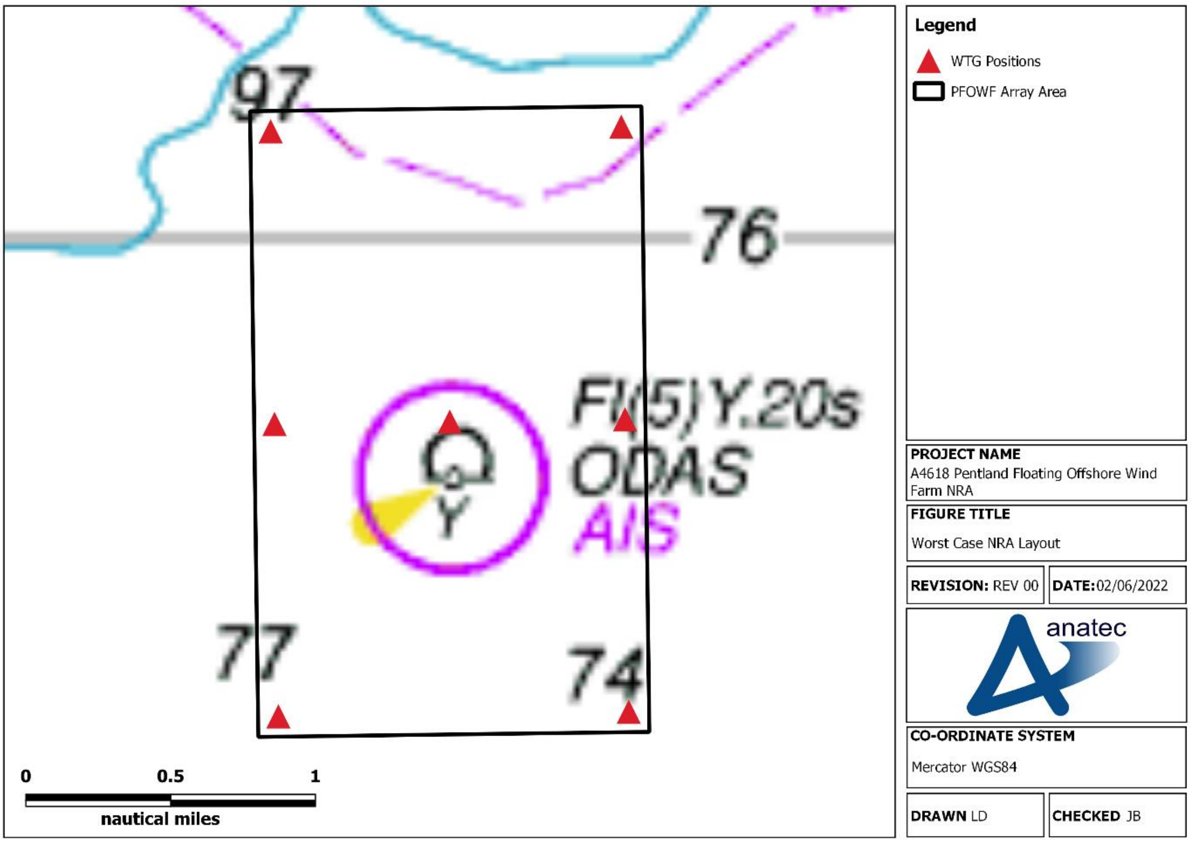

Figure 6.2 Worst Case Layout chosen for NRA Modelling

47. The coordinates of the seven WTGs in the indicative worst case array layout, considered in the NRA are presented in Table 6.3.

Table 6.3 Coordinates of WTGs in the Worst Case NRA Layout (WGS84)

Project WTG ID	Latitude	Longitude
WTG-01	58° 38′ 20.58″ N	003° 53′ 24.76″ W
WTG-02	58° 39′ 21.03″ N	003° 53′ 26.30″ W
WTG-03	58° 40′ 21.49″ N	003° 53′ 27.84″ W
WTG-04	58° 40′ 22.43″ N	003° 51′ 08.82″ W
WTG-05	58° 39′ 21.97″ N	003° 51′ 07.34″ W
WTG-06	58° 38′ 21.52″ N	003° 51′ 05.87″ W
WTG-07	58° 39′ 21.51″ N	003° 52′ 16.82″ W

6.2.2 WTGs

48. Within the project design envelope there will be a maximum of seven WTGs installed within the array, with each installed on floating foundations secured by up to nine mooring lines. It is noted that the mooring system will permit some excursion of the floating structures, with this being up to a maximum of 75 m in the most extreme conditions the mooring system is designed for.

49. The MDS WTG parameters, derived from the Project design envelope, are provided in Table 6.4.

Table 6.4 MDS for Shipping and Navigation - WTGs

Parameter	MDS for Shipping and Navigation
Number of WTGs	7
Foundation Type	Floating
Maximum Number of Mooring Lines Per Turbine	9
Maximum Platform Dimensions	125 m x 125 m
Maximum Blade Tip Height (above water level)	300 m
Minimum Air Gap (above water level)	35 m (in all tidal states)
Maximum Rotor Diameter	260 m
Maximum Lateral Movement in Extreme Conditions	75 m

6.3 Mooring Lines and Anchors

50. Each floating foundation will be secured to the seabed using up to nine mooring lines per foundation. The worst case mooring configurations to be considered as part of the NRA are taut mooring lines and catenary mooring lines. Figure 6.3 presents examples of the possible mooring configurations.

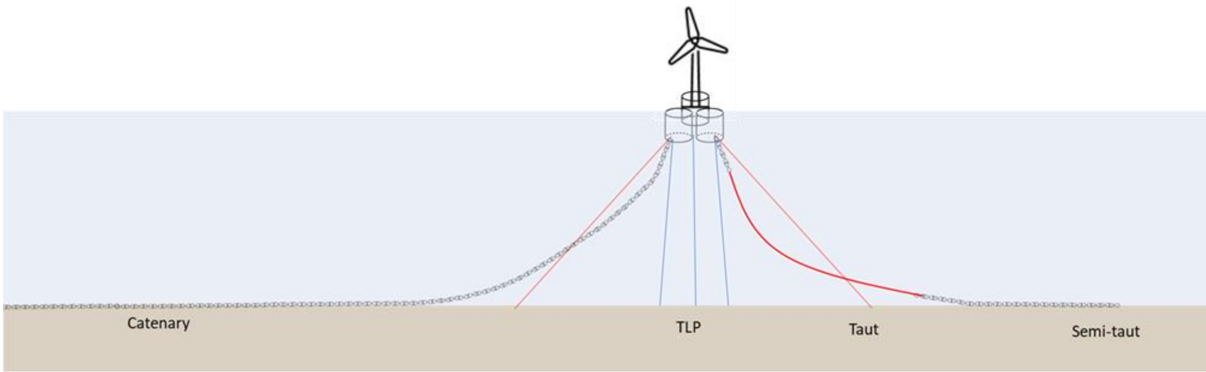

Figure 6.3 Examples of Possible Mooring Configurations

51. Taut mooring lines are highly tensioned synthetic mooring lines with an indicative maximum spread radius of approximately 750 m. Taut mooring lines represent the worst case for under keel clearance as the tensioned lines remain higher in the water column at greater distances from the floating platform than other mooring solutions, as illustrated in Figure 6.4.

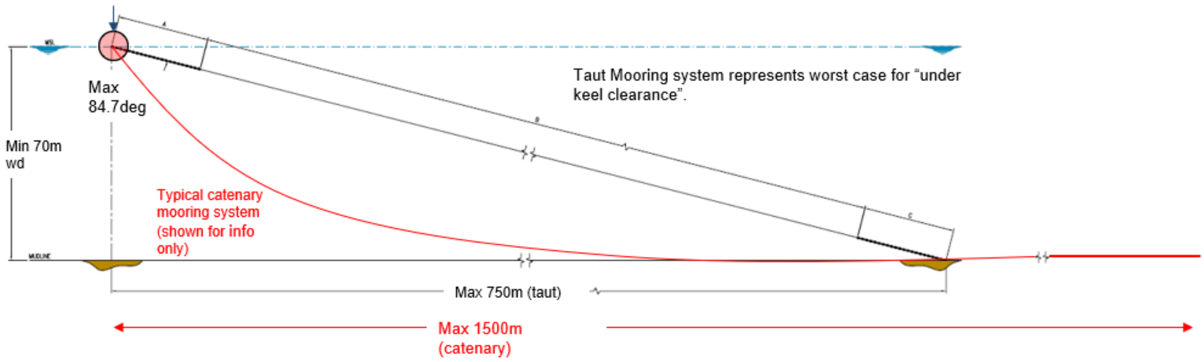

Figure 6.4 Typical Profile of Taut and Catenary Mooring Lines

52. Indicative draughts of a taut mooring line at selected offsets from the floating platform are given in Table 6.5 and plotted in Figure 6.5. Note that these are based on a water depth of 70 m and a maximum spread radius of 750 m.

Table 6.5 Draught of Taut Mooring Line at Selected Offsets from Floating Platform

Horizontal Offset from Floating Platform (m)	Draught of Mooring Line below Sea Level (m)
10	0.93
20	1.87
30	2.80
40	3.73
50	4.67
70	6.53
100	9.33
150	14.00
250	23.33
500	46.67
750	70.00

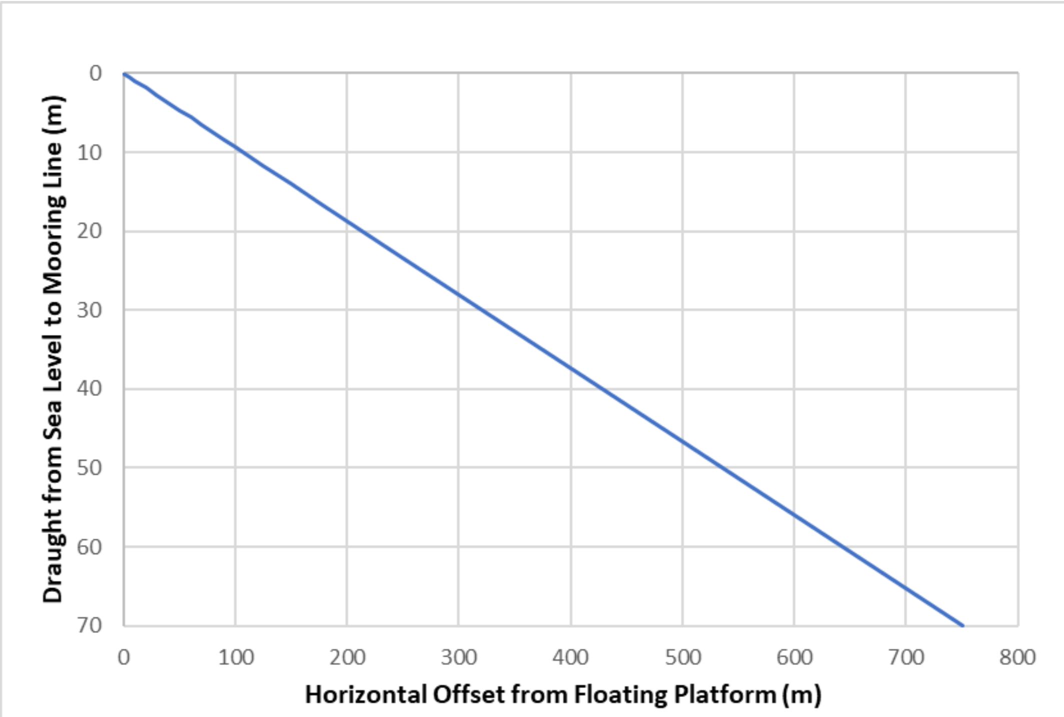

Figure 6.5 Draught of Taut Mooring Line vs. Horizontal Offset from Floating Platform

53. Catenary mooring systems are typically made up of heavy steel chain The weight of the steel chain provides both stability and station-keeping to the floating foundation. The

chains drop to the seabed at a steeper angle than taut mooring lines, however, they extend further on the seabed to provide additional weight and resistance to horizontal movement. The maximum spread radius of catenary mooring lines is 1500 m.

6.4 Subsea Cables

6.4.1 Export Cables

54. Up to two offshore export cables will be installed to carry the electricity from the PFOWF Array Area to the landfall site adjacent to Sandside Bay, each with a maximum length of 12.5 km.

55. The export cables will be buried to an indicative target depth between 0.6 m and 1.5 m where technically possible, with the target being for 100% of the cable length on the seabed that is not subjected to dynamic movement to be buried. However, as much as 50% of the cable length may require remedial protection. Horizontal Directional Drilling (HDD) will be utilised so that the cable is protected between 400 m and 700 m from the landfall. The maximum height of any cable protection used above the seabed will be 1 m.

56. Depending on the timing and final design of the SHE Transmission Orkney-Caithness Transmission Project, there is potential for interaction during construction at the landfall location at Dounreay.

6.4.2 Inter-Array Cables

57. A network of up to seven inter-array cables will connect the WTGs, with a maximum total cable length of 20 km. Burial of the inter-array cables is dependent on geotechnical information and a Cable Burial Risk Assessment, with the target burial depth of between 0.6 m and 1.5 m where technically possible. Up to 50% of the inter-array cables on the seabed may require additional protection. Where required, the maximum height of the rock protection above the seabed is 1 m.

58. Figure 6.6 presents the typical profile of a dynamic cable section compared with the typical mooring line profiles shown previously in Figure 6.4. The cable profile is often described as a ‘lazy S’ and has a deeper draught than the mooring lines in the taut case. The dynamic cable may rise above a catenary mooring line deeper in the water, though the draught at this point is likely to be sufficiently deep to not cause any issues for under keel clearance.

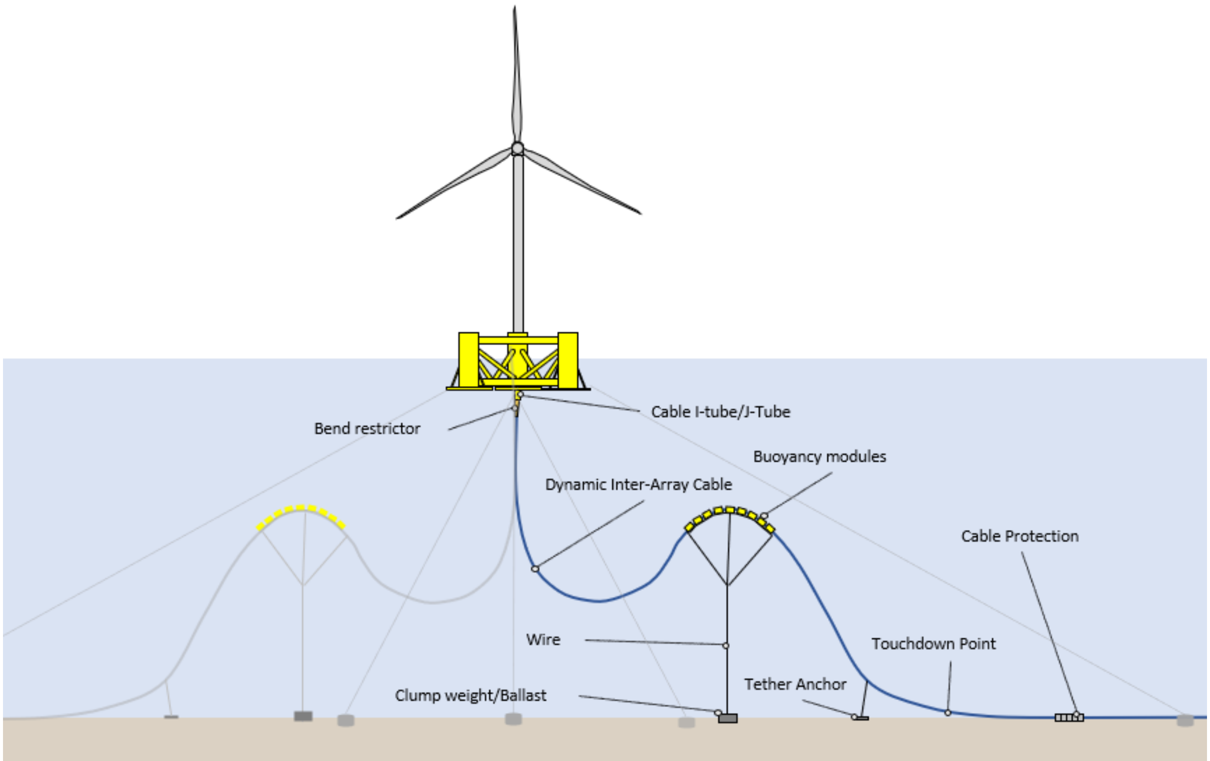

Figure 6.6 Typical Profile of Dynamic Cable Section Compared with Mooring Lines

6.5 Timescales

6.5.1 Construction Phase

59. The offshore components will be installed over a two year construction phase. It is anticipated that subsea infrastructure such as anchors and offshore export cables would take place in Stage 1, with the installation of a single WTG and floating foundation installed at this time. Following this, the remaining WTGs will be installed in Stage 2. The installation of a single turbine would provide an opportunity to test technology required for the wider array. Additionally, HDD works are planned to commence in the year prior to Stage 1 (anticipated to be 2024).

6.5.2 Operation and Maintenance Phase

60. The operation and maintenance phase of the Offshore Development will last up to 30 years.

6.5.3 Decommissioning Phase

61. The decommissioning phase will generally be the reverse of the construction phase in terms of duration, vessel types and vessel numbers. A Decommissioning Programme will

be prepared and updated prior to the beginning of decommissioning works which will contain full details on the duration, vessel types and numbers.

6.6 Vessel Numbers

6.6.1 Construction Phase

62. A maximum of 660 transits will be made by vessels associated with the Offshore Development throughout the construction phase, with up to 10 vessels present onsite at any time. It is noted that this number of transits does not include unplanned transits such as those due to breakdowns or adverse weather. The routes to be used by vessels associated with the Offshore Development are not available at this stage but will be defined within the Navigational Safety Plan (NSP) and Vessel Management Plan (VMP) as part of marine coordination (see Section 22).

63. Table 6.6 presents the maximum number of vessels which will be used during the construction phase, broken down by vessel type. Following this, Table 6.7 presents the maximum number of transits and the maximum number of vessels onsite simultaneously during each of the construction phase activities.

Table 6.6 Maximum Vessel Numbers per Vessel Type for Construction Phase

Parameter	Maximum Vessel Numbers
Cable installation vessel	4
Anchor handling tug	8
Remotely operated vehicle support vessel	3
Pre-lay grapnel run vessel	2
Rock placement vessel	2
Guard vessel (if required)	2
Survey vessel	1
Geotech drilling vessel	2
Crew transfer / walk to work vessel	3
Total vessels throughout construction phase (rounded)	**30[1]**

[1] Note that the total vessels have been rounded up from the sum of the individual vessel counts. Potential use of guard vessels has been included in the total to be conservative.

Table 6.7 Maximum Transit and Vessel Numbers per Phase of Construction

Construction Activity	Maximum Vessel Numbers Onsite Simultaneously	Maximum Number of Transits
Unexploded ordinance	4	1
Geotech	4	2
Anchor installation	2	40
Mooring line pre-lay/wet-store	4	60
Export cable installation	2	12
Inter-array cable installation	2	12
WTG/floater tow and station-keeping	7	60
Mooring line stretch and hook-up	1	20
Cable pull-in	2	24
System commissioning	2	420
Overall (rounded)	**10**	**660**[1]

6.6.2 Operational Phase

64. A maximum of 210 transits per year will be made by vessels associated with the Offshore Development during the operational phase, with the maximum number of vessels onsite simultaneously being 10. As per the construction phase, the routes that will be used by vessels associated with the Offshore Development will be defined within the NSP and VMP.

65. Table 6.8 presents the maximum number of vessels which will be used during the construction phase, broken down by vessel type. Following this, Table 6.9 presents the maximum number of transits and the maximum number of vessels onsite simultaneously during each of the construction phase activities.

Table 6.8 Maximum Vessel Numbers per Vessel Type for Operation Phase

Parameter	Maximum Vessel Numbers
Cable installation vessel	1
Anchor handling tug	2
Remotely operated vehicle support vessel	1
Pre-lay grapnel run vessel	1

Parameter	Maximum Vessel Numbers
Rock placement vessel	2
Guard vessel (if required)	2
Crew transfer / walk to work vessel	3
Total vessels throughout operational phase	**20**[1]

Table 6.9 Maximum Transit and Vessel Numbers per Phase of Operation

Operational Activity	Maximum Vessel Numbers Onsite Simultaneously	Maximum Number of Transits
Planned turbine and balance of plant (BoP) O&M	1	40
Unscheduled maintenance	1	120
Subsea inspection, repair and maintenance	2	30
Major component change-out (tow-in)	5	11
Cable repair/replacement	3	4
Component exchange using self-hoisting crane	1	1
Maximum	**10**	**210**[1]

6.6.3 Decommissioning Phase

66. It is anticipated that the decommissioning phase will generally be the reverse of the construction phase in terms of vessel types and numbers.

7 Data Sources

67. This section summarises the main data sources used to assess the shipping and navigation baseline deemed relevant to the Offshore Development, including consideration of any limitations associated with the data sources considered.

7.1 Offshore Study Area

68. The Offshore Study Area within which the assessment has been undertaken is defined as a minimum 10 nm buffer of the PFOWF Array Area and the Offshore Export Cable Corridor. It is noted that the Offshore Study Area was defined based on a previous iteration of the project boundaries, and therefore covers a slightly larger area than a 10 nm buffer on the presented boundaries, which is not an issue but provides a degree of conservativism to the assessment. The Offshore Study Area is shown in Figure 7.1.

69. The Offshore Study Area is considered to capture the relevant passing traffic and activity close to the Offshore Development.

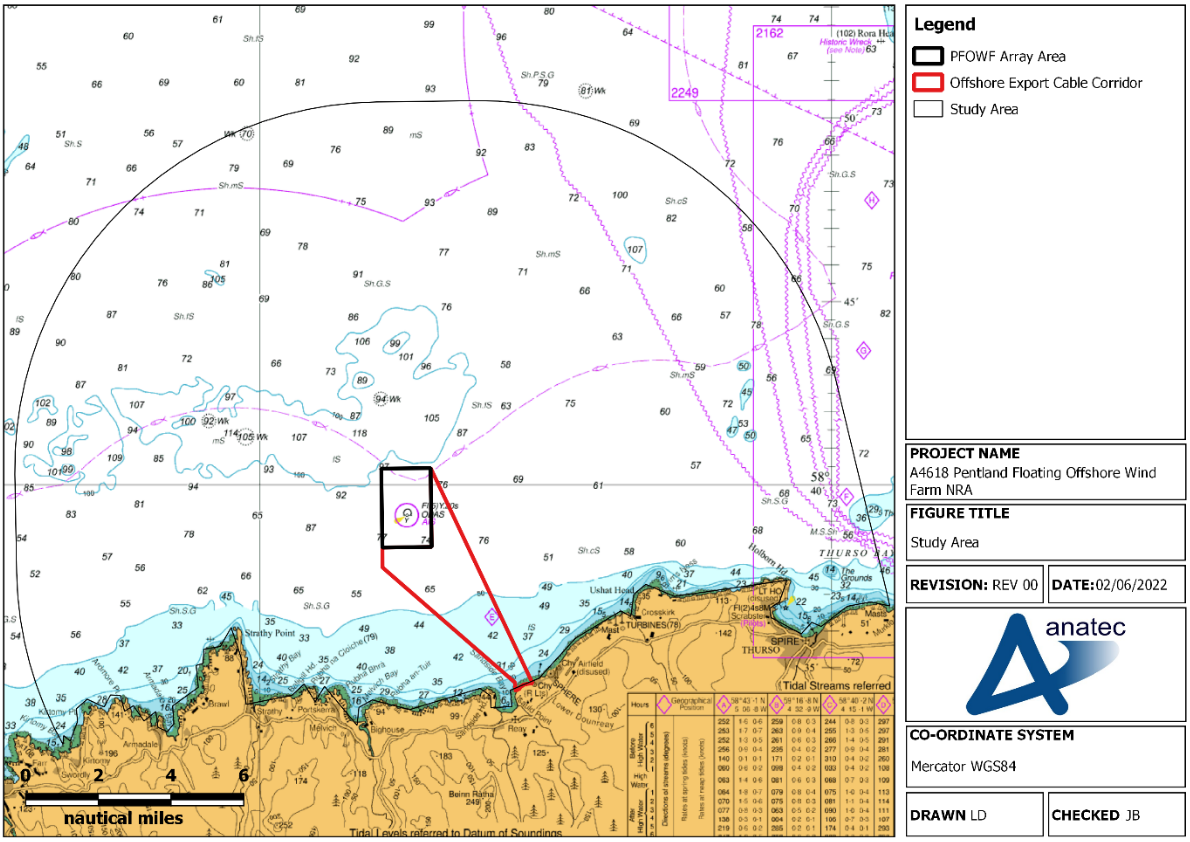

Figure 7.1 Offshore Study Area

7.2 Marine Traffic Data

70. As per Section 8, the NRA has considered 28 days of survey data (Automatic Identification System (AIS), radar and visual observation data) collected on site via shore-based surveys based at the Strathy Point Lighthouse. This is split into a 14-day summer survey during July/August 2021 and a 14-day winter survey during November 2021 to capture the seasonal variations in vessel activity.

71. Additional AIS data from previous studies were used in Section 14 to extend and validate the data collected during the two vessel traffic surveys. The 2019 Scoping Report for the Offshore Development consisted of 28 days of AIS data, covering 14 days each from July and December 2019. The Demonstrator Project NRA (Dounreay Tri Ltd, 2016) presented a further 28 days of AIS data covering 14 days from each of July 2015 and January 2016. The final source of AIS data was a Marine Scotland study carried out in 2012 by Anatec on shipping in the Pentland Firth and Orkney Waters, which presented 56 days of AIS data, covering 28 days in January/February and 28 days in July 2012. In addition, five months of AIS data from the summers of 2011 and 2012 was also presented for recreational vessels.

72. Similarly, statistics from Scrabster Harbour and Orkney Marinas have been used to understand changes in traffic patterns due to COVID-19, and to further inform the baseline analysis of vessel traffic.

7.3 Summary of Data Sources

73. Table 7.1 summarises the main data sources which have been used to characterise the shipping and navigation baseline relative to the Offshore Development.

Table 7.1 Data Sources

Data	Source	Purpose
Vessel Traffic	28 days of AIS, radar and visual observation data collected over 14 days in July/August 2021 and 14 days in November 2021	To establish the marine traffic baseline
	28 days of AIS data collected over 14 days in July 2019 and 14 days in December 2019 for the Scoping Report	
	Dounreay Tri Floating Wind Demonstration Project – Marine Safety Navigational Risk Assessment presenting 28 days of AIS data collected over 14 days in July 2015 and 14 days in January 2016 (Dounreay Tri Ltd, 2016)	

Data	Source	Purpose
	Anatec Shipping Study of the Pentland Firth and Orkney Waters presenting 56 days of AIS data, collected over 28 days from January/February and 28 days from July 2012 (Anatec, 2012)	
Recreational Traffic	RYA Coastal Atlas of Recreational Boating (RYA, 2019b)	To establish the recreational baseline
	CCC Sailing Directions (CCC, 2020)	
Maritime Incidents	Marine Accident Investigation Branch (MAIB) marine incidents database (2000 to 2019)	To define the baseline rate of incidents occurring within the Offshore Study Area
	RNLI incident data (2010 to 2019)	
	Department for Transport (DfT) UK civilian SAR helicopter taskings (2015 to 2021)	
Other Navigational Features	UKHO Admiralty Sailing Directions North Coast of Scotland Pilot NP52 (UKHO, 2018)	To establish the baseline in terms of navigational features
	UKHO Admiralty Charts (UKHO, 2021)	
Weather	UKHO Admiralty Sailing Directions North Coast of Scotland Pilot NP52 (UKHO, 2018)	Visibility data
	UKHO Admiralty Chart 1954 (UKHO, 2021)	Tidal stream data
	DHI Report (DHI, 2021)	Wind and wave data

7.4 Data Limitations

7.4.1 Marine Traffic Data

74. The use of AIS data to characterise the vessel traffic in the area assumes that vessels which are under a legal obligation to broadcast via AIS will do so. Both the long-term AIS data and the AIS component of the vessel traffic survey assume that, unless there is clear evidence to the contrary, details broadcast via AIS are correct.

75. The main vessel traffic surveys took place in 2021, meaning that traffic patterns such as vessel numbers and behaviour may have been affected by the ongoing COVID-19 pandemic. Stakeholder consultation, pre-COVID data and harbour / marina statistics have been used to assess the impact of COVID on vessel activity.

7.4.2 RYA Coastal Atlas of Recreational Boating

76. The RYA Coastal Atlas of Recreational Boating data used to assess the relative densities of recreational vessels contains only data from recreational vessels which broadcast via AIS.

The RYA state that the general boating element of the RYA Coastal Atlas provides a good indication of non-AIS recreational use of the area.

77. The relative densities of the general boating areas are based on predictions of the locations of recreational vessels based upon information from local clubs, the location of harbours / mariners and 2015 RYA club survey data. Therefore, combined with vessel traffic survey data and stakeholder consultation, the RYA Coastal Atlas is considered to provide a good overall indication of both AIS and non-AIS recreational activity within the Offshore Study Area.

7.4.3 Historical Incident Data

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

79. The Royal National Lifeboat Institution (RNLI) incident data cannot be considered comprehensive of all incidents in the Offshore Study Area. Although hoaxes and false alarms are excluded, any incident to which an RNLI resource was not mobilised has not been accounted for in this dataset

7.4.4 United Kingdom Hydrographic Office (UKHO) Admiralty Charts

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

8 Vessel Traffic Survey Methodology

81. In agreement with the MCA and the NLB, the NRA has been informed by the following marine traffic data sources:

- 28 days of AIS, radar and visual observation data collected during 14-day surveys in July/August 2021 and November 2021; and
- Additional AIS data sources outlined in Section 7.2.

8.1 Survey Methodology

82. Marine traffic surveys of the PFOWF Array Area and surrounding Offshore Study Area were undertaken during July/August and November 2021. The surveys were shore-based, performed from Strathy Point on the north coast of Scotland. Figure 8.1 provides a photograph of the Strathy Point Lighthouse used as the survey location, with details of the location presented in Table 8.1.

Figure 8.1 Strathy Point Lighthouse

Table 8.1 Strathy Point Lighthouse Details

Parameter	Specification
Name	Strathy Point Lighthouse
Latitude (WGS84)	58° 35.93’ N
Longitude	004° 01.120’ W
Elevation	45 m

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

84. Therefore, larger vessels were recorded on AIS, while smaller vessels without AIS installed (i.e., certain fishing vessels under 15 m LOA and certain recreational craft) were recorded, on the Automatic Radar Plotting Aid (ARPA) radar installed on the roof of the lighthouse, with visual observation data collected where possible.

9 Navigational Features

85. The navigational features in proximity to the Offshore Development have been identified using the relevant UKHO Admiralty Sailing Directions and the UKHO Admiralty charts. The features identified are presented in Figure 9.1. The following subsections discuss the navigational features presented.

86. The charted water depth within the PFOWF Array Area is approximately 75 m throughout the majority of the site, with the deepest water charted at 97 m in the north-west corner of the site. However, investigations of the site, conducted by HWL, indicated a maximum depth of 101.2 m.

87. It is noted that there is a buoy located within the PFOWF Array Area which is marked on charts. This is an Ocean Data Acquisition System (ODAS) deployed by the Project in August 2021 to collect data to support in the design.

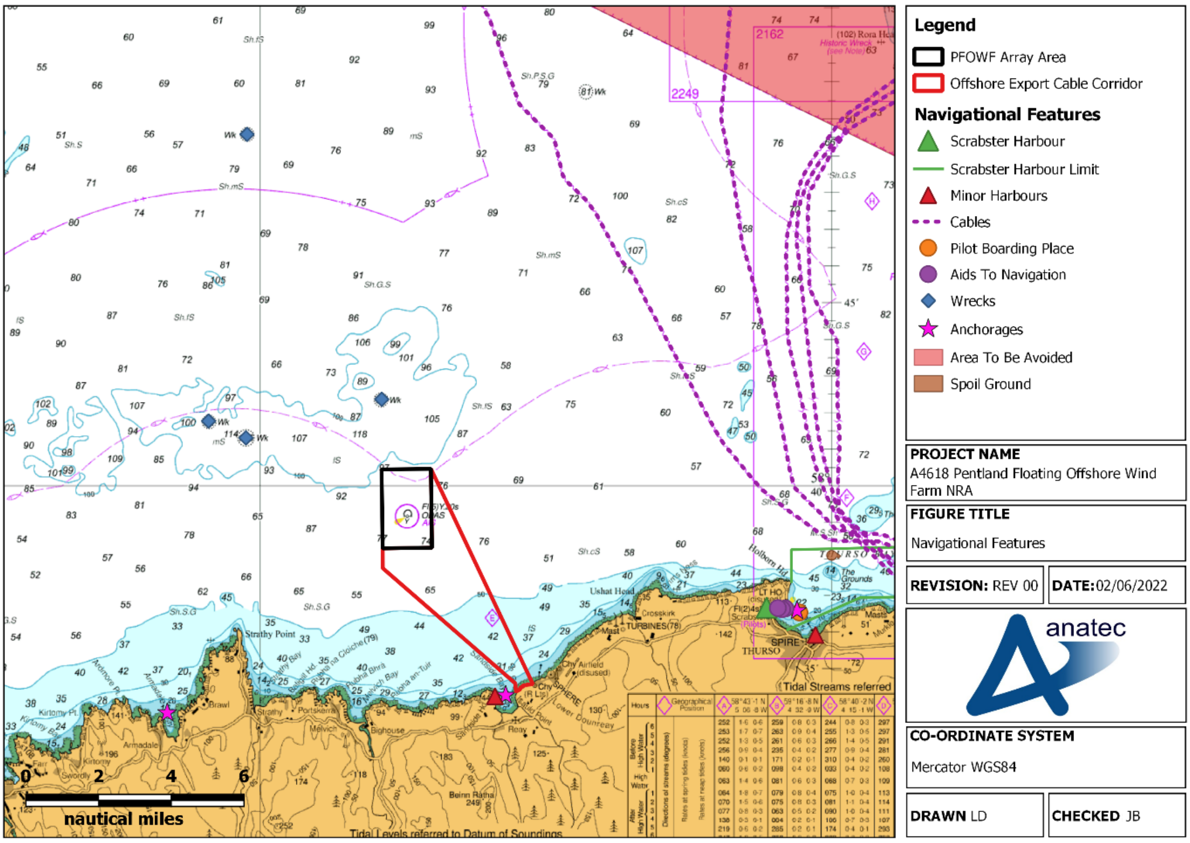

Figure 9.1 Navigational Features

9.1 IMO Routeing Measures

88. An IMO-adopted Area to be Avoided lies 13.5 nm to the north-east of the PFOWF Array Area, covering the waters surrounding Orkney, except for the Pentland Firth and approach

to Scapa Flow. A chart note warns that vessels over 5000 GT carrying oil or hazardous cargoes should avoid the area.

9.2 Submarine Cables

89. There are five submarine cables intersecting the Offshore Study Area. This was made up of interconnectors between Orkney and the mainland, and communications cables. None of the currently constructed cables intersect the PFOWF Array Area.

9.3 Wrecks

90. There are a total of four charted wrecks located within the Offshore Study Area, all of which lie north or north-west of the PFOWF Array Area. The closest wreck lies 2 nm north of the PFOWF Array Area. It should be noted that there may be other wrecks not shown on Admiralty charts.

9.4 Harbours

91. Figure 9.2 presents the harbours close to the PFOWF Array Area. The main harbour in the area is Scrabster Harbour, located 8 nm east of the PFOWF Array Area. There are a further two minor harbours within the Offshore Study Area, with Sandside Bay 4 nm south of the PFOWF Array Area and Thurso Harbour 9.5 nm to the east.

92. Scrabster Harbour is the busiest harbour in the area, and is used mainly by fishing vessels, but also commercial vessels such as cargo vessels and tankers. The roll on-roll off (ro-ro) ferry *Hamnavoe* also runs between Scrabster and Stromness multiple times per day. The Pentland Firth Yacht Club is based within Scrabster and is an RYA registered club and training centre. Vessel arrivals at Scrabster are discussed in Section 14.5.

93. Sandside Bay is a minor fishing harbour, while Thurso Harbour is closed to all but boat traffic.

94. In addition to the harbours within the Offshore Study Area, the vessel traffic in the vicinity of the Offshore Development will also be affected by the presence of the harbours and marinas in Orkney. There are 29 piers and harbours located throughout Orkney, with Marine Services being the Competent Harbour Authority for all of these. The facilities range from the Oil Port at Scapa Flow which accommodates vessels serving the Flotta Oil Terminal, as well as the major harbours at Kirkwall, Hatston and Stromness. There are also a range of smaller facilities throughout the islands, as well as the marinas in Kirkwall, Stromness and Westray. Orkney Marina statistics are discussed in Section 14.6.

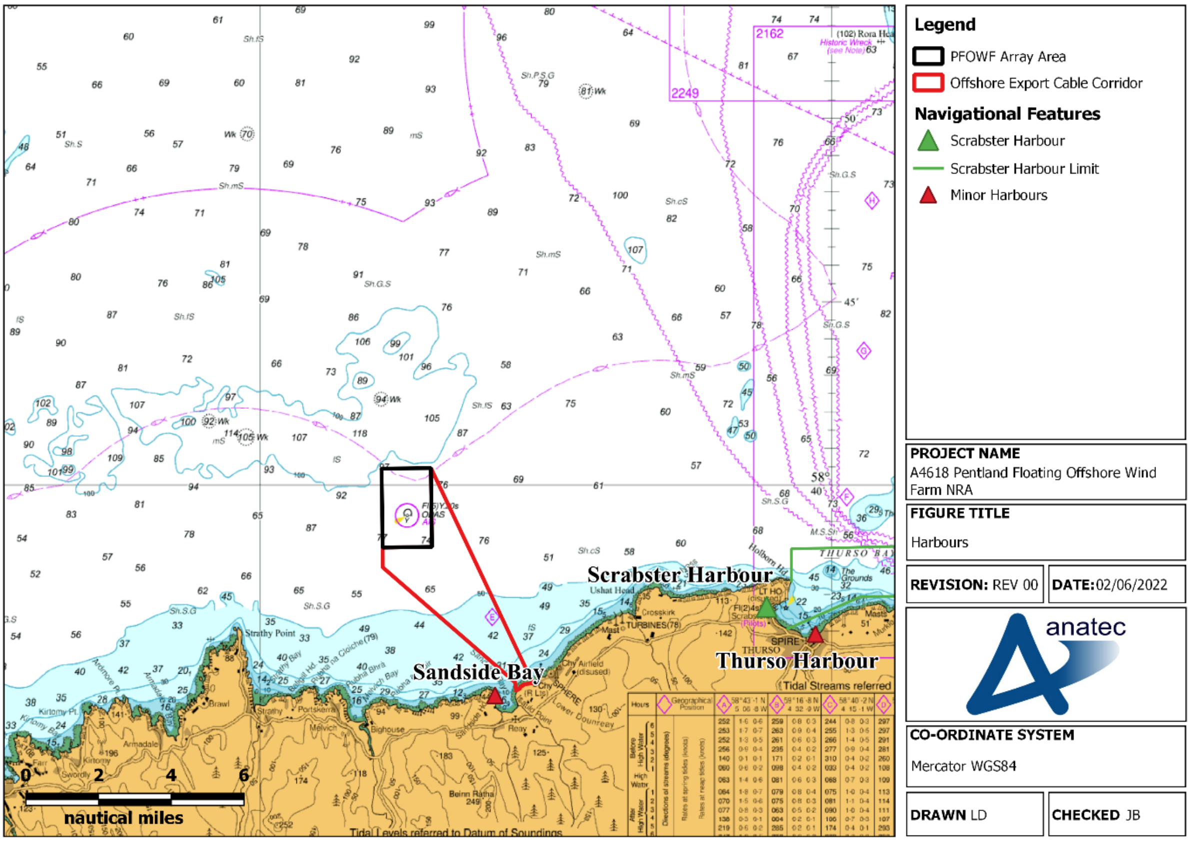

Figure 9.2 Harbours

9.5 Anchorages

95. The *CCC Sailing Directions and Anchorages* (CCC, 2020) recommends that anchorage can be found in Sandside Bay, approximately 4.5 nm south-east of the PFOWF Array Area, or in fair weather at Armadale Bay, 7.5 nm south-west of the PFOWF Array Area. Commercial vessels were also recorded anchoring in Thurso Bay, 8.8 nm east of the PFOWF Array Area during the 2019 Scoping data. It is noted that the anchorages mentioned above are traditional anchorages, as opposed to charted ones.

9.6 Military Practice and Exercise Areas

96. Ministry of Defence (MoD) Practice and Exercises Areas (PEXAs) Cape Wrath (North West) (MoD area D801) and Cape Wrath (South East) (MoD area D802) are located 19 nm to the east of the PFOWF Array Area. Chart 1954 (UKHO, 2021) notes that no restrictions are placed on the right to transit the areas at any time, with the areas operated using a clear range procedure, meaning that exercises and firing only takes place when the areas are considered to be clear of all shipping. The areas are operated by the Navy.

97. The Offshore Study Area and PFOWF Array Area also overlap the MoD Northern Managed Danger Area (MDA) (MoD areas D712B and D172C). The Northern MDA covers the whole north coast of Scotland.

9.7 Marine Environmental High Risk Areas

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

99. The closest MEHRA to the PFOWF Array Area is located 18 nm to the north-east, covering the west coast of Hoy, between the Hoy mouth and the Pentland Firth. It is noted that the MEHRA is located within the ATBA around Orkney.

9.8 Spoil Grounds

100. There is only one spoil ground in the vicinity of the PFOWF Array Area, which is located 11 nm east of the PFOWF Array Area, within Thurso Bay. In addition, there is a disused spoil ground located north-east of the existing one.

10 Metocean Data

101. This section presents meteorological and oceanographic statistics of relevance in the vicinity of the Offshore Development, based on the available data sources as detailed in Section 7. It is noted that the data presented within this section is used as input to collision and allision risk modelling within Section 19.

10.1 Wind

102. Based on wind direction data from the Pentland Floating Offshore Wind Demonstrator Metocean Hindcast Data and Analysis Report (DHI, 2021), modelled at a location approximately 10 km north of the Array Development Area at a height of 10 m above mean sea level, the proportion of the wind direction (coming from) within each 30-degree interval is presented in Figure 10.1 in the form of a wind rose.

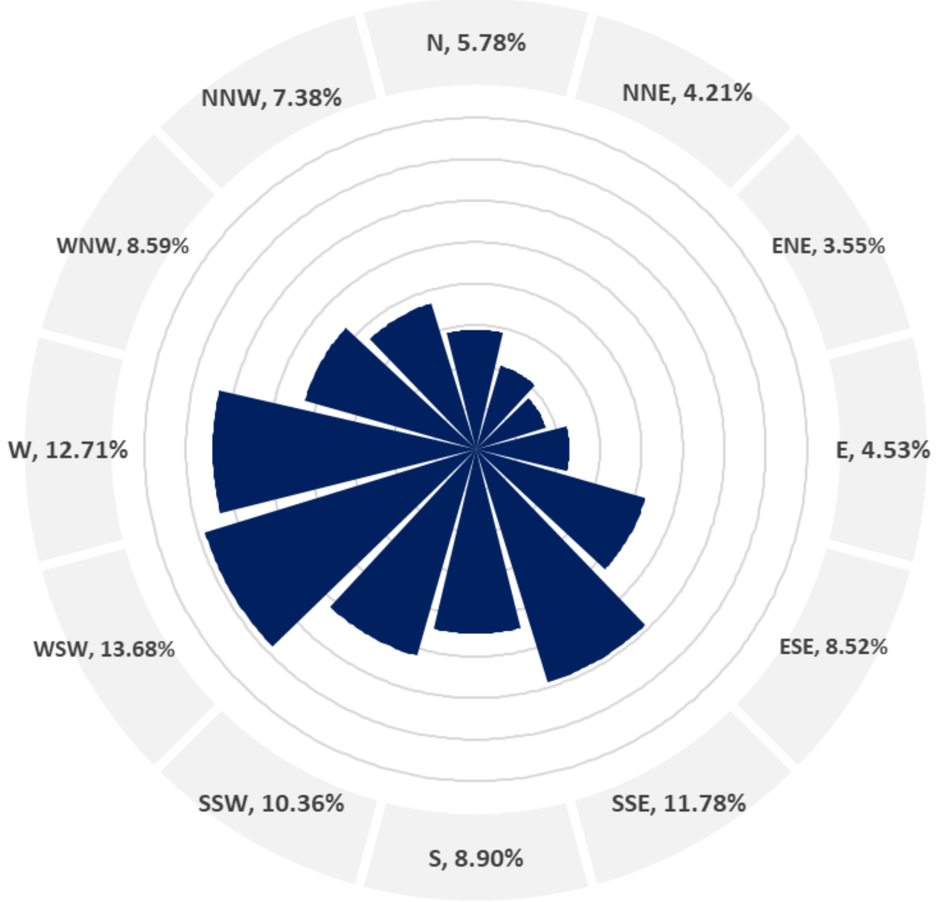

Figure 10.1 Wind Direction Distribution (1979 – 2020)

10.2 Wave

103. Based on significant wave height data from the Pentland Floating Offshore Wind Demonstrator Metocean Hindcast Data and Analysis Report (DHI, 2021), the proportion of the sea state within three defined ranges is presented in Table 10.1. The sea state is based upon significant wave height. The proportions presented have been rounded to one decimal place.

Table 10.1 Sea State Distribution

Sea State, Hs	Proportion (%)
Calm (<1 m)	18.3
Moderate (1–5 m)	78.5
Severe (>5 m)	3.3

10.3 Visibility

104. It is assumed that the annual proportion of poor visibility is 3%. This is based upon information from UKHO Admiralty Sailing Directions North Coast of Scotland Pilot NP52 (UKHO, 2018).

10.4 Tidal

105. Tidal data to be used as an input to the collision and allision modelling is based upon information available from Admiralty Chart 1954. Table 10.2 presents the peak flood and ebb direction and speed values for the Chart 1954 charted tidal diamonds C, D, E, F, G and H in proximity to the PFOWF Array Area.

Table 10.2 Tidal Data

Tidal Diamond (Chart 1954)	Flood		Ebb	
	Direction (°)	Speed (knots)	Direction (°)	Speed (knots)
C	266	1.4	081	1.1
D	297	0.8	114	0.8
E	258	0.6	063	0.6
F	245	1.8	052	1.1
G	282	1.5	115	1.6
H	326	1.3	120	1.0

11 Emergency Response Overview

11.1 Her Majesty's Coastguard

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

107. The HMCG coordinates SAR operation through a network of 11 Maritime Rescue Coordination Centres (MRCC) and the UK Joint Rescue Coordination Centre (JRCC UK). A corps of over 3,500 volunteer Coastguard Rescue Officers (CRO) around the UK from 352 local Coastguard Rescue Teams (CRT) are involved in coastal rescue, searches, and surveillance.

108. All of the MCA's operations, including SAR, are divided into three geographical regions. The 'Scotland' region covers the area encompassing the Offshore Development. Each region is divided into six districts with its own MRCC, which coordinates the SAR response for maritime and coastal emergencies within its district boundaries. The Pentland Firth is monitored by the Shetland MRCC, located approximately 120nm north-east of the PFOWF Array Area.

11.2 Search and Rescue Helicopters

109. Since April 2015, the Bristow Group has provided helicopter SAR operations in the UK. The next contract for provision of the SAR helicopter service is due to be awarded in October 2022.

110. The SAR helicopter service is operated out of 10 base locations around the UK. The closest of these locations is located at Inverness Airport, approximately 70 nm south of the Array Development Area. Based on feedback from the Hazard Workshop, Sumburgh and Stornoway helicopter stations may also respond to an incident within the vicinity of the PFOWF Array Area.

11.3 Royal National Lifeboat Institution

111. The RNLI is organised into divisions, with the relevant region for the Offshore Development being "Scotland". Based out of more than 230 stations around the UK, there are approximately 430 lifeboats across the RNLI fleet, including both All-Weather Lifeboats (ALBs) and Inshore Lifeboats (ILBs). Figure 11.1 presents the locations of RNLI stations in proximity to the Offshore Development, and Table 11.1 summarises the types of lifeboats operated by the RNLI out of Thurso, Stromness and Longhope lifeboat stations, which all may respond to incidents within the Offshore Study Area. Given the proximity of Thurso to the PFOWF Array Area, it is likely that the majority of incidents would be responded to by Thurso Lifeboat Station, however, it was noted at the Hazard

Workshop that depending on availability of resources and the severity of an incident, Stromness and Longhope may also respond.

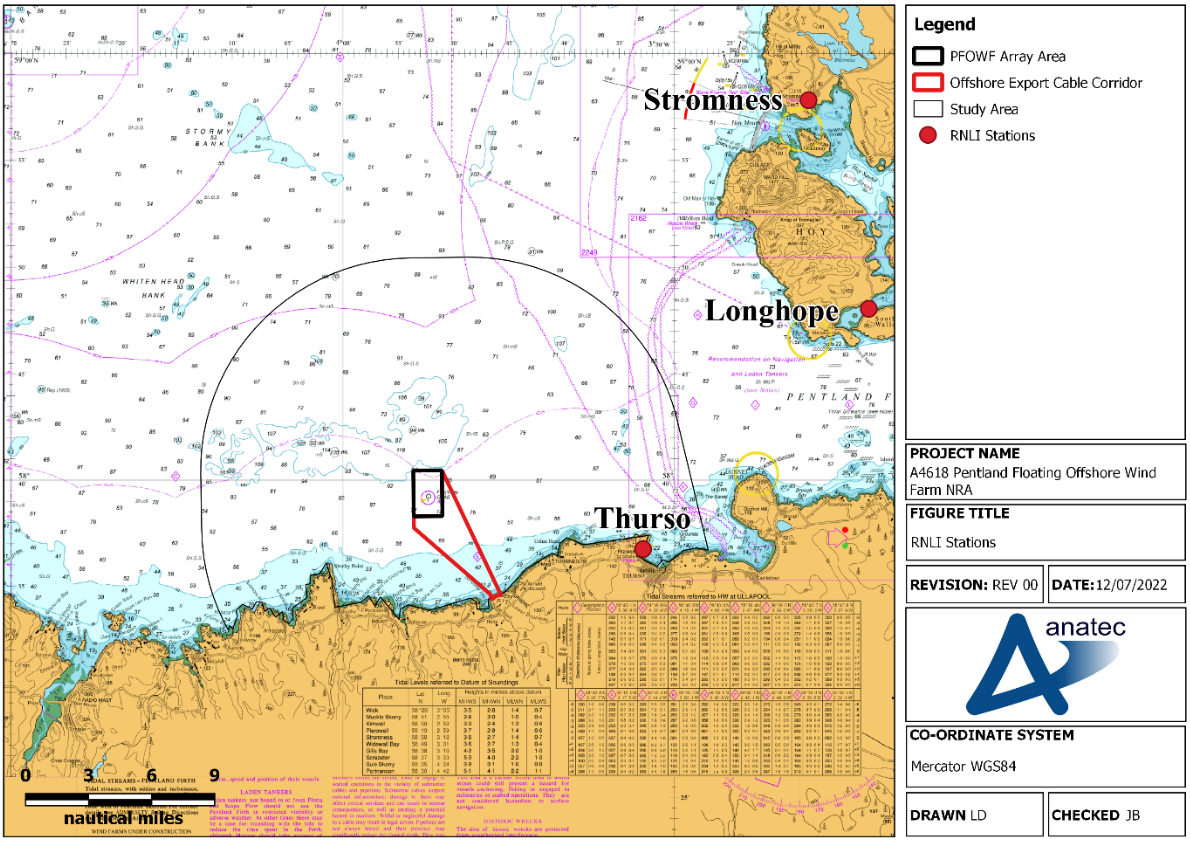

Figure 11.1 RNLI Stations

Table 11.1 RNLI Station Details

Station	Lifeboat(s)	ALB Class	Minimum Distance to PFOWF Array Area (nm)
Thurso	ALB	Severn	9.6
Longhope	ALB	Tamar	21.5
Stromness	ALB	Severn	24.5

112. RNLI lifeboats are available on a 24-hour bases throughout the year. More information on recent responses is presented in Section 12.2. RNLI Thurso personnel also attended the Hazard Workshop (see Section 4.4).

11.4 Emergency Towage Resources

113. The ETV *Ievoli Black* is available for emergency tug support, and is based in the north of Scotland, splitting its time between the North Minch and Orkney. Response times will therefore vary depending on the location of the incident and the tug. It was noted during consultation that the contract for the ETV is due for renewal in 2022, and it cannot be guaranteed that an ETV is available in the area throughout the lifetime of the Offshore Development.

114. In addition to the ETV, there are three tugs based in Scapa Flow, which are included in the Coastguard Agreement on Salvage and Towage (CAST), meaning that they can be called into service to support the MCA in emergency situations which may lead to pollution or danger to other shipping.

12 Historical Maritime Incidents

12.1 Marine Accident Investigation Branch

12.1.1 2010 to 2019

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

116. A total of 13 incidents were recorded by the MAIB within the Offshore Study Area between 2010 and 2019, which corresponds to an average of one incident per year. Of these, no incidents were recorded within the PFOWF Array Area, with the closest occurring approximately 1.9 nm east of the PFOWF Array Area.

117. The most common incident type was “Machinery Failure” which accounted for 46% of the total, followed by “Accident to person” which accounted for 23%. The incident occurring closest to the PFOWF Array Area was a machinery failure experienced by a fishing vessel in 2011.

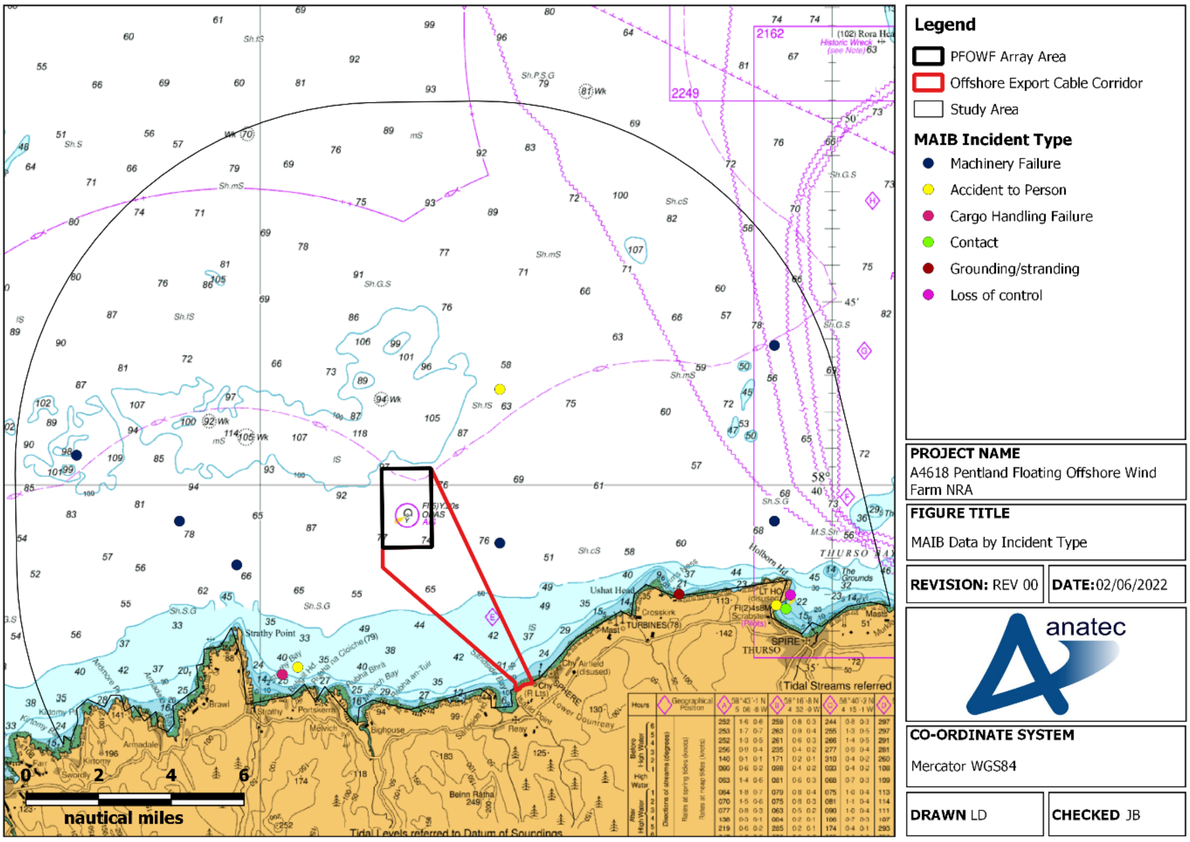

Figure 12.1 MAIB Data by Incident Type

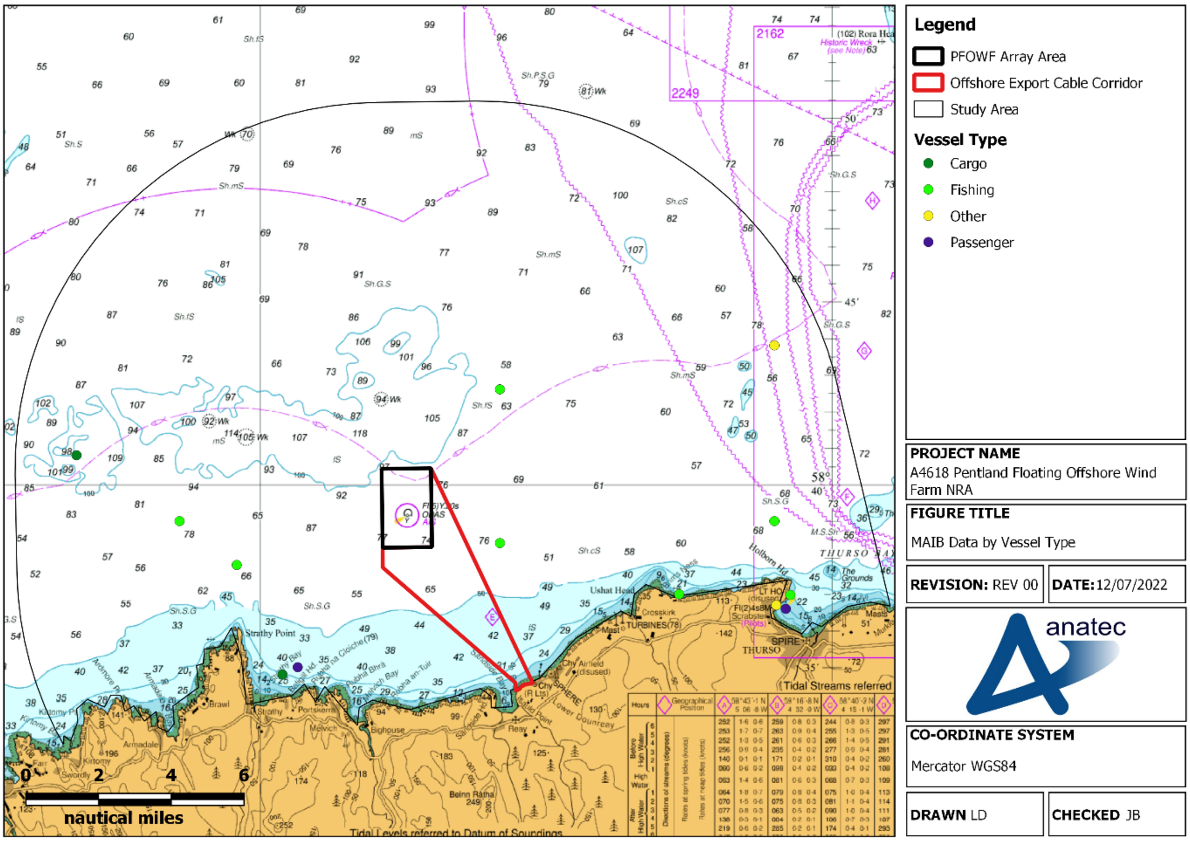

Figure 12.2 MAIB Data by Vessel Type

12.1.2 2000 to 2009

118. At the request of UK Chamber of Shipping (CoS), an additional ten years of MAIB incident data covering between 2000 and 2009 has also been considered to bring the total up to 20 years.

119. A total of 22 incidents were recorded by the MAIB within the Offshore Study Area between 2000 and 2009, which corresponds to an average of two incidents per year. No incidents occurred within the PFOWF Array Area, with the closest being a flooding/foundering incident suffered by a fishing vessel approximately 1.6 nm south-east of the PFOWF Array Area. The most common incident type was "Machinery Failure" followed by "Flooding/Foundering".

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

12.2 Royal National Lifeboat Institution

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

122. A total of 47 incidents were recorded by the RNLI within the Offshore Study Area between 2010 and 2019, corresponding to an average of five incidents per year. Of these, none were recorded within the PFOWF Array Area, with the closest recorded around 2.4 nm east of the PFOWF Array Area.

123. The most common incident types were “Person In Danger”, which accounted for 32% of the total, followed by “Machinery Failure” which accounted for 28%. It is noted that a large proportion of the “Person in Danger” incidents occurred within Thurso Bay and close to the coast. The most common vessel types/people involved in incidents were fishing vessels (32%) and “Person In Danger” (30%). Thurso Lifeboat Station responded to all of the incidents recorded within the Offshore Study Area, however it was noted at the Hazard Workshop that Longhope and Stromness may also respond to an incident in proximity to the PFOWF Array Area, depending on availability and the severity of an incident.

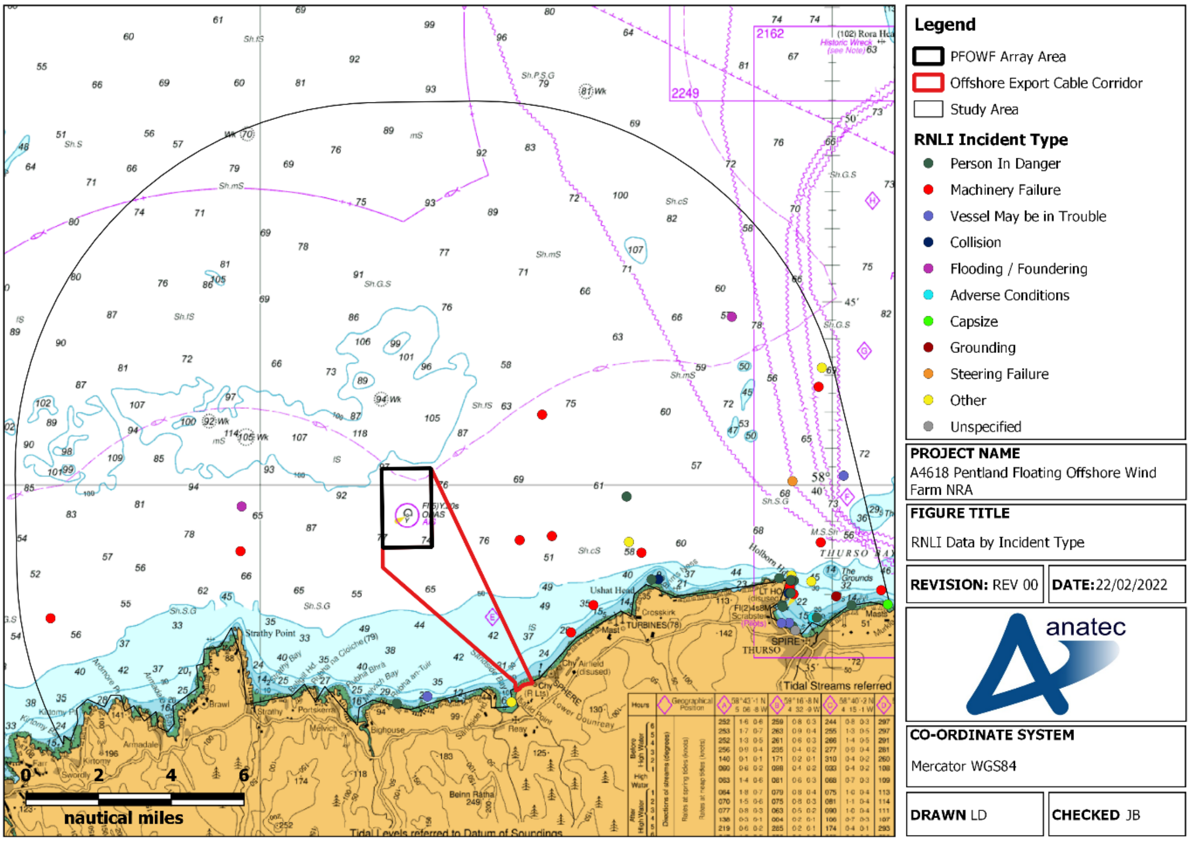

Figure 12.3 RNLI Data by Incident Type

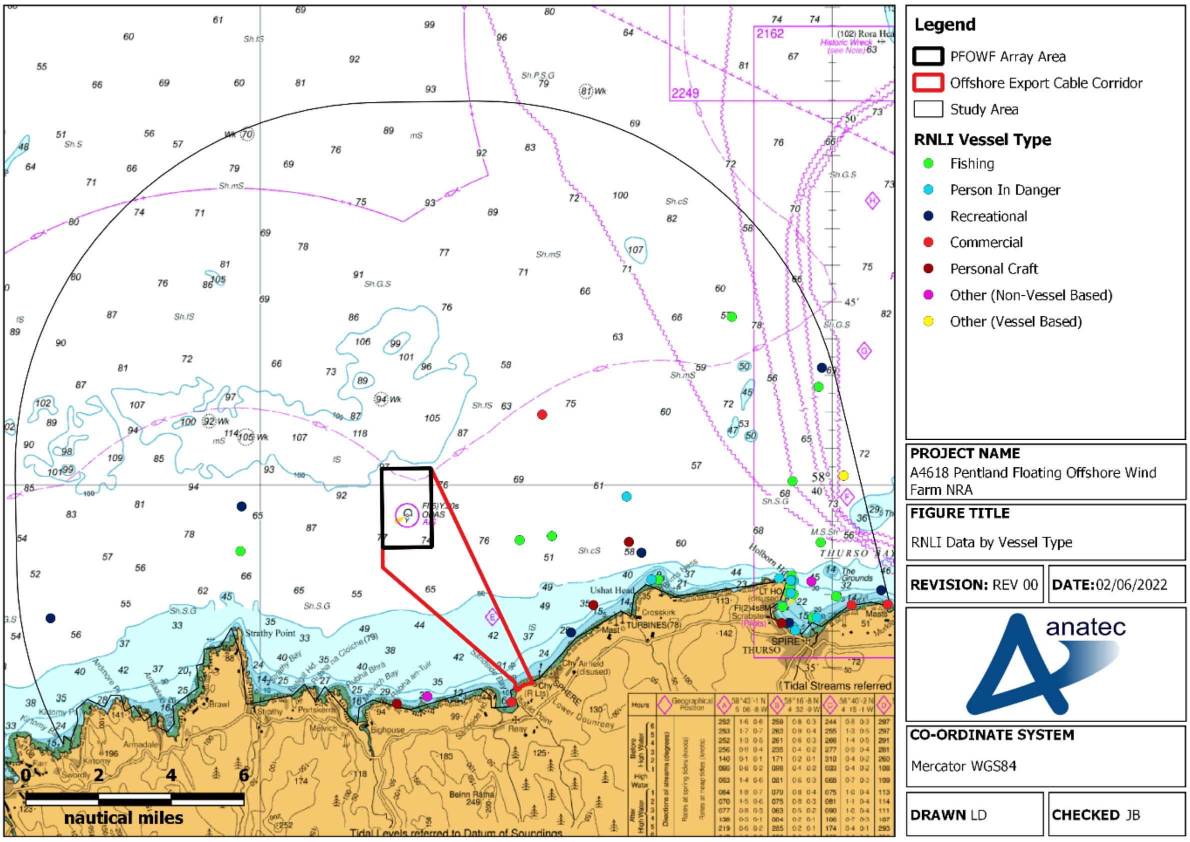

Figure 12.4 RNLI Data by Vessel Type

12.3 Search and Rescue Helicopter Taskings

124. A total of five SAR helicopter taskings were undertaken for incidents within the Offshore Study Area between 2015 and 2021, corresponding to an average of less than one tasking per year. No SAR helicopter taskings were undertaken within the PFOWF Array Area. Figure 12.5 presents the SAR helicopter taskings undertaken within the Offshore Study Area, colour-coded by tasking type.

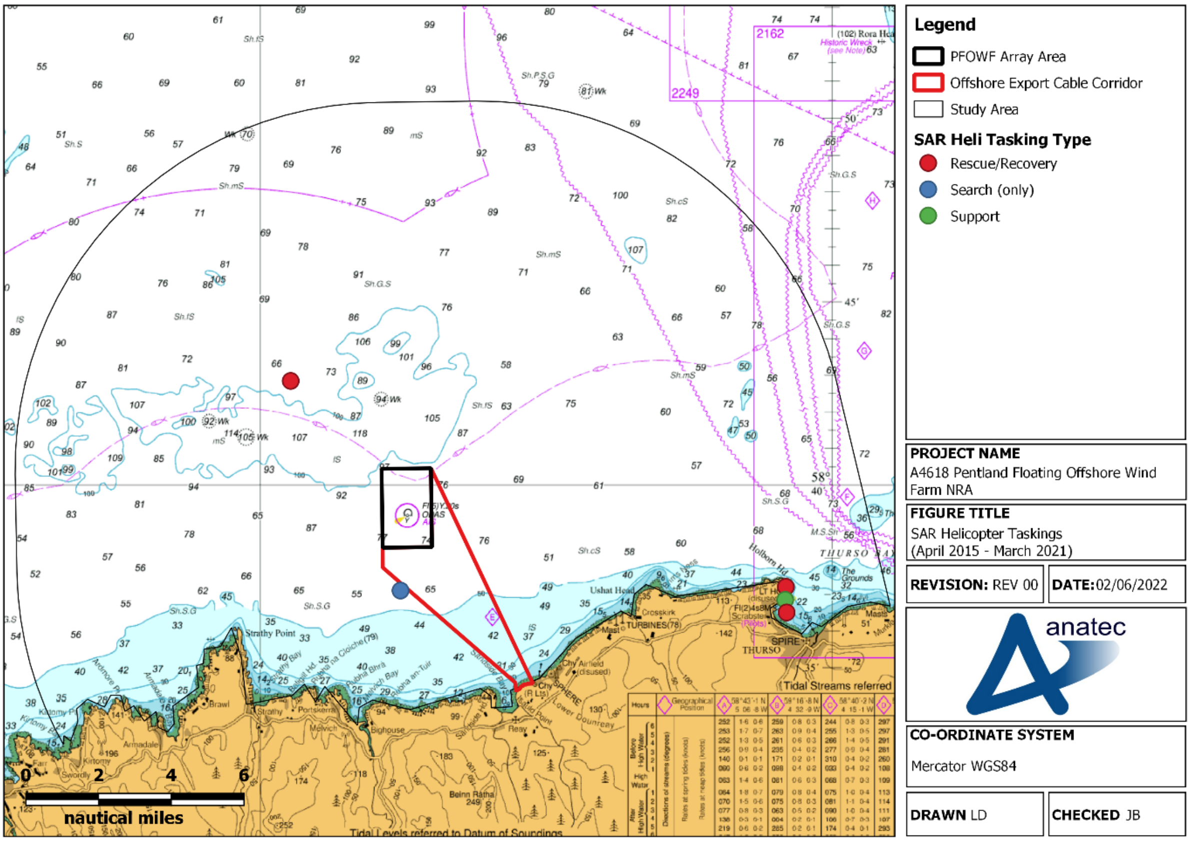

Figure 12.5 SAR Helicopter Taskings (April 2015 – March 2021)

12.4 Historical Offshore Wind Farm Incidents

125. At the time of writing[2] there are 41 fully commissioned and operational OWFs in the UK, ranging from the North Hoyle OWF (fully commissioned in 2003) to Moray East OWF (fully commissioned in 2022). To date[2], these developments consist of approximately 18,400 fully operational wind turbine years.

126. MAIB incident data has been used to collate a list of historical collision and allision incidents involving UK OWF developments, which is summarised in Table 12.1. Other sources have been used to supplement this list including the UK Confidential Human Factors Incident Reporting Programme (CHIRP) for Aviation and Maritime, International Marine Contractors Association (IMCA) and basic web searches.

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

[2] 7th June 2022

128. As of June 2022, there have been no collisions as a result of the presence of an OWF in the UK. The only reported collision incident in relation to a UK OWF involved a project vessel hitting a third-party vessel whilst in harbour.

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

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

130. As of June 2022 there have been 12 reported[3] cases of an allision between a vessel and a WTG (under construction, operational or disused) in the UK, with all but one involving a support vessel for the development and the errant vessel in each case under power rather than drifting. Therefore, there has been an average of approximately 1,531 years per WTG allision incident in the UK, noting that this is a conservative calculation given that only operational WTG years have been included (whereas allision incidents counted include non-operational WTGs). Table 12.1 includes details of these 12 WTG allision incidents, any other allision incidents, and collision incidents involving UK OWF developments.

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

Table 12.1 Summary of Historical Collision and Allision Incidents Involving UK OWF Developments

Incident Vessel	Incident Type	Date	Description of Incident	Vessel Damage	Injury to Person	Source
Project	Allision – project vessel with WTG	7th Aug 2005	A vessel involved with the installation of WTGs underestimated the effect of the current and allided with the base of a WTG whilst manoeuvring alongside it. Minor damage was sustained to a gangway on the vessel, the WTG tower and a WTG blade.	Minor damage to gangway on the vessel	None	MAIB
Project	Allision – project vessel with WTG	29th Sep 2006	When approaching a WTG, an offshore services vessel was struck by the tip of a WTG blade which was rotating rather than secured in a fixed position.	None	None	MAIB
Project	Allision – project vessel with disused pile	8th Feb 2010	The Skipper on-board a work boat slipped their hand on the throttle controls whilst in proximity to a disused pile. There was insufficient time to correct the error and the vessel struck the pile. A passenger moving around the interior of the vessel was thrown off his feet. Although not known at the time, the passenger was later diagnosed with back injuries. No serious damage was caused to the vessel.	Minor	Injury	MAIB
Project	Collision – third party vessel with project vessel	23rd Apr 2011	A third-party catamaran was hit by a project guard vessel within a harbour.	Moderate	None	MAIB

Incident Vessel	Incident Type	Date	Description of Incident	Vessel Damage	Injury to Person	Source
Project	Allision – project vessel with WTG	18th Nov 2011	The Officer of the Watch (OOW) on-board a cable-laying vessel fell asleep and woke to find the vessel inside a wind farm. He attempted to manoeuvre the vessel out of the wind farm on autopilot but the settings did not allow a quick turn and the vessel struck the foundations of a partially completed WTG. The vessel suffered two hull breaches.	Major	None	MAIB
Project	Collision – project vessel with service vessel	2nd Jun 2012	A Crew Transfer Vessel (CTV) became lodged under the boat landing equipment of a flotel. Nine persons were safely evacuated and transferred to a nearby vessel before being brought back in to port.	Moderate	None	UK CHIRP
Project	Allision – project vessel with WTG	20th Oct 2012	The OOW misjudged the distance from a WTG monopile and made contact with the vessel's stern resulting in minor damage.	Minor	None	MAIB

Incident Vessel	Incident Type	Date	Description of Incident	Vessel Damage	Injury to Person	Source
Project	Allision – project vessel with buoy	21st Nov 2012	A wind farm passenger transfer catamaran struck a buoy at high speed whilst supporting an operation for an OWF. The vessel was abandoned by the crew of 12 with the vessel having been holed, causing extensive flooding. There were, however, no injuries. It was found that the Master had unknowingly altered the vessel's course and had not been formally assessed to determine his suitability for the role.	Major	None	MAIB
Project	Allision – project vessel with WTG	21st Nov 2012	A work boat allided with the unlit transition piece of a WTG at moderate speed. The impact caused all five persons on-board to be forced out of their seats. The vessel was able to proceed to port unassisted with no water ingress incurred, although there was some structural damage. It was found that the vessel's Master had relied too heavily on visual cues and there had been insufficient training with navigation equipment. The WTG transition piece had been reported as unlit although the defect reporting system had failed to promulgate a navigation warning.	Moderate	Injury	MAIB

Incident Vessel	Incident Type	Date	Description of Incident	Vessel Damage	Injury to Person	Source
Project	Allision – project vessel with WTG	1st Jul 2013	After disembarking passengers at an offshore substation a service vessel's jets were disengaged, but the vessel jet drive suffered a failure which resulted in an allision with a WTG foundation. The vessel suffered some damage whereas the WTG foundation was not damaged.	Minor	None	IMCA Safety Flash
Project	Allision – project vessel with WTG	14th Aug 2014	A standby safety vessel allided with a WTG pile and consequently leaked marine gas oil and a surface sheen trailed from the vessel. Under its own power the vessel moved away from environmentally sensitive areas until the leak was stopped.	Minor with pollution	None	UK CHIRP
Third Party	Allision – fishing vessel with wind turbine	26th May 2016	A crew member on board a fishing vessel left the autopilot on, resulting in an allision with a wind turbine. A lifeboat attended the incident.	Moderate	Injury	Web search (RNLI, 2016)
Third party	Allision – recreational vessel with buoy	12th Aug 2018	A recreational vessel allided with a buoy associated with the Minesto tidal device mistaking the light as being from a lighthouse located much further away. A RNLI lifeboat was deployed and towed the vessel into port. The vessel's mast was broken and the radar reflector on the buoy was lost.	Moderate	None	Anatec consultation meeting with client (2021)

Incident Vessel	Incident Type	Date	Description of Incident	Vessel Damage	Injury to Person	Source
Project	Allision – project vessel with WTG jacket	14th Feb 2019	A survey vessel undertaking a survey at an OWF ran too close to a wind farm jacket whilst the autopilot was engaged. Before the autopilot could be disengaged the vessel's rubbing strake made light contact with the jacket.	Minor	None	MAIB
Project	Allision – project vessel with WTG	16th Jan 2020	A project vessel servicing a number of WTGs allided with a WTG whilst transiting back to port resulting in a member of the crew coming into contact with the railings. The vessel proceeded unaided back to port where then man was subsequently taken to hospital to obtain doctors' advice.	None	Injury	Web search (Vessel Tracker, 2020)
Project	Allision – project vessel with WTG	27th Jan 2020	When picking up crew from a WTG, auto dynamic positioning was deployed by the OOW on a project vessel. However, the OOW (who was alone on the bridge) left the dynamic positioning desk to deal with other duties without having confirmed that the vessel was indeed in full auto DP. In reality the vessel was still in DP surge mode and, with help from the current, drifted towards a wind turbine and made contact six minutes later at a speed of 1.1 knots. The allision resulted in minor damage to the WTG and vessel and no personal injuries.	Minor	None	Marine Safety Forum

13 Vessel Traffic

131. This section presents the results of analysis of the marine traffic survey data, collected during shore-based surveys (AIS, radar and visual) in summer 2021 and winter 2021 as per Section 8. Full survey reports were published presenting detailed analysis of the data recorded during each of the surveys (Anatec, 2021a and 2021b), with the main findings of both being summarised in this section.

132. Figure 13.1 and Figure 13.2 show the tracks of vessels recorded within the Offshore Study Area, colour-coded by vessel type, during the summer and winter survey periods. Following this, Figure 13.3 and Figure 13.4 show the vessel density during each of the survey periods.

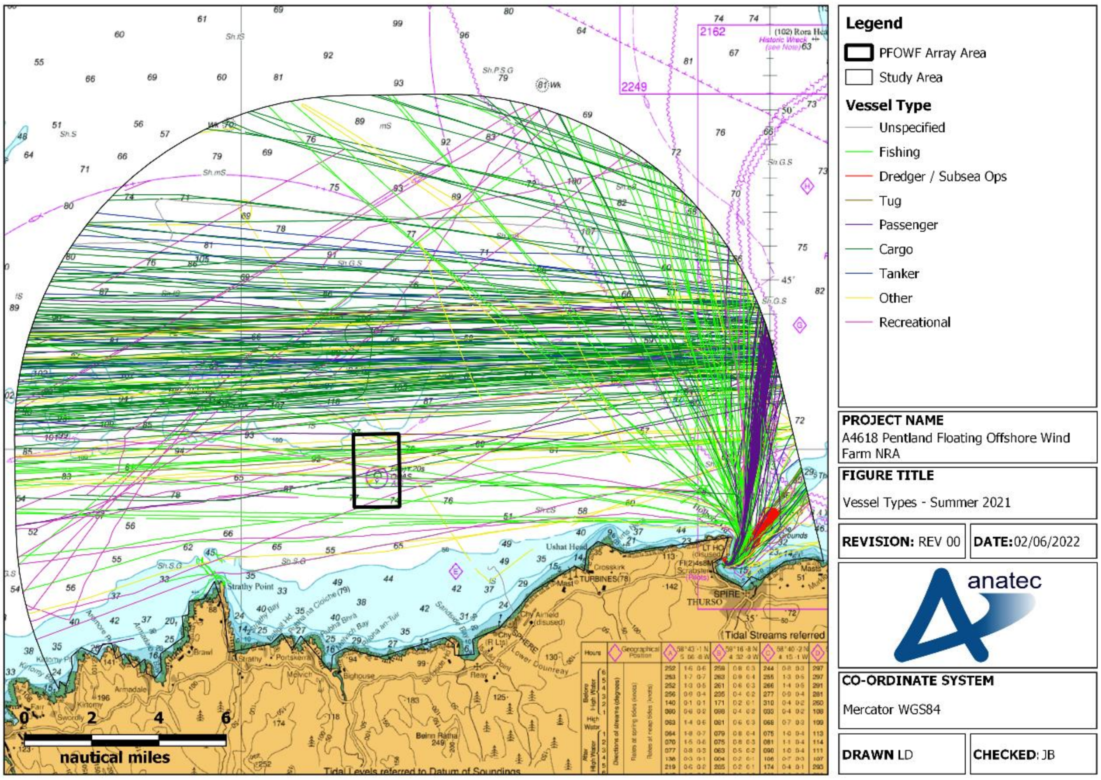

Figure 13.1 Vessel Types – Summer 2021

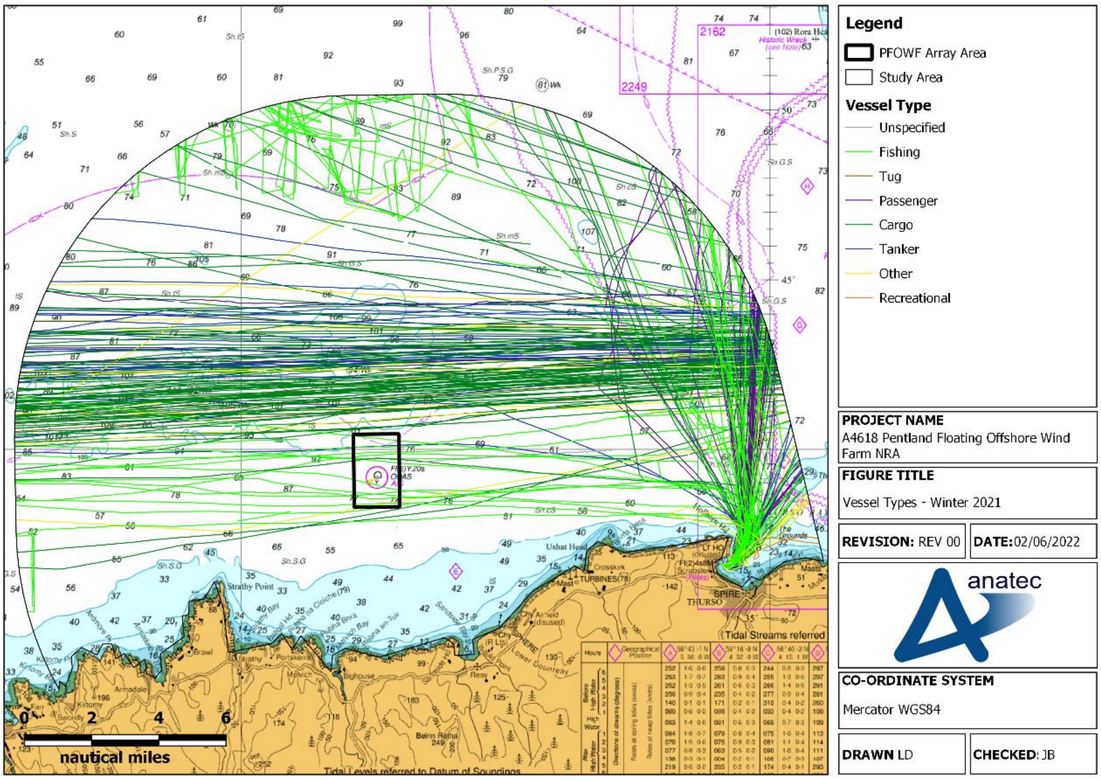

Figure 13.2 Vessel Types – Winter 2021

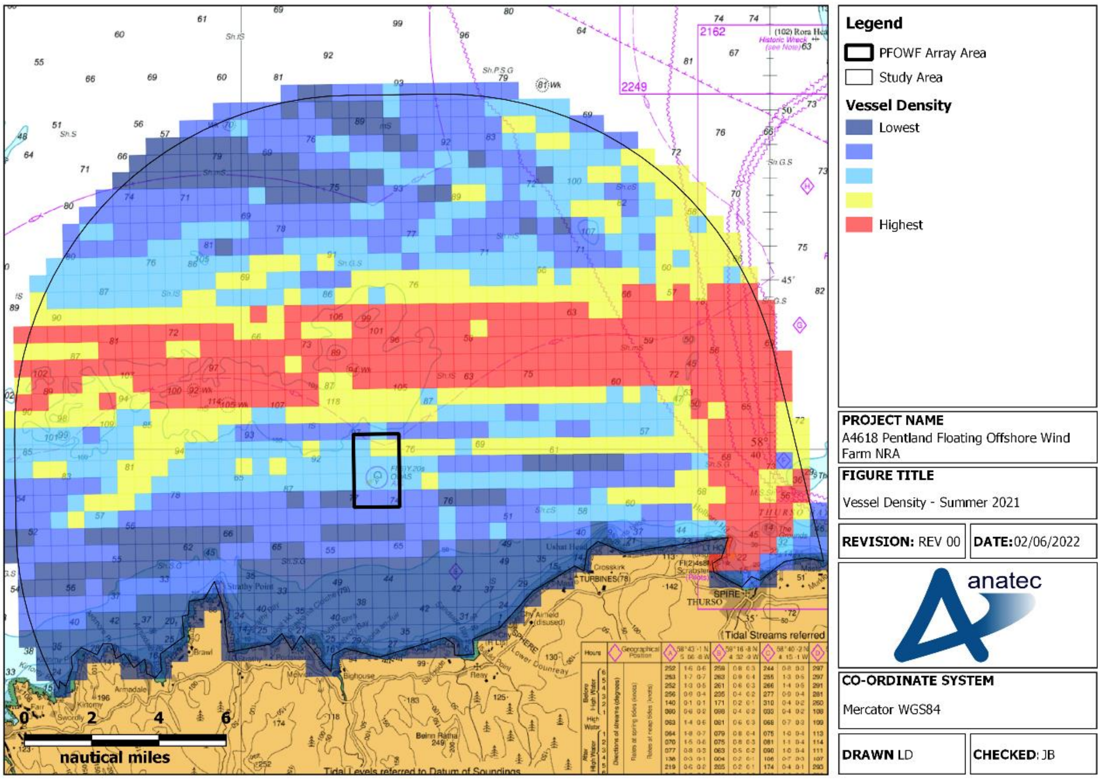

Figure 13.3 Vessel Density – Summer 2021

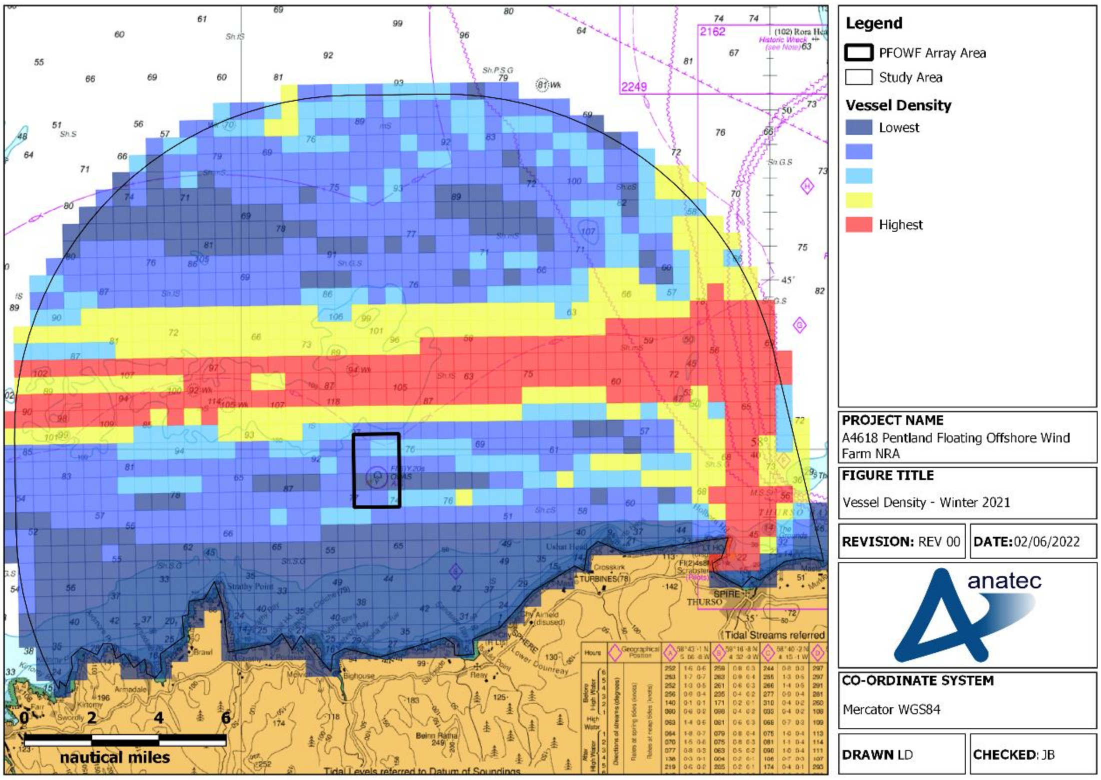

Figure 13.4 Vessel Density – Winter 2021

13.1 Vessel Counts

133. The numbers of unique vessels recorded per day within the 10 nm Offshore Study Area and intersecting the PFOWF Array Area during the summer survey period are presented in Figure 13.5. The average number of unique vessels recorded per day within the Offshore Study Area was 24. The busiest day of the summer survey was 26th July, when 30 unique vessels were recorded within the Offshore Study Area. An average of 1.9 unique vessels per day were recorded within the PFOWF Array Area, with a peak daily count of 4 recorded on each of the 22nd and 31st July.

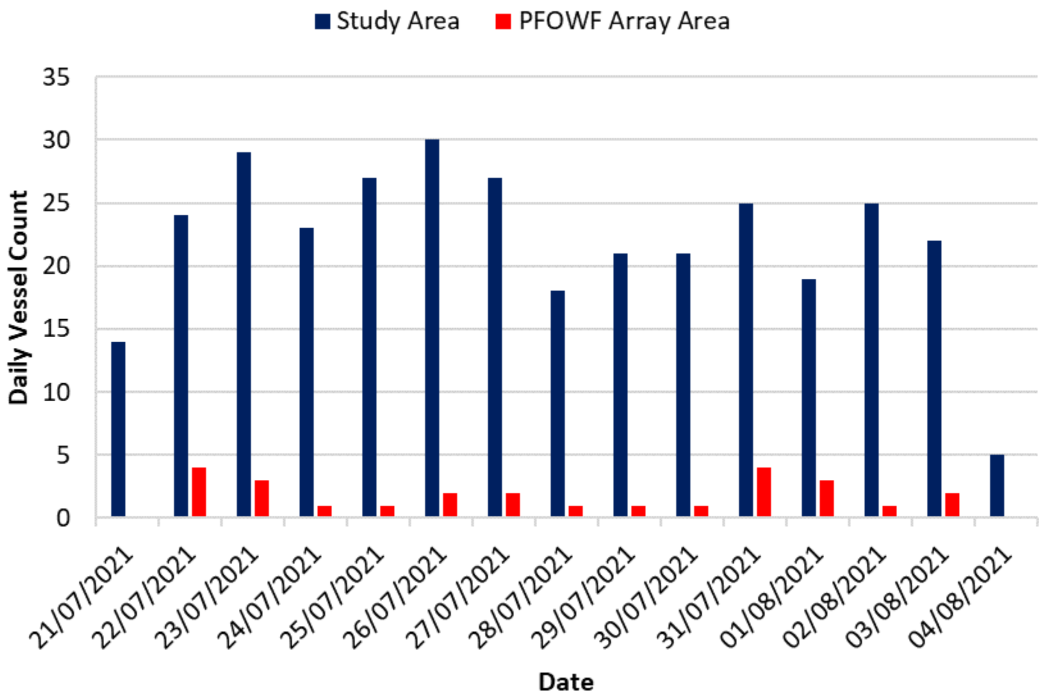

Figure 13.5 Unique Vessels Per Day – Summer Survey Period

134. The numbers of unique vessels recorded per day within the Offshore Study Area and intersecting the PFOWF Array Area during the winter survey period are presented in Figure 13.6. An average of 17 unique vessels per day were recorded within Offshore Study Area, with the busiest days of the survey being the 12th and 13th November, each with 22 vessels. An average of 1.1 vessels intersected the PFOWF Array Area per day, with 16th November being the busiest day within the area with 3 unique vessels recorded.

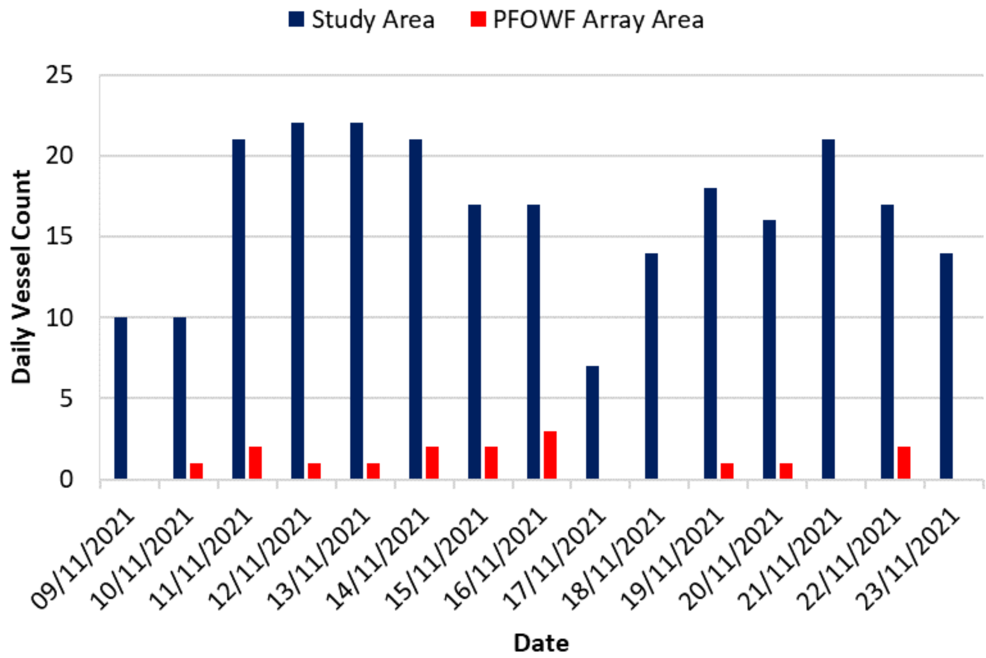

Figure 13.6 Unique Vessels Per Day – Winter Survey Period

13.2 Vessel Types

135. Figure 13.7 presents the relative proportions of vessel types recorded within the Offshore Study Area and the PFOWF Array Area during the summer survey period.

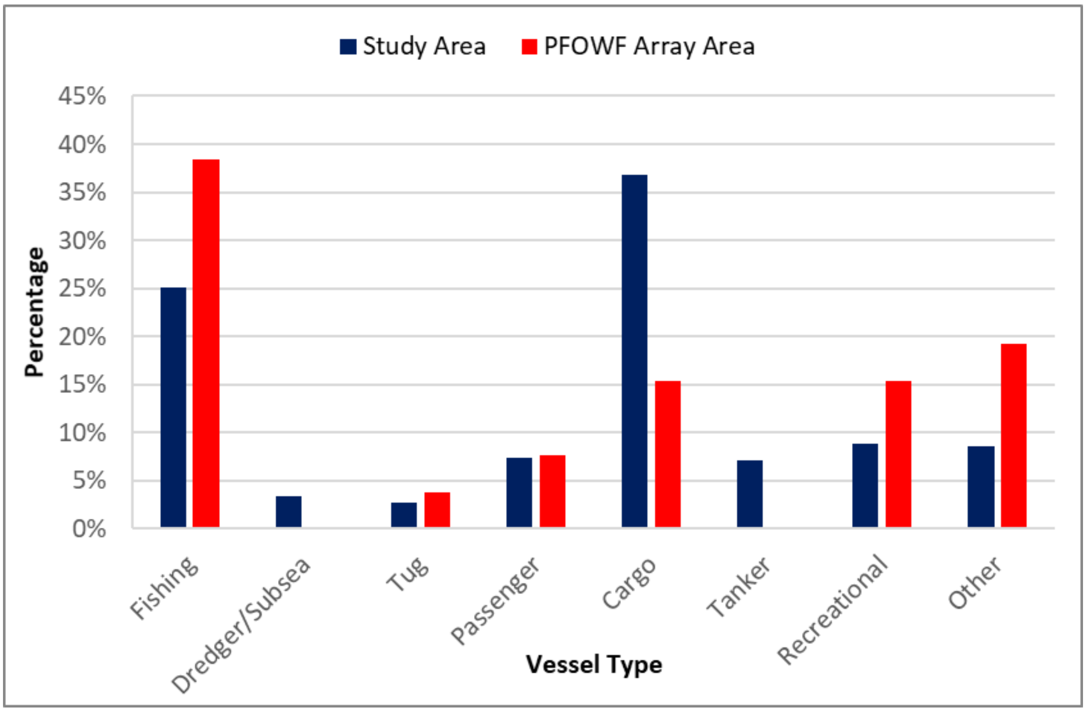

Figure 13.7 Vessel Type Distribution – Summer Survey Period

136. The main vessel types recorded within the Offshore Study Area during the summer survey period were cargo vessels (37%) and fishing vessels (25%). Of the 26 vessels recorded intersecting the PFOWF Array Area, 10 were fishing vessels, with five being ‘Other’ vessels, consisting of three research / survey vessels, an offshore standby vessel and a dive vessel. Four cargo vessels, four recreational vessels, two passenger vessels and one tug were also recorded intersecting the PFOWF Array Area.

137. Figure 13.8 presents the relative proportions of vessel types recorded within the Offshore Study Area and the PFOWF Array Area during the winter survey period.

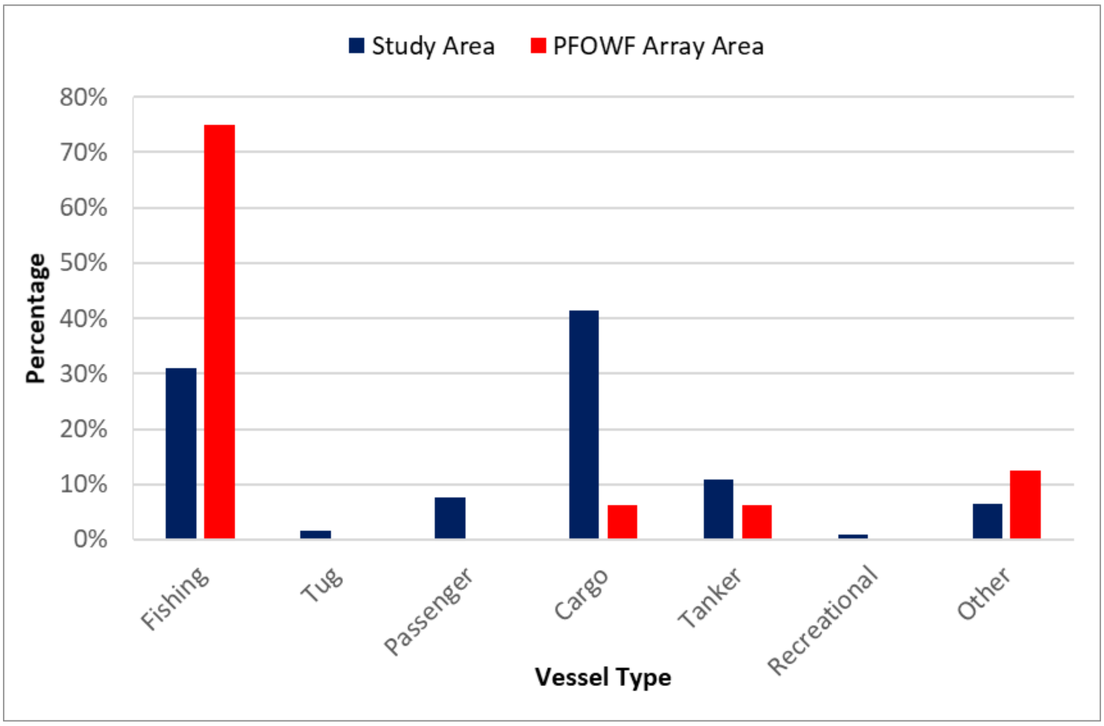

Figure 13.8 Vessel Type Distribution – Winter Survey Period

138. The most common vessel types recorded within the Offshore Study Area during the winter survey period were cargo vessels (41%) and fishing vessels (31%). Of the 16 vessels recorded intersecting the PFOWF Array Area, 12 were fishing vessels, with 1 cargo vessel and a tanker also recorded. The remaining two vessels were classified as 'Other', with one being a fish carrier and the other a radar target of unknown type.

13.2.1 Cargo Vessels

139. The tracks of cargo vessels recorded within the Offshore Study Area throughout both survey periods, colour-coded by vessel length are presented in Figure 13.9.

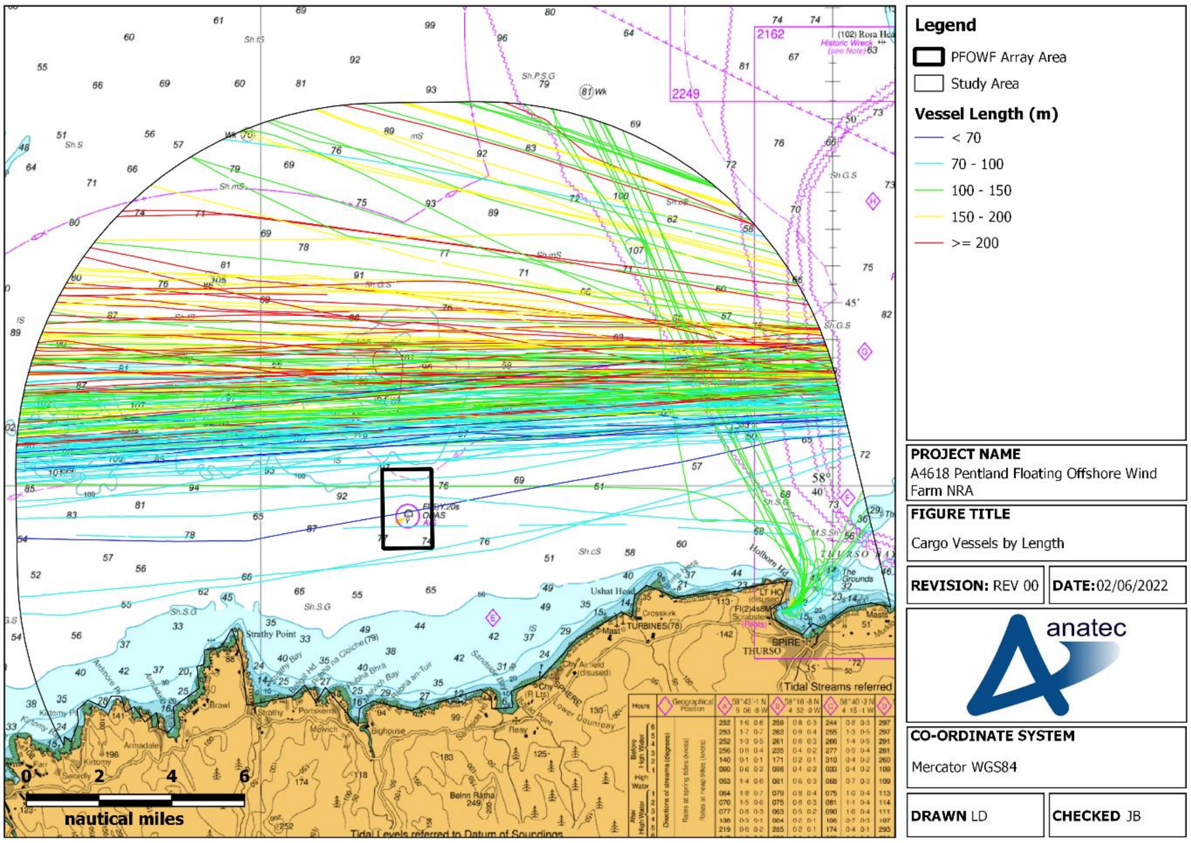

Figure 13.9 Cargo Vessels by Length – Summer and Winter 2021

140. During the two survey periods, an average of eight cargo vessels per day were recorded within the Offshore Study Area. The majority of these were seen transiting east-west through the Offshore Study Area, passing to the north of the PFOWF Array Area.

13.2.2 Tankers

141. The tracks of tankers recorded within the Offshore Study Area throughout both survey periods, colour-coded by vessel length are presented in Figure 13.10.

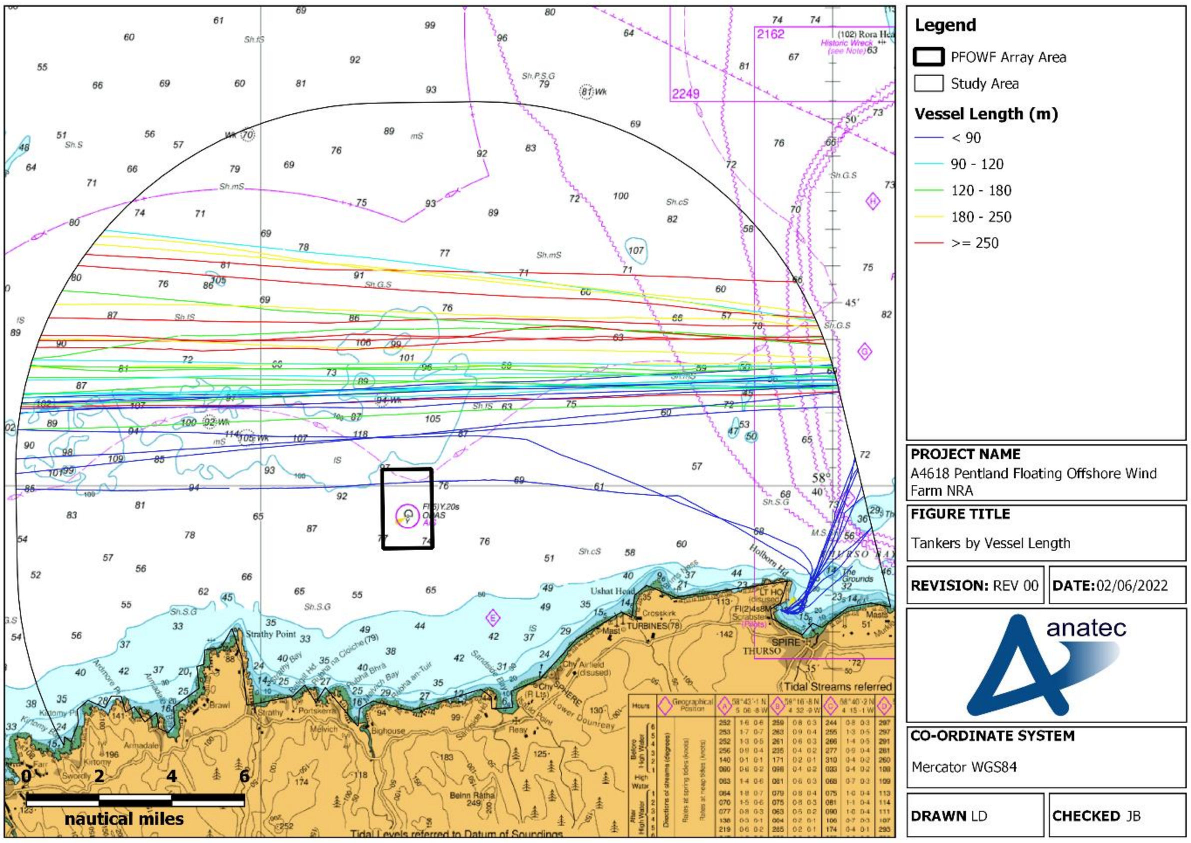

Figure 13.10 Tankers by Vessel Length – Summer and Winter 2021

142. An average of two tankers per day were recorded in the Offshore Study Area during the two survey periods. These were mostly recorded transiting east-west to the north of the PFOWF Array Area, with only one tanker recorded passing through the array area itself. Two unique tankers were recorded heading to Scrabster, with one of these also recorded passing through the PFOWF Array Area after leaving Scrabster.

13.2.3 Passenger Vessels

143. The tracks of passenger vessels recorded within the Offshore Study Area throughout both survey periods are presented in Figure 13.11.

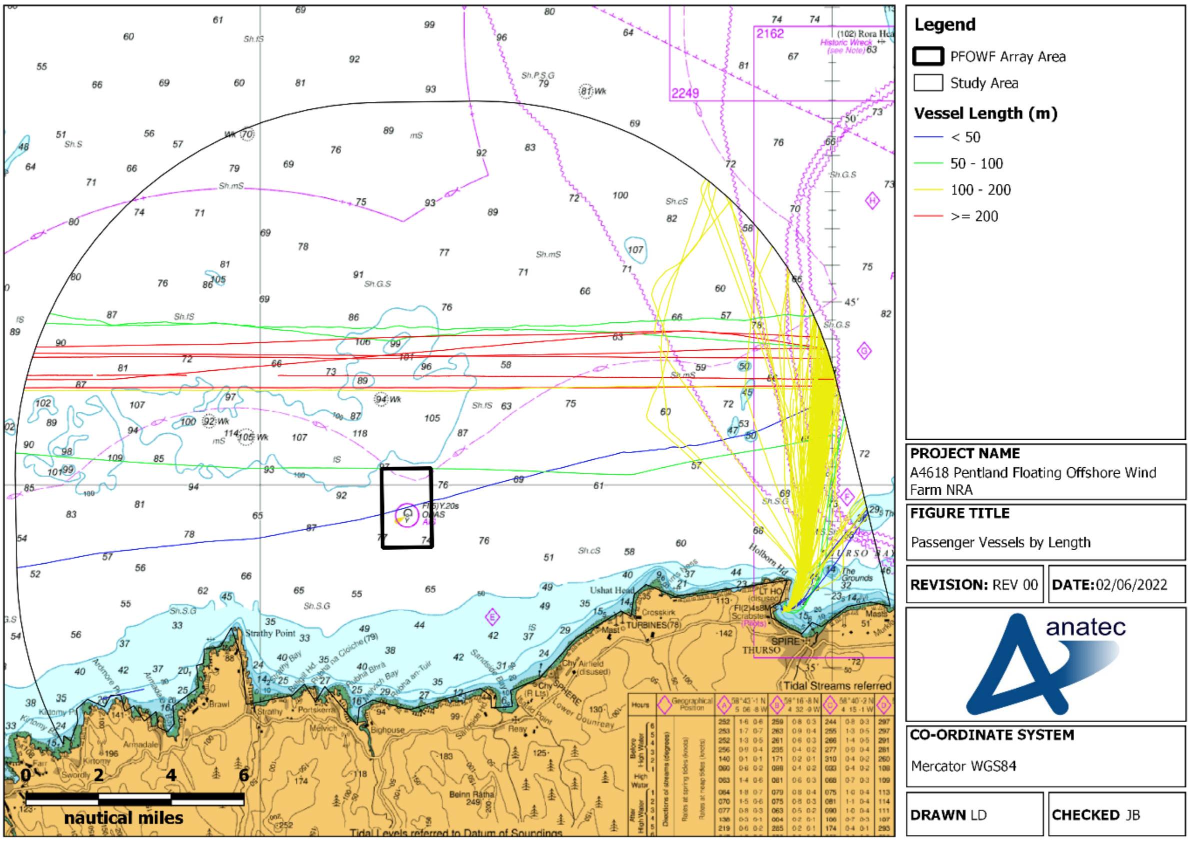

Figure 13.11 Passenger Vessels – Summer and Winter 2021

144. An average of one to two passenger vessels were recorded each day across the two survey periods. The ro-ro ferry *Hamnavoe* accounted for most of the passenger tracks throughout both survey periods, running between Scrabster and Stromness multiple times each day. The tracks of *Hamnavoe* are seen passing north-south on the eastern edge of the Offshore Study Area. In addition to this, several large cruise ships were recorded passing east-west north of the PFOWF Array Area. Two passenger vessels were recorded within the PFOWF Array Area, a 90 m cruise ship and the tall ship *Bessie Ellen*.

13.2.4 Fishing Vessels

145. Figure 13.12 presents a plot of the fishing vessels recorded within the Offshore Study Area during both survey periods, colour-coded by vessel length.

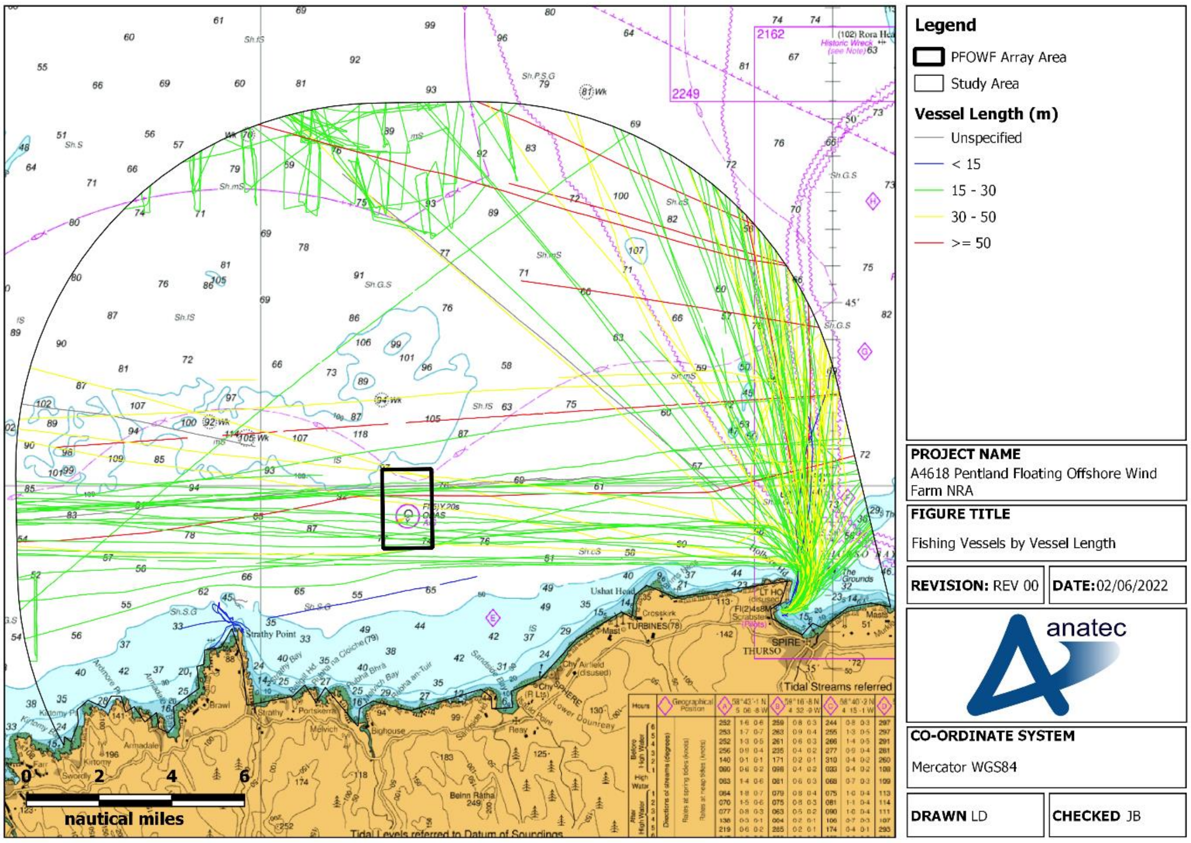

Figure 13.12 Fishing Vessels by Vessel Length – Summer and Winter 2021

146. An average of five to six fishing vessels per day were recorded within the Offshore Study Area during the two survey periods. The majority of the tracks recorded within the Offshore Study Area appear to be transiting, with some tracks which appear to be actively fishing on the north and west edges of the Offshore Study Area. In addition, the potter *Girl Erica* was frequently recorded during the summer survey period using a combination of radar and visual observations.

147. Further details on commercial fishing vessel activity are given in Volume 2, Chapter 13: Commercial Fisheries.

13.2.5 Recreational Vessels

13.2.5.1 Vessel Traffic Survey Data

148. Figure 13.13 shows the tracks of recreational vessels recorded within the Offshore Study Area during the two survey periods. It is noted that recreational vessels may be underrepresented on AIS as many smaller vessels, such as yachts often choose not to broadcast. The use of radar and visual observation data should mitigate this to an extent, however, other sources such as the RYA Coastal Atlas and local stakeholder consultation have also been used to inform the recreational traffic baseline.

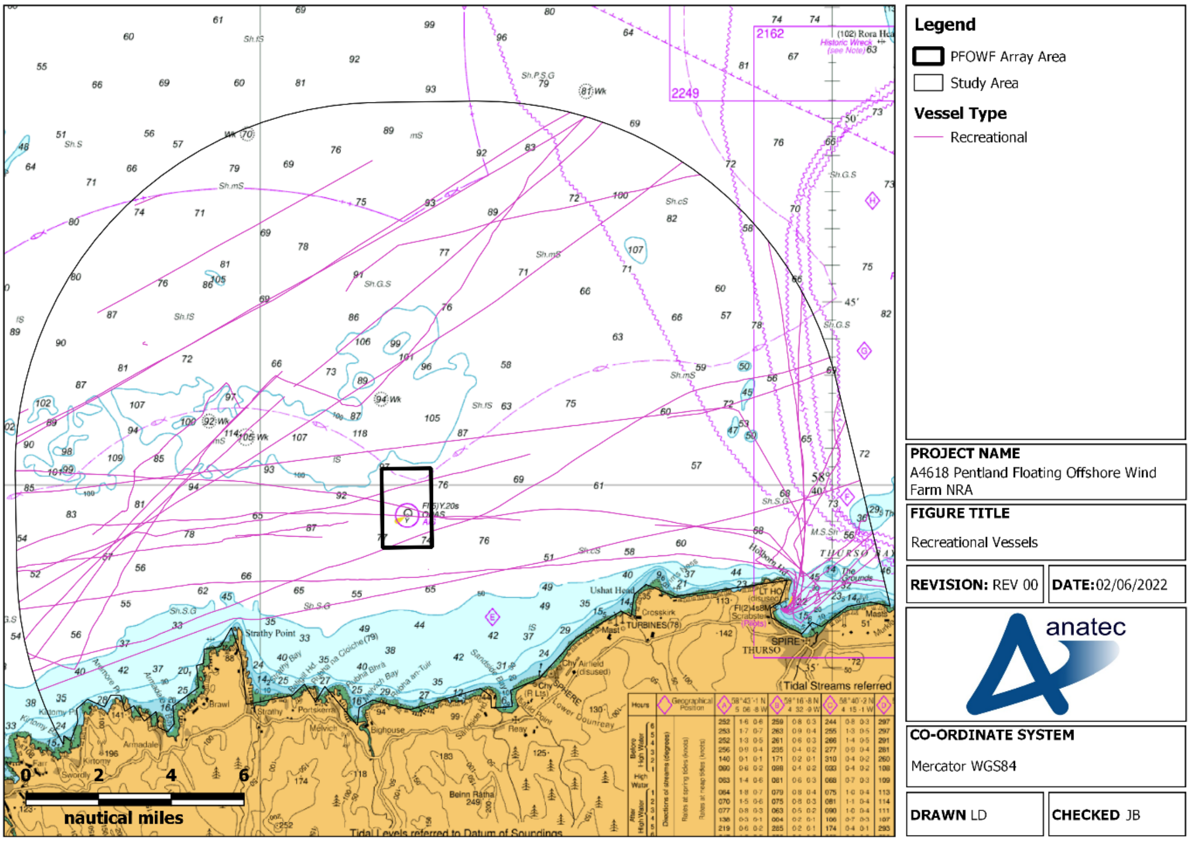

Figure 13.13 Recreational Vessels – Summer and Winter 2021

149. An average of two recreational vessels per day were recorded during the summer survey period, with only two recreational vessels recorded throughout the entire winter survey period close to Scrabster Harbour.

13.2.5.2 Anchored Vessels

150. No vessels were recorded at anchor within the Offshore Study Area during the two survey periods.

13.3 Vessel Sizes

13.3.1 Vessel Length

151. The vessel tracks recorded within the Offshore Study Area during both the summer and winter survey periods, colour-coded by vessel length, are presented in Figure 13.14. Following this, the distribution of the vessel length is shown in Figure 13.15.

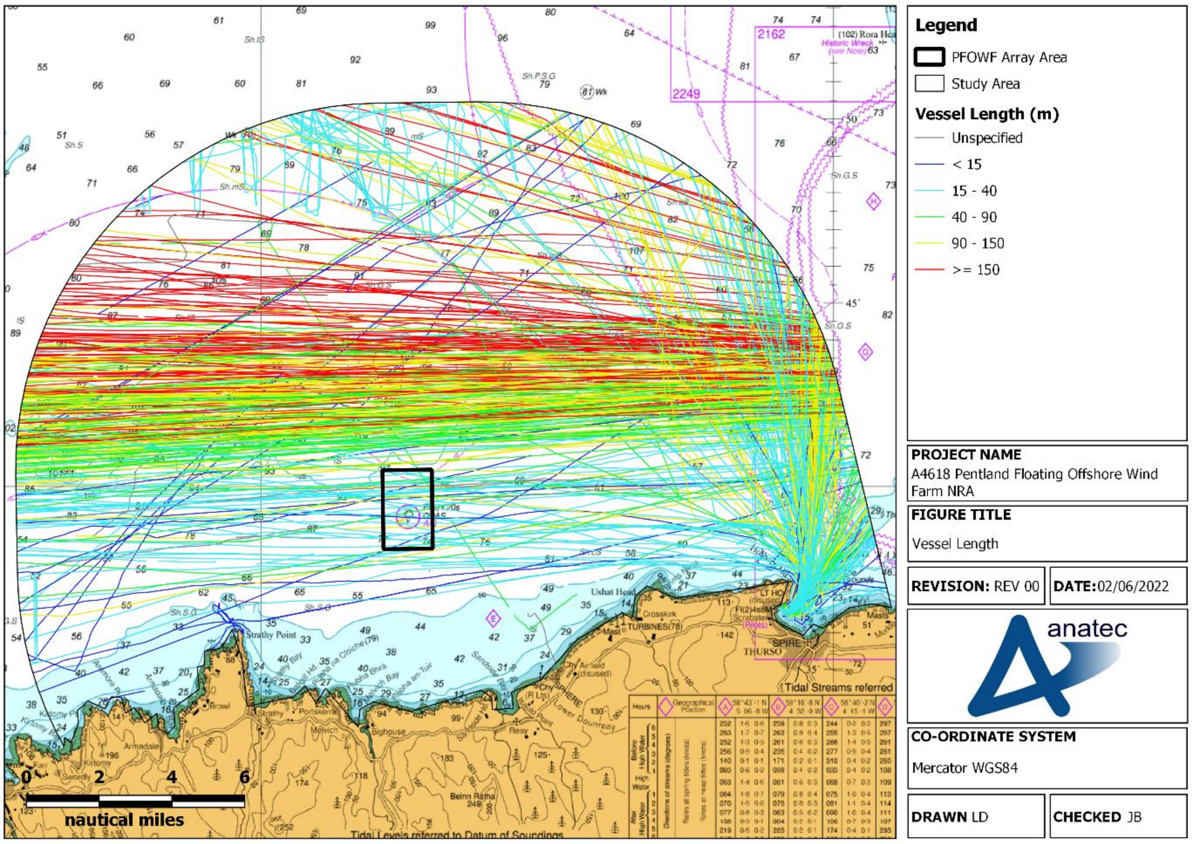

Figure 13.14 Vessel Lengths – Summer and Winter 2021

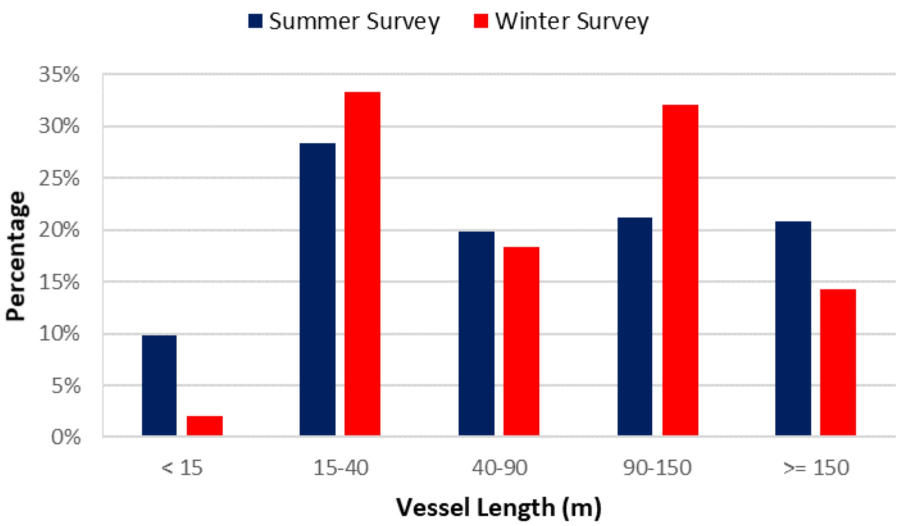

Figure 13.15 Vessel Length Distribution – Summer and Winter 2021

152. Excluding 2% Unspecified, the average length of vessels recorded within the Offshore Study Area during the summer and winter survey periods was 90 m and 87 m respectively. The largest vessel recorded during the two surveys was a 319 m cruise ship which passed

3 nm north of the PFOWF Array Area during the summer survey, while passing from Inverness to Liverpool.

153. The largest vessel recorded passing through the PFOWF Array Area was a 115 m cargo vessel which was heading to Scrabster. The average length of vessels passing through the PFOWF Array Area was 36 m.

13.3.2 Vessel Draught

154. The vessel tracks recorded within the Offshore Study Area during both the summer and winter survey periods, colour-coded by vessel draught, are presented in Figure 13.16. Following this, the distribution of the vessel draught recorded in each survey period is shown in Figure 13.17.

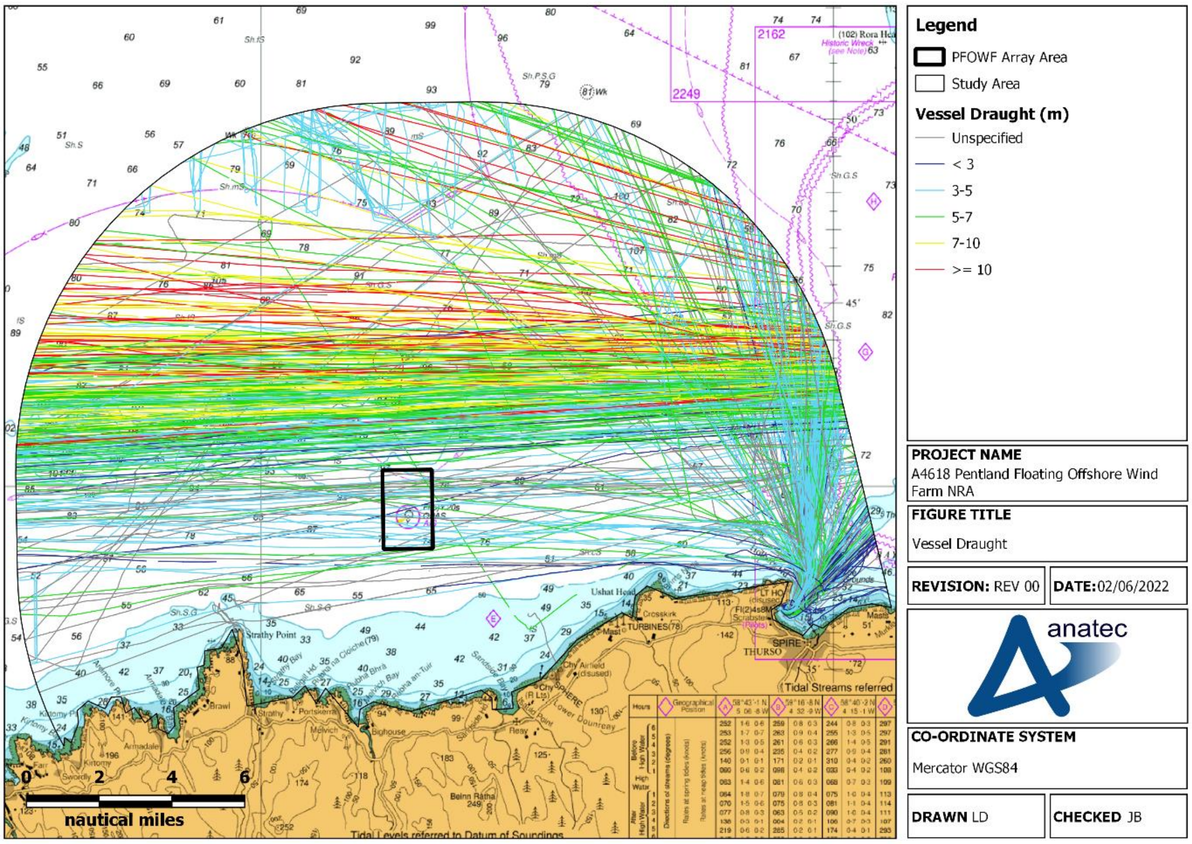

Figure 13.16 Vessel Draught – Summer and Winter 2021

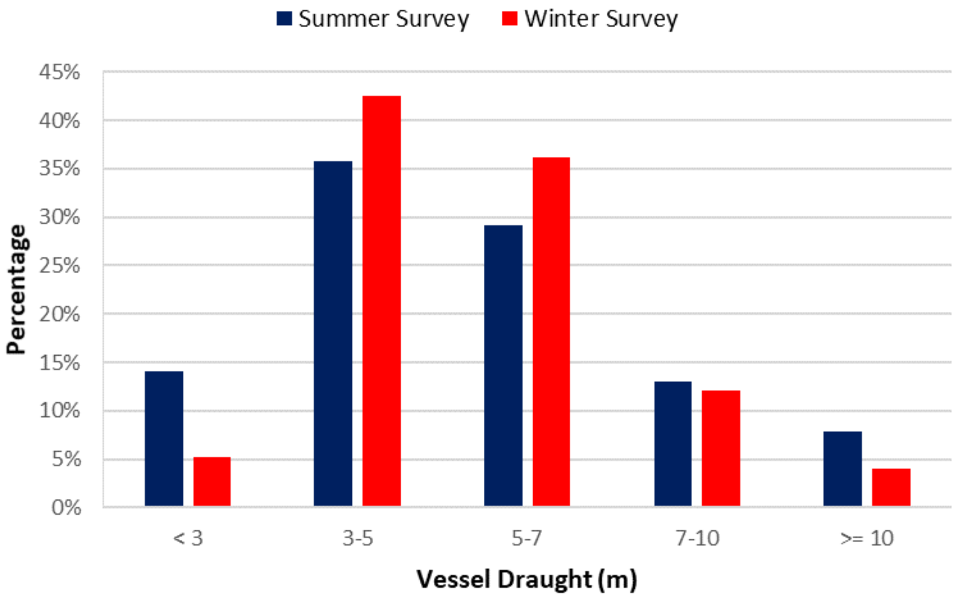

Figure 13.17 Vessel Draught Distribution – Summer and Winter 2021

155. Vessel draught information was available for approximately 83% of vessels recorded within the Offshore Study Area throughout the two survey periods. The unspecified vessels were either radar-only or AIS targets that did not broadcast a valid draught, which tended to be smaller vessels.

156. Overall, the deepest draught of 16.7 m broadcast by a crude oil tanker, which passed 4 nm north of the PFOWF Array Area. Excluding unspecified, the average draught of vessels recorded within the Offshore Study Area was 5.5 m during the summer and 5.3 m during the winter survey period.

157. The average draught of vessels recorded within the PFOWF Array Area was 4.5 m, with the deepest draught being 6.2 m, broadcast by a research / survey vessel which passed from south-east to north-west through the PFOWF Array Area during the summer survey.

13.4 Vessel Routeing

13.4.1 Definition of a Main Route

158. Main routes passing through the Offshore Study Area have been identified using the principles set out in MGN 654 (MCA, 2021). Vessel traffic data are assessed and vessels transiting at similar headings and locations are identified as a main route. To aid in identifying routes, vessel traffic data can also be interrogated to show vessels (by name or operator) that frequently transit those routes, identifying ‘regular runner/operator routes’. The route width can then be calculated using the 90^{th} percentile rule from the median line of the potential shipping route as shown in Figure 13.18.

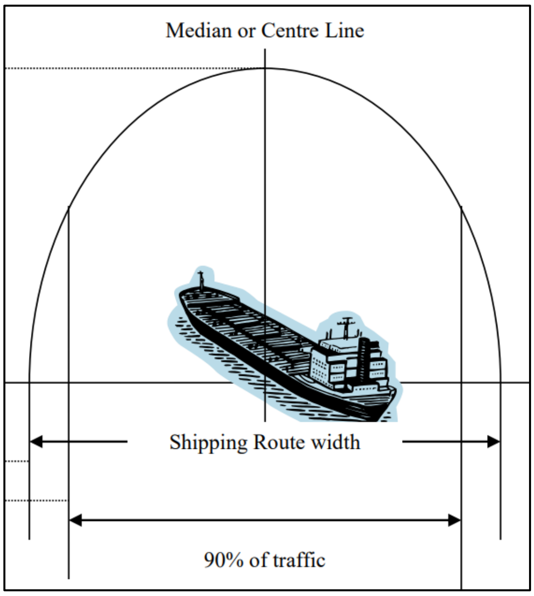

Figure 13.18 Illustration of Main Route Calculation (MCA, 2016)

13.4.2 Pre-Wind Farm Main Commercial Routes

159. A total of five main routes were identified from the AIS data studied. These routes and corresponding 90th percentiles are shown relative to the PFOWF Array Area in Figure 13.19. Following this, relevant details of the identified routes are given in Table 13.1. This includes the key terminus / origin ports, however, it should be noted that these are based on the most common destinations transmitted via AIS by vessels on the routes, and therefore it should not be assumed that a vessel transiting on a given route will necessarily be heading to the destination listed. It is also noted that for route 1, the destinations reported on AIS were considered too diffuse to allocate a particular port as a terminus or origin, as the Pentland Firth is frequently used as a gateway between North America and a variety of European ports.

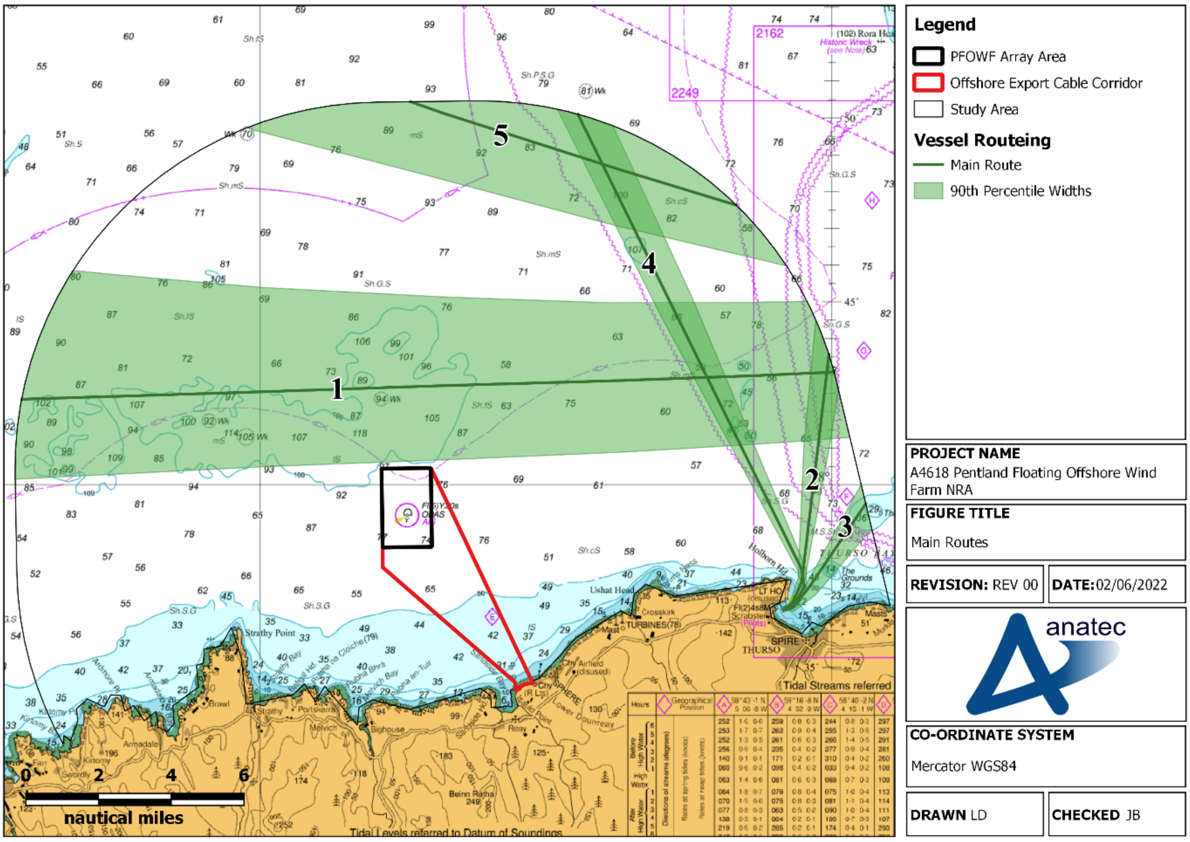

Figure 13.19 Main Routes

Table 13.1 Main Route Details

Route	Key Terminus / Origin Ports	Average Transits per Day	Description
1	Various USA Ports / Various European Ports	10	Major shipping route passing east-west to the north of the PFOWF Array Area.
2	Scrabster / Stromness	6	Largely passenger route utilised by the *Hamnavoe*.
3	Scrabster / Immingham	1	Route passing east out of Scrabster.
4	Scrabster / Tórshavn	<1	Route passing north-west from Scrabster.
5	Rotterdam (The Netherlands) / Reykjavik (Iceland)	1	Route passing through the Pentland Firth and through the north-east corner of the Offshore Study Area.

14 Additional Vessel Traffic Data

160. This section presents analysis of additional vessel traffic data sources which have been used to supplement the 28 days data collected during the two dedicated vessel traffic surveys analysed in Section 13.

161. The additional sources have primarily been used to capture any longer-term trends, and to validate the 2021 vessel traffic data which may have been affected by the COVID-19 pandemic. The latter was raised as a concern during consultation, particularly relating to recreational vessels (RYA Scotland) and cruise ships (Chamber of Shipping).

14.1 AIS Survey Data (2019)

162. At the scoping stage of the NRA process for the Offshore Development, an initial review of 28 days of AIS data was undertaken. This comprised 14 days from summer, recorded from 8th August to 13th August 2019, and 14 days from winter, recorded from 6th December to 19th December 2019, in order to capture seasonal variations in vessel traffic patterns.

163. Figure 14.1 and Figure 14.2 present the tracks of vessels recorded on AIS during the summer and winter periods respectively, colour-coded by vessel type. The key characteristics of the vessel traffic survey data analysed in Section 13 are generally present in the 2019 data, which indicates that the COVID-19 impact on commercial vessels in particular was relatively minor.

164. The main vessel routes discussed in Section 13.4 were consistent with those observed in the Scoping Report data, with the east-west commercial route being similarly defined. Vessel numbers and the frequency of vessel types were also in generally good agreement with the 2021 survey data. There was a decrease in the number of cruise ships recorded within the area, with 8 recorded in 2021 compared to 12 recorded in 2019.

165. Two notable differences were observed in the Scoping Data, the first being a greater presence of tracks which may represent active fishing. This is especially prevalent in the summer 2019 data (see Figure 14.1), where potential fishing tracks were observed in and around the eastern edge of the PFOWF Array Area.

166. The second notable difference was in the composition of the recreational traffic recorded in summer 2019. While overall recreational vessel numbers remained similar, a much greater proportion of non-UK recreational vessels was observed in 2019 (62%) compared to 2021 (12%). This is likely due to COVID-19 effects.

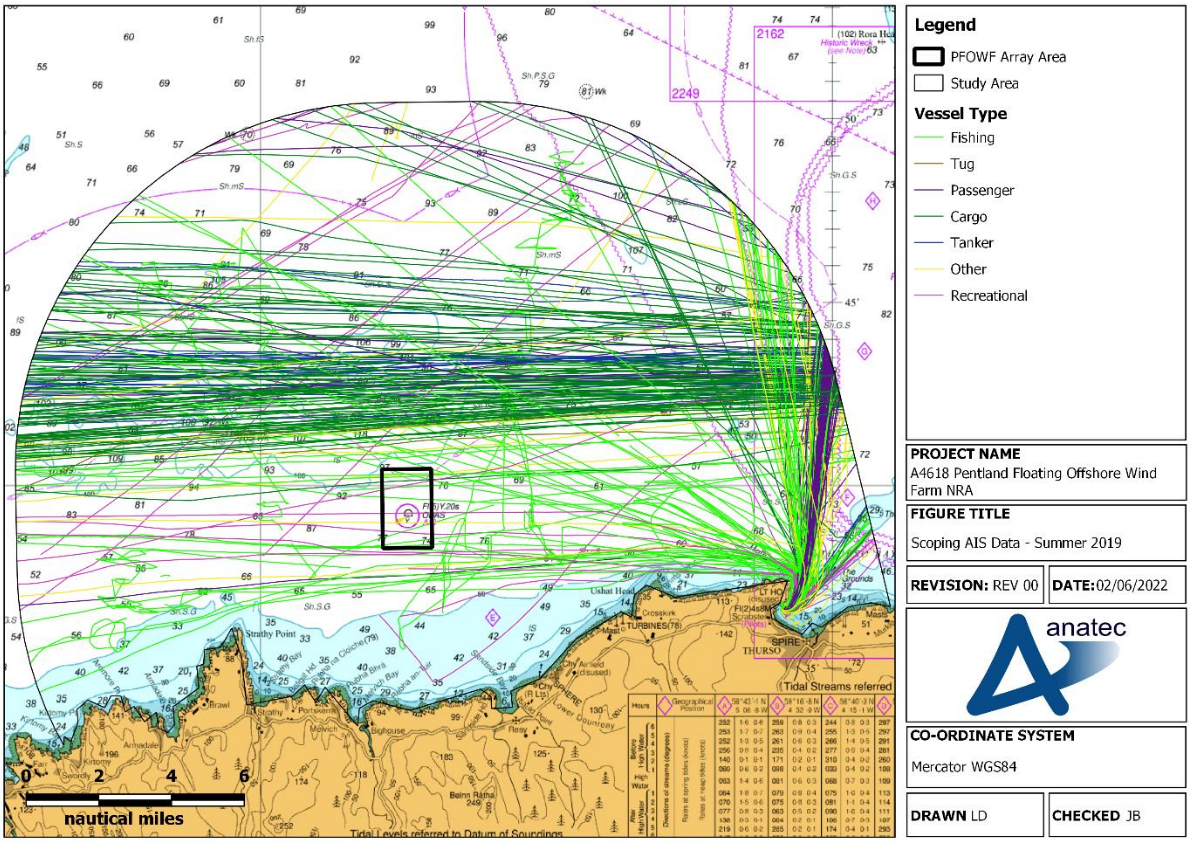

Figure 14.1 Scoping AIS Data – Summer 2019

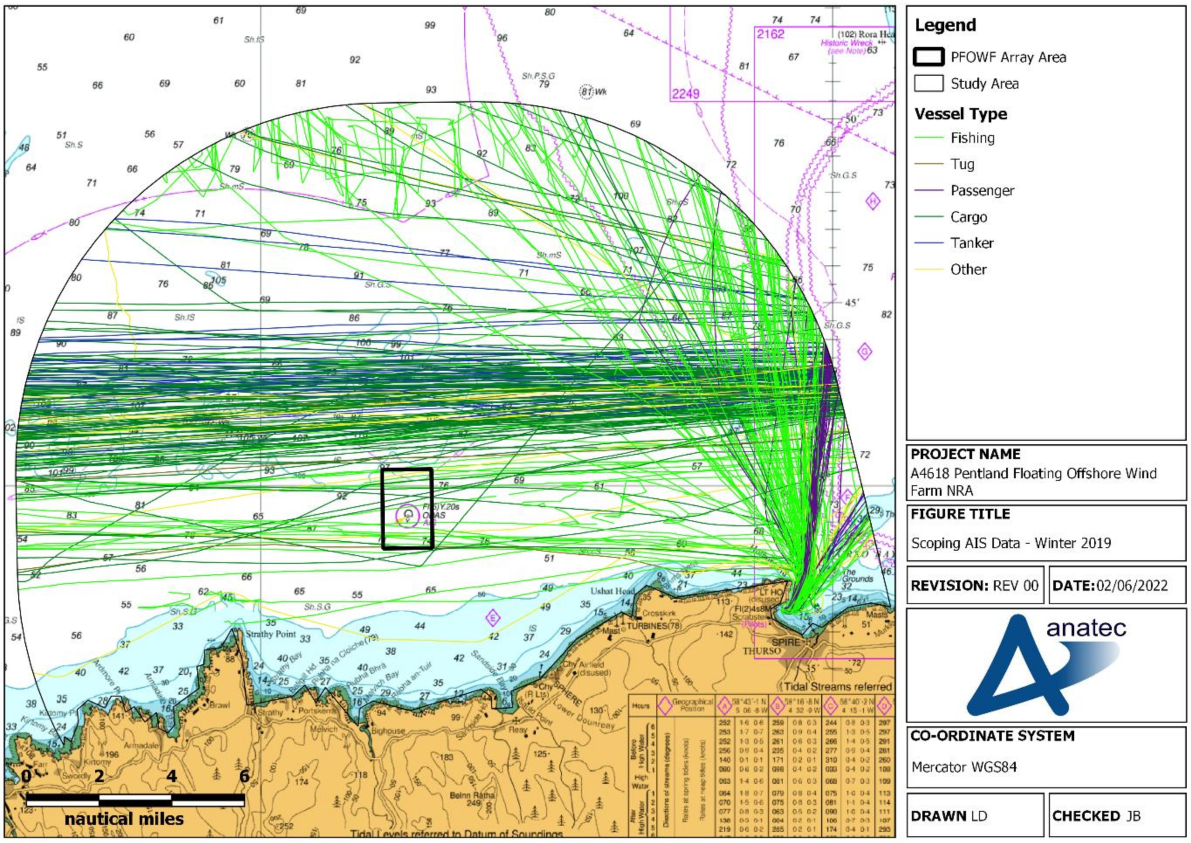

Figure 14.2 Scoping AIS Data – Winter 2019

14.2 Dounreay Tri Demonstrator Project NRA (2015/16)

167. Further historical traffic patterns were assessed in the 2016 NRA carried out for the Dounreay Tri Demonstrator Project (Dounreay Tri Ltd, 2016). The NRA analysed 28 days of survey data, covering 18th to 31st July 2015 and 18th to 31st January 2016, and revealed traffic patterns which agree well with the 2021 vessel traffic data assessed in Section 13. The main routes used in the area are consistent with those seen in 2021, with vessel density appearing to be similarly distributed as it was in 2021.

168. The traffic levels within the PFOWF Array Area were noticeably lower in 2015/16 than in 2021, though it is noted that the 2015/16 data does not include radar or visual observations.

14.3 Shipping Study for Marine Scotland (2012)

169. Anatec completed a study in 2012 for Marine Scotland which analysed shipping in the Pentland Firth and Orkney Waters Strategic Area. The study was focused on commercial and recreational vessels, and encompassed a wide area which included the PFOWF Array Area.

170. Figure 14.3 presents the overall vessel density throughout the Pentland Firth and Orkney Waters in Summer 2012 based on the study area used in the report. The main vessel routes are again consistent with the 2021 vessel traffic data, with the route passing east-west north of the PFOWF Array Area being the most significant route in the area. The route used by the *Hamnavoe* ro-ro ferry between Scrabster and Stromness was also clearly defined in the density grid.

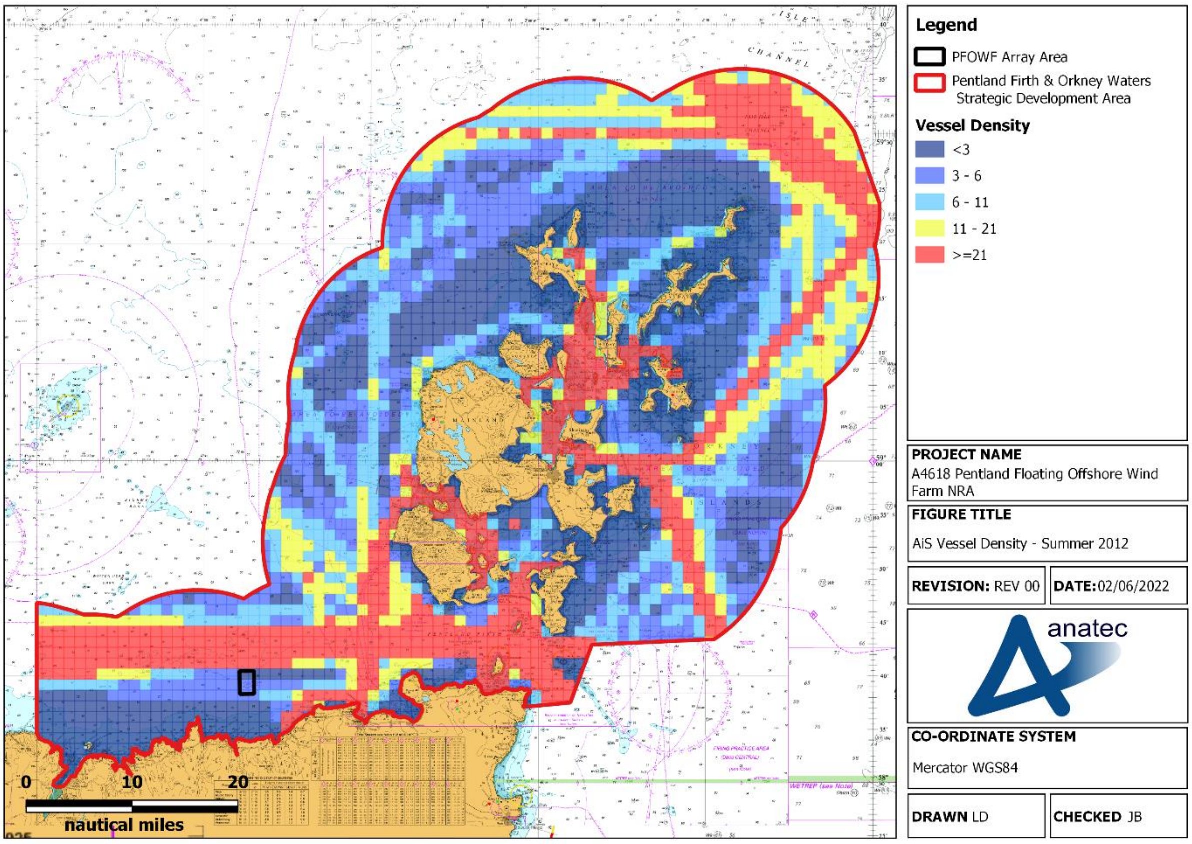

Figure 14.3 AIS Vessel Density – Summer 2012

171. Figure 14.4 presents the tracks of recreational vessels recorded on AIS within the Pentland Firth and Orkney Water Strategic Area in the summers of 2011 and 2012. Note that this was restricted to AIS vessels, which are a minority and tend to be larger, better equipped vessels. There were recreational tracks recorded passing east-west through the Pentland Firth, including a proportion crossing the PFOWF Array Area. There were also a group of tracks heading NE-SW between Stromness in Orkney and the NW coast of Scotland passing north of the PFOWF Array Area.

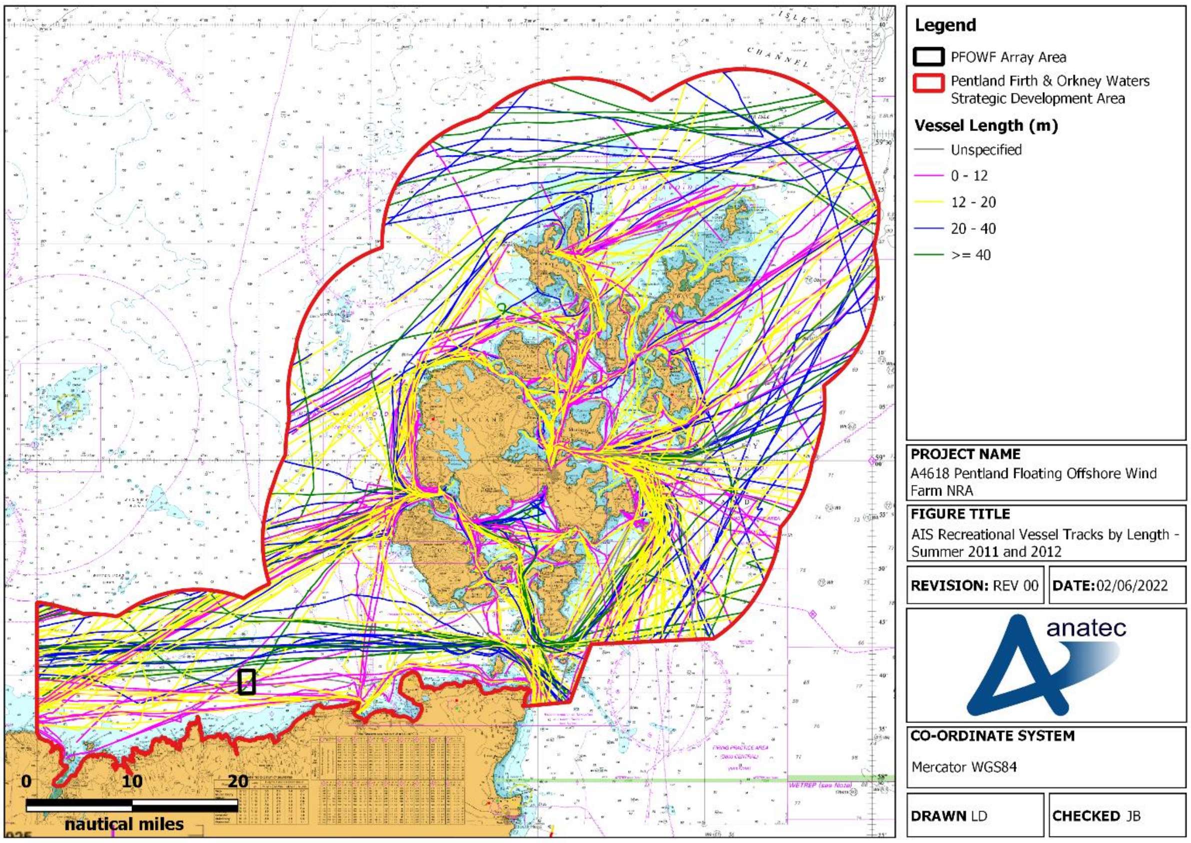

Figure 14.4 AIS Recreational Vessel Tracks by Length – Summer 2011 and 2012

14.4 RYA Coastal Atlas of Recreational Boating

172. In addition to analysis of the vessel traffic survey data, the *RYA Coastal Atlas of Recreational Boating* (RYA, 2019) has been obtained and reviewed for the area. The RYA Coastal Atlas may be used to "*help identify and protect areas of importance to recreational boaters, to advise on new development proposals and in discussions over navigational safety".* A density heat map is included in the Atlas which indicates the density of recreational activity around the UK coast.

173. Figure 14.5 presents a plot of the RYA Coastal Atlas heat map in the area surrounding the PFOWF Array Area.

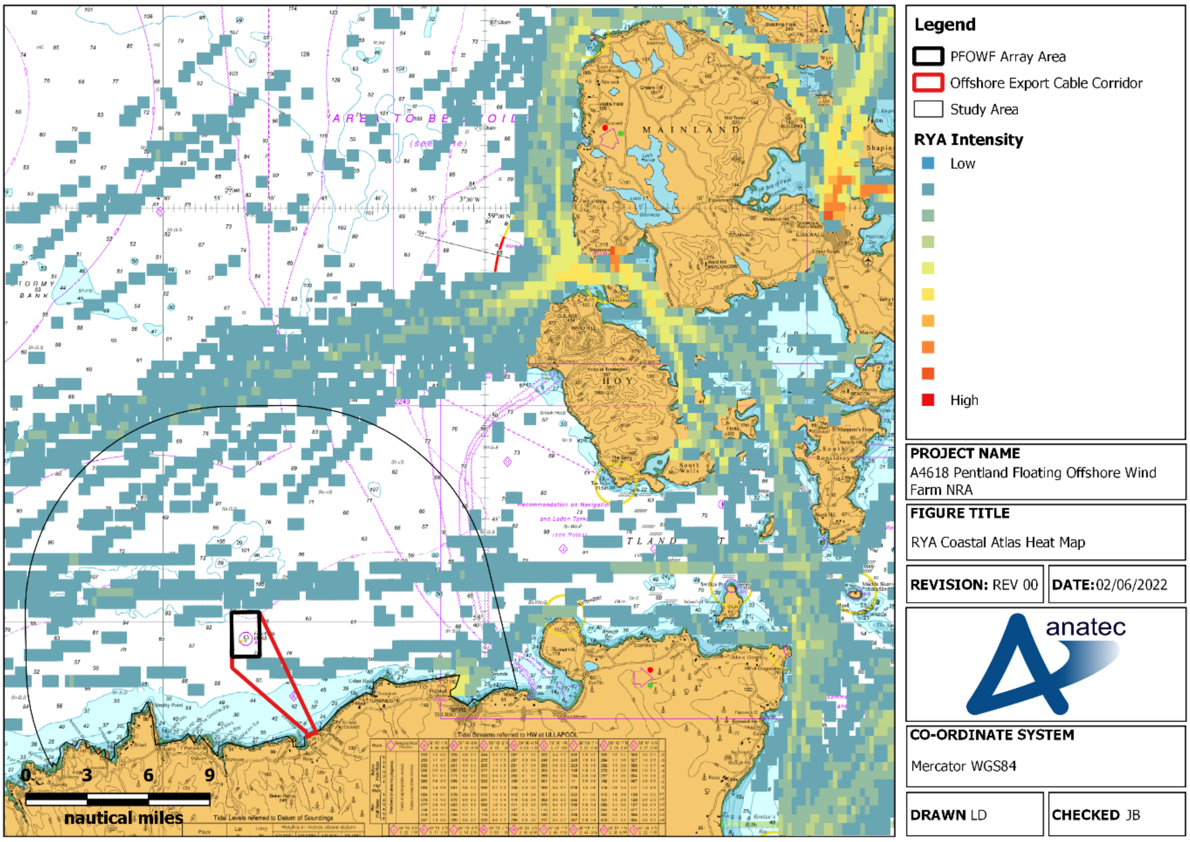

Figure 14.5 RYA Coastal Atlas Heat Map

174. Recreational boating within the Offshore Study Area was generally low, with slightly higher levels of activity recorded close to Scrabster Harbour. There was considered to be good correlation between the RYA Coastal Atlas data and the data collected during the vessel traffic surveys. Densities within the Array Area were low.

14.5 Scrabster Harbour Statistics

175. Data on vessel arrivals at Scrabster harbour was provided following consultation, in order to assess the baseline traffic and the COVID-19 impact on vessel numbers in the vicinity of the PFOWF Array Area. Total vessel arrivals per month are presented in Figure 14.6.

176. The average number of vessel arrivals per day reduced from 4.2 vessels per day in 2019 (entire year), to 3.7 in 2021 (Jan-Oct only). This was largely due to a drop in fishing vessels from 3.2 to 2.8 per day, while yachts also decreased from 0.2 to 0.1 arrivals per day. Cargo vessel arrivals increased slightly from 0.8 per day in 2019 to 0.9 per day in 2021. This suggests the COVID-19 pandemic had an effect on small vessel arrivals at Scrabster during 2021. The peak in July 2019 is in part due to a significant increase in recreational activity, with 28 yachts arriving at Scrabster, compared with a maximum of 16 in any of the other months for which statistics were provided.

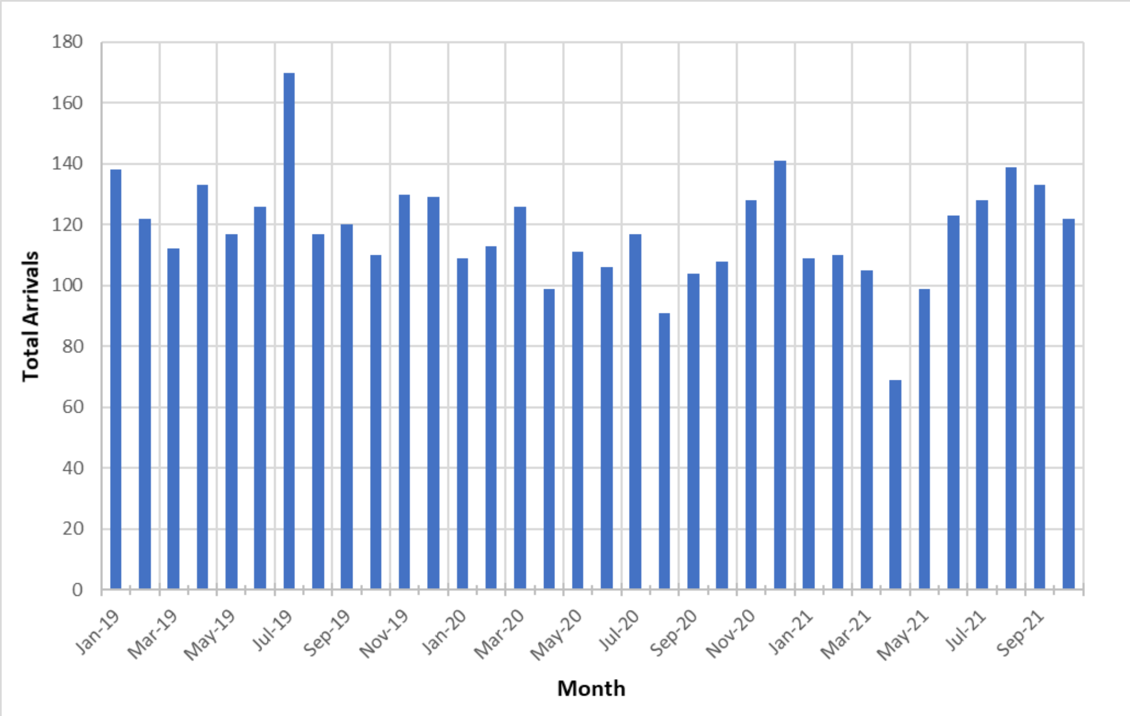

Figure 14.6 Total Arrivals per Month at Scrabster Harbour

14.6 Orkney Marinas

177. Following consultation, Orkney Marinas which operate marinas at Kirkwall, Stromness and Westray, provided visitor figures for the years 2016 to 2021, which are presented in Figure 14.7. Vessel arrivals dropped from an average of 707 from 2016-19 to 176 in 2020 due to the impact of the COVID-19 pandemic. Visitor numbers for UK vessels returned to pre-pandemic levels in 2021, however, non-UK vessels remained at just 13% of the pre-pandemic average.

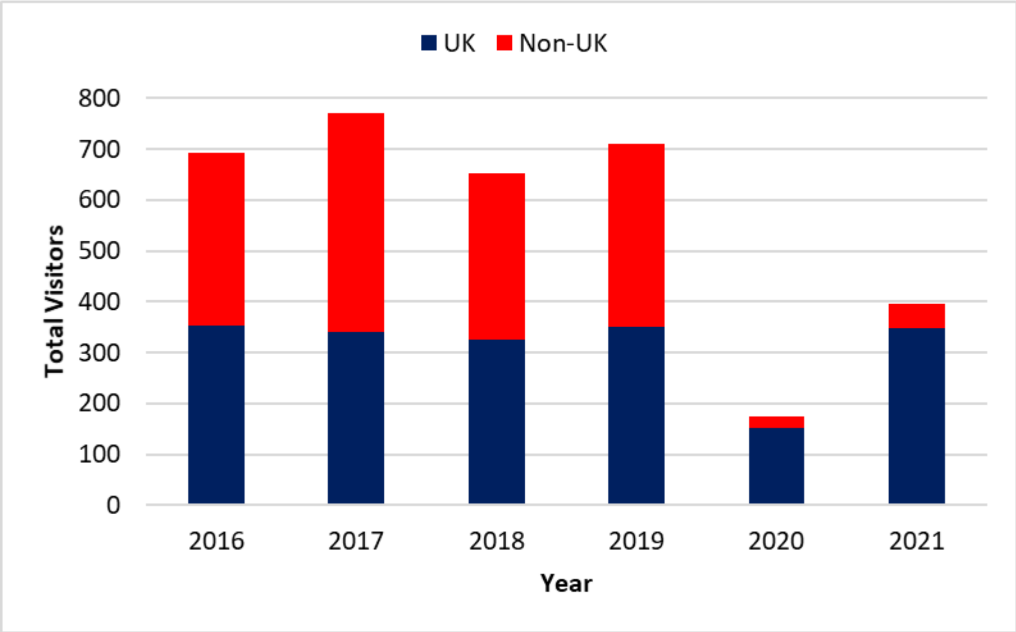

Figure 14.7 Total Visitors per Year at Orkney Marinas

15 Review of Subsea Infrastructure

178. This section reviews the potential for interaction with the subsea infrastructure by maritime users of the area. This includes the export cable to shore and the mooring lines and inter-array cables associated with the Offshore Development.

15.1 Offshore Export Cable Corridor

15.1.1 Vessel Traffic

179. Figure 15.1 presents the tracks of vessels recorded intersecting the Offshore Export Cable Corridor during the 28 days of AIS, radar and visual observation data. Following this, Figure 15.2 presents the number of unique vessels per day which were recorded intersecting the Offshore Export Cable Corridor, broken down by vessel type. The Offshore Export Cable Corridor encompasses the eastern and southern edges of the PFOWF Array Area, as well as a corridor to the landfall site adjacent to Sandside Bay.

180. Vessels were recorded intersecting the Offshore Export Cable Corridor approximately twice per day across the two survey periods. The majority (55%) of vessels recorded within the Offshore Export Cable Corridor were fishing vessels, with ‘Other’ vessels (14%) (including research / survey vessels, an RNLI lifeboat and an offshore supply ship) and recreational vessels (12%) and cargo vessels (12%) making up a significant proportion of vessels intersecting the Offshore Export Cable Corridor. An average of two vessels per day was also recorded during the 2019 scoping survey periods, noting this is AIS-only. Vessel types recorded within the Offshore Export Cable Corridor in 2019 were also in good agreement with the 2021 survey data.

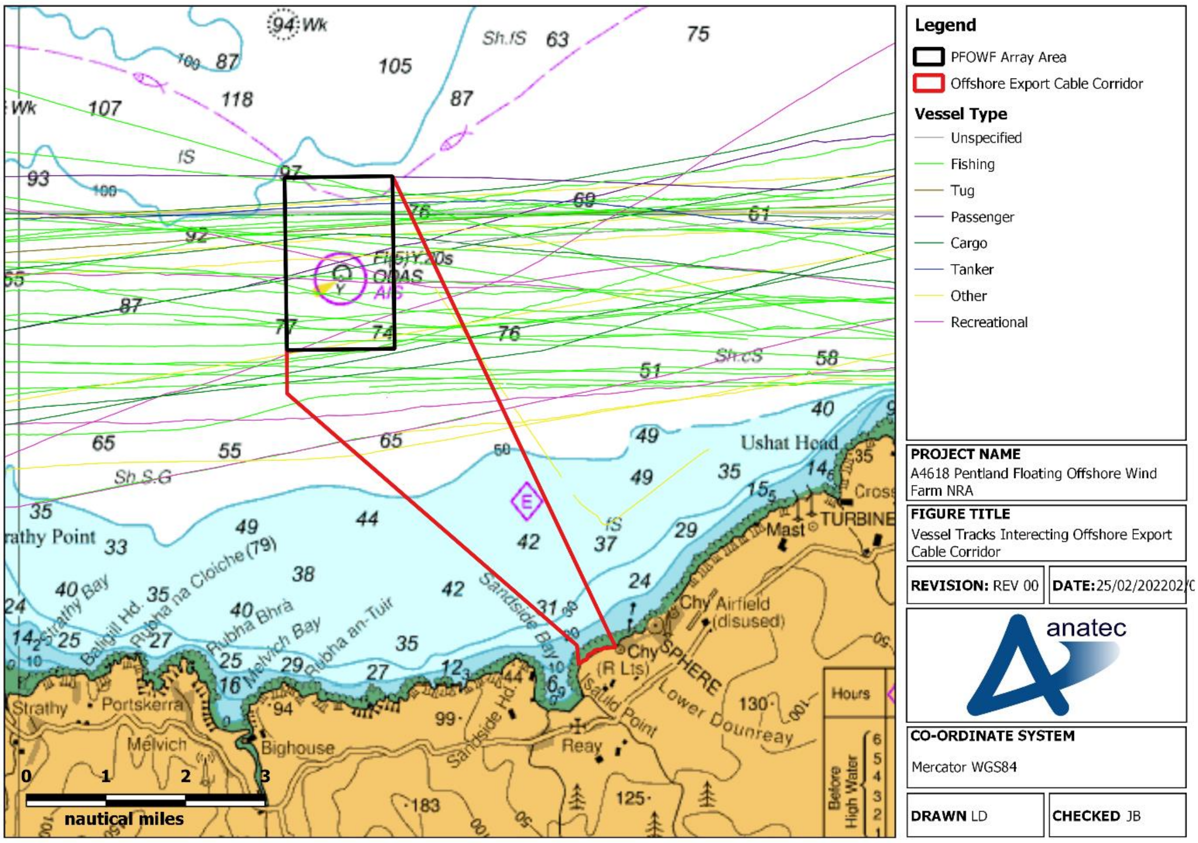

Figure 15.1 Vessel Tracks Intersecting Offshore Export Cable Corridor

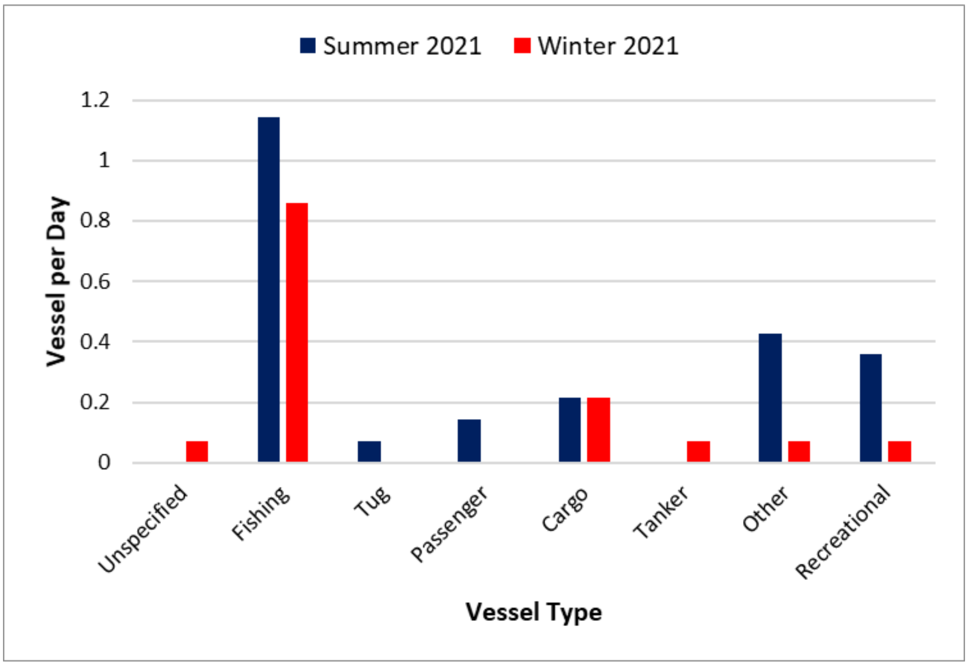

Figure 15.2 Vessels per Day Intersecting Offshore Export Cable Corridor

181. The average length of vessels recorded within the Offshore Export Cable Corridor was 32 m, with the largest vessel being a 115 m cargo vessel recorded heading to Scrabster.

182. Draught information was unavailable for a significant proportion (38%) of the vessels recorded within the Offshore Export Cable Corridor. For the vessels with draught information available, the average draught was 4.9 m, with the deepest draught being recorded by the longest vessel in the area, the 115 m cargo vessel, with a draught of 6.2 m.

15.1.2 Potential Interaction

183. Across both the 2021 and 2019 survey data, the only anchoring activity recorded within the Offshore Study Area was located within Thurso Bay, approximately 10 nm east of the PFOWF Array Area. There is an anchorage available to recreational vessels located within Sandside Bay, adjacent to the Offshore Export Cable Corridor landfall, however, this is only likely to be used by small vessels and is sheltered from the Offshore Export Cable Corridor by the bay. Therefore, the likelihood of anchor interaction with the export cable is thought to be low.

184. Charted water depths within the Offshore Export Cable Corridor range from approximately 75 m at the boundary with the PFOWF Array Area to approximately 20 m close to shore, with water more than 0.5 nm offshore being at least 30 m deep. Therefore, it is not thought that any cable protection is likely to significantly affect under keel clearance. The maximum height of any installed cable protection above the seabed will be approximately 1 m, which will make minimal difference to the navigable depth throughout the majority of the Offshore Export Cable Corridor. Given the charted water depths in the area, water depth are likely to be reduced by 5% or more only within 600 m of the shore. However, the intention is to utilise HDD starting from between 400 m and 700 m from the shore, which means that the cable may be under the seabed at this point. The draughts of any vessels transiting this area will also be very shallow.

185. The Hazard Review Workshop assessed the risk of fishing gear snagging on cables to be tolerable with mitigation. This is considered further within the EIAR, Volume 2, Chapter 13: Commercial Fisheries.

15.2 Mooring Lines and Inter-Array Cables

15.2.1 Vessel Draught

186. As discussed in Section 6, the mooring lines and inter-array cables pose a potential under keel hazard to vessels passing close to the floating structures. The taut mooring lines represent the worst-case as they remain higher in the water column for longer than catenary moorings and inter-array cables (see Table 6.5).

187. To investigate the potential under keel hazard, draught analysis for vessels recorded within the PFOWF Array Area during both the 2021 and 2019 surveys has been carried

out. The distribution of the vessel draughts is presented in Figure 15.3. The average draught of vessels recorded within PFOWF Array Area was 4.6 m, with the deepest draught recorded at 6.4 m by a cargo vessel heading to Liverpool. It is noted that draught information was not available for a significant proportion (39%) of vessels recorded within the PFOWF Array Area, due to this information being either unavailable for radar-only targets, or not broadcast on AIS; such vessels will tend to be smaller and hence shallower draught. The distribution of the vessel draughts is presented in Figure 15.3.

188. For comparison, the draughts of vessels recorded transiting on the most significant commercial route during the 28 days of 2021 survey data (see Route 1 in Figure 13.19 and Table 13.1) have also been analysed. The average draught of vessels recorded on this route was 6.6 m, with the deepest draught of 16.7 m recorded by a crude oil tanker which passed 4 nm to the north of the PFOWF Array Area heading for Port Said, Egypt.

189. These findings agree with the analysis in Section 13.3.2, where it was observed that the vessels passing close to shore and within the PFOWF Array Area tended to have relatively shallow draught, reducing the risk of interaction with the mooring lines, while the largest vessels with the deepest draught pass further offshore to the north of the PFOWF Array Area.

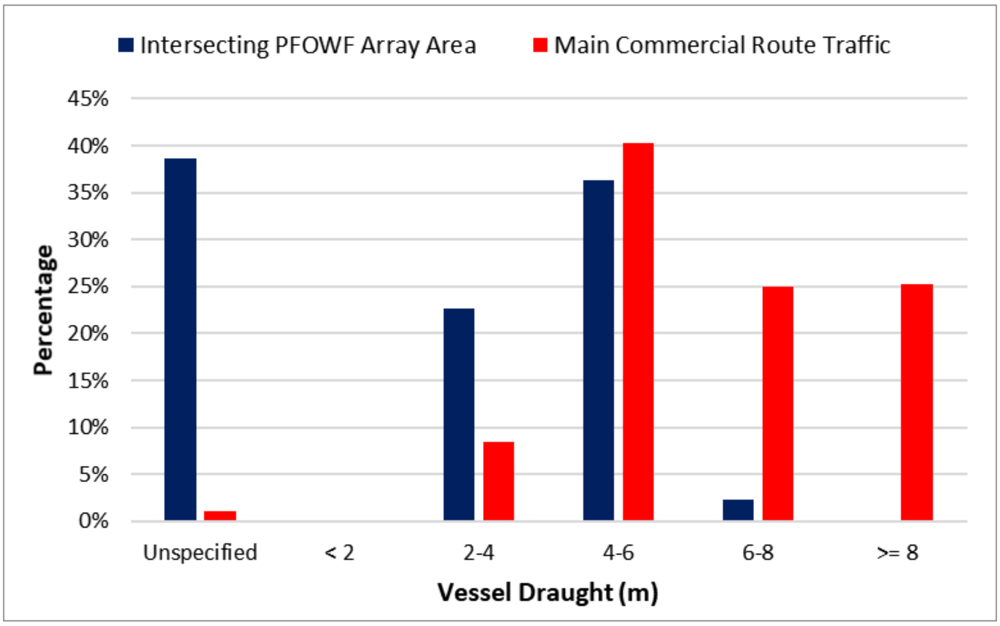

Figure 15.3 Draught Comparison Between Vessels Recorded within PFOWF Array Area and Commercial Vessels Transiting on Route 1

190. It was noted in Section 6.3 that a taut mooring configuration would see the mooring lines remain close to the sea surface at a considerable distance from the floating structures. Given the deepest draught recorded within the Offshore Study Area during either the scoping or survey periods was 16.7 m, a vessel with a similar draught would be at risk of interacting with the taut mooring lines at a distance of between 150 m and 200 m, given the indicative draught measurements given in Table 6.5.

15.2.2 Potential Interaction

191. Based on the average (static) draught of 4.5 m within the PFOWF Array Area, and allowing a conservative 50% for dynamic motion due to waves, etc., this implies an average vessel could interact with lines within 6.8 m of sea level. For the taut mooring configuration outlined in Section 6.3 this extends to approximately 75 m from the floating foundation. For the deepest (static) draught vessel of 6.4 m, with an assumed dynamic draught of 9.6 m, the range of potential interaction would be approximately 100 m from the surface structure.

192. It was noted during consultation that promulgation of information would be a key mitigation measure in reducing risk posed by the mooring lines associated with the Offshore Development. This includes appropriate marking on charts, as well as publications such as Notices to Mariners and Kingfisher bulletins, in order to ensure local sea users have an understanding of the mooring configuration and the safe passing distances available to them. This is particularly important given that the hazard is subsea.

193. The deepest draught vessel recorded within the 10 nm Offshore Study Area was 16.7 m, equating to a (conservative) dynamic draught of 25 m. This vessel could therefore interact with the taut mooring lines at a distance of approximately 270 m. This would only be likely in a drifting scenario as larger vessels under power naturally tend to avoid the array, passing to the north.

194. It is considered that larger vessels at under keel risk will likely navigate around the perimeter of the array rather than between turbines, especially in heavy seas when dynamic motion will be greatest. Some smaller vessels may choose to navigate through the array in suitable conditions. Consultation with the Cruising Association indicated that 100 m would be a reasonable minimum passing distance for yachts, which would provide a safe under keel clearance for these vessels.

195. Details on the mooring spreads and associated hazards will also be taken into account within procedures for vessels working within the PFOWF Array Area, and will be shared with the emergency services including the RNLI as part of the ERCoP.

196. The water depths within the array mean that anchoring is unlikely to take place in the PFOWF Array Area. Throughout both the 2021 surveys and the 2019 scoping data, no anchoring was observed taking place in proximity to the PFOWF Array Area. The risk of fishing gear snagging on mooring lines was assessed in the Hazard Review Workshop to be tolerable with mitigation. This is considered further within Volume 2, Chapter 13: Commercial Fisheries.

16 Navigation, Communication and Position Fixing Equipment

197. This section discusses the potential hazards relating to the navigation, communication, and position-fixing equipment of vessels that may arise due to the infrastructure associated with the Offshore Development.

16.1 Very High Frequency Communications (Including Digital Selective Calling)

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

199. The WTGs had no noticeable effect on voice communications within the array or ashore. It was noted that if small craft vessel-to-vessel and vessel-to-shore communications were not significantly affected by the presence of WTGs, then it is reasonable to assume that larger vessels with higher-powered, and more efficient, systems would also be unaffected.

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

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

202. In addition to the North Hoyle trials, a desk-based study was undertaken for the Horns Rev 3 OWF in December 2014. It was concluded that there were not expected to be any conflicts between point-to-point radio communications networks, and no interference upon VHF communications (Energinet, 2014).

203. Following consideration of these reports, and noting that since the trials discussed above there have been no significant issues with regards to VHF observed or reported, the presence of the Offshore Development is anticipated to have no significant impact upon VHF communications.

16.2 Very High Frequency Direction Finding

204. During the North Hoyle OWF trials in 2004, the VHF Direction Finding (DF) equipment carried in the trial boats did not function correctly when very close to WTGS (within

approximately 50 m). This is deemed to be a relatively small-scale impact due to the limited use of VHF DF equipment and will not impact operational or SAR activities (MCA and QinetiQ, 2004).

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

16.3 Automatic Identification System

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

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

16.4 Navigational Telex System

208. The Navigational Telex (NAVTEX) system is used for the automatic broadcast of localised Maritime Safety Information (MSI) and either prints it out in hard copy or displays it on a screen, depending upon the model.

209. There are two NAVTEX frequencies. All transmissions on NAVTEX 518 Kilohertz (kHz), the international channel, are in English. NAVTEX 518 kHz provides the mariner (both recreational and commercial) with weather forecasts, severe weather warnings and navigation warnings such as obstructions or buoys off station. Depending on the user’s location, other information options may be available such as ice warnings for high latitude sailing.

210. The 490 kHz national NAVTEX service may be transmitted in the local language. In the UK, full use is made of this secondary frequency including useful information for smaller craft, such as the inshore waters forecast and actual weather observations from weather stations around the coast.

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

16.5 Global Positioning System

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

213. The additional tests showed that *"even with a very close proximity of a wind turbine to the GPS antenna there were always enough satellites elsewhere in the sky to cover for any that might be shadowed by the wind turbine tower"* (MCA and QinetiQ, 2004).

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

16.6 Electromagnetic Interference

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

216. Like any magnetic device, compasses are affected by nearby ferrous materials as well as by strong electromagnetic forces, such as magnetic fields emitted from power cables. As the compass still serves as an essential means of navigation in the event of power loss or as a secondary source, it should not be allowed to be affected to the extent that safe navigation is prohibited. The important factors with respect to cables that affect the resultant deviation are:

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

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

218. To date, there have been no problems reported relating to magnetic compasses in any of the trials carried out (inclusive of SAR helicopters) nor at any operational OWFs.

However, small vessels with simple magnetic steering and hand bearing compasses should be wary of using these close to WTGs as with any structure in which there is a large amount of ferrous material (MCA and QinetiQ, 2004).

16.7 Marine Radar

219. This section summarises trials and studies undertaken in relation to radar effects from OWFs in the UK. It is important to note that since the time of the trials and studies discussed, WTG technology has advanced significantly, most notably in terms of the size of WTGs available to be installed and utilised. The use of these larger WTGs allows for a greater spacing between WTGs than was achievable at the time of the studies being undertaken, which is beneficial in terms of radar interference effects (and surface navigation in general) as detailed below.

16.7.1 Trials

220. During the early years of offshore renewables within the UK, maritime regulators undertook a number of trials (both shore-based and vessel-based) into the effects of WTGs on the use and effectiveness of marine radar.

221. In 2004, trials undertaken at the North Hoyle OWF (MCA, 2005) identified areas of concern regarding the potential impact on marine- and shore- based radar systems due to the large vertical extents of the WTGs (based on the technology at that time). This resulted in radar responses strong enough to produce interfering side lobes and reflected echoes (often referred to as false targets or ghosts).

222. Side lobe patterns are produced by small amounts of energy from the transmitted pulses that are radiated outside of the narrow main beam. The effects of side lobes are most noticeable within targets at short range (below 1.5 nm) and with large objects. Side lobe echoes form either an arc on the radar screen similar to range rings, or a series of echoes forming a broken arc, as illustrated in Figure 16.1.

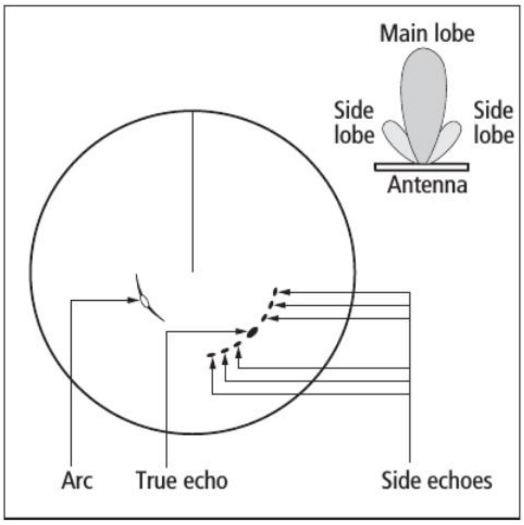

Figure 16.1 Illustration of Side Lobes on Radar Screen

223. Multiple reflected echoes are returned from a real target by reflection from some object in the radar beam. Indirect echoes or 'ghost' images have the appearance of true echoes but are usually intermittent or poorly defined; such echoes appear at a false bearing and false range, as illustrated in Figure 16.2.

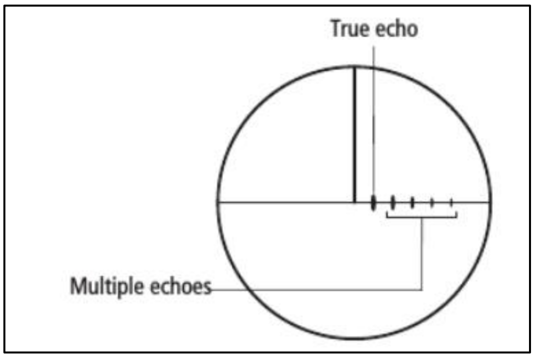

Figure 16.2 Illustration of Multiple Reflected Echoes on Radar Screen

224. Based on the results of the North Hoyle trials, the MCA produced a Shipping Route Template designed to give guidance to mariners on the distances which should be established between shipping routes and OWFs. The latest version of the Shipping Route Template is included in MGN 654.

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

226. Theoretical modelling of the effects of the proposed Atlantic Array OWF, which was to be located off the south coast of Wales, on marine radar systems was undertaken by the Atlantic Array project (Atlantic Array, 2012) and considered a wider spacing of WTGs than were considered within the early trials. The main outcomes of the modelling were the following:

- Multiple and indirect echoes were detected under all modelled parameters;
- The main effects noticed were stretching of targets in azimuth (horizontal) and appearance of ghost targets;
- There was a significant amount of clear space amongst the returns to ensure the recognition of vessels moving amongst the WTGs and safe navigation;
- Even in the worst case with radar operator settings artificially set to be poor, there is significant clear space around each WTG that does not contain any multipath or side lobe ambiguities, to ensure any safe navigation and allow differentiation between false and real (both static and moving) targets;
- Overall it was concluded that the amount of shadowing observed was very little (noting that the model considered lattice-type foundations which are sufficiently sparse to allow radar energy to pass through;
- The lower the density of WTGs the easier it is to interpret the radar returns and fewer multipath ambiguities are present;
- In dense, target rich environments, S-Band radar scanners suffer more severely from multipath effects in comparison to X-Band radar scanners;
- It is important for passing vessels to keep a reasonable separation distance between the WTGs in order to minimise the effect of multipath and other ambiguities;
- The Atlantic Array study undertaken in 2012, noted that the potential for radar interference was mainly a problem during periods of reduced visibility when mariners may not be able to visually confirm the presence of other vessels in proximity (those without IAS installed which are usually fishing and recreational craft). It is noted that this situation would arise with or without WTGs in place; and
- There is potential for the performance of a vessel's ARPA to be affected when tracking targets in or near the array. Although greater vigilance is required, during the Kentish Flats trials it was shown that false targets were quickly identified by mariners and then by the equipment itself.

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

228. The MCA has also produced guidance to mariners operating in proximity to OREIs in the UK which highlights radar issues amongst others to be taken into account when planning and undertaking voyages in proximity to OREIs (MCA, 2008). The interference buffers presented in Table 16.1 are primarily based on MGN 654 (MCA, 2021) but also consider the content of MGN 371 (MCA, 2008a), MGN 543 (MCA, 2016) and MGN 372 (MCA, 2008b).

Table 16.1 Distances at which Impacts on Marine Radar Occur

Distance at Which Effect Occurs (nm)	Identified Effects (as per MGNs)
0.5	▪ Intolerable impacts can be experienced at under 0.5 nm. ▪ X-Band radar interference is intolerable under 0.25 nm. ▪ Vessels may generate multiple echoes on shore-based radars under 0.45 nm.
1.5	▪ Under MGN 654, impacts on radar are considered to be tolerable with mitigation between 0.5 nm and 3.5 nm. ▪ S-band radar interference starts at 1.5 nm. ▪ Echoes develop at approximately 1.5 nm, with progressive deterioration in the radar display as the range closes. Where a main vessel route passes within this range, considerable interference may be expected along a line of WTGs. ▪ The WTGs produced strong radar echoes giving early warning of their presence. ▪ Target size of the WTG echo increases close to the WTG with a consequent degradation on both X and S-Band radars.

229. As noted in Table 16.1, the onset range from the WTGs of false returns is approximately 1.5 nm, with progressive deterioration in the radar display as the range closes. If interfering echoes develop, the requirements of the Convention on International Regulations for Preventing Collisions at Sea (COLREGs) *Rule 6 Safe Speed* are particularly applicable and must be observed with due regard to the prevailing circumstances (IMO, 1972/77). In restricted visibility, *Rule 19 Conduct of Vessels in Restricted Visibility* and compliance with *Rule 5 Look-out* applies, to take into account information from other sources which may include sound signals and VHF information, for example from a VTS or AIS (MCA, 2017).

16.7.2 Experience from Operational Developments

230. The evidence from mariners operating in proximity to existing OWFs is that they quickly learn to adapt to any effects. This section examines existing cases of operational wind farms for the purpose of assessing potential impact of operational WTGs on marine radar.

231. AIS information can also be used to verify the targets of larger vessels (generally vessels over 15 m LOA – the minimum threshold for fishing vessel AIS carriage requirements). Approximately 13% of the vessel traffic recorded within the Offshore Study Area during the summer survey was under 15 m LOA, although throughout the summer survey approximately 94% of vessel tracks were recorded on AIS, indicating a high level of AIS take-up among vessels for which AIS carriage is not mandatory.

232. For any smaller vessels, particularly fishing vessels and recreational vessels, AIS Class B devices are becoming increasingly popular and allow the position of these small craft to be verified when in proximity to an OWF.

16.7.3 Increased Radar Returns

233. Beam width is the angular width, horizontal or vertical, of the path taken by the radar pulse. Horizontal beam width ranges from 0.75° to 5°. How well an object reflects energy back towards the radar depends upon its size, shape and aspect angle.

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

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

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

236. It is noted that there are multiple operational wind farms, such as Galloper in the outer Thames, that successfully operate fixed radar antenna from locations on the periphery of the array. The antennas are able to provide accurate and useful information to onshore coordination centres.

16.7.5 Application to the Offshore Development

237. Upon construction of the Offshore Development, some commercial vessel may pass within 1.5 nm of the wind farm structures and therefore may be subject to a minor level of radar interference. Trials, modelling and experience from existing developments note that any impact can be mitigated by adjustment of radar controls.

238. Figure 16.3 presents an illustration of potential radar interference due to the Offshore Development based on consideration of the distances shown in Table 16.1 alongside the worst case layout assessed within the NRA (see Section 6.2.1).

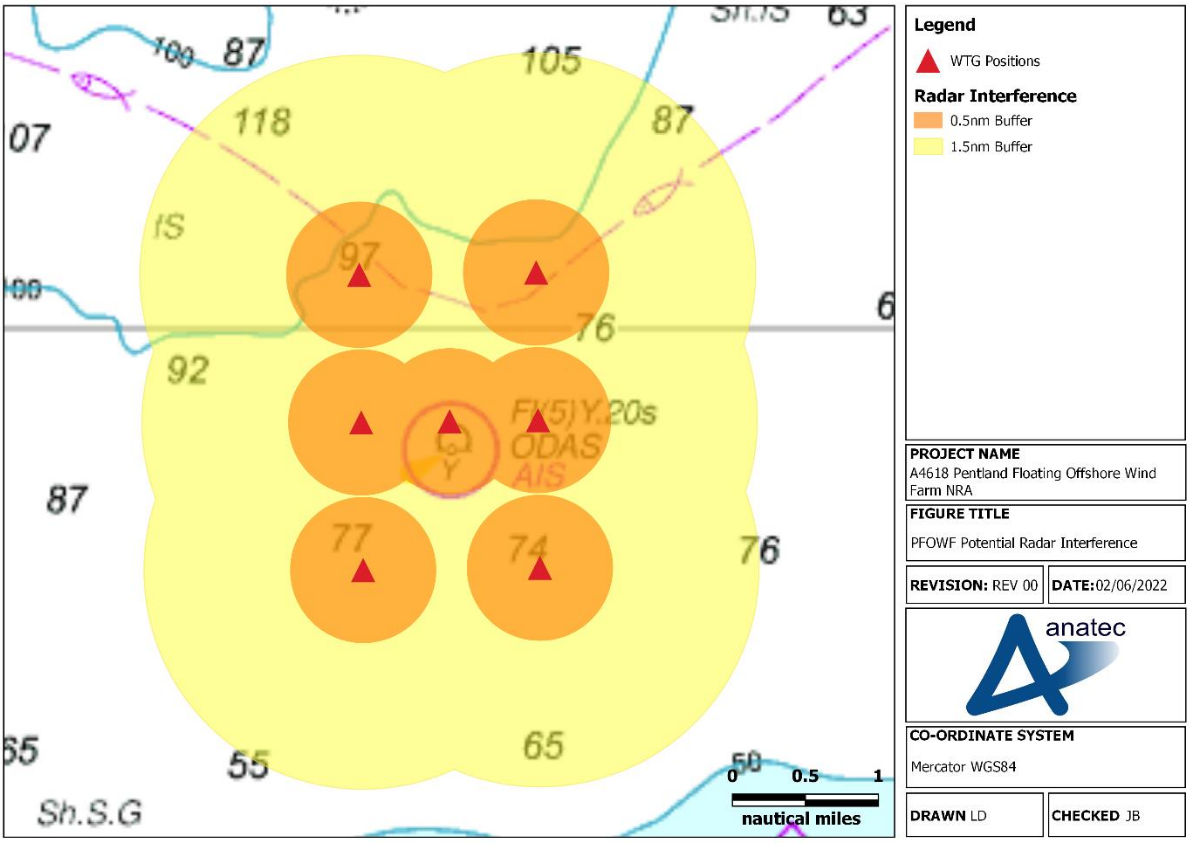

Figure 16.3 PFOWF Potential Radar Interference

239. Vessels passing within the PFOWF Array Area will be subject to a greater level of radar interference, as impacts become more substantial in close proximity to WTGs. This may require additional mitigation by vessels choosing to pass within the PFOWF Array Area, including the consideration of navigational conditions such as visibility when passage planning. Compliance with the COLREGs will be essential.

240. Vessels transiting on the shipping route which passes east-west north of the PFOWF Array Area may pass within 1.5 nm of WTGs, and therefore may experience some radar interference. The average passing distance of vessels using this route is approximately 2.2 nm north of the PFOWF Array Area, meaning that vessels on the southernmost extreme of the route transit through the PFOWF Array Area.

241. Based on previous experience at existing operational wind farms, there is not considered to be any notable effect on radar which cannot be effectively managed by the adjustment of radar controls.

16.8 Sound Navigation Ranging Systems

242. No evidence has been found to date with regard to existing OWFs to suggest that Sound Navigation and Ranging (SONAR) systems produce any kind of SONAR interference

which is detrimental to the fishing industry, or to military systems. No impact is therefore anticipated relating to the presence of the Offshore Development.

16.9 Noise

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

16.10 Summary of Impact

244. Based on the detailed technical assessment of the effects due to the presence of the Offshore Development on navigation, communication, and position-fixing equipment in the previous subsections, assessment of frequency and consequence and the resulting residual effect for each component of this impact is summarised in Table 16.2.

Table 16.2 Summary of Impact on Navigation, Communication, and Position-Fixing Equipment

Topic	Frequency	Consequences	Residual Effect
VHF	Negligible	Minor	Broadly Acceptable
VHF DF	Extremely Unlikely	Minor	Broadly Acceptable
AIS	Negligible	Minor	Broadly Acceptable
NAVTEX	Negligible	Minor	Broadly Acceptable
GPS	Negligible	Minor	Broadly Acceptable
EMF	Extremely Unlikely	Negligible	Broadly Acceptable
Marine radar	Remote	Minor	Broadly Acceptable
WTG generated noise	Negligible	Minor	Broadly Acceptable
SONAR	Negligible	Minor	Broadly Acceptable

17 Cumulative Overview

245. Potential cumulative effects have been considered for activities in combination and cumulatively with the Offshore Development. This section provides an overview of the developments and projects that have been screened into the cumulative impact assessment based on the criteria provided in Section 3.4.

246. The only cumulative project identified which is of relevance to shipping and navigation users is the Scottish Hydro Electric (SHE) Transmission Orkney-Caithness Transmission Project. The cable is consented and is planned to have a landfall in a similar location to the Offshore Development, at the existing Dounreay substation. Based on publicly available information, It is noted that there is potential for interaction between the Offshore Export Cable and the transmission cable, including the possible need for a cable crossing close to the landfall of both projects, though, however, this is subject to the final design decisions and construction timelines of both projects. The cable route is shown alongside the Offshore Development in Figure 17.1.

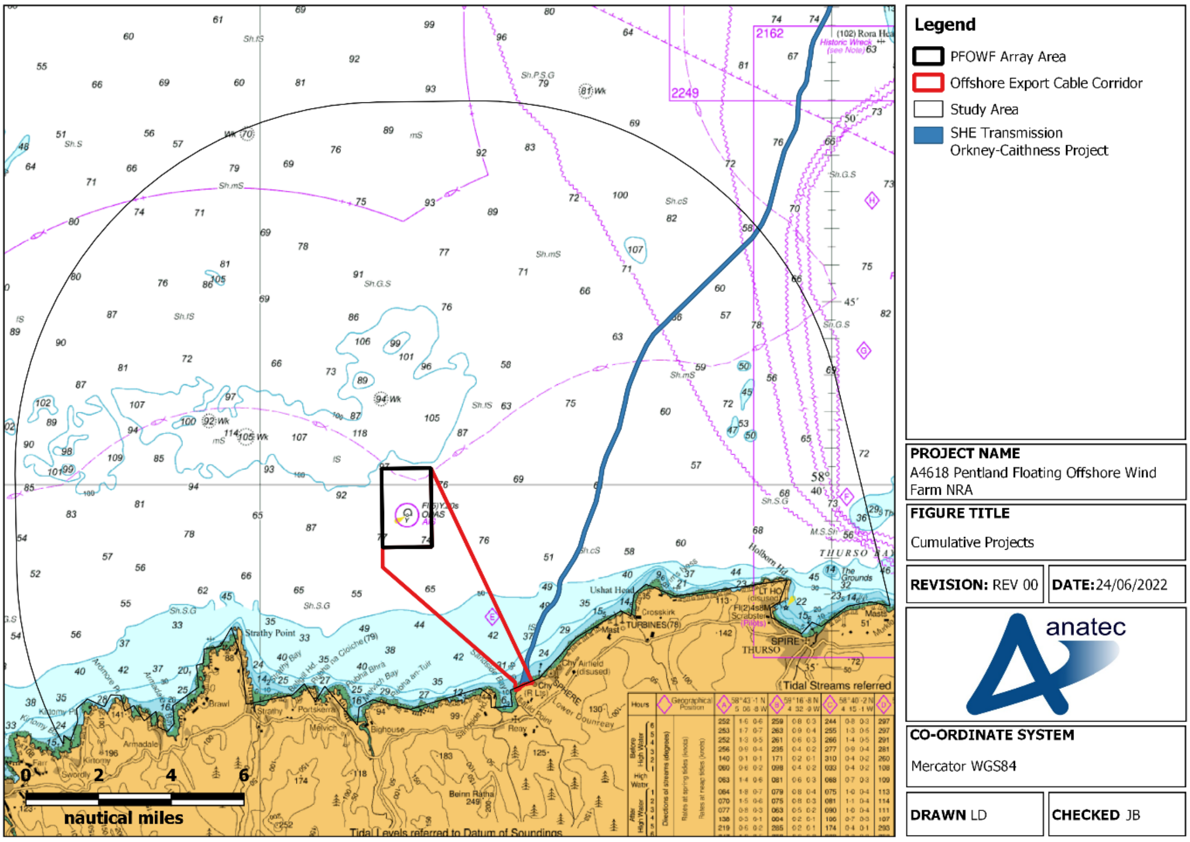

Figure 17.1 Cumulative Projects

247. It is expected that the main effect on shipping and navigation users due to the cable would occur during the construction phase of the Offshore Development, due to the cable-laying operations causing temporary, localised displacement of traffic. There may

also be effects during cable maintenance over the life of the Project. With the implementation of standard industry practice mitigation measures it is expected the risk to shipping and navigation users would be temporary, minor and not significant.

248. Due to the limited and short term effects of the cable installation on shipping and navigation users, it is not anticipated that any significant cumulative effects would arise due to the Offshore Development in combination with the SHE Transmission Orkney-Caithness Project.

18 Future Case Traffic

249. This section presents the predicted future case level of activity within and in proximity to the Offshore Development, and the anticipated shift in the mean positions of the main commercial routes as they adapt to the presence of the Offshore Development, identified from the marine traffic data (see Section 13.4).

18.1 Increases in Commercial Traffic

250. During the course of the NRA, consultation was held with local harbours, which included discussion of their future plans for expansion. However, it was noted in consultation, and observed from the survey data analysis, that most of the commercial traffic heading east-west via the Pentland Firth is associated with ports further afield, such as in the North Sea, Baltic Sea and North America.

251. Given the diverse nature of commercial shipping using the Pentland Firth, and as future commercial traffic trends are dependent on various factors, and hence difficult to predict, future case vessel traffic scenarios have been modelled assuming potential increases of both 10% and 20% within the commercial traffic allision and collision risk modelling. These are designed to be conservative figures, in line with the approach taken in other UK NRAs, in the absence of specific local developments that are known to affect traffic.

18.2 Increases in Commercial Fishing Vessel Activity

252. There is limited reliable information on future commercial fishing vessel activity levels upon which any firm assumption could be made. The NRA includes future case vessel traffic scenarios assuming potential increases of both 10% and 20% for the purposes of quantitative assessment of fishing allision risk. These are considered conservative figures, as above.

18.3 Increase in Recreational Activity

253. Orkney Marinas are expanding their capacity, which may lead to an increase in recreational vessels in the area. In addition, Stornoway's Newton Marina underwent construction work to double its number of yacht berths. Stornoway Port Authority is the located in the Outer Hebrides on Scotland's west coast, approximately 80 nm from the PFOWF Array Area. It is assumed that the future case vessel traffic scenarios, assuming potential increases of both 10% and 20%, capture the potential developments above.

18.4 Commercial Traffic Routeing

254. It is not possible to comprehensively predict the alternative routeing choices that commercial traffic may follow, and therefore a worst case alternative has been considered based upon the existing baseline routeing relative to the PFOWF Array Area (see Section 13.4).

255. As shown in Section 13.4.2, none of the main routes identified intersect the PFOWF Array Area. However, outlying vessels associated with Route 1 were observed near and within the PFOWF Array Area. On this basis it is likely that post wind farm, there will be a minor shift in the mean route position of Route 1 to the north, with the overall route width also narrowing slightly.

256. To ensure a worst case is assessed within the NRA, for the purposes of the modelling it has been assumed that the mean route position of Route 1 will not change, however, the overall route width will narrow to take into account the reduced sea room to the south. This approach is considered a worst case given:

- For allision risk, it assumes a minority of commercial vessels could still interact with structures within the PFOWF Array Area (a conservative assumption) and
- For vessel-to-vessel collision risk, the narrowing of the route around the current mean position and overall reduced sea room will increase the rate of encounters and hence potential for collisions.

19 Allision and Collision Risk Modelling

19.1 Overview

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

19.1.1 Allision and Collision Scenarios

258. For each element of the quantitative assessment both a pre- and post-wind farm scenario with base and future case vessel traffic levels have been considered, as per the MCA Methodology for Assessing Navigational Safety and Emergency Response Risks of OREIs (Annex 1 of MCA, 2021). This means the following four distinct scenarios have been modelled:

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

19.1.2 Hazards Assessed

259. Hazards considered in the quantitative allision and collision assessment are as follows:

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

260. The pre-wind farm collision assessment has used the vessel traffic survey data (see Section 13), as well as the outputs from consultation (see Section 4) and other baseline data sources (see Section 7). Conservative assumptions have then been made with regard to route deviations and future shipping growth (see Section 18).

19.2 Pre-Wind Farm

19.2.1 Encounters

19.2.1.1 Overview

261. An assessment of current vessel to vessel encounters in proximity to the PFOWF Array Area has been undertaken by replaying at high speed the data collected as part of the two vessel traffic surveys.

262. The model defines an encounter as two vessels passing within 1 nm of each other within the same minute. This helps to identify areas where existing congestion is highest, and therefore where offshore developments such as OWFs may potentially increase congestion (i.e., potentially increase the risk of encounters and collisions). It is noted that no account has been given to whether encounters are head on or head to stern; just whether the associated vessels were in close proximity.

263. To ensure the focus of the assessment was vessels in transit, encounters which involved one or more vessels recorded entirely within Scrabster port for the duration of the encounter have been removed. Encounters that only involved fishing vessels have been retained, however it should be considered that such cases may have been part of a planned fishing operation (e.g., pair trawling).

264. On this basis a total of 166 genuine encounter were identified within the 28 days of survey data. The identified encounters are presented in Figure 19.1, followed by the encounter density in Figure 19.2.

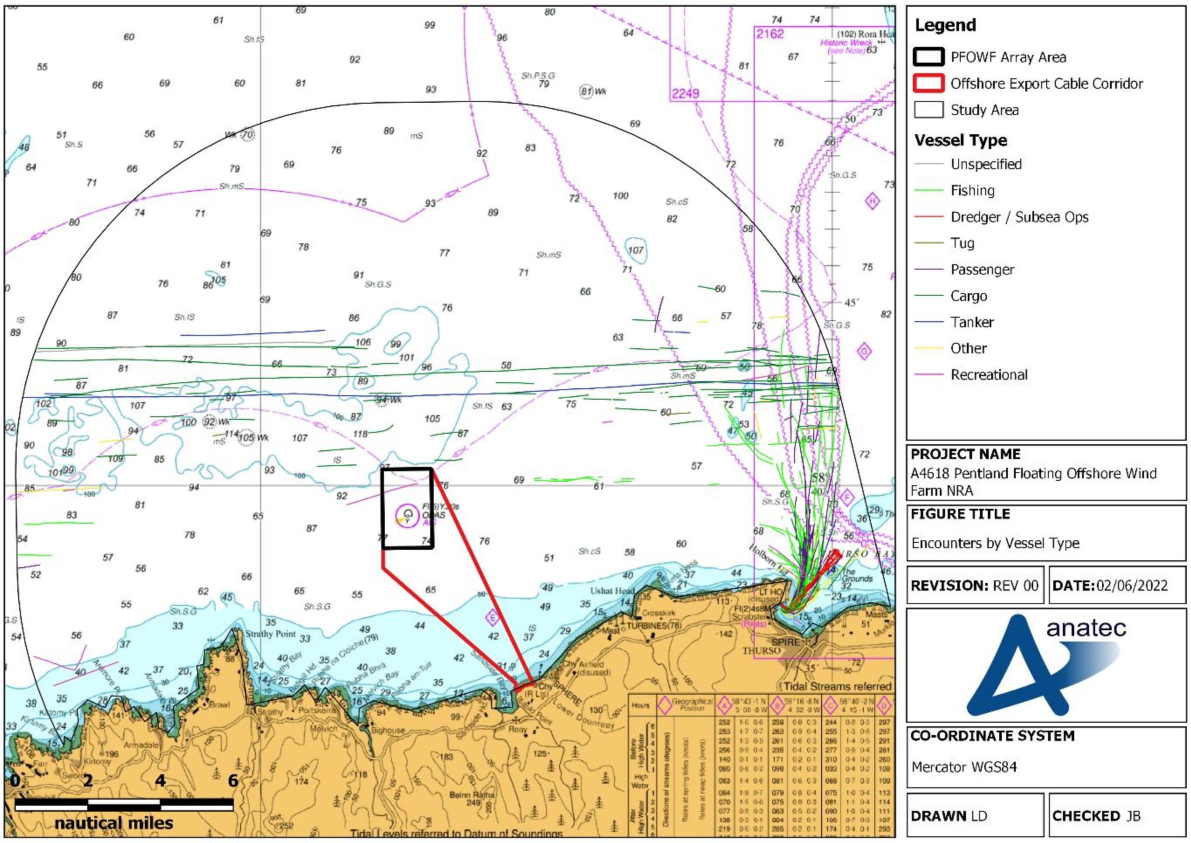

Figure 19.1 Encounters by Vessel Type

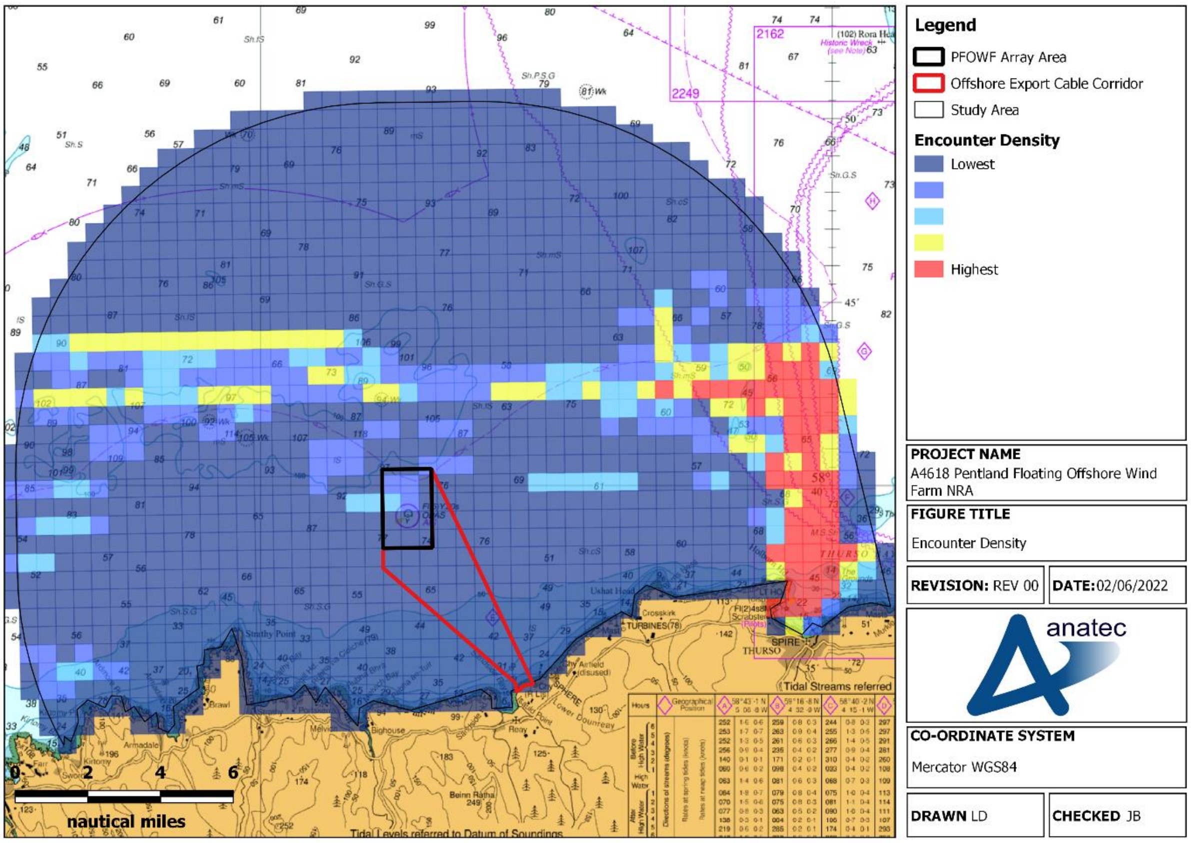

Figure 19.2 Encounter Density

As shown, the majority of encounters were observed to occur between vessels associated with transits to / from Scrabster. In comparison, encounters recorded within or near the PFOWF Array Area were limited.

19.2.1.2 Encounter Counts

265. The number of encounters recorded per day is presented in Figure 19.3.

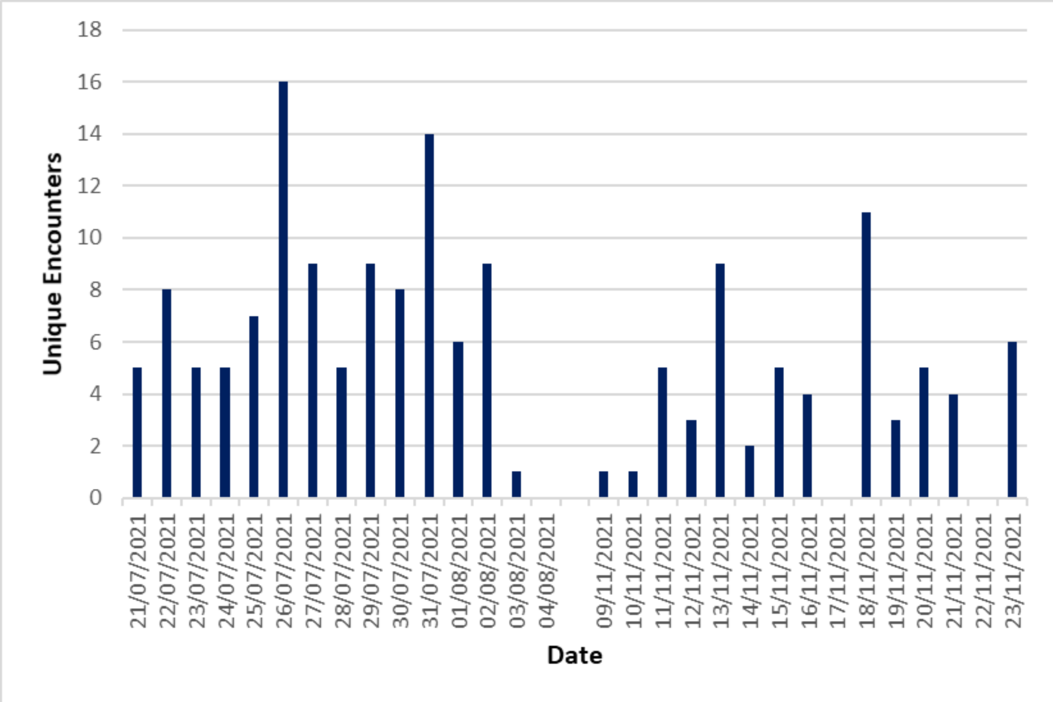

Figure 19.3 Encounters per Day

266. An average of 6 encounters per day was identified over the 28 days of survey data. The busiest day in terms of encounters was the 26th July 2021, when 16 unique encounters were recorded. No encounters were recorded on the 17th and 22nd November. It is noted that adverse weather and poor visibility were observed on several days of the two surveys, which may have caused vessels to increase passing distances and thereby reducing the rate of encounters.

19.2.1.3 Encounters by Vessel Type

267. The distribution of vessel types involved in the identified encounters is shown Figure 19.4.

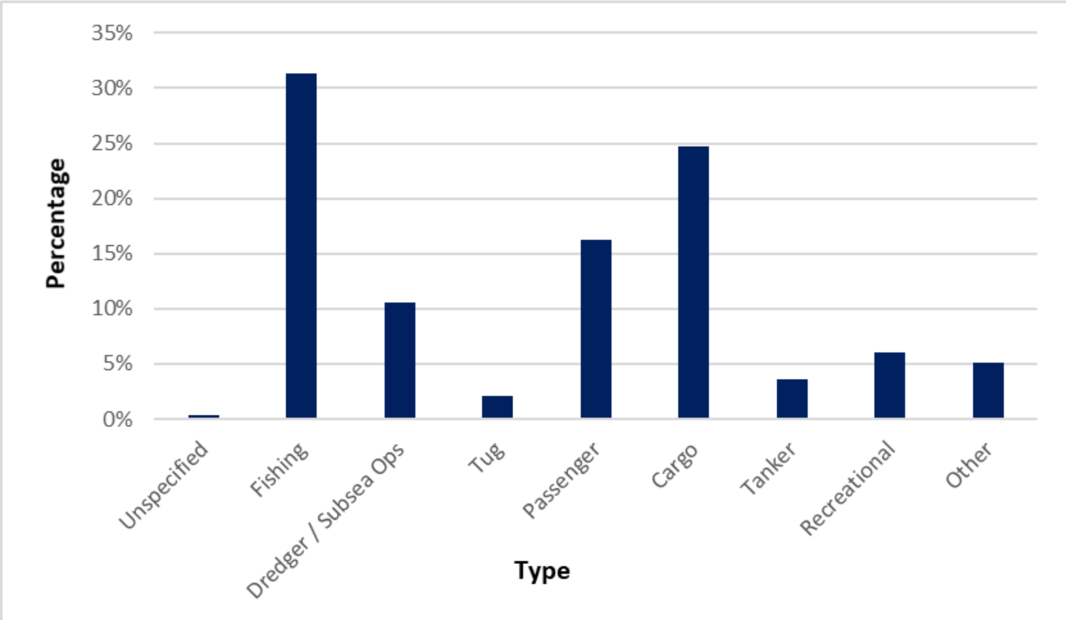

Figure 19.4 Encounters – Vessel Type Distribution

268. The most common vessel type involved in encounters was fishing, accounting for 31%, the majority of which were recorded heading to or from Scrabster. Cargo vessels accounted for 25%, while passenger vessels accounted for 16%, most of which involved the ro-ro ferry *Hamnavoe*. Dredger / subsea ops also accounted for a significant proportion (11%), which was associated with a maintenance dredger at Scrabster Harbour during the summer survey period.

19.2.2 Vessel to Vessel Collision

269. Using the pre-wind farm routeing (see Section 13.4) as input, Anatec's COLLRISK model has been run to estimate the vessel to vessel collision risk in the vicinity of the PFOWF Array Area.

270. The results of the pre-wind farm collision assessment are presented graphically in Figure 19.5, which shows a collision risk heat map presented in a 0.25x0.25 nm resolution grid. Future case results are included in Section 19.4.

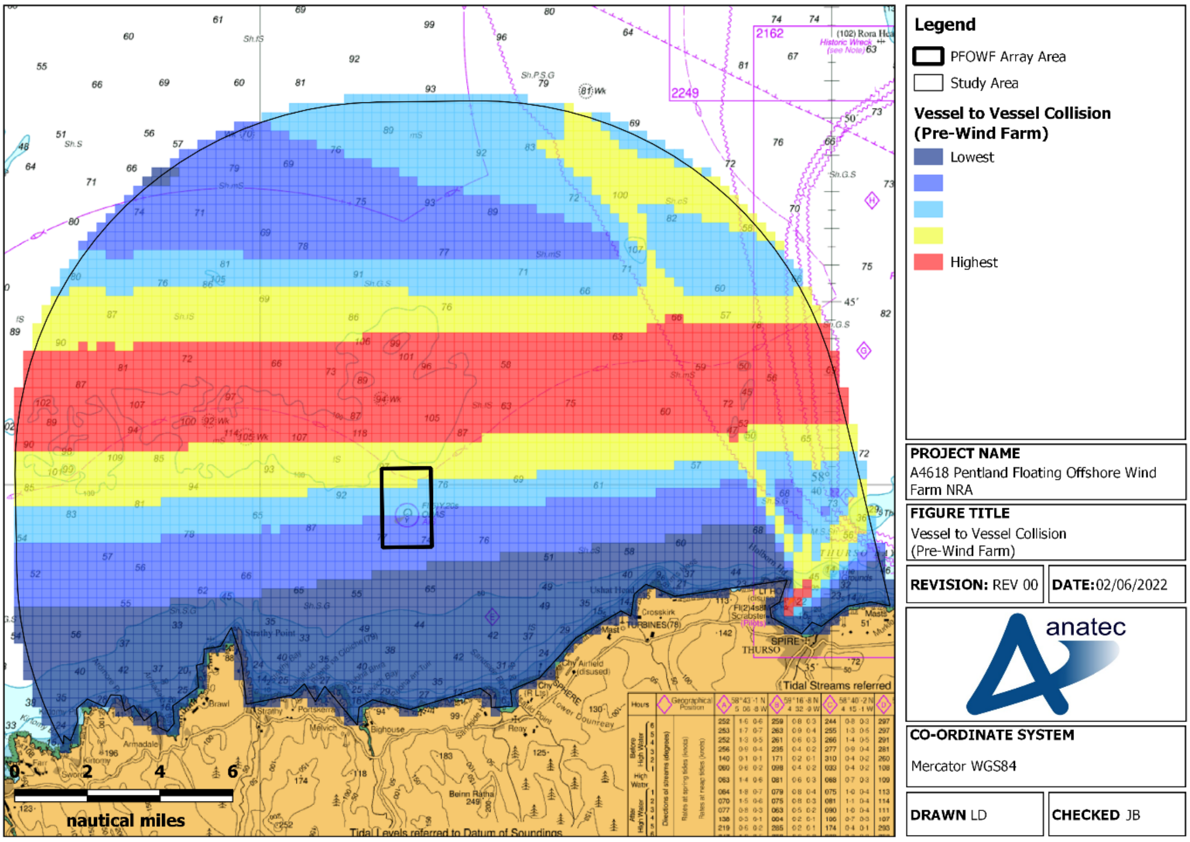

Figure 19.5 Vessel to Vessel Collision (Pre-Wind Farm)

271. Assuming base case traffic levels, it was estimated that a vessel would be involved in a collision on average once every 623 years pre-wind farm. The most significant area of risk was Route 1 (see Section 13.4 for route details), the major shipping route which passes east-west to the north of the PFOWF Array Area, as well as in proximity to Scrabster Harbour where vessels are converging. Areas of moderately high collision risk are also present where multiple routes cross. Collision risk inshore of the PFOWF Array Area was relatively low.

19.3 Post-Wind Farm

19.3.1 Vessel to Vessel Collision

272. Using the predicted post-wind farm routeing as input (see Section 18.4), Anatec's COLLRISK model was run to estimate the vessel to vessel collision risk within the Offshore Study Area following the construction of the Offshore Development.

273. The results of the post-wind farm collision assessment are presented graphically in Figure 19.6, which shows a collision risk heat map presented in a 0.25x0.25 nm resolution grid. Future case results are included in Section 19.4.

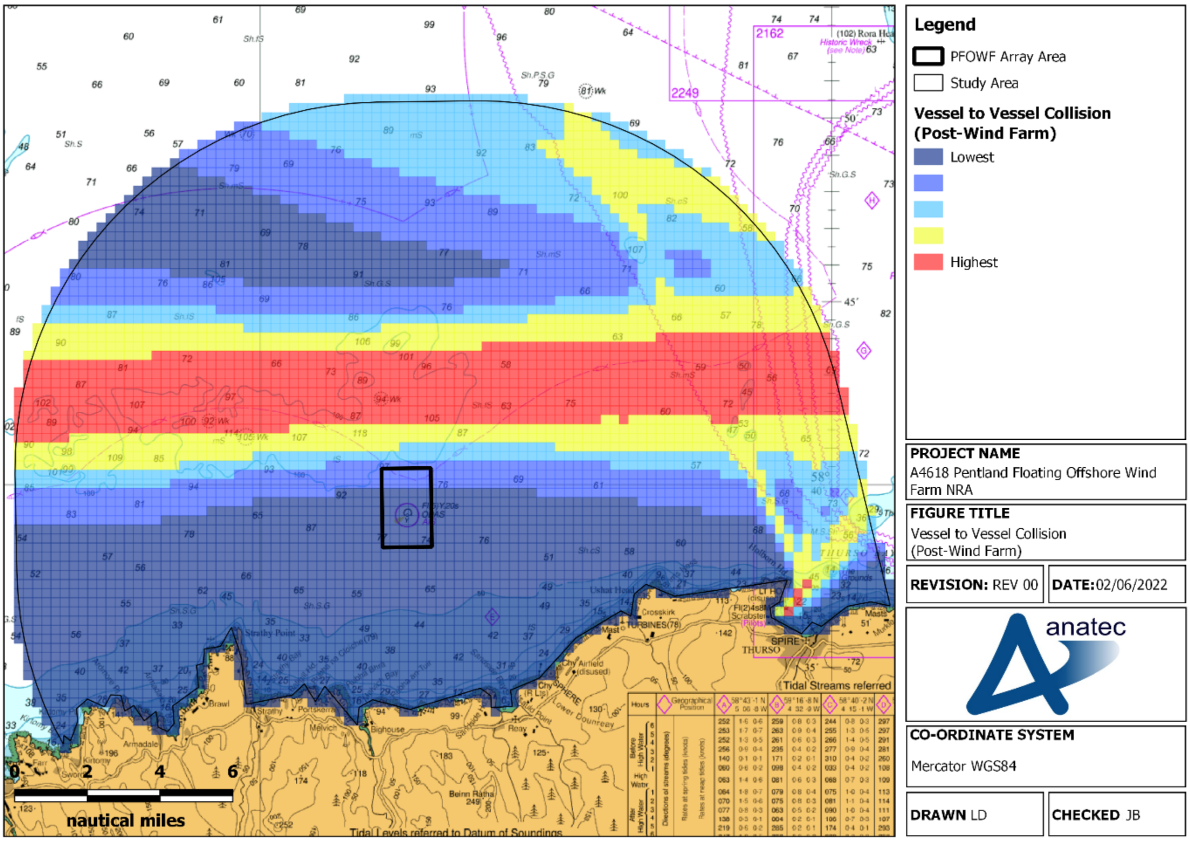

Figure 19.6 Vessel to Vessel Collision (Post-Wind Farm)

274. Assuming base case traffic levels, it was estimated that a vessel would be involved in a collision on average once every 406 years following the construction of the Offshore Development. This represents an additional 8.54×10^{-4} vessel collisions per year, or 1 in 1,170 years, over the corresponding pre-wind farm case (see Section 19.2.2). As per Section 18.4, it has been assumed that Route 1 will narrow (as opposed to deviate), which is conservative.

19.3.2 Powered Allision Risk

275. Based upon the vessel routeing identified in the Offshore Study Area, the anticipated change in routeing due to the Offshore Development, the mitigations to be in place, and levels of allision incidents to date associated with UK OWFs, the frequency of an errant vessel under power deviating from its route to the extent that it comes into proximity with a structure within the PFOWF Array Area is considered low.

276. From consultation with the shipping industry and observations at other UK wind farms, both under construction and operational, it is assumed that commercial vessels would be highly unlikely to navigate between wind farm structures, due to the restricted sea room, and will instead be directed by the AtoN installed in the region. During the construction, operation and decommissioning phases, this will consist primarily of

appropriate lighting and marking of the wind farm structures (noting that final lighting and marking of the structures will be agreed in consultation with the NLB).

277. Using the predicted routeing following the construction of the Offshore Development (see Section 18.4) as the primary input, Anatec's COLLRISK model was run to estimate the likelihood of a commercial vessel alliding with one of the structures within the PFOWF Array Area whilst under power. A plot of the annual powered allision frequency per structure assuming base case traffic levels is presented in Figure 19.7. Future case results are provided in Section 19.4.

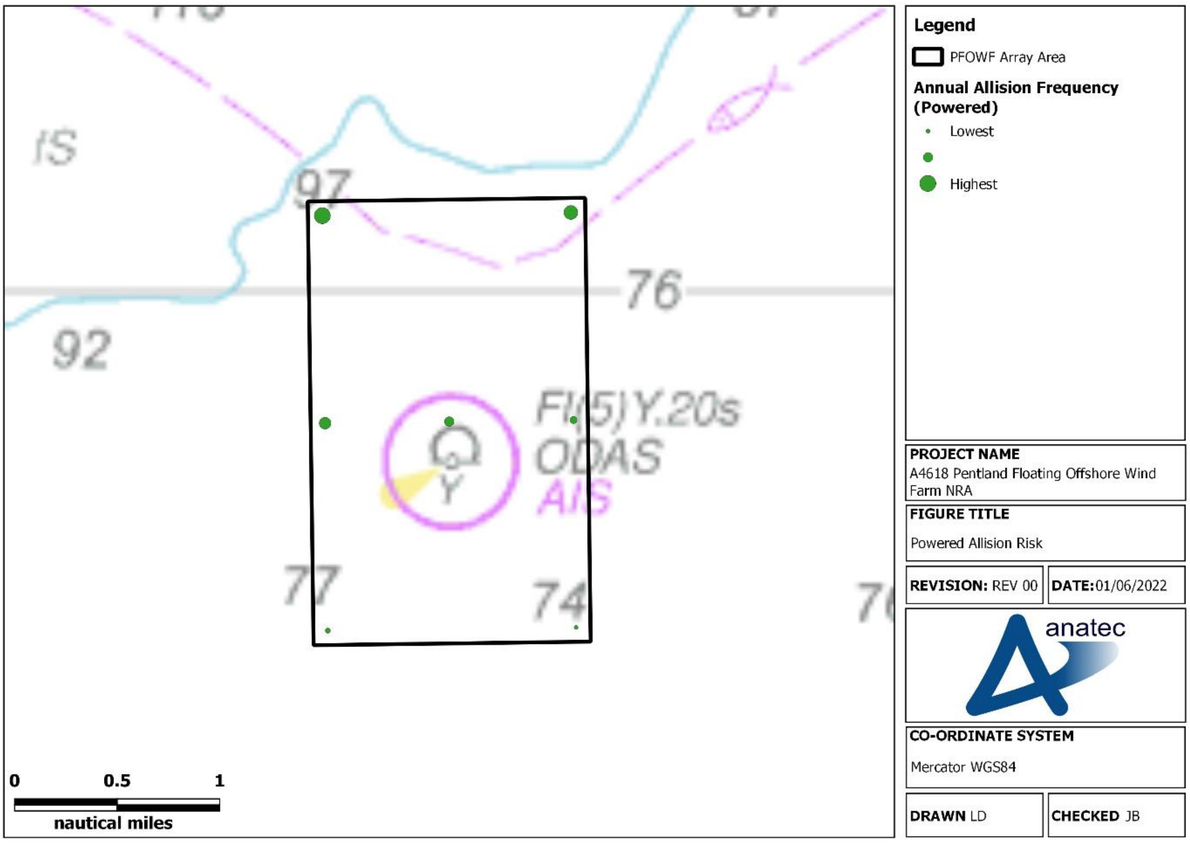

Figure 19.7 Powered Allision Risk

278. Assuming base case traffic levels, it was estimated that a vessel would allide with a structure whilst under power on average once per 809 years. The majority of this predicted risk was associated with the structures on the northern edge of the PFOWF Array Area, resulting from the proximity to Route 1, the busy commercial route running east-west north of the PFOWF Array Area (see Section 13.4).

19.3.3 Drifting Allision Risk

279. Using the post-wind farm routeing as the primary input (see Section 18.4), Anatec's COLLRISK model was run to estimate the likelihood of a drifting commercial vessel alliding with one of the structures within the PFOWF Array Area. The model is based on the

premise that propulsion on a vessel must fail before drifting will occur. The model takes account of the type and size of the vessel, the number of engines and the average time required to repair, but does not consider navigational error caused by human actions.

280. The exposure times for a drifting scenario are based upon the vessel hours spent in proximity to the PFOWF Array Area. These have been estimated based upon the revised routeing following the construction of the Offshore Development. The exposure is divided by vessel type and size to ensure these factors, which based upon analysis of historical incident data have been shown to influence incident rates, are taken into account within the modelling.

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

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

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

283. After modelling the drift scenarios, it was established that the weather dominated scenario produced the worst case results. On this basis, a plot of the annual drifting allision frequency per structure assuming base case traffic levels is presented in Figure 19.8.

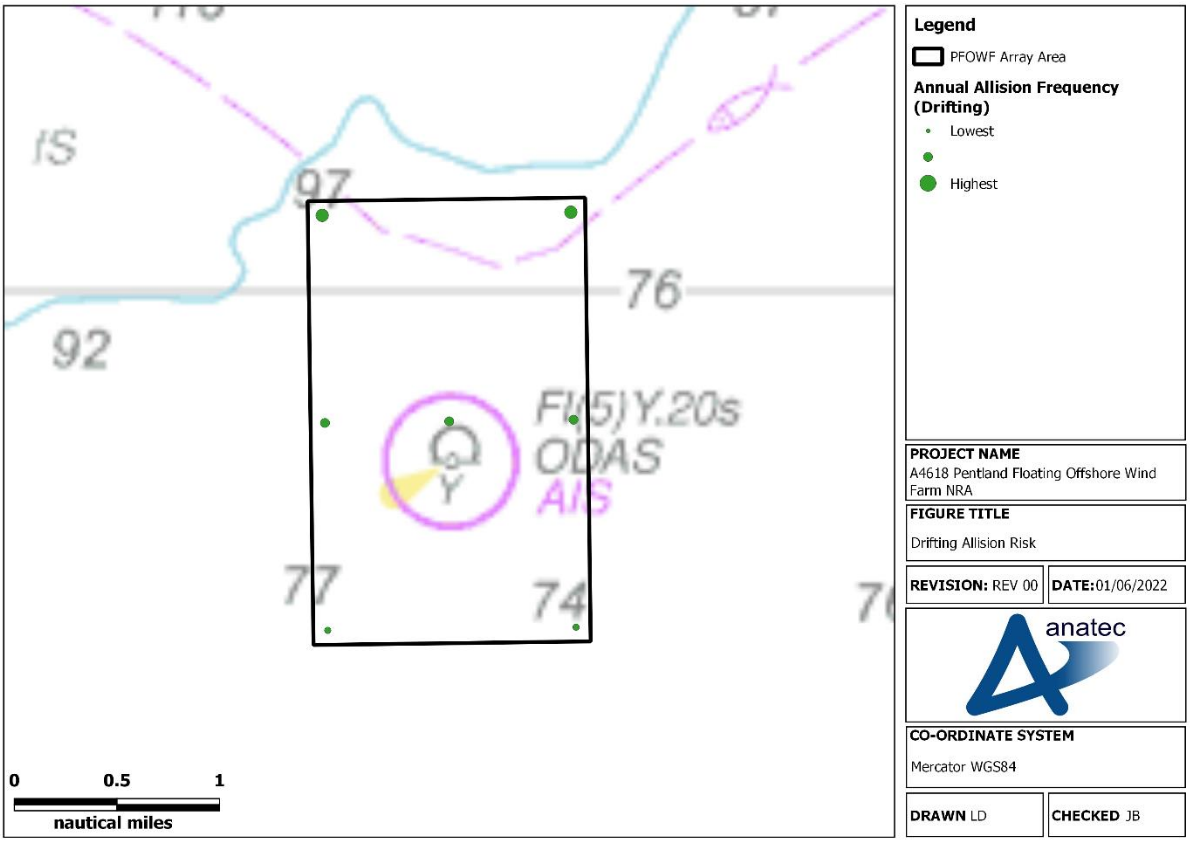

Figure 19.8 Drifting Allision Risk

284. Assuming base case traffic levels, it was estimated that drifting vessel would allide with a structure once per 28,979 years. The majority of this predicted risk was associated with the structures on the northern edge of the PFOWF Array Area, resulting from their proximity to Route 1, the busy commercial route which passes east-west north of the PFOWF Array Area (see Section 13.4).

285. External recovery from emergency response resources that may be available in the area, such as the ETV and the tugs based in Scapa Flow, has not been taken into account with the modelling, as it is not certain that these would be available to assist in the time available.

19.3.4 Fishing Allision Risk

286. The 28 days of marine traffic survey data (see Section 13.2.4) was used as input to the fishing allision function of Anatec's COLLRISK modelling software suite to assess the potential fishing vessel allision risk following the construction of the Offshore Development.

287. A fishing vessel allision is classified separately from other allision since, unlike commercial traffic which is characterised by the main routes (see Section 13.4), fishing vessels may be either in transit or actively fishing within the area. Furthermore, fishing

vessels may be observed internally within the array in addition to externally. The COLLRISK fishing allision model uses fishing vessel numbers (length and beam), wind farm layout, and structure surface dimensions as input. It is noted that the fishing allision model does not consider subsea infrastructure such as mooring lines and cables. The likelihood of a fishing vessel allision incident has been calibrated against historical maritime incident data and historical AIS vessel traffic data within operational offshore arrays in the UK. Only AIS vessels have been included as input.

288. Noting the uncertainty around potential fishing vessel behaviour following the construction of the Offshore Development, it should be considered that the model conservatively assumes no changes to baseline activity in terms of proximity to structures (i.e., vessels are not altering their navigational or fishing behaviour based on the presence of structures). This is considered a conservative approach given experience shows that while commercial fishing vessels may continue to transit operational arrays, activity immediately around the structures is likely to reduce.

289. The results of the fishing allision assessment are shown geographically in Figure 19.9.

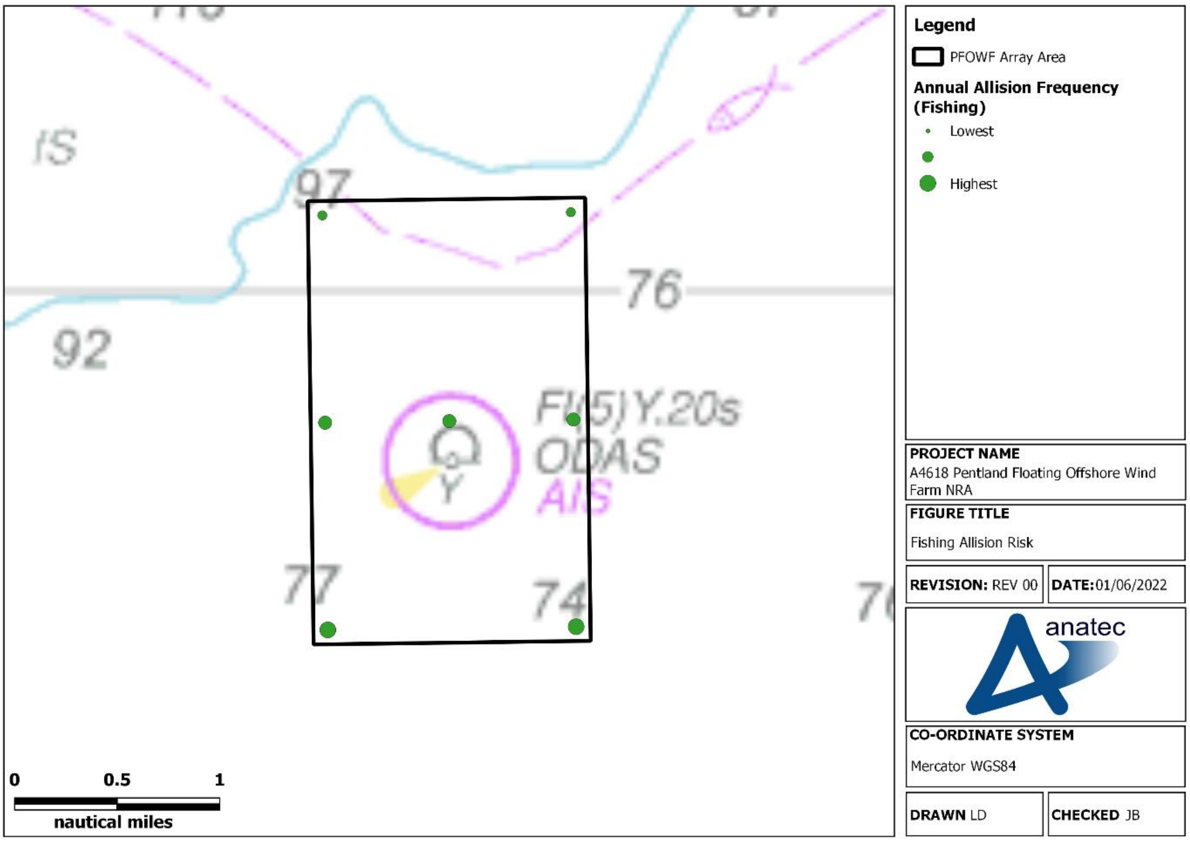

Figure 19.9 Fishing Allision Risk

290. Assuming base case traffic levels, it was estimated that a vessel would allide with a structure within the PFOWF Array Area on average once per 24 years. The majority of this predicted risk was associated with the structures within the southern extent of the of the

PFOWF Array Area, which aligns with the marine traffic data (see Section 13.2.4), where fishing vessels were seen passing closest to these positions.

19.4 Results Summary

291. As per Section 18.1, both pre- and post-wind farm scenarios with base case and future case traffic levels have been run. The results are summarised in Table 19.1.

Table 19.1 Allision and Collision Risk Modelling Results Summary

Collision / Allision Risk	Scenario	Annual Frequency (Return Period)		
		Pre-Wind Farm	Post-Wind Farm	Change
Vessel to vessel collision	Base case	1.61×10^{-3} (1 in 623 years)	2.46×10^{-3} (1 in 406 years)	8.54×10^{-4} (1 in 1,170 years)
	Future case (+10%)	1.94×10^{-3} (1 in 516 years)	2.97×10^{-3} (1 in 337 years)	1.03×10^{-3} (1 in 970 years)
	Future case (+20%)	2.30×10^{-3} (1 in 435 years)	3.52×10^{-3} (1 in 284 years)	1.22×10^{-3} (1 in 818 years)
Powered vessel to structure allision	Base case	N/A	1.24×10^{-3} (1 in 809 years)	1.24×10^{-3} (1 in 809 years)
	Future case (+10%)	N/A	1.36×10^{-3} (1 in 736 years)	1.36×10^{-3} (1 in 736 years)
	Future case (+20%)	N/A	1.48×10^{-3} (1 in 676 years)	1.48×10^{-3} (1 in 676 years)
Drifting vessel to structure allision	Base case	N/A	3.45×10^{-5} (1 in 28,979 years)	3.45×10^{-5} (1 in 28,979 years)
	Future case (+10%)	N/A	3.79×10^{-5} (1 in 26,374 years)	3.79×10^{-5} (1 in 26,374 years)
	Future case (+20%)	N/A	4.13×10^{-5} (1 in 24,213 years)	4.13×10^{-5} (1 in 24,213 years)
Fishing vessel to structure allision	Base case	N/A	4.11×10^{-2} (1 in 24 years)	4.11×10^{-2} (1 in 24 years)
	Future case (+10%)	N/A	4.47×10^{-2} (1 in 22 years)	4.47×10^{-2} (1 in 22 years)
	Future case (+20%)	N/A	4.84×10^{-2} (1 in 21 years)	4.84×10^{-2} (1 in 21 years)
Total	Base case	1.61×10^{-3} (1 in 623 years)	4.48×10^{-2} (1 in 22 years)	4.32×10^{-2} (1 in 23 years)
	Future case (+10%)	1.94×10^{-3} (1 in 516 years)	4.91×10^{-2} (1 in 20 years)	4.71×10^{-2} (1 in 21 years)

Collision / Allision Risk	Scenario	Annual Frequency (Return Period)		
		Pre-Wind Farm	Post-Wind Farm	Change
	Future case (+20%)	2.30×10^{-3} (1 in 435 years)	5.34×10^{-2} (1 in 19 years)	5.11×10^{-2} (1 in 20 years)

19.5 Consequences

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

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

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

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

296. The overall annual increase in PLL estimated due to the impact of the Offshore Development on 3rd party vessels is approximately 2.92×10^{-4} (assuming base case traffic levels) corresponding to one additional fatality in approximately 3,420 years. In terms of individual risk to people, the incremental increase estimated due to the impact of the Offshore Development for the base case is 8.72×10^{-6}.

297. Based upon the collision and allision frequencies and the historical oil spill data, the overall increase in oil spilled due to the presence of the Offshore Development is estimated to be 0.21 tonnes of oil per year for the base case. From research undertake as part of the identification of MEHRAs in the UK (DfT, 2001) the average annual tonnes of oil spilled in the waters around the British Isles due to the marine incidents in the 10-year

period from 1989 to 1998 was 16,111. Therefore, the overall increase in oil pollution estimated for the Offshore Development represents a very small increase compared to the current average annual tonnes of oil spilled and hence can be considered minimal in comparison to the annual average.

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

20 Hazard Screening

299. This section details the hazards of relevance to shipping and navigation which have been scoped into the FSA within Offshore EIAR (Volume 2): Chapter 14: Shipping and Navigation based on the findings of the NRA process.

300. It is noted that hazards associated with vessels engaged in fishing activities (i.e., with gear deployed) are considered in Offshore EIAR (Volume 2): Chapter 13: Commercial Fisheries.

301. Hazards associated with interference with marine navigation, communications and position fixing equipment are assessed in Table 16.2. The risks associated with these hazards are considered to be broadly acceptable, therefore this hazard has not been scoped into the FSA within Offshore EIAR (Volume 2): Chapter 14: Shipping and Navigation.

302. The following hazards which were scoped in are assessed in Volume 2, Chapter 14: Shipping and Navigation:

- Vessel displacement;
- Vessel to vessel collision risk between a third-party vessel and a project vessel due to the presence of project related vessels;
- Increased vessel to vessel collision risk between third party vessels due to vessel displacement;
- Vessel to structure allision risk due to the presence of new structures associated with the Offshore Development;
- Reduced access to local ports due to construction activities associated with the Offshore Development;
- Reduction of under keel clearance due to the presence of moorings / inter-array cables / export cable / cable protection associated with the Offshore Export Cable Corridor;
- Vessel interaction with subsea cables and mooring lines associated with the Offshore Development;
- Loss of station;
- Reduction of emergency response capability due to increased incident rates and / or reduced access for SAR responders; and
- Cumulative impacts.

21 Hazard Assessment

303. This section outlines the final shipping and navigation hazards for the Offshore Development which have been identified based upon:

- Baseline data;
- Consultation;
- Hazard log; and
- Quantitative allision and collision risk modelling.

304. For each hazard, a description of the hazard is given along with the relevant users. As per Section 16.10, hazards associated with navigation, communications and position fixing equipment have been screened out of the FSA. Fishing gear snagging with subsea infrastructure has been considered at a high-level from a safety perspective, however active fishing is considered in greater detail within Volume 2, Chapter 13: Commercial Fisheries.

305. The risk assessment has been undertaken within Volume 2, Chapter 14: Shipping and Navigation, in line with EIA requirements, but following the FSA methodology. To avoid replication of text, the full risk assessment has not been reproduced. Table 21.1 summarises the outputs of the risk assessment undertaken with consideration of the embedded mitigation measures outlined in Section 22.

306. It is noted that in Table 21.1, ‘Tolerable with Mitigation’ refers to the management plans as listed in Table 22.1 and the embedded mitigation measures as listed in Table 22.2. No additional mitigation measures have been proposed.

Table 21.1 Summary of the Outputs of the Risk Assessment

Summary of Hazard	Chapter 14 Ref.	User	Frequency	Consequence	Assessment of Risk	Rationale	Additional Mitigation	Residual Effect
Construction / Installation								
Vessel displacement due to construction activities; leading to increased collision risk for third party vessels and / or reduction in port access	Section 14.6.1.1	All vessels	Extremely unlikely	Moderate	Broadly acceptable	Given the location and size of the PFOWF Array Area and any buoyed construction area, the displacement of vessels is expected to be minor, with no reduction of port access anticipated. Given the limited displacement, it is not expected that the additional collisions occur due to the construction phase of the Offshore Development. Small vessels being displaced into commercial routes is not thought to be a concern based on consultation. Details of the split construction period will be discussed	No	Broadly acceptable

Summary of Hazard	Chapter 14 Ref.	User	Frequency	Consequence	Assessment of Risk	Rationale	Additional Mitigation	Residual Effect
						with NLB so that appropriate buoyage can be applied per period.		
Vessel to vessel collision risk between a third-party vessel and an Offshore Development due to the presence of Offshore Development vessels	Section 14.6.1.2	All vessels	Extremely unlikely	Moderate	Broadly acceptable	Project vessels will be managed via marine coordination, with mitigation including safety zones also serving to protect project vessels from collision. Given the duration for which construction vessels will be onsite and the mitigations in place, collisions are considered unlikely.	No	Broadly acceptable
Vessel to structure allision risk due to the presence of new structures associated with the Offshore Development	Section 14.6.1.3	All vessels	Extremely unlikely	Moderate	Broadly acceptable	Structures are unlikely to be present on site for an extended period of time during the construction phase. This combined with the presence of any buoyed construction area	No	Broadly acceptable

Summary of Hazard	Chapter 14 Ref.	User	Frequency	Consequence	Assessment of Risk	Rationale	Additional Mitigation	Residual Effect
						that is required means that an allision is considered unlikely.		
Fishing gear interaction with subsea infrastructure	Section 14.6.1.4	Commercial fishing vessels	Extremely unlikely	Moderate	Broadly acceptable	Subsea infrastructure may be in place (wet storage) before surface structures have been installed. Ensuring fishermen are aware of the subsea hazard should ensure that any interaction is unlikely.	No	Broadly acceptable
Reduction in under keel clearance due to subsea cables / cable protection leading to an increased grounding risk	Section 14.6.1.5	All vessels	Negligible	Minor	Broadly acceptable	Water depths are deep enough in the majority of the Offshore Export Cable Corridor that reduction in under keel clearance is unlikely to be significant. The only area of concern is likely to be close to shore, where it is anticipated that HDD will be utilized meaning that	No	Broadly acceptable

Summary of Hazard	Chapter 14 Ref.	User	Frequency	Consequence	Assessment of Risk	Rationale	Additional Mitigation	Residual Effect
						under keel clearance will not be reduced in this area.		
Operation and Maintenance								
Vessel displacement due to the presence of new structures leading to increased collision risk for third party vessels and / or reduction in port access	Section 14.6.2.1	All vessels	Extremely unlikely	Moderate	Broadly acceptable	Given the location and size of the PFOWF Array Area, the displacement of vessels is expected to be minor, with no reduction of port access anticipated. The increase in collision risk is estimated at 1 additional collision per 1,170 years. Small vessels being displaced into commercial routes is not thought to be a concern.	No	Broadly acceptable
Vessel to vessel collision risk between a third-party vessel and an Offshore Development due to the presence of	Section 14.6.2.2	All vessels	Extremely unlikely	Moderate	Broadly acceptable	Project vessels will be managed via marine coordination, with mitigation including safety zones also serving	No	Broadly acceptable

Summary of Hazard	Chapter 14 Ref.	User	Frequency	Consequence	Assessment of Risk	Rationale	Additional Mitigation	Residual Effect
Offshore Development vessels						to protect project vessels from collision.		
Commercial vessel to structure allision risk due to the presence of new structures associated with the Offshore Development	Section 14.6.2.3	Commercial vessels	Extremely unlikely	Moderate	Broadly acceptable	Quantitative modelling was undertaken to assess the likelihood of powered or drifting allision, which showed that one commercial vessel allision was anticipated every 787 years. Embedded mitigation measures to ensure users are aware of the Offshore Development should allow safe passing distances to be maintained. Emergency response resources are available in the case of a drifting incident.	No	Broadly acceptable

Summary of Hazard	Chapter 14 Ref.	User	Frequency	Consequence	Assessment of Risk	Rationale	Additional Mitigation	Residual Effect
Fishing vessel to structure allision risk due to the presence of new structures associated with the Offshore Development	Section 14.6.2.4	Commercial fishing vessels	Remote	Moderate	Tolerable with mitigation[4]	Quantitative modelling estimates the internal allision risk to fishing vessels at 1 allision every 24 years based on conservative assumptions. Allisions are most likely to be minor contacts resulting in only minor vessel damage.	No	Tolerable with mitigation
Recreational vessel to structure allision risk due to the presence of new structures associated with the Offshore Development	Section 14.6.2.5	Recreational vessels	Extremely unlikely	Moderate	Broadly acceptable	Recreational users of the area are likely to be experienced sailors capable of plotting course. The proximity of Thurso Lifeboat Station is likely to allow swift emergency response to avoid drifting incidents. Recreational vessels are likely to pass within the PFOWF Array Area,	No	Broadly acceptable

[4] Note that 'Tolerable with Mitigation' refers to the embedded mitigations and management plans, as opposed to any additional mitigation.

Summary of Hazard	Chapter 14 Ref.	User	Frequency	Consequence	Assessment of Risk	Rationale	Additional Mitigation	Residual Effect
						however WTG spacing should be sufficient to allow this safely.		
Anchor interaction with subsea infrastructure	Section 14.6.2.6	All vessels	Extremely unlikely	Moderate	Broadly acceptable	No anchoring activity was recorded within the Offshore Study Area during the vessel traffic surveys. A historical anchorage was recorded close to the Offshore Export Cable Corridor which was not thought to be of concern.	No	Broadly acceptable
Fishing gear interaction with subsea infrastructure	Section 14.6.2.7	Commercial fishing vessels	Remote	Moderate	Tolerable with mitigation	No clear active fishing was recorded within the PFOWF Array Area, though it was noted the north-west corner of the site is used in adverse weather. A local fishing representative indicated that fishermen would prefer to do their own risk	No	Tolerable with mitigation

Summary of Hazard	Chapter 14 Ref.	User	Frequency	Consequence	Assessment of Risk	Rationale	Additional Mitigation	Residual Effect
						assessments rather than being excluded. Promulgation of information will include information about the subsea hazards including mooring lines.		
Transiting vessel interaction with subsea infrastructure	Section 14.6.2.8	All vessels	Remote	Moderate	Tolerable with mitigation	Vessel draught analysis revealed that the largest vessels recorded within the Offshore Study Area would be at risk of interacting with mooring lines up to 270 m from structures. Smaller vessels such as recreational and fishing vessels might risk interaction up to around 80 m away from surface structures. Consequences of interaction with the mooring lines are likely to	No	Tolerable with mitigation

Summary of Hazard	Chapter 14 Ref.	User	Frequency	Consequence	Assessment of Risk	Rationale	Additional Mitigation	Residual Effect
						be minor to the transiting vessel.		
Reduction in under keel clearance due to subsea cables / cable protection leading to an increased grounding risk	Section 14.6.2.9	All vessels	Negligible	Minor	Broadly acceptable	Water depths are deep enough in the majority of the Offshore Export Cable Corridor that reduction in under keel clearance is unlikely to be significant. The only area of concern is likely to be close to shore, where it is anticipated that HDD will be utilised meaning that under keel clearance will not be reduced in this area.	No	Broadly acceptable
Loss of WTG station	Section 14.6.2.10	All vessels	Negligible	Serious	Broadly acceptable	A loss of station incident is considered unlikely given the safety factors associated with the station keeping system designed in accordance with the relevant	No	Broadly acceptable

Summary of Hazard	Chapter 14 Ref.	User	Frequency	Consequence	Assessment of Risk	Rationale	Additional Mitigation	Residual Effect
						regulations, classifications and standards. Most likely consequences are a single mooring line failure leading to a temporary increase in the maximum excursion of the structure.		
Reduction of emergency response capability due to increased incident rates and / or reduced access for SAR responders	Section 14.6.2.11	Emergency responders	Extremely unlikely	Minor	Broadly acceptable	The RNLI noted that the PFOWF Array Area would block a straight-line tow to Scrabster, potentially leading to delays in emergency response.	No	Broadly acceptable
Decommissioning								
Vessel displacement due to decommissioning activities; leading to increased collision risk for third party vessels and / or reduction in port access	Section 14.6.3.1	All vessels	Extremely unlikely	Moderate	Broadly acceptable	Given the location of the PFOWF Array Area and any buoyed decommissioning area, the displacement of vessels is expected to be minor, with no reduction	No	Broadly acceptable

Summary of Hazard	Chapter 14 Ref.	User	Frequency	Consequence	Assessment of Risk	Rationale	Additional Mitigation	Residual Effect
						of port access anticipated. Small vessels being displaced into commercial routes is not thought to be a concern.		
Vessel to vessel collision risk between a third-party vessel and an Offshore Development due to the presence of Offshore Development vessels	Section 14.6.3.2	All vessels	Extremely unlikely	Moderate	Broadly acceptable	Project vessels will be managed via the NSP and VMP marine coordination, with mitigation including safety zones also serving to protect project vessels from collision. Given the length of the decommissioning phase and mitigations in place, collisions are considered unlikely.	No	Broadly acceptable
Vessel to structure allision risk due to the presence of new structures associated	Section 14.6.3.3	All vessels	Extremely unlikely	Moderate	Broadly acceptable	Structures are unlikely to be present on site for an extended period of time during the decommissioning phase.	No	Broadly acceptable

Summary of Hazard	Chapter 14 Ref.	User	Frequency	Consequence	Assessment of Risk	Rationale	Additional Mitigation	Residual Effect
with the Offshore Development						This combined with the presence of any buoyed decommissioning area that is required means that an allision is considered unlikely.		
Fishing gear interaction with subsea infrastructure	Section 14.6.3.4	Commercial fishing vessels	Extremely unlikely	Moderate	Broadly acceptable	Subsea infrastructure may remain after surface structures have been removed. Ensuring fishermen are aware of the subsea hazard should ensure that any interaction is unlikely.	No	Broadly acceptable
Reduction in under keel clearance due to subsea cables / cable protection leading to an increased grounding risk	Section 14.6.3.5	All vessels	Negligible	Minor	Broadly acceptable	Water depths are deep enough in the majority of the Offshore Export Cable Corridor that reduction in under keel clearance is unlikely to be significant. The only area of concern is likely to be close to shore, where it is	No	Broadly acceptable

Summary of Hazard	Chapter 14 Ref.	User	Frequency	Consequence	Assessment of Risk	Rationale	Additional Mitigation	Residual Effect
						anticipated that HDD will be utilised meaning that under keel clearance will not be reduced in this area.		
Cumulative – Construction Phase								
Vessel displacement due to the presence of project vessels associated with the SHE Transmission Orkney-Caithness Project	Section 14.7.2.1	All vessels	Extremely unlikely	Minor	Broadly acceptable	Any works associated with the cable would be short term and would only result in very localised traffic displacement. Implementation of standard industry practice mitigation measures would mean that any risk is temporary and minor.	No	Broadly acceptable
Reduction in under keel clearance due to subsea cables / cable protection associated with the SHE	Section 14.7.2.2	All vessels	Extremely unlikely	Minor	Broadly acceptable	Water depths are deep enough throughout the Offshore Export Cable Corridor that water depths should not be	No	Broadly acceptable

Summary of Hazard	Chapter 14 Ref.	User	Frequency	Consequence	Assessment of Risk	Rationale	Additional Mitigation	Residual Effect
Transmission Orkney-Caithness Project						significantly reduced by cable crossings.		
Cumulative – Operation and Maintenance Phase								
Vessel displacement due to the presence of project vessels associated with the SHE Transmission Orkney-Caithness Project	Section 14.7.3.1	All vessels	Extremely unlikely	Minor	Broadly acceptable	Any works associated with the cable would be short term and would only result in very localised traffic displacement. Implementation of standard industry practice mitigation measures would mean that any risk is temporary and minor.	No	Broadly acceptable
Reduction in under keel clearance due to subsea cables / cable protection associated with the SHE Transmission Orkney-Caithness Project	Section 14.7.3.2	All vessels	Extremely unlikely	Minor	Broadly acceptable	Water depths are deep enough throughout the Offshore Export Cable Corridor that water depths should not be significantly reduced by cable crossings.	No	Broadly acceptable
Cumulative – Decommissioning Phase								

Summary of Hazard	Chapter 14 Ref.	User	Frequency	Consequence	Assessment of Risk	Rationale	Additional Mitigation	Residual Effect
Vessel displacement due to the presence of project vessels associated with the SHE Transmission Orkney-Caithness Project	Section 14.7.4.1	All vessels	Extremely unlikely	Minor	Broadly acceptable	Any works associated with the cable would be short term and would only result in very localised traffic displacement. Implementation of standard industry practice mitigation measures would mean that any risk is temporary and minor.	No	Broadly acceptable
Reduction in under keel clearance due to subsea cables / cable protection associated with the SHE Transmission Orkney-Caithness Project	Section 14.7.4.2	All vessels	Extremely unlikely	Minor	Broadly acceptable	Water depths are deep enough throughout the Offshore Export Cable Corridor that water depths should not be significantly reduced by cable crossings.	No	Broadly acceptable

22 Mitigation

307. The risk assessment within Volume 2, Chapter 14: Shipping and Navigation of the EIAR and in Section 21 assumes certain embedded mitigation measures and management plans will be in place. The required management plans are summarised in Table 22.1, following this, embedded mitigations are summarised in Table 22.2.

Table 22.1 Management Plans

Management Plan	Description
Cable Plan (CaP) / Cable Burial Risk Assessment (CBRA)	A CaP will be provided for the Offshore Development which will detail the location/ route and cable laying techniques of the inter-array and offshore export cables and detail the methods for cable surveys during the operational life of the cables for the Offshore Development. This will be supported by survey results from the geotechnical, geophysical and benthic surveys. The CaP will also detail electromagnetic fields of the cables deployed. A CBRA will also be undertaken and included within the CaP which will detail cable specifications, cable installation, cable protection, target burial depths / depth of lowering and any hazards the cable will present during the lifetime of the cable.
Marine Pollution Contingency Plan	Consent conditions will require a Marine Pollution Contingency Plan to outline procedures in the event of an accidental pollution event arising from activities associated with the Offshore Development.
Vessel Management Plan (VMP)	A VMP will be prepared for the Offshore Development which will detail the number, type and specification of vessels utilised during construction and operation. This will also detail the ports and transit corridors proposed.
Navigational Safety Plan (NSP)	A NSP will be developed for the Offshore Development which will detail all navigational safety measures, construction exclusion zones if required, notices to mariners and radio navigation warnings, anchoring areas, lighting and marking requirements and emergency response procedures during all phases of the project.
LMP	A LMP will be developed for the Offshore Development. This will provide that the Offshore Development be lit and marked in accordance with the current Civil Aviation Authority (CAA) and MoD aviation lighting policy and guidance. The LMP will also detail the navigational lighting requirements detailed in IALA R139 and G1162.

Management Plan	Description
DSLP	A DSLP will be produced for the Offshore Development which will, allow stakeholders to see the specifics of the Offshore Development e.g. WTG positions within the array and mooring arrangement position.

Table 22.2 Embedded Mitigations

Embedded Mitigation	Justification
MGN 654 compliance	The Offshore Development will comply with MGN 654 and its annexes as required by consent conditions to ensure that impacts on navigational safety and emergency response are considered, assessed and mitigated. This includes post consent completion of the Search and Rescue Checklist including an ERCoP.
Charting Requirements	Prior to construction, the positions and final height of the WTGs will be provided to the UKHO, MoD and Defence Geographic Centre (DGC) for aviation and nautical charting purposes. All structures of more than 91.4 m in height will be charted on aeronautical charts and reported to the DGC, which maintains the UK's database of tall structures (Digital Vertical Obstruction File) at least ten weeks prior to construction. Further to this, the project will sign up to the Kingfisher Information Service – Offshore Renewable & Cable Awareness project (KIS-ORCA) project. This is a joint initiative between the European Subsea Cables Association (ESCA) and the Kingfisher Information Service of Seafish. The Offshore Development infrastructure, including cables mooring lines, anchoring points, as well as turbines and floating foundations, will be plotted and provided to other sea users to be uploaded on their plotters.
Notice to Mariners, Kingfisher notifications and other navigational warnings on the location, duration and nature of works.	HWL will issue Notices to Mariners, Kingfisher notifications and other navigational warnings, as required and in a timely and efficient manner. This ensures navigational safety and minimises the risk of equipment snagging through the appropriate propagation of notices to other sea users.

Embedded Mitigation	Justification
Post-consent application for safety zones	500 m safety zones will be applied for during construction, major maintenance, and decommissioning works. These will be centred on the OREI being worked on at the time. In addition, a 500 m advisory safe passing distance will also be requested around project vessels, e.g., during cable-laying. Operational safety zones are under consideration for the Offshore Development. If statutory operational safety zones are planned, further consultation will be held with stakeholders before making an application, which will be supported by risk-based justification.
The use of guard vessels and Offshore Fisheries Liaison Officers (OFLOs), where required.	The appointment of guard vessels and Offshore Fisheries Liaison Officers during construction, major maintenance works and decommissioning works, where required, ensures effective communication with the fishing community during the Offshore Development activities and reduces the potential for interactions with fishing activities. Where possible, guard vessels will be sourced locally and, ats a minimum, will be Scottish vessels.
Minimum blade clearance	MGN 654 requires that the minimum blade clearance will be at least 22 m above mean high water springs noting that for floating foundations the value is calculated above Mean sea level noting that consideration of motion is also required. This clearance is to ensure clearance for SAR activities and avoid allision with vessels – in particular yacht masts. It is noted that the Design Envelope includes a minimum blade clearance of 35 m.
Buoyed construction area	As agreed in consultation with NLB, construction buoyage will be deployed to mark the PFOWF Array Area. Construction buoyage will be secured though the LMP.

23 Through Life Safety Management

23.1 Quality, Health, Safety and Environment

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

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

23.2 Incident Reporting

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

311. The Project will maintain records of investigation and analyse incidents in order to:

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

312. All investigations shall be performed in a timely manner, and / or as directed by the statutory requirement.

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

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

23.3 Review of Documentation

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

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

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

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

23.4 Inspection of Resources

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

23.5 Audit Performance

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

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

23.6 Safety Management System

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

23.7 Cable Monitoring

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

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

324. Details of the cable monitoring will be included in full within the cable burial risk assessment document to be produced post-consent.

23.8 Hydrographic Surveys

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

23.9 Decommissioning Plan

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

24 Summary and Next Steps

327. Using various baseline data sources and giving consideration to the consultation undertaken throughout the NRA process, hazards relating to shipping and navigation that may arise as a result of the Offshore Development have been identified.

24.1 Navigational Features

328. There is an IMO-adopted ATBA 12.5 nm north-east of the PFOWF Array Area, prohibiting large vessels carrying hazardous cargo from entry.

329. There are five submarine cables within the Offshore Study Area, none of which intersect the PFOWF Array Area or the Offshore Export Cable Corridor.

330. Scrabster Harbour is the largest harbour in proximity to the PFOWF Array Area and is used by fishing vessels, commercial vessels (including cargo vessels and tankers) and recreational vessels. Orkney Harbours are further away but given the location of the Offshore Development in the Pentland Firth, is still considered of relevance to traffic patterns.

331. There are two anchorages suitable for small recreational vessels within bays close to the PFOWF Array Area. There is also anchorage available close to Scrabster in Thurso Bay, which is suitable for commercial vessels.

24.2 Historical Maritime Incidents

332. A total of 13 incidents were recorded by the MAIB between 2010 and 2019 within the Offshore Study Area, corresponding to an average of approximately one incident per year. None of the incidents were recorded within the PFOWF Array Area, while one machinery failure occurred on the eastern boundary of the Offshore Export Cable Corridor.

333. The RNLI recorded a total of 47 incidents within the Offshore Study Area between 2010 and 2019, corresponding to an average of approximately five incidents per year. None of these incidents were recorded within the PFOWF Array Area or the Offshore Export Cable Corridor.

334. There were five SAR helicopter taskings undertaken within the Offshore Study Area between 2015 and 2021, corresponding to an average of less than one tasking per year. No taskings were undertaken within the PFOWF Array Area, with one search tasking located on the western boundary of the Offshore Export Cable Corridor.

24.3 Vessel Traffic

335. There was an average of 24 unique vessels per day during the summer survey period, and an average of 17 per day during the winter survey period. During the summer survey period, 8% of the vessels recorded within the Offshore Study Area intersected the PFOWF

Array Area, compared with 7% during the winter survey period. The main types of vessels recorded within the Offshore Study Area were cargo vessels and fishing vessels, while the majority of vessels recorded intersecting the PFOWF Array Area were fishing vessels.

336. Fishing vessels were recorded both in transit and actively fishing within the Offshore Study Area, with the active fishing vessels generally recorded on the northern edge of the Offshore Study Area. Recreational vessels were recorded throughout the Offshore Study Area during the summer survey period, but were almost absent during the winter survey.

337. Additional data sources (pre-2020) were used to confirm COVID effects including changes in recreational vessel and cruise ship movements.

24.4 Main Routes

338. A total of five main routes were identified within the Offshore Study Area from the AIS data studied, with the most significant of these (in terms of vessels per day and relevance to the PFOWF Array Area) being the busy commercial route used by traffic passing though the Pentland Firth. This route was conservatively assumed to narrow in the post-wind farm scenario modelled, though it is likely that the mean route position will also move further north of the PFOWF Array Area as vessels maintain a safe passing distance.

24.5 Allision and Collision Modelling

339. Using Anatec's COLLRISK modelling suite, it was estimated that vessel-to-vessel collision risk will increase by approximately 1 in 1,170 years, noting that this is largely the result of a conservative assumption made regarding the narrowing of the main commercial route through the Offshore Study Area. A powered allision was estimated to occur once every 809 years, while a drifting allision was estimated to occur once every 28,979years.

340. A fishing vessel allision was estimated to take place once every 24 years, noting that this is based on the conservative assumption that there will be no change in fishing vessel activity, and is inclusive of low impact (and low consequence) contacts.

24.6 Hazard Assessment

341. Hazards identified as requiring further assessment based on the findings of the NRA are assessed within Volume 1, Chapter 14: Shipping and Navigation, with the findings of the FSA summarised in Table 21.1.

342. Overall, the FSA concluded that all identified risks arising from the Offshore Development were broadly acceptable or tolerable with the embedded mitigation measures in place during the construction, operation and maintenance, and decommissioning phases.

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Appendix A MGN 654 Checklist

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

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

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

Table A.1 MGN 654 Checklist

MGN Reference	Compliance	Comments
Planning Stage – Prior to Consent		
Site and Installation Co-ordinates: Developers are responsible for ensuring that formally agreed co-ordinates and subsequent variations of site perimeters and individual OREI structures are made available, on request, to interested parties at relevant project stages, including application for consent, development, array variation, operation and decommissioning. This should be supplied as authoritative Geographical Information System (GIS) data, preferably in Environmental Systems Research Institute (ESRI) format. Metadata should facilitate the identification of the data creator, its date and purpose, and the geodetic datum used. For mariners' use, appropriate data should also be provided with latitude and longitude coordinates in WGS84 (ETRS89) datum.	✓	**Section 6: Project Description** Presents the coordinates of the worst case array layout.
Traffic Survey – includes:		
All vessel types	✓	**Section 13: Vessel Traffic** All vessel types are considered with specific breakdowns by vessel type given (see Section 13.2)
At least 28 days duration, within either 12 or 24 months prior to submission of the EIAR	✓	**Section 13: Vessel Traffic** A total of 28 days of marine traffic data has been collected

MGN Reference	Compliance	Comments
		and analysed, complying with MGN 654 requirements.
Multiple data sources	✓	**Section 8: Vessel Traffic Survey Methodology** The vessel traffic survey data includes AIS, radar and visual observation data. Additional data sources such as the RYA Coastal Atlas have also been considered to supplement the survey data (see Section 7).
Seasonal variations	✓	**Section 13: Vessel Traffic** The vessel traffic survey data covers two 14-day periods chosen to capture summer and winter variations. **Section 7: Data Sources** Details the additional data sources used to ensure seasonal variations are considered.
MCA consultation	✓	**Section 4: Consultation** The MCA has been consulted as part of the NRA process.
General Lighthouse Authority consultation	✓	**Section 4: Consultation** The NLB has been consulted as part of the NRA process.
Chamber of Shipping and shipping company consultation	✓	**Section 4: Consultation** UK Chamber of Shipping has been consulted as part of the NRA process.
Recreational and fishing vessel organisations consultation	✓	**Section 4: Consultation** RYA Scotland and CA have been consulted as part of the NRA process. Fishing and recreational representatives were present at the Hazard Workshop.

MGN Reference	Compliance	Comments
Port and navigation authorities consultation, as appropriate	✓	**Section 4: Consultation** Relevant navigation authorities including Scrabster Harbour and Orkney Marinas have been consulted.
Assessment of the cumulative and individual effects of (as appropriate):		
i. Proposed OREI site relative to areas used by any type of marine craft.	✓	**Section 13: Vessel Traffic** Vessel traffic data in proximity to the PFOWF Array Area has been analysed. **Chapter 14: Shipping and Navigation** Hazards to vessel traffic in proximity to the PFOWF Array Area have been assessed.
ii. Numbers, types and sizes of vessels presently using such areas	✓	**Section 13: Vessel Traffic** Vessel traffic data in proximity to the PFOWF Array Area has been analysed and includes breakdowns of daily count, vessel type and vessel size.
iii. Non-transit uses of the areas, e.g. fishing, day cruising of leisure craft, racing, aggregate dredging, personal watercraft etc.	✓	**Section 13: Vessel Traffic** Non-transit users were identified in the vessel traffic survey data and included recreational traffic, fishing vessels and dredgers.
iv. Whether these areas contain transit routes used by coastal, deep-draught or international scheduled vessels on passage.	✓	**Section 13.4: Vessel Routeing** Main routes in proximity to the PFOWF Array Area have been identified using the principles set out in MGN 654.
v. Alignment and proximity of the site relative to adjacent shipping routes	✓	**Section 13.4: Vessel Routeing** Discusses the PFOWF Array Area relative to adjacent shipping routes.
vi. Whether the nearby area contains prescribed routeing schemes or precautionary areas	✓	**Section 9: Navigational Features**

MGN Reference	Compliance	Comments
		Section 9.1 shows the PFOWF Array Area relative to the IMO Routeing Measure around Orkney.
vii. Proximity of the site to areas used for anchorage (charted or uncharted), safe haven, port approaches and pilot boarding or landing areas.	✓	**Section 9: Navigation Features** Section 9.4 presents the nearby ports and harbours.
viii. Whether the site lies within the jurisdiction of a port and/or navigation authority.	✓	**Section 9: Navigation Features** Section 9.4 presents the nearby ports and harbours.
ix. Proximity of the site to existing fishing grounds, or to routes used by fishing vessels to such grounds.	✓	**Section 13: Vessel Traffic** Section 13.2.4 presents the fishing vessel movements.
x. Proximity of the site to offshore firing/bombing ranges and areas used for any marine military purposes.	✓	**Section 9:Navigational Features** Section 9.6 discusses military areas.
xi. Proximity of the site to existing or proposed submarine cables or pipelines, offshore oil / gas platform, marine aggregate dredging, marine archaeological sites or wrecks, Marine Protected Area or other exploration/exploitation sites	✓	**Section 9: Navigational Features** ▪ Section 9.2 (subsea cables) ▪ Section 9.3 (charted wrecks) ▪ Section 9.7 (MEHRAs)
xii. Proximity of the site to existing or proposed OREI developments, in co-operation with other relevant developers, within each round of lease awards.	✓	**Section 3: Navigational Assessment Methodology** The parameters of the cumulative assessment are set out in Section 3.4. **Section 17: Cumulative Overview** Discusses the developments considered within the cumulative assessment.

MGN Reference	Compliance	Comments
xiii. Proximity of the site relative to any designated areas for the disposal of dredging spoil or other dumping ground	✓	**Section 9: Navigational Features** Section 9.8 discusses spoil grounds.
xiv. Proximity of the site to aids to navigation and/or Vessel Traffic Services (VTS) in or adjacent to the area and any impact thereon.	✓	**Section 9: Navigational Features** Figure 9.1 displays the positions of AtoN.
xv. Researched opinion using computer simulation techniques with respect to the displacement of traffic and, in particular, the creation of 'choke points' in areas of high traffic density and nearby or consented OREI sites not yet constructed.	✓	**Section 19: Allision and Collision Risk Modelling** Allision and collision risk modelling has been undertaken for the Offshore Development, which includes consideration of the effect of likely vessel displacement on collision risk.
xvi. With reference to xv. above, the number and type of incidents to vessels which have taken place in or near to the proposed site of the OREI to assess the likelihood of such events in the future and the potential impact of such a situation.	✓	**Section 12: Historical Maritime Incidents** Historical vessel incident data published by the MAIB, RNLI and DfT in proximity to the PFOWF Array Area has been considered, alongside historical OWF incident data throughout the UK. **Section 19: Allision and Collision Risk Modelling** Allision and collision risk modelling has been undertaken to estimate the effects of the Offshore Development on allision and collision incident rates.
xvii. Proximity of the site to areas used for recreation which depend on specific features of the area	✓	**Section 13: Vessel Traffic** Recreational traffic is considered in Section 13.2.5 noting this includes consideration of the RYA

MGN Reference	Compliance	Comments
		Coastal Atlas features (RYA, 2019b).
Predicted Effect of OREI on traffic and Interactive Boundaries – where appropriate, the following should be determined:		
a. The safe distance between a shipping route and OREI boundaries.	✓	**Section 18: Future Case Traffic** Presents the methodology followed for the post-wind farm routeing, including the assumptions made when considering safe passing distances between a shipping route and the PFOWF Array Area.
b. The width of a corridor between sites or OREIs to allow safe passage of shipping.	✓	**Section 18: Future Case Traffic** Post-wind farm routeing is considered, noting that there are no existing OWFs in proximity to the PFOWF Array Area, and there are therefore no corridors considered within the routeing.
OREI Structures – the following should be determined:		
a. Whether any feature of the OREI, including auxiliary platforms outside the main generator site, mooring and anchoring systems, inter-device and export cabling could pose any type of difficulty or danger to vessels underway, performing normal operations, including fishing, anchoring and emergency response.	✓	**Section 19: Allision and Collision Risk Modelling** Allision and collision risk modelling has been undertaken for the Offshore Development. **Section 15: Subsea Hazards** Discusses the hazards involving the reduction of under keel clearance such as that posed by the export cable and the mooring lines. **Chapter 14: Shipping and Navigation** Based upon the baseline environment and consultation

MGN Reference	Compliance	Comments
		undertaken, hazards have been identified following the IMO FSA, including anchoring and emergency response hazards.
b. Clearances of fixed or floating wind turbine blades above the sea surface are not less than 22 metres (above MHWS for fixed). Floating turbines allow for degrees of motion.	✓	**Section 22: Mitigation** The minimum blade tip height above the sea surface will be at least 22 m, noting that the minimum blade clearance in the design envelope is 35 m.
c. Underwater devices i. changes to charted depth ii. maximum height above seabed iii. Under Keel Clearance	✓	**Section 6: Project Description** The inter-array and export cable specifications are included in the MDS for cables. The mooring arrangement is also considered. **Section 15: Subsea Hazards** Hazards due to subsea infrastructure such as mooring lines and the export cable have been assessed. **Chapter 14: Shipping and Navigation** Hazards due to subsea infrastructure such as mooring lines and the export cable have been assessed.
d. Whether structures block or hinder the view of other vessels or other navigational features.	✓	**Section 9: Navigational Features** Figure 9.1 displays the positions of AtoNs. **Section 19: Allision and Collision Risk Modelling** Allision and collision risk modelling has been

MGN Reference	Compliance	Comments
		undertaken for the Offshore Development and includes the use of post-wind farm routes.
The Effect of Tides, Tidal Streams and Weather: It should be determined whether:		
a. Current maritime traffic flows and operations in the general area are affected by the depth of water in which the proposed installation is situated at various states of the tide i.e. whether the installation could pose problems at high water which do not exist at low water conditions, and vice versa.	✓	**Section 10: Metocean Data** Provides various states of tide local to the PFOWF Array Area. **Section 13: Vessel Traffic** Vessel traffic data in proximity to the PFOWF Array Area has been analysed. **Section 19: Allision and Collision Risk Modelling** The allision and collision risk models consider tidal conditions.
b. The set and rate of the tidal stream, at any state of the tide, has a significant affect on vessels in the area of the OREI site.	✓	**Section 10: Metocean Data** Provides various states of tide local to the PFOWF Array Area. **Section 19: Allision and Collision Risk Modelling** The allision and collision risk models consider tidal conditions.
c. The maximum rate tidal stream runs parallel to the major axis of the proposed site layout, and, if so, its effect.	✓	
d. The set is across the major axis of the layout at any time, and, if so, at what rate.	✓	
e. In general, whether engine failure or other circumstance could cause vessels to be set into danger by the tidal stream, including unpowered vessels and small, low speed craft.	✓	**Section 10: Metocean Data** Provides various states of tide local to the PFOWF Array Area. **Section 19: Allision and Collision Risk Modelling** The allision and collision risk models consider tidal conditions, and assesses whether a machinery failure could cause vessels to drift into danger.

MGN Reference	Compliance	Comments
f. The structures themselves could cause changes in the set and rate of the tidal stream.	✓	**Section 10: Metocean Data** No effects are anticipated.
g. The structures in the tidal stream could be such as to produce siltation, deposition of sediment or scouring, affecting navigable water depths in the wind farm area or adjacent to the area.	✓	**Section 22: Mitigation** Mitigations have been included as part of the NRA, including MGN 654 compliance with regards to under keel clearance and changes in water depth. **Chapter 14: Shipping and Navigation** Based upon the baseline environment and consultation undertaken, hazards have been identified following the IMO FSA, including the changes in water depths.
h. The site, in normal, bad weather, or restricted visibility conditions, could present difficulties or dangers to craft, including sailing vessels, which might pass in close proximity to it.	✓	**Section 10: Metocean Data** Provides weather and visibility data local to the PFOWF Array Area. **Section 13: Vessel Traffic** Vessel traffic data in proximity to the array has been analysed including recreational vessels. **Chapter 14: Shipping and Navigation** Assesses hazards associated with adverse weather routeing.
i. The structures could create problems in the area for vessels under sail, such as wind masking, turbulence or sheer.	✓	**Chapter 14: Shipping and Navigation** Based upon the baseline environment and consultation undertaken, hazards have been identified following the

MGN Reference	Compliance	Comments
		IMO FSA, including hazards to recreational vessels.
j. In general, taking into account the prevailing winds for the area, whether engine failure or other circumstances could cause vessels to drift into danger, particularly if in conjunction with a tidal set such as referred to above.	✓	**Section 19: Allision and Collision Risk Modelling** The drifting allision risk model considers weather and tidal conditions and assesses whether machinery failure could cause vessels to drift into danger.
Assessment of Access to and Navigation Within, or Close to, an OREI. To determine the extent to which navigation would be feasible within the OREI site itself by assessing whether:		
a. Navigation within or close to the site would be safe: for all vessels, or for specified vessel types, operations and/or sizes. in all directions or areas, or in specified directions or areas. in specified tidal, weather or other conditions	✓	**Section 16: Navigation, Communication and Position Fixing Equipment** Potential hazards to navigation of the different communications and position fixing devices used in and around OWFs are assessed. **Section 19: Allision and Collision Risk Modelling** Allision and collision risk modelling has been undertaken for the Offshore Development which includes use of post-wind farm routeing and takes account of tidal and weather conditions. **Section 22: Mitigation** Mitigation measures have been included within the NRA. **Chapter 14: Shipping and Navigation** Based upon the baseline environment and consultation undertaken, hazards have

MGN Reference	Compliance	Comments
		been identified and assessed following the IMO FSA.
b. Navigation in and/or near the site should be prohibited or restricted: for specified vessels types, operations and/or sizes. in respect of specific activities, in all areas or directions, or in specified areas or directions, or in specified tidal or weather conditions.	✓	**Section 16: Navigation, Communication and Position Fixing Equipment** Potential hazards to navigation of the different communications and position fixing devices used in and around OWFs are assessed. **Section 18: Future Case Vessel Traffic** Allision and collision risk modelling has been undertaken for the Offshore Development and includes the use of post-wind farm routeing which assumes commercial vessels will avoid the PFOWF Array Area. **Chapter 14: Shipping and Navigation** Based upon the baseline environment and consultation undertaken, hazards have been identified and assessed following the IMO FSA.
c. Where it is not feasible for vessels to access or navigate through the site it could cause navigational, safety or routeing problems for vessels operating in the area e.g. by preventing vessels from responding to calls for assistance from persons in distress	✓	**Section 18: Future Case Vessel Traffic** Assessment of post-wind-farm routeing which assumes commercial vessel traffic avoids the PFOWF Array Area has been undertaken.
d. Guidance on the calculation of safe distance of OREI boundaries from shipping routes has been considered	✓	**Section 18: Future Case Vessel Traffic**

MGN Reference	Compliance	Comments
		Presents the methodology for the assessment of post-wind-farm routeing.
Search and rescue, maritime assistance service, counter pollution and salvage incident response. The MCA, through HM Coastguard, is required to provide Search and Rescue and emergency response within the sea area occupied by all offshore renewable energy installations in UK waters. To ensure that such operations can be safely and effectively conducted, certain requirements must be met by developers and operators.		
a. An ERCoP will be developed for the construction, operation and decommissioning phases of the OREI.	✓	**Section 22: Mitigation** The Project will comply with MGN 654, which requires the production of an ERCoP.
b. The MCA's guidance document Offshore Renewable Energy Installation: Requirements, Advice and Guidance for Search and Rescue and Emergency Response for the design, equipment and operation requirements will be followed.	✓	**Section 22: Mitigation** The Project will comply with MGN 654 and its annexes.
c. A SAR checklist will be completed to record discussions regarding the requirements, recommendations and considerations outlined in the above document (to be agreed with MCA)	P	**Section 22: Mitigation** The Project will comply with MGN 654 and its annexes, including the requirement for a SAR checklist.
Hydrography - In order to establish a baseline, confirm the safe navigable depth, monitor seabed mobility and to identify underwater hazards, detailed and accurate hydrographic surveys are included or acknowledged for the following stages and to MCA specifications:		
i. Pre-construction: The proposed generating assets area and proposed cable route	✓	The Project will provide the data in the requested format.
ii. On a pre-established periodicity during the life of the development	✓	
ii. Post-construction: Cable route(s)	✓	
iii. Post-decommissioning of all or part of the development: the installed generating assets area and cable route	✓	
Communications, Radar and Positioning Systems - To provide researched opinion of a generic and, where appropriate, site specific nature concerning whether:		
a. The structures could produce radio interference such as shadowing, reflections or phase changes, and	✓	

MGN Reference	Compliance	Comments
emissions with respect to any frequencies used for marine positioning, navigation and timing (PNT) or communications, including GMDSS and AIS, whether ship borne, ashore or fitted to any of the proposed structures, to:		**Section 16: Navigation, Communication and Position Fixing Equipment** Potential hazards to navigation of the different communications and position fixing devices used in and around OWFs are assessed.
i. Vessels operating at a safe navigational distance	✓	
ii. Vessels by the nature of their work necessarily operating at less than the safe navigational distance to the OREI, e.g. support vessels, survey vessels, SAR assets.	✓	
iii. Vessels by the nature of their work necessarily operating within the OREI.	✓	
b. The structures could produce radar reflections, blind spots, shadow areas or other adverse effects: Vessel to vessel; Vessel to shore; VTS radar to vessel; Racon to/from vessel	✓	**Section 16: Navigation, Communication and Position Fixing Equipment** Potential hazards to navigation of the different communications and position fixing devices used in and around OWFs are assessed. This includes the effects on radar as per Section 16.7.
c. The structures and generators might produce sonar interference affecting fishing, industrial or military systems used in the area.	✓	**Section 16: Navigation, Communication and Position Fixing Equipment** Potential hazards to navigation of the different communications and position fixing devices used in and around OWFs are assessed. This includes sonar effects as per Section 16.8.
d. The site might produce acoustic noise which could mask prescribed sound signals.	✓	**Section 16: Navigation, Communication and Position Fixing Equipment** Potential hazards to navigation of the different communications and position fixing devices used in and around OWFs are assessed.

MGN Reference	Compliance	Comments
		This includes sound effects as per Section 16.9.
e. Generators and the seabed cabling within the site and onshore might produce electro-magnetic fields affecting compasses and other navigation systems.	✓	**Section 16: Navigation, Communication and Position Fixing Equipment** Potential hazards to navigation of the different communications and position fixing devices used in and around OWFs are assessed. This includes potential EMF effects as per Section 16.6.
Risk mitigation measures recommended for OREI during construction, operation and decommissioning.		
Mitigation and safety measures will be applied to the OREI development appropriate to the level and type of risk determined during the (EIA).The specific measures to be employed will be selected in consultation with the MCA and will be listed in the developer's Environmental Statement (ES). These will be consistent with international standards contained in, for example, the Safety of Life at Sea (SOLAS) Convention - Chapter V, IMO Resolution A.572 (14)3 and Resolution A.671(16)4 and could include any or all of the following:	✓	**Section 22: Mitigation** The Project will comply with MGN 654, which requires the production of an ERCoP.
i. Promulgation of information and warnings through notices to mariners and other appropriate maritime safety information (MSI) dissemination methods.	✓	**Section 22: Mitigation** Promulgation of information will be undertaken as per the mitigations set out in the NRA.
ii. Continuous watch by multi-channel VHF, including DSC.	✓	**Section 22: Mitigation** Marine coordination will be implemented, as per the mitigations set out in the NRA.
iii. Safety zones of appropriate configuration, extent and application to specified vessels[5]	✓	**Section 22: Mitigation** As per the mitigations included in the NRA, safety zones will be applied for if deemed necessary by risk assessment.

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

MGN Reference	Compliance	Comments
iv. Designation of the site as an area to be avoided (ATBA).	✓	It is not planned to propose any areas as an ATBA, noting that consultation is ongoing.
v. Provision of AtoN as determined by the GLA	✓	**Section 22: Mitigation** Lighting and marking will be agreed in consultation with the NLB.
vi. Implementation of routeing measures within or near to the development.	✓	**Section 22: Mitigation** It is not planned to propose any additional routeing measures.
vii. Monitoring by radar, AIS, CCTV or other agreed means	✓	**Section 22: Mitigation** The Project will comply with MGN 654, including requirements to complete the SAR checklist. **Section 23: Through Life Safety Management** Outlines the plans to monitor vessel movements by AIS during construction and operations.
viii. Appropriate means for OREI operators to notify, and provide evidence of, the infringement of safety zones.	✓	**Section 22: Mitigation**
ix. Creation of an Emergency Response Cooperation Plan with the MCA's Search and Rescue Branch for the construction phase onwards.	✓	**Section 22: Mitigation** The Project will comply with MGN 654, which requires the creation of an ERCoP.
x. Use of guard vessels, where appropriate	✓	**Section 22: Mitigation** As per the mitigations set out in the NRA, guard vessels will be utilised where deemed necessary via risk assessment.
xi. Update NRAs every two years e.g. at testing sites.	✓	Not applicable to the Project.
xii. Device-specific or array-specific NRAs	✓	**Section 6: Project Description** All offshore elements have been considered in this NRA.

MGN Reference	Compliance	Comments
xiii. Design of OREI structures to minimise risk to contacting vessels or craft	✓	No additional hazards have been identified to craft compared with previous floating offshore wind farms and so no additional measures have been identified.
xiv. Any other measures and procedures considered appropriate in consultation with other stakeholders.	✓	**Section 22: Mitigation** Presents the embedded mitigations considered.

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

The following content is included:	Compliance	Comments
A risk claim is included that is supported by a reasoned argument and evidence	✓	The risk assessment within **Chapter 14: Shipping and Navigation** assesses risk to shipping and navigation users of the area based on the NRA findings, including (but not limited to) the outputs of the Hazard Workshop, stakeholder consultation, baseline shipping analysis and lessons learnt from existing offshore developments.
Description of the marine environment	✓	**Section 9: Navigational Features** Details the relevant navigational features in the vicinity of the PFOWF Array Area. **Section 17: Cumulative Overview** Details potential future developments relevant to the Offshore Development.

The following content is included:	Compliance	Comments
Search and Rescue overview and assessment	✓	**Section 11: Emergency Response Overview** Details existing baseline SAR resources in the vicinity of the PFOWF Array Area. **Section 12: Historical Maritime Incidents** Historical incident data is assessed to determine the baseline incident rates.
Description of the OREI development and how it changes the marine environment	✓	**Section 6: Project Description** Presents details of the project of relevance to shipping and navigation. **Section 19: Allision and Collision Risk Modelling** Provides quantitative assessment of pre- and post-wind farm allision and collision risk.
Analysis of the marine traffic, including base case and future traffic densities and types.	✓	**Section 13: Vessel Traffic** Assesses base case traffic volumes and types. **Section 18: Future Case Traffic** Assesses and considers future case traffic.
Status of the hazard log ▪ Hazard Identification ▪ Risk Assessment ▪ Influences on level of risk ▪ Tolerability of risk ▪ Risk matrix	✓	**Section 3: Navigational Safety Risk Assessment** The Hazard Log and Workshop methodology are presented in Section 3.3. **Appendix B: Hazard Log** Presents the agreed Hazard Log.

The following content is included:	Compliance	Comments
Navigation Risk Assessment ▪ Appropriate risk assessment ▪ MCA acceptance for assessment techniques and tools ▪ Demonstration of results ▪ Limitations	✓	**Section 2: Guidance and Legislation** MGN 654 and the IMO's FSA guidelines are the primary guidance documents used during the assessment. **Section 4: Consultation** NRA approach and methodology has been discussed and agreed with MCA. **Section 19: Allision and Collision Risk Modelling** Allision and collision risk modelling has undertaken with the results outlined numerically and graphically (where appropriate).
Risk control log	✓	**Section 22: Mitigation** Details the embedded mitigation that will be applied.

Appendix B Hazard Log

346. The complete hazard log, created following the Hazard Workshop, is presented in Table B.1.

Table B.1 Hazard Log

Hazard Type	Hazard Title	Phase (Construction / Operation / Decommissioning)	Possible Causes	Embedded Mitigations	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation and Additional Comments
							Consequences								Consequences						
						Frequency	People	Environment	Property	Business	Average	Risk		Frequency	People	Environment	Property	Business	Average	Risk	
Commercial Vessels																					
Displacement	Commercial vessels may be displaced from their existing routes due to construction / decommissioning activities associated with the Offshore Development	C/D	Presence of project vessels during these phases. Marking of work site on charts with cautionary note. Potential buoyage marking the site.	Promulgation of information Marking on Admiralty Charts	Most commercial vessels pass to north. May be a small proportion that increase their clearance. Limited increase in journey time/distance as a proportion of overall route.	4	1	1	1	1	1.0	Broadly Acceptable	Increased encounters involving commercial vessels and impacts on compliance with COLREGs resulting in increased voyage distance / time, impacting on schedules	2	1	1	2	2	1.5	Broadly Acceptable	
Displacement	Commercial vessels may be displaced from their existing adverse weather routes due to construction activities associated with the Offshore Development	C/D	Adverse weather Presence of project vessels during construction/ decommissioning	Promulgation of information Marking on Admiralty Charts Allowable weather limits on work activities	Site work is likely to be suspended in adverse weather. In any case, commercial vessels should be able to identify a suitable alternative route either north or south of array in adverse weather.	3	1	1	1	1	1.0	Broadly Acceptable	Commercial vessel is unable to identify a suitable alternative route in adverse weather resulting in an unsafe passage or the passage not being made at all with subsequent impacts on schedules	1	1	1	4	4	2.5	Broadly Acceptable	

Collision risk	The presence of project vessels during construction may increase the likelihood of vessel-to-vessel encounters and subsequently increase the collision risk between commercial vessels and project vessels	C/D	Presence of project vessels during construction / decommissioning. Lack of familiarity of 3rd party vessels with the Offshore Development. Vessels restricted in manoeuvrability at times. Non-adherence to COLREGS.	Promulgation of information Marine coordination Compliance of project vessels with international marine regulations Application for safety zones	Increased encounters involving commercial vessels and project vessels that do not impact on compliance with the COLREGs	4	1	1	1	1	1.0	Broadly Acceptable	Increased encounters involving commercial vessels and project vessels that impact on compliance with COLREGs and result in collisions	1	5	4	5	4	4.5	Broadly Acceptable	
Collision risk	Displaced vessels may lead to increased traffic densities in certain areas and subsequently increase the collision risk for commercial vessels	C/D	Presence of project vessels during construction/ decommissioning Adverse weather Non-adherence to COLREGS	Promulgation of information	Most commercial vessels pass to north. Displacement expected to be limited but main route may narrow leading to increased encounters. Not expected to impact on the ability of vessels to comply with COLREGs.	4	1	1	1	1	1.0	Broadly Acceptable	Increased encounters involving commercial vessels that impact on compliance with COLREGs and result in collisions.	1	5	4	4	4	4.3	Broadly Acceptable	
Allision risk	Structures within the array could create an allision risk to a passing commercial vessel under power	C/D	Presence of new structures associated with the Offshore Development Watchkeeper failure Bad visibility and ineffective radar use Unfamiliarity with project Failure of AtoN	Marking on Admiralty Charts Promulgation of information Application for safety zones Lighting and marking Guard vessel(s) where required	Commercial vessel has to make late alteration to course resulting in near-miss	4	1	1	1	1	1.0	Broadly Acceptable	Commercial vessel allides with structure resulting in vessel damage, injury / fatality and/or pollution	2	5	5	4	4	4.5	Tolerable	The busy commercial route passing north of the site through the Pentland Firth is used by large vessels such as passenger cruise ships and oil tankers, as such the potential consequences of an incident could be severe in terms of fatalities and pollution. As a floating project, the construction/decommissioning phases are likely to be shorter than for a fixed project as the surface structures will be towed to the site prior to installation.

Allision risk	Structures within the array could create an allision risk for drifting commercial vessels	C/D	Presence of new structures Engine failure Adverse weather Failure of AtoN	Marking on Admiralty Charts Promulgation of information Application for safety zones Lighting and marking Guard vessel(s) where required	Commercial vessel suffers engine failure and drifts in proximity to the array under influence of prevailing conditions. Repair or external recovery (towage) required to prevent allision	3	1	1	1	2	1.3	Broadly Acceptable	Commercial vessels allides with structure while drifting, resulting in vessel damage, injury / fatality and/or pollution	1	5	5	4	4	4.5	Broadly Acceptable	Anchoring unlikely to be possible given water depths in area. Consequences of allision could be severe for large passenger vessel or oil tanker. Emergency towage may be available from Coastguard ETV or Orkney tug but response time will vary. RNLI lifeboat only capable of assisting smaller vessels. As a floating project, these phases are likely to be shorter than for a fixed project in terms of partially complete surface structures in the water.
Displacement	Commercial vessels may be displaced from their existing routes due to the presence of the structures and associated work vessels	O	Presence of structures associated with Offshore Development Presence of project vessels during O&M	Promulgation of information Marking on Admiralty Charts	Most commercial vessels pass to north. A proportion may have to increase their clearance. Limited increase in voyage distance / time as a proportion of their overall route.	4	1	1	1	1	1.0	Broadly Acceptable	Increased encounters involving commercial vessels and impacts on compliance with COLREGs resulting in increased journey time/distance impacting on schedules	3	1	1	3	3	2.0	Broadly Acceptable	
Displacement	Commercial vessels may be displaced from their existing adverse weather routes due to the presence of structures and associated work vessels	O	Presence of structures associated with Offshore Development Presence of project vessels during O&M Adverse weather	Promulgation of information Marking on Admiralty Charts Allowable weather limits on O&M activities	Commercial vessel is able to identify a suitable alternative route in adverse weather	2	1	1	1	1	1.0	Broadly Acceptable	Commercial vessel is unable to identify a suitable alternative route in adverse weather resulting in an unsafe passage or the passage not being made at all with subsequent impacts on schedules	1	1	1	4	4	2.5	Broadly Acceptable	

Collision risk	The presence of project vessels during operation may increase the likelihood of vessel-to-vessel encounters and subsequently increase the collision risk between third party commercial vessels and project vessels	O	Presence of project vessels during maintenance Unfamiliarity with project Non-adherence to COLREGS	Promulgation of information Marine coordination Compliance of project vessels with international marine regulations Construction period (pre-operation) will have increased awareness	Increased encounters involving commercial vessels and project vessels that do not impact on compliance with the COLREGs	5	1	1	1	1	1.0	**Tolerable**	Increased encounters involving commercial vessels and project vessels that result in a collision	1	5	4	5	4	4.5	**Broadly Acceptable**	
Collision risk	Displaced vessels may lead to increased traffic densities in certain areas and a subsequent increase in collision risk for commercial vessels	O	Presence of structures associated with Offshore Development Presence of project vessels during maintenance Adverse weather Non-adherence to COLREGS	Promulgation of information	Most commercial vessels pass to north. Displacement expected to be limited; main route may narrow leading to increased encounters but unlikely to affect ability to comply with COLREGs	4	1	1	1	1	1.0	**Broadly Acceptable**	Increased encounters involving commercial vessels that impact on compliance with COLREGs and result in collisions	1	5	4	5	4	4.5	**Broadly Acceptable**	
Allision risk	Structures within the array could create an allision risk to passing commercial traffic under power	O	Presence of structures associated with Offshore Development Watchkeeper failure Bad visibility and ineffective radar use Unfamiliarity with project Failure of AtoN	Marking on Admiralty Charts Promulgation of information Lighting and marking Guard vessel(s) where required	Commercial vessel has to make late alteration to course resulting in near-miss	4	1	1	1	1	1.0	**Broadly Acceptable**	Commercial vessel allides with structure resulting in vessel damage, injury and potentially pollution	2	5	4	5	4	4.5	**Tolerable**	The busy commercial route passing north of the site through the Pentland Firth is used by large vessels such as passenger cruise ships and oil tankers, as such the potential consequences of an incident could be severe in terms of fatalities and pollution.

Allision risk	Structures within the array could create an allision risk to drifting commercial vessels	O	Presence of structures Engine failure Adverse weather Failure of AtoN	Marking on Admiralty Charts Promulgation of information Lighting and marking	Commercial vessel suffers engine failure and drifts in proximity to the array under influence of prevailing conditions. Repair or external recovery (towage) required to prevent allision	3	1	1	1	2	1.3	Broadly Acceptable	Commercial vessels allides with structure while drifting, resulting in potential vessel damage, injury / fatality and pollution	1	5	4	5	4	4.5	Broadly Acceptable	Anchoring unlikely to be possible given water depths in area. Consequences of allision could be severe for large passenger vessel or oil tanker. Emergency towage may be available from Coastguard ETV or Orkney tug but response time will vary. RNLI lifeboat only capable of assisting smaller vessels. As a floating project, these phases are likely to be shorter than for a fixed project in terms of partially complete surface structures in the water.
Mooring line interaction	Commercial vessel passing in proximity to structures may risk interacting with underwater sections of the mooring line close to the surface due to inadequate under keel clearance	O	Presence of subsea mooring lines Watchkeeper failure Engine failure	Promulgation of information Marking on Admiralty Charts	Deeper draught commercial vessels tend to pass to the north. All vessels will generally plan to pass at a safe distance. Any passing or drifting close to the structures may contact under water mooring lines causing minor damage	2	1	1	2	1	1.3	Broadly Acceptable	Commercial vessels passing or drifting close to the structures may interact with subsea mooring lines, potentially leading to more severe damage, e.g., a fouled propeller or loss of mooring line	1	1	2	3	2	2.0	Broadly Acceptable	
Commercial Fishing Vessels																					
Displacement	Commercial fishing vessels may be displaced from their existing routes due to the construction activities associated with the Offshore Development	C/D	Presence of project vessels during these phases. Marking of work site on charts with cautionary note. Potential buoyage marking the site.	Promulgation of information Marking on Admiralty Charts	Increased encounters involving fishing vessels that do not impact on compliance with the COLREGs but result in increased voyage distance / time.	5	1	1	1	1	1.0	Tolerable	Increased encounters involving fishing vessels and impacts on compliance with COLREGs resulting in increased journey time/distance.	2	1	1	2	2	1.5	Broadly Acceptable	A separate, specialist study on commercial fishing impacts is being carried out as part of the EIA.

Displacement	Commercial fishing vessels may be displaced from their adverse weather routes due to the construction activities associated with the Offshore Development	C/D	Adverse weather Presence of project vessels during construction/ decommissioning	Promulgation of information Marking on Admiralty Charts Allowable weather limits on work activities	Site work is likely to be suspended in adverse weather. Fishing vessel is able to identify a suitable alternative route in adverse weather, e.g., north or south of array.	4	1	1	1	2	1.3	Broadly Acceptable	Fishing vessel is unable to identify a suitable alternative route in adverse weather resulting in an unsafe passage or the passage not being made at all with subsequent impacts on fishing	1	1	1	3	3	2.0	Broadly Acceptable	A separate, specialist study on commercial fishing impacts is being carried out as part of the EIA.
Collision risk	The presence of project vessels during construction may increase the likelihood of vessel-to-vessel encounters and subsequently increase the collision risk between commercial fishing vessels and project vessels	C/D	Presence of project vessels during construction / decommissioning. Lack of familiarity with the Offshore Development. Vessels restricted in manoeuvrability at times. Non-adherence to COLREGS.	Promulgation of information inc. Kingfisher Marine coordination Compliance of project vessels with international marine regulations Application for safety zones	Increased encounters involving commercial fishing vessels and project vessels that do not impact on compliance with the COLREGs	4	1	1	1	1	1.0	Broadly Acceptable	Increased encounters involving commercial fishing vessels and project vessels that impact on compliance with the COLREGs and result in collisions	2	5	3	3	2	3.3	Broadly Acceptable	
Collision risk	Displaced vessels may lead to increased traffic densities in certain areas and a subsequent increase in collision risk for commercial fishing vessels	C/D	Presence of project vessels during construction/ decommissioning. Adverse weather	Promulgation of information inc. Kingfisher Marine coordination Compliance of project vessels with international marine regulations Application for safety zones	Increased encounters involving commercial fishing vessels that do not impact on compliance with the COLREGs	4	1	1	1	1	1.0	Broadly Acceptable	Increased encounters involving commercial fishing vessels that impact on compliance with the COLREGs and result in collisions	2	5	3	3	2	3.3	Broadly Acceptable	

Allision risk	Structures within the array could create an allision risk to a passing commercial fishing vessel under power	C/D	Presence of new structures Watchkeeper failure Bad visibility and ineffective radar use Unfamiliarity with project Failure of AtoN	Marking on Admiralty Charts Promulgation of information inc. Kingfisher Application for safety zones Lighting and marking Guard vessel(s) where required	Fishing vessel has to make late course alteration resulting in a near-miss	4	1	1	1	1	1.0	Broadly Acceptable	Commercial fishing vessel allides with structure resulting in vessel damage, injury / fatality and/or oil spill	3	5	3	4	4	4.0	Tolerable	As a floating project, the construction/decommissioning phases are likely to be shorter than for a fixed project as the surface structures will be towed to the site prior to installation.
Allision risk	Structures within the array could create an allision risk for drifting commercial fishing vessels	C/D	Presence of new structures Engine failure Adverse weather Failure of AtoN	Marking on Admiralty Charts Promulgation of information inc. Kingfisher Application for safety zones Lighting and marking Guard vessel(s) where required	Fishing vessel suffers engine failure and drifts in proximity to the array under influence of prevailing conditions. Repair or external recovery (towage) required to prevent allision.	4	1	1	1	2	1.3	Broadly Acceptable	Commercial fishing vessel allides with structure resulting in vessel damage, injury/fatality and/or oil spill	3	5	3	4	4	4.0	Tolerable	It was noted at Hazard Workshop that fishing vessels tended to have only one engine, making them more susceptible to drifting incidentsWater depths means anchoring unlikely to be feasible. RNLI lifeboat may be able to assist recovery by taking vessel in tow, as well as larger tugs, e.g., Coastguard ETV or Orkney Harbour.As a floating project, the construction/decommissioning phases are likely to be shorter than for a fixed project, with fewer partially completed structures present.
Displacement	Commercial fishing vessels may be displaced from their existing routes due to the presence of new structures and project vessels associated with the Offshore Development	O	Presence of structures associated with the Offshore Development Presence of Project vessels during O&M	Promulgation of information inc. Kingfisher Marking on Admiralty Charts	Increased encounters involving fishing vessels that do not impact on compliance with the COLREGs but result in increased voyage distance / time	4	1	1	1	1	1.0	Broadly Acceptable	Increased encounters involving fishing vessels and impacts on compliance with COLREGs and resulting in increased journey time/distance.	2	1	1	2	3	1.8	Broadly Acceptable	Experience at other offshore wind farms suggests that fishing vessels may continue to pass through the array, reducing displacement effects but potentially increasing other hazards such as allision risk

Displacement	Commercial fishing vessels may be displaced from their adverse weather routes due to the presence of the site	O	Presence of structures associated with the Offshore Development Presence of project vessels during O&M Adverse weather	Promulgation of information inc. Kingfisher Marking on Admiralty Charts Allowable weather limits on O&M activities	Fishing vessel is able to identify a suitable alternative route in adverse weather	3	1	1	1	1	1.0	Broadly Acceptable	Fishing vessel is unable to identify a suitable alternative route in adverse weather resulting in an unsafe passage or the passage not being made at all with subsequent impacts on fishing	2	1	1	3	3	2.0	Broadly Acceptable	It was noted that in adverse weather, fishing vessels may fish closer to the site when fishing grounds further west are unavailable. A separate, specialist study on commercial fishing impacts is being carried out as part of the EIA.
Collision risk	The presence of project vessels during operation may increase the likelihood of vessel-to-vessel encounters and subsequently increase the collision risk between third party commercial fishing vessels and project vessels	O	Presence of project vessels during maintenance Unfamiliarity with project Non-adherence to COLREGS	Promulgation of information inc. Kingfisher Marine coordination Compliance of project vessels with international marine regulations Application for safety zones during major maintenance	Increased encounters involving fishing vessels and project vessels that do not impact on compliance with the COLREGs	5	1	1	1	1	1.0	Tolerable	Increased encounters involving fishing vessels and project vessels that result in a collision	2	4	3	4	4	3.8	Broadly Acceptable	
Collision risk	Displaced vessels may lead to increased traffic densities in certain areas and a subsequent increase in collision risk for commercial fishing vessels	O	Presence of structures Presence of project vessels during maintenance Non-adherence to COLREGS Adverse weather	Promulgation of information inc. Kingfisher	Increased encounters involving fishing vessels that do not impact on compliance with the COLREGs	5	1	1	1	1	1.0	Tolerable	Increased encounters involving fishing vessels that result in a collision	3	4	3	4	4	3.8	Tolerable	It was noted at the Hazard Workshop that fishing vessels may choose to pass inshore of the site, or through the array, rather than joining the route used by larger vessels north of the site
Allision risk	Structures within the array could create an allision risk to passing commercial fishing vessels under power	O	Presence of structures associated with the Project Watchkeeper failure Bad visibility and ineffective radar use Unfamiliarity with project Failure of AtoN	Marking on Admiralty Charts Promulgation of information inc. Kingfisher Lighting and marking Guard vessel(s) where required	Fishing vessel has to make late course alteration resulting in a near-miss	4	1	1	1	1	1.0	Broadly Acceptable	Fishing vessel allides with structure resulting in vessel damage, injury / fatality and/or oil spill	3	5	3	4	4	4.0	Tolerable	

Allision risk	Structures within the array could create an allision risk for drifting commercial fishing vessels	O	Presence of structures Engine failure Adverse weather Failure of AtoN	Marking on Admiralty Charts Promulgation of information inc. Kingfisher Lighting and marking	Fishing vessel suffers engine failure and drifts in proximity to the array under influence of prevailing conditions. Repair or external recovery (towage) required to prevent allision.	4	1	1	1	2	1.3	Broadly Acceptable	Commercial fishing vessel allides with structure resulting in vessel damage, injury and potentially pollution	3	5	3	4	4	4.0	Tolerable	It was noted at Hazard Workshop that fishing vessels tended to have only one engine, making them more susceptible to drifting incidents Water depths means anchoring unlikely to be feasible. RNLI lifeboat may be able to assist recovery by taking vessel in tow, as well as larger tugs, e.g., Coastguard ETV or Orkney Harbour.
Fishing gear interaction	The presence of prelaid subsea cables and mooring lines associated with the Project may lead to fishing gear interaction including snagging	C/D	Presence of subsea cables Lack of awareness Lack of cable protection	Marking on Admiralty Charts Promulgation of information inc. Kingfisher Guard vessel(s) where required	Fishing vessel gear interacts with subsea equipment leading to loss of the gear	4	2	2	2	2	2.0	Tolerable	Fishing vessel gear snags on subsea equipment leading to capsize of the vessel	2	5	4	4	4	4.3	Tolerable	A separate, specialist study on commercial fishing impacts is being carried out as part of the EIA. It was noted at workshop that Kingfisher bulletins should be used alongside Notices to Mariners and local fishing liaison in order to inform fishermen of the mooring line, anchor and cable positions.
Fishing gear interaction	The presence of subsea cables and mooring lines associated with the Project may lead to fishing gear interaction including snagging	O	Presence of subsea cables Lack of awareness Mechanical or technical failure	Marking on Admiralty Charts Promulgation of information inc. Kingfisher Implementation and monitoring of cable protection	Fishing vessel gear interacts with subsea equipment leading to loss of the gear	4	2	2	2	2	2.0	Tolerable	Fishing vessel gear snags on subsea equipment leading to capsize of the vessel	2	5	4	4	4	4.3	Tolerable	A separate, specialist study on commercial fishing impacts is being carried out as part of the EIA.It was noted at workshop that Kingfisher bulletins should be used alongside Notices to Mariners and local fishing liaison in order to inform fishermen of the mooring line, anchor and cable positions.

Mooring line interaction	Commercial fishing vessel passing in proximity to structures may risk interacting with underwater sections of the mooring line close to the surface due to inadequate under keel clearance	O	Presence of subsea mooring lines Watchkeeper failure Engine failure	Promulgation of information inc. Kingfisher Marking on Admiralty Charts	Fishing vessels tend to be relatively shallow draught. Any passing or drifting very close to the structures may contact under water mooring line causing minor damage	3	2	2	2	2	2.0	**Broadly Acceptable**	Fishing vessel passing or drifting very close to the structures may strike mooring lines, leading to capsize of vessel	2	5	4	4	4	4.3	**Tolerable**	It was noted at workshop that Kingfisher bulletins should be used alongside Notices to Mariners and local fishing liaison in order to inform fishermen of the mooring line, anchor and cable positions.
Recreational Vessels																					
Displacement	Recreational vessels may be displaced from their existing routes due to the construction activities associated with the Offshore Development	C/D	Presence of project vessels during these phases. Marking of work site on charts with cautionary note. Potential buoyage marking the site.	Promulgation of information Marking on Admiralty Charts	Increased encounters involving recreational vessels that do not impact on compliance with the COLREGs but result in increased voyage distance / time.	5	1	1	1	1	1.0	**Tolerable**	Increased encounters involving recreational vessels and impacts on compliance with COLREGs resulting in increased voyage distance / time.	2	1	1	2	2	1.5	**Broadly Acceptable**	It was noted at the Hazard Workshop that recreational vessels should be able to transit through the array given the turbine spacing being considered
Collision risk	The presence of project vessels during construction may increase the likelihood of vessel-to-vessel encounters and subsequently increase the collision risk between recreational vessels and project vessels	C/D	Presence of project vessels during construction / decommissioning. Lack of familiarity with the Project (including non-UK sailors). Vessels restricted in manoeuvrability at times. Non-adherence to COLREGS.	Promulgation of information including updated Sailing Directions Marine coordination Compliance of project vessels with international marine regulations Application for safety zones	Increased encounters involving recreational vessels and project vessels that do not impact on compliance with the COLREGs	4	1	1	1	1	1.0	**Broadly Acceptable**	Increased encounters involving recreational vessels and project vessels that impact on compliance with the COLREGs and result in collisions	2	5	3	3	2	3.3	**Broadly Acceptable**	It was noted at the workshop that Kingfisher bulletins were a helpful resource for some sailors

Collision risk	Displaced vessels may lead to increased traffic densities in certain areas and a subsequent increase in collision risk for recreational vessels	C/D	Presence of project vessels during construction/ decommissioning. Adverse weather Unfamiliarity with project for non-UK sailors	Promulgation of information including updated Sailing Directions Marine coordination Compliance of project vessels with international marine regulations Application for safety zones	Increased encounters involving recreational vessels that do not impact on compliance with the COLREGs	4	1	1	1	1	1.0	Broadly Acceptable	Increased encounters involving recreational vessels and project vessels that impact on compliance with the COLREGs and result in collisions	2	5	3	3	2	3.3	Broadly Acceptable	It was noted that Kingfisher bulletins would be effective alongside Notices to Mariners for informing non-UK sailors of the Project
Allision risk	Structures within the array could create a powered allision risk to passing recreational traffic	C/D	Presence of new structures Watchkeeper failure Bad visibility and ineffective radar use Unfamiliarity with project Failure of AtoN	Marking on Admiralty Charts Promulgation of information including updated Sailing Directions Application for safety zones Lighting and marking Guard vessel(s) where required	Recreational vessel has to make late course alteration resulting in a near-miss	4	1	1	1	1	1.0	Broadly Acceptable	Recreational vessel allides with structure resulting in vessel damage, injury/fatality and/or pollution	3	4	3	4	4	3.8	Tolerable	It was noted that Kingfisher bulletins would be effective alongside Notices to Mariners for informing some sailors about the Project It was noted that the Pentland Firth is a challenging stretch to navigate so tired sailors may choose to use auto-pilot after passing Orkney and that well-informed course plotting would be important Note that as a floating project, the construction/decommissioning phases are likely to be much shorter than for a fixed project, with fewer partially completed structures present

Allision risk	Structures within the array could create an allision risk for drifting recreational vessels	C/D	Presence of new structures Engine failure Adverse weather Failure of AtoN	Marking on Admiralty Charts Promulgation of information including updated Sailing Directions Application for safety zones Lighting and marking Guard vessel(s) where required	Recreational vessel suffers engine failure and drifts in proximity to the array under influence of prevailing conditions. May be able to use sail to influence direction otherwise repair or external recovery (towage) required to prevent allision.	4	1	1	1	2	1.3	Broadly Acceptable	Recreational vessel allides with structure resulting in vessel damage, injury/fatality and/or oil spill	3	5	3	4	4	4.0	Tolerable	Water depths prevent anchoring in the area. RNLI lifeboat may be able to assist recovery by taking vessel in tow, as well as larger tugs, e.g., Coastguard ETV or Orkney Harbour. As a floating project, the construction / decommissioning phases are likely to be much shorter than for a fixed project, with fewer partially completed structures present
Displacement	Recreational vessels may be displaced from their existing routes due to the presence of new structures and project vessels associated with the Project.	O	Presence of structures associated with the Project Presence of project vessels during O&M	Promulgation of information inc. updated Sailing Directions Marking on Admiralty Charts	Increased encounters involving recreational vessels that do not impact on compliance with the COLREGs but result in increased journey time/distance impacting on schedules	4	1	1	1	1	1.0	Broadly Acceptable	Increased encounters involving recreational vessels and impacts on compliance with COLREGs resulting in increased voyage distance / time	2	1	1	2	3	1.8	Broadly Acceptable	
Collision risk	The presence of project vessels during operation may increase the likelihood of vessel-to-vessel encounters and subsequently increase the collision risk between third party recreational vessels and project vessels	O	Presence of project vessels during maintenance Unfamiliarity with project Non-adherence to COLREGS	Promulgation of information inc. updated Sailing Directions Marine coordination Compliance of project vessels with international marine regulations Application for safety zones during major maintenance	Increased encounters involving recreational vessels and project vessels that do not impact on compliance with the COLREGs	5	1	1	1	1	1.0	Tolerable	Increased encounters involving recreational vessels and project vessels that result in a collision	2	4	3	4	4	3.8	Broadly Acceptable	It was noted that Kingfisher bulletins would be effective alongside Notices to Mariners for informing some sailors about the Project

Collision risk	Displaced vessels may lead to increased traffic densities in certain areas and a subsequent increase in collision risk for recreational vessels	O	Presence of structures Presence of project vessels during maintenance Non-adherence to COLREGS Adverse weather	Promulgation of information inc. updated Sailing Directions	Increased encounters involving recreational vessels that do not impact on compliance with the COLREGs	5	1	1	1	1	1.0	**Tolerable**	Increased encounters involving recreational vessels that result in a collision	3	4	4	4	4	4.0	**Tolerable**	It was noted at the Hazard Workshop that small vessels such as recreational vessels would likely pass inshore of the site rather than joining the busier commercial route It was noted that Kingfisher bulletins would be effective alongside Notices to Mariners for informing some sailors of the Project
Allision risk	Structures within the array could create a powered allision risk to passing recreational traffic	O	Presence of structures associated with the Project Watchkeeper failure Bad visibility and ineffective radar use Unfamiliarity with project Failure of AtoN	Marking on Admiralty Charts Promulgation of information inc. updated Sailing Directions Lighting and marking Guard vessel(s) where required	Recreational vessel has to make late course alteration resulting in a near-miss	4	1	1	1	1	1.0	**Broadly Acceptable**	Recreational vessel allides with structure resulting in vessel damage, injury/fatality and/or oil spill	3	5	3	4	4	4.0	**Tolerable**	It was noted that Kingfisher bulletins would be effective alongside Notices to Mariners for informing some sailors about the Project It was noted that the Pentland Firth is a challenging stretch to navigate so tired sailors may choose to use auto-pilot after passing Orkney and that well-informed course plotting would be important
Allision risk	Structures within the array could create an allision risk for drifting recreational vessels	O	Presence of structures Engine failure Adverse weather Failure of AtoN	Marking on Admiralty Charts Promulgation of information inc. updated Sailing Directions Lighting and marking	Recreational vessel suffers engine failure and drifts in proximity to the array under influence of prevailing conditions. May be able to use sail to influence direction otherwise repair or external recovery (towage) required to prevent allision.	4	1	1	1	1	1.0	**Broadly Acceptable**	Recreational vessel allides with structure resulting in vessel damage, injury/fatality and/or oil spill	3	5	3	4	4	4.0	**Tolerable**	Water depths prevent anchoring in the area. RNLI lifeboat may be able to assist recovery by taking vessel in tow, as well as larger tugs, e.g., Coastguard ETV or Orkney Harbour.

Mooring line interaction	Recreational vessels passing in proximity to structures may risk interacting with underwater sections of the mooring line close to the surface due to inadequate under keel clearance	O	Presence of subsea mooring lines Watchkeeper failure Engine failure	Promulgation of information inc. updated Sailing Directions Marking on Admiralty Charts	Recreational vessels tend to be relatively shallow draught. Any passing or drifting very close to the structures may contact under water mooring line causing minor damage	3	2	2	2	2	2.0	Broadly Acceptable	Recreational vessels passing or drifting close to the structures may strike mooring lines leading to capsize of vessel	2	5	3	4	4	4.0	Tolerable	
All Vessels																					
Reduced under keel clearance due to cable protection	The implementation of cable protection may reduce water depths and under-keel clearance	C/O/D	Reduction of water depth due to the installation of cable protection	Marking on Admiralty Charts Promulgation of information Implementation and monitoring of cable protection	Vessel transits over an area of slightly reduced clearance but does not make contact	5	1	1	1	1	1.0	Tolerable	Vessel transits over and contacts the cable protection resulting in vessel damage, injury/fatality and/or pollution	1	5	5	4	4	4.5	Broadly Acceptable	Based on water depths only likely to be a potential issue (if at all) close to landfall. Further assessment will be carried out if depths reduced by more than 5% as per MCA guidance.
Port access	Access to local ports for all vessels may be impacted due to construction, decommissioning and/or maintenance activities associated with the Project	C/O/D	Presence of project vessels during construction/ decommissioning	Marine coordination Compliance of project vessels with international marine regulations Liaison with port and updated port procedures	Increased voyage distance / time but does not impact on schedules	4	1	1	1	1	1.0	Broadly Acceptable	Increased voyage distance / time impacting on schedules	2	1	1	1	3	1.5	Broadly Acceptable	
Anchor interaction	The presence of subsea cables and mooring lines associated with the Project may increase the likelihood of anchor interaction for all vessels	C/O/D	Presence of subsea cables and cable protection Human error Mechanical or technical failure Adverse weather leading to anchor drag	Marking on Admiralty Charts Promulgation of information Implementation and monitoring of cable protection Guard vessel(s) where required	Vessels do not anchor in array area due to water depth. Commercial vessel could drop or drag anchor in vicinity of an installed cable but interaction is unlikely	2	1	1	1	1	1.0	Broadly Acceptable	Vessel anchors on or drags anchor over an installed cable/protection resulting in damage to the cable/protection and/or anchor	1	3	3	3	3	3.0	Broadly Acceptable	Water depths around the site are too deep for anchoring in the area to be common. None observed in maritime traffic surveys.

Loss of station	A mooring system failure could cause a structure to lose station and drift creating a navigational hazard to all vessels	O	Adverse weather Inadequate design of mooring for conditions Mechanical or technical failure	Deploy and monitor approach (Demonstrator project to be tested before array) Mooring design and certification based on worst-case storms Implementation of mooring line monitoring systems Notices to Mariners Emergency Response Cooperation Plan Alerting and recovery procedures	Failure of a single mooring line leads to temporary increase in the maximum excursion of the floating foundation but not full loss of station	2	1	1	3	3	2.0	**Broadly Acceptable**	Total failure of mooring system leads to drifting structure with risk of collision with vessels	1	5	5	4	4	4.5	**Broadly Acceptable**	It was noted at the Hazard Workshop that mooring systems are designed with several layers of redundancy to reduce risk of total failure, meaning single mooring line breakage is much more likely than total loss of station It was also noted that it was important to ensure mooring systems were appropriate given recent mooring issues on other projects
Interference with navigational equipment	Communication and position-fixing equipment may be affected by the presence of structures within the site, or proposed Offshore Export Cable Corridor	C/O/D	Presence of structures Human error relating to use of radar controls	Marking on Admiralty Charts Promulgation of information	Minor but manageable effects upon vessel equipment	5	1	1	1	1	1.0	**Tolerable**	Interference with marine equipment affecting efficiency of navigation and/or collision avoidance	2	2	2	2	2	2.0	**Broadly Acceptable**	
Emergency Responders																					
Emergency response capability	The presence of the Project may result in an increased number of incidents requiring emergency response associated with project vessels and/or third-party vessels. The presence of the structures may reduce access for SAR responders, e.g., SAR or surface craft such as lifeboats	C/O/D	Presence of array reduces emergency response access compared with open sea location Adverse weather	MGN 654 Compliance Promulgation of information Emergency Response Coordination Plan Marine Coordination Compliance of project vessels with international marine regulations Marine Pollution Contingency Plan Marking on charts Lighting and marking	Minimal impact on emergency response	4	1	1	1	1	1.0	**Broadly Acceptable**	Reduced probability of detection of a casualty leading to delay in rescue	2	4	2	2	4	3.0	**Broadly Acceptable**	It was noted at the Hazard Workshop that the lifeboat is likely to be first responder. The site may obstruct a straight-line tow by lifeboat back to Scrabster, as would likely tow around the array.
Cumulative - All Vessel Types																					

Cumulative displacement leading to increased encounters and collision risk	Vessels may be displaced from their existing routes due to construction activities associated with the Project and other offshore developments	C/O/D	Presence of project vessels during construction, maintenance and decommissioning Presence of other offshore developments in the area and associated project vessels	Promulgation of information Marking on Admiralty Charts	Increased displacement that does not impact on compliance with the COLREGs but results in minor increases in voyage distance / time without impacting on schedules	5	1	1	1	1	1.0	**Tolerable**	Increased displacement and encounters that impact on compliance with the COLREGs and result in potential collisions as well as impact on schedules	2	3	3	3	3	3.0	**Broadly Acceptable**	It was noted at the Hazard Workshop that ScotWind sites could lead to potential cumulative impacts

Appendix C Consequences

C.1 Introduction

347. This appendix presents an assessment of the consequences of collision and allision incidents, in terms of people and the environment, due to the presence of the Offshore Development.

348. The significance of the impact due to the presence of the Offshore Development is also assessed based on risk evaluation criteria and comparison with historical incident data in UK waters[6].

C.2 Risk Evaluation Criteria

C.2.1 Risk to People

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

- Individual risk; and
- Societal risk.

C.2.1.1 Individual Risk

350. Individual risk considers whether the risk from an incident to a particular individual changes significantly due to the presence of the Offshore Development. Individual risk considers not only the frequency of the incident and the consequences (e.g. likelihood of death), but also the individual's fractional exposure to that risk, i.e. the probability of the individual being in the given location at the time of the incident.

351. The purpose of estimating the individual risk is to ensure that individuals who may be affected by the presence of the Offshore Development are not exposed to excessive risks. This is achieved by considering the significance of the change in individual risk resulting from the presence of the Offshore Development relative to the UK background individual risk levels.

352. Annual risk levels to crew (the annual risk to an average crew member) for different vessel types are presented in Figure C.1, which also includes the upper and lower bounds for risk acceptance criteria as suggested in IMO Maritime Safety Committee 72/16 (IMO, 2001). The annual individual risk level to crew falls within the ALARP region for each of the vessel types presented.

[6] For the purposes of this assessment, UK waters is defined as the UK EEZ and UK territorial waters refers to the 12 nm limit from the British Isles, excluding the Republic of Ireland.

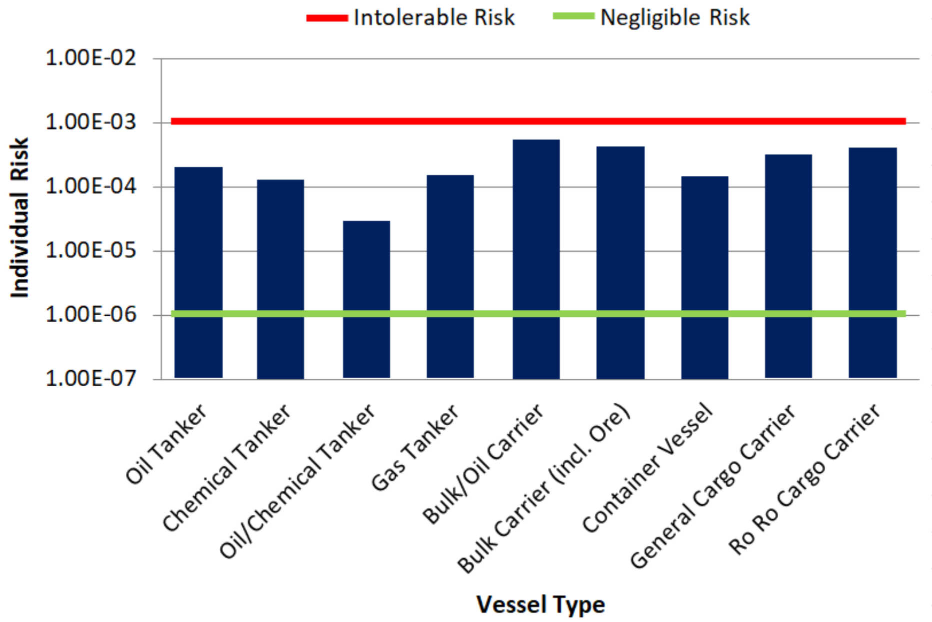

Figure C.1 Individual Risk Levels and Acceptance Criteria per Vessel Type

353. The typical bounds defining the ALARP regions for decision making within shipping are presented in Table C.1. For a new vessel, the target upper bound for ALARP is set lower since new vessels are expected to benefit (in terms of design) from changes in legislation and improved maritime safety.

Table C.1 Individual Risk ALARP Criteria

Individual	Lower Bound for ALARP	Upper Bound for ALARP
To crew member	10^{-6}	10^{-3}
To passenger	10^{-6}	10^{-4}
Third-party	10^{-6}	10^{-4}
New vessel target	10^{-6}	Above values reduced by one order of magnitude

354. On a UK basis, the MCA have presented individual risks for various UK industries based on HSE data from 1987 to 1991. The risks for different industries are presented in Figure C.2.

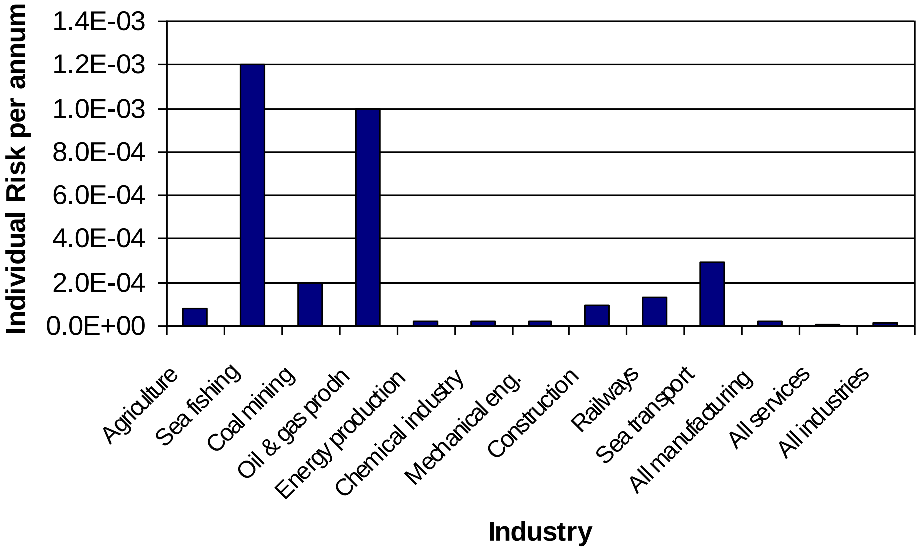

Figure C.2 Individual Risk per Year for Various UK Industries

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

25.1.1.1 Societal Risk

356. Societal risk is used to estimate risks of incidents affecting many persons (catastrophes) and acknowledging risk adverse or neutral attitudes. Societal risk includes the risk to every person, even if a person is only exposed to risk on one brief occasion. For assessing the risk to a large number of affected people, societal risk is desirable because individual risk is insufficient in evaluating risks imposed on large numbers of people.

357. Within this assessment, societal (navigation based) risk can be assessed for the Offshore Development, giving account to the change in risk associated with each incident scenario cause by the introduction of the WTGs. Societal risk may be expressed as:

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

358. When assessing societal risk this study focuses on PLL, which accounts for the number of people likely to be involved in an incident (which is higher for certain vessel types) and assesses the significance of the change in risk compared to the UK background risk levels.

C.2.1.2 Risk to Environment

359. For risk to the environment the key criteria considered in terms of the risk due to the Offshore Development is the potential quantity of oil spilled from a vessel involved in an incident.

360. It is recognised that there will be other potential pollution, e.g. hazardous containerised cargoes; however oil is considered the most likely pollutant and the extent of predicted oil spills will provide an indication of the significance of pollution risk due to the Project compared to UK background pollution risk levels.

C.3 Marine Accident Investigation Branch Incident Data

C.3.1 All Incidents in UK Waters

361. All British flagged commercial vessels are required to report incidents to the MAIB. Non-British flagged vessels do not have to report an incident to the MAIB unless located at a UK port or within 12 nm territorial waters and carrying passengers to a UK port. There are no requirements for non-commercial recreational craft to report incidents to the MAIB; however, a significant proportion of such incidents are reported to and investigated by the MAIB.

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

363. Only incidents occurring in UK waters have been considered within this assessment for which the MAIB data is most comprehensive. It is also noted that incidents occurring in ports/harbours and rivers/canals have been excluded since the causes and consequences may differ considerably from an incident occurring offshore, which is the location of most relevance to the Offshore Development.

364. Accounting for these criteria, a total of 12,093 accidents, injuries and hazardous incidents were reported to the MAIB in the 20-year period between 2000 and 2019 involving 13,965 vessels (some incidents, such as collisions, involved more than one vessel).

365. The location of all incidents in proximity to the UK are presented in Figure C.3, colour-coded by incident type[7]. The majority of incidents occur in coastal waters.

[7] The MAIB aim for 97% accuracy in reporting the location of incidents.

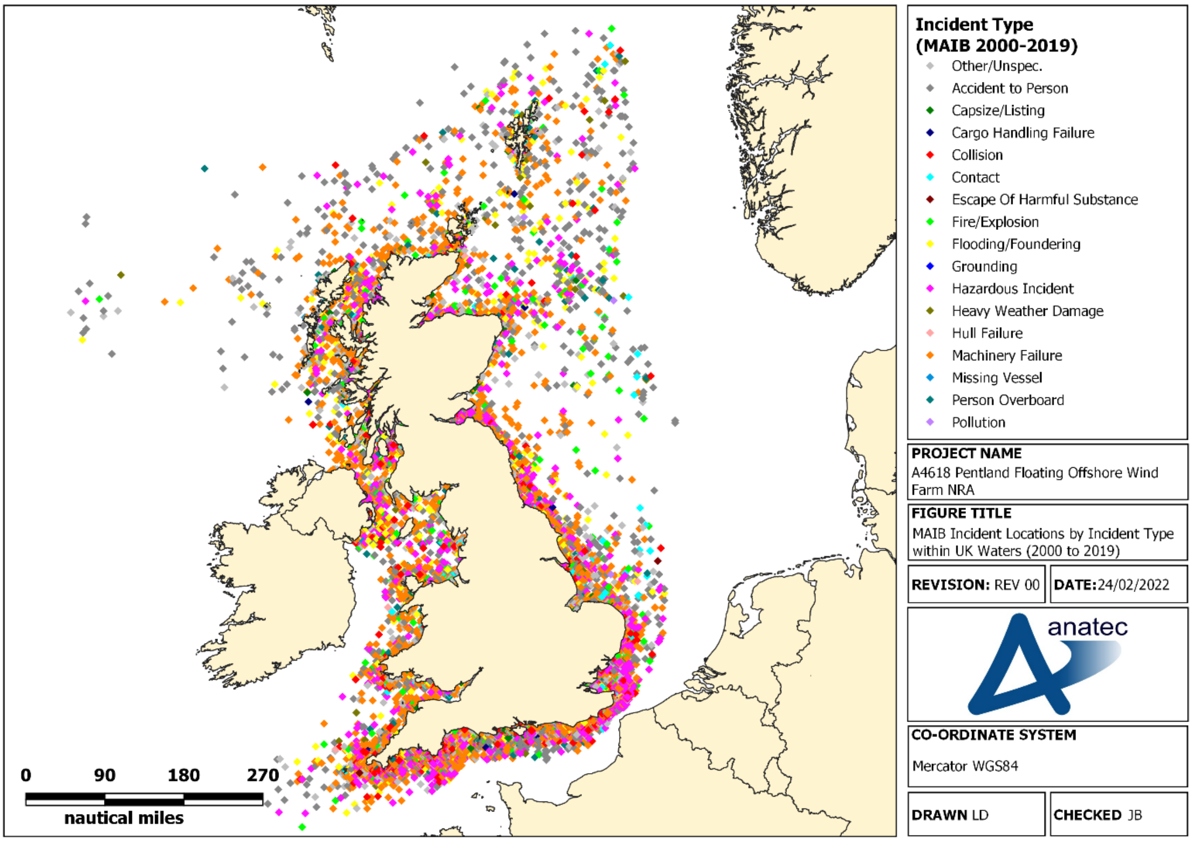

Figure C.3 MAIB Incident Locations by Incident Type within UK Waters (2000 to 2019)

366. The distribution of incidents by year in UK waters is presented in Figure C.4.

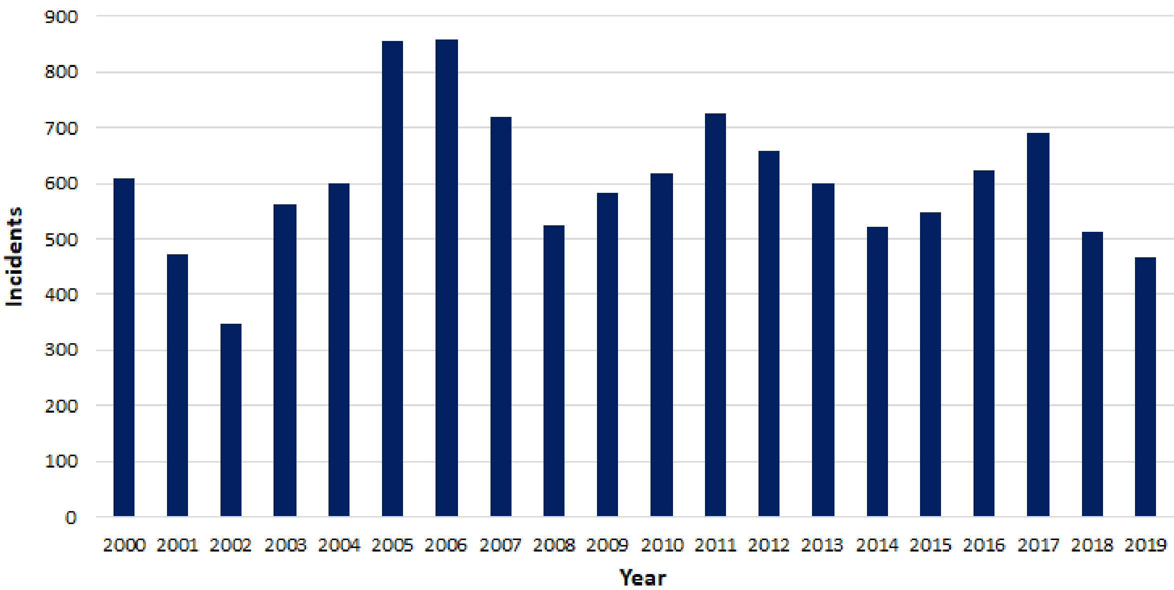

Figure C.4 MAIB Unique Incidents per Year within UK Waters (2000 to 2019)

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

368. The distribution of incidents in UK waters by incident type is presented in Figure C.5.

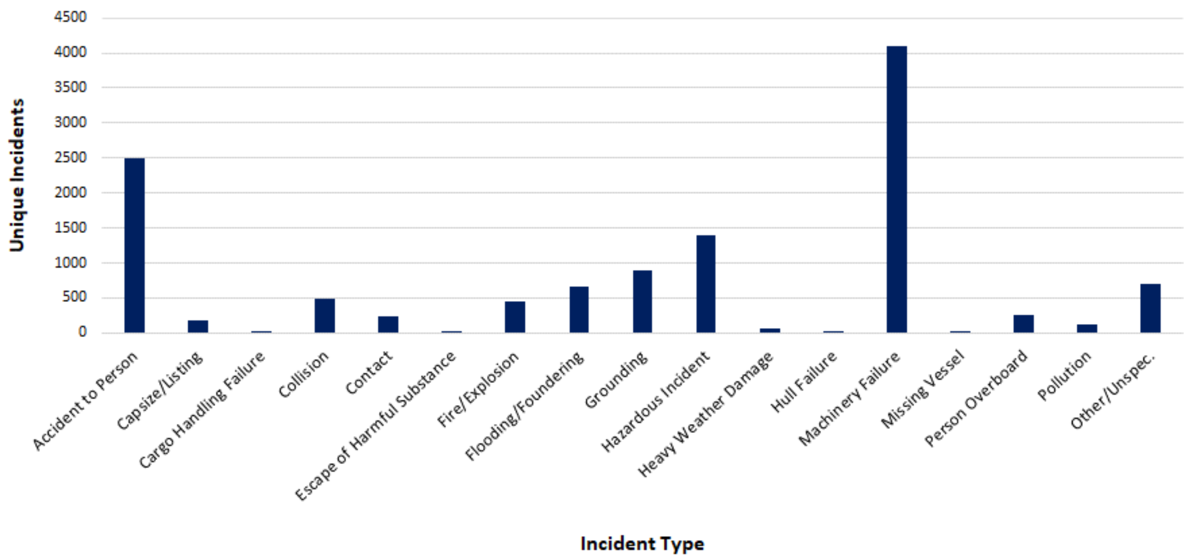

Figure C.5 MAIB Incident Types Breakdown within UK Waters (2000 to 2019)

369. The most frequent incident types were "*machinery failure*" (34%), "*accident to person*" (21%) and "*hazardous incident*" (12%). "*Collision*" and "*contact*" incidents represented 4% and 2% of total incidents, respectively.

370. The distribution of incidents in UK waters by vessel type is presented in Figure C.6.

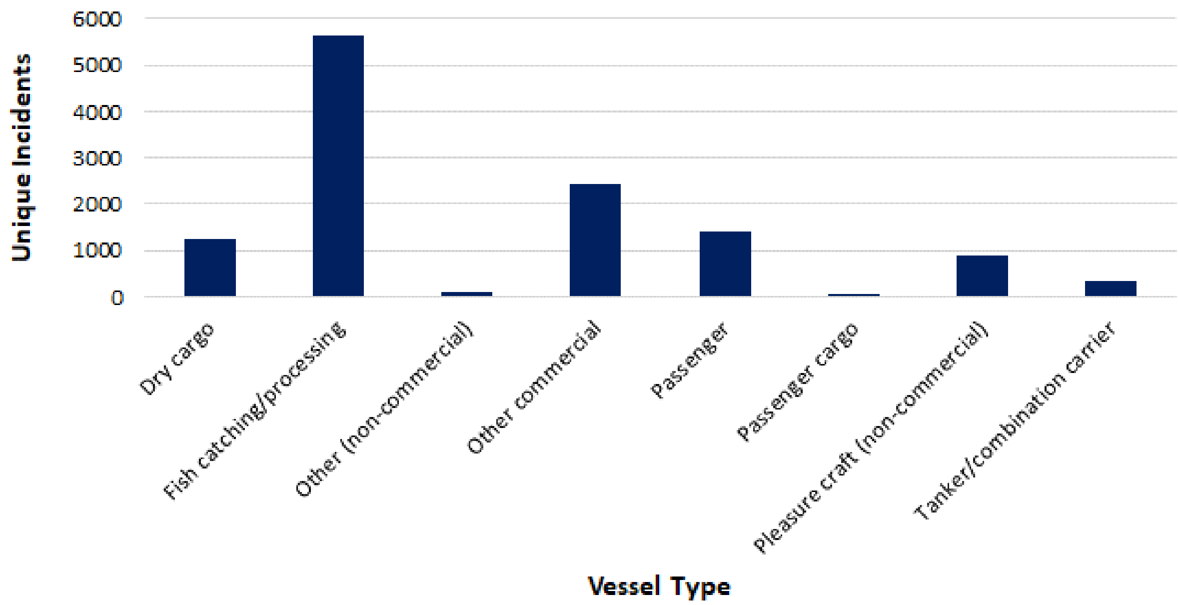

Figure C.6 MAIB Incident Types Breakdown within UK Waters (2000 to 2019)

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

372. A total of 373 fatalities were reported in the MAIB incidents within UK waters between 2000 and 2019, corresponding to an average of 19 fatalities per year.

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

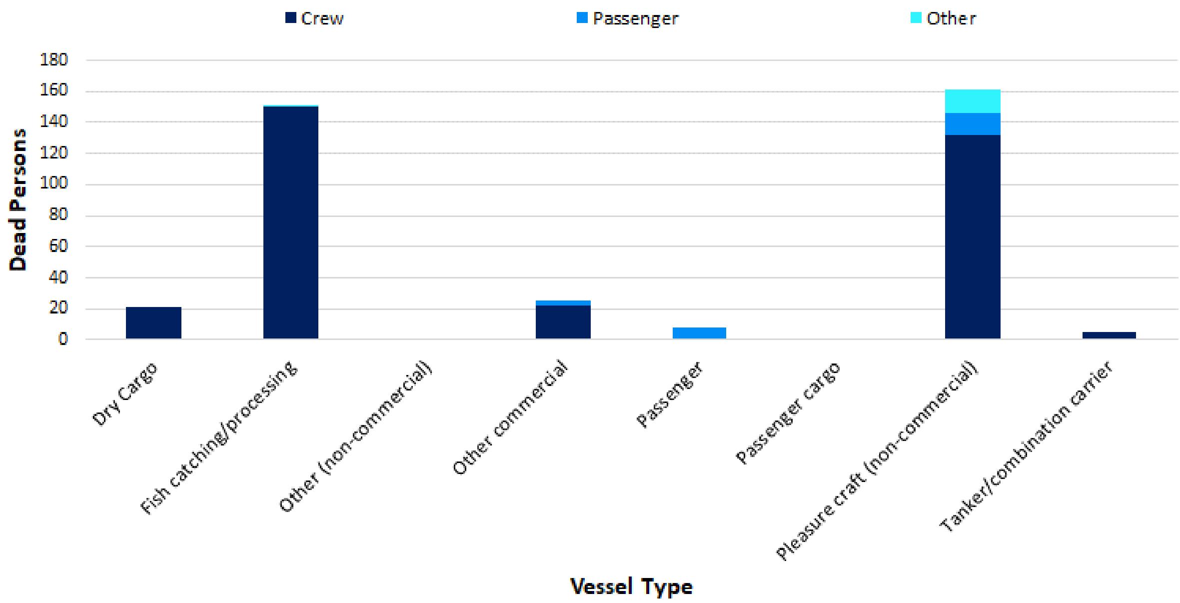

Figure C.7 MAIB Fatalities by Vessel Type within UK Waters (2000 to 2019)

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

C.3.2 Collision Incidents

375. The MAIB define a collision incident as "ships striking or being struck by another ship, regardless of whether the ships are underway, anchored or moored" (MAIB, 2013).

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

377. The locations of collision incidents reported in proximity to the UK are presented in Figure C.8.

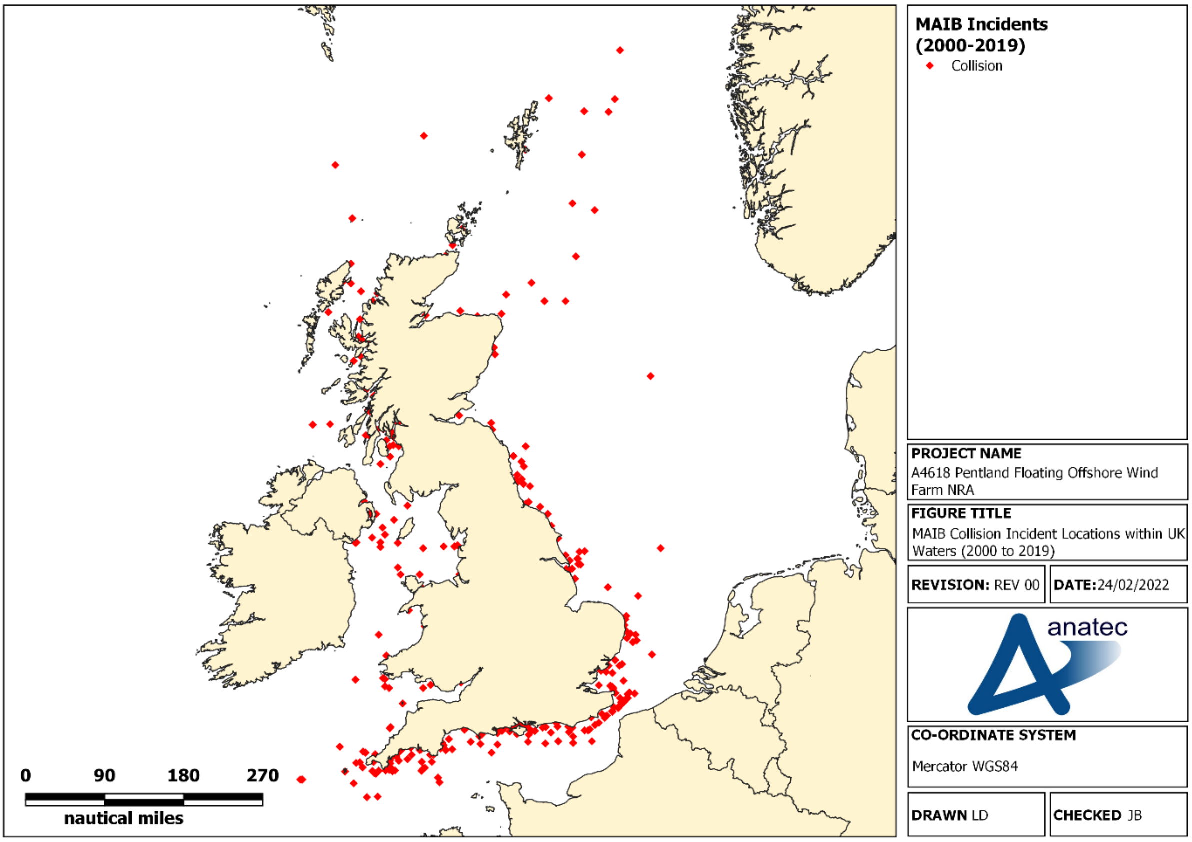

Figure C.8 MAIB Collision Incident Locations within UK Waters (2000 to 2019)

378. The distribution of collision incidents per year is presented in Figure C.9.

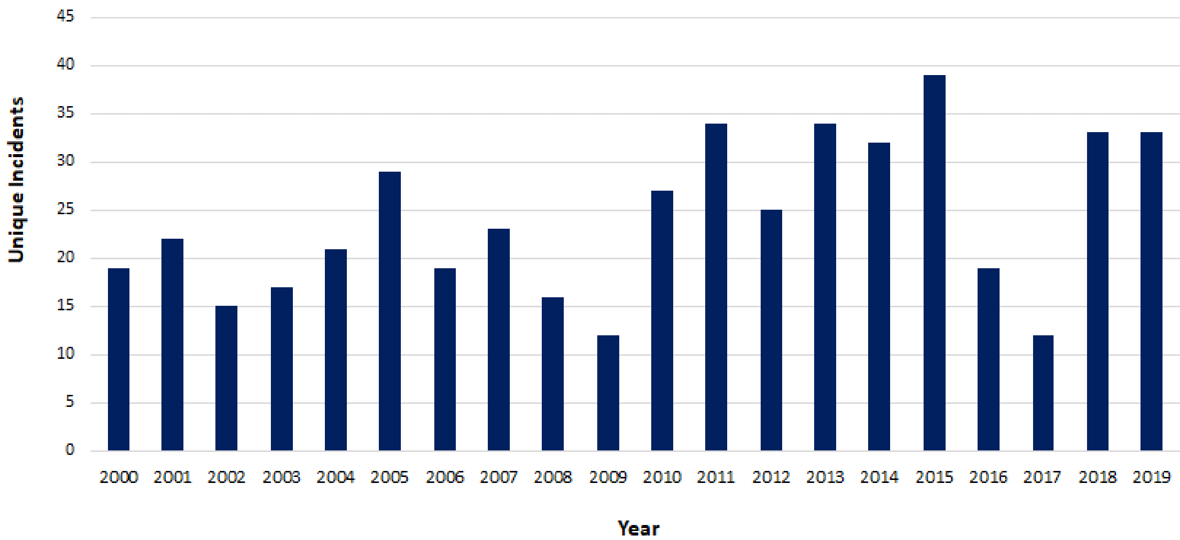

Figure C.9 MAIB Annual Collision Incidents within UK Water (2000 to 2019)

379. The average number of collision incidents per year was 14. There has been an overall slight increasing trend in collision incidents over the 20-year period, which may be due to better reporting of less serious incidents in recent years.

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

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

Table C.2 Description of Fatal MAIB Collision Incidents (2000 to 2019)

Date	Description	Fatalities
October 2001	A dry cargo vessel and a chemical tanker collided in the south-west traffic lane of the Dover Strait TSS to the south east of Hastings. Although the weather and visibility were good, both watchkeepers were too late to take effective avoiding action. The collision resulted in the sinking of the dry cargo vessel from which five out of six crew members were rescued.	1
July 2005	A collision between two powerboats near Castle Point, St. Mawes resulted in the death of one of the helmsmen. The incident occurred during the night with both vessels unlit whilst transiting through the area. Both helmsmen had consumed alcohol prior to the incident which is suspected to have caused reduced peripheral vision, deterioration of judgment and slower reaction times from both helmsmen, resulting in the collision.	1
October 2007	A fishing vessel was involved in a collision with a coastal general cargo vessel. The collision took place about 21 miles off the Humber near the Rough gas field. Neither of the vessels was found to be keeping an effective lookout. The weather at the time was good with fair to good visibility. As a result of the collision, the fishing vessel suffered major structural damage and sank within seconds. Of the four crew onboard, three managed to get into a life raft and abandon the vessel; sadly the fourth member of crew was not recovered.	1
August 2010	An Italian registered passenger ferry collided with a British registered fishing vessel around four miles off St Abb's Head. As a result of the collision, the fishing vessel sank. The skipper was recovered from the sea but, despite an extensive search by the rescue services and a large number of local fishing vessels, the remaining crew member was lost.	1
June 2015	A collision occurred between a Rigid-hulled Inflatable Boat (RIB) and the yacht that had been carrying the RIB earlier the same day. One 36-year old man was seriously injured as a result of the incident and was airlifted to hospital before being pronounced dead later in the evening. It is believed that there were originally a dozen or so people aboard the motorboat, with the majority being taken ashore by the Cowes and Gosport lifeboats. Local rescue crews towed the RIB from the scene into Cowes, with the larger motorboat being escorted by a police launch.	1

Date	Description	Fatalities
June 2018	Emergency services were called to West Bay, Bridport following a fatal crash during a power boat race. One of the power boats taking part in the offshore circuit racing event overturned after colliding with another. A man from Canterbury, understood to be the boat's pilot, was pronounced dead at the scene.	1

C.3.3 Contact Incidents

382. The MAIB define a contact incident as "ships striking or being struck by an external object. The objects can be: floating object (cargo, ice, other or unknown); fixed object, but not the sea bottom; or flying object" (MAIB, 2013).

383. A total of 235 contact incidents were reported to the MAIB within UK waters between 2000 and 2019 involving 270 vessels (in a small number of cases the contact involved a moving vessel and a stationary vessel).

384. The locations of contact incidents reported in proximity to the UK are presented in Figure C.10.

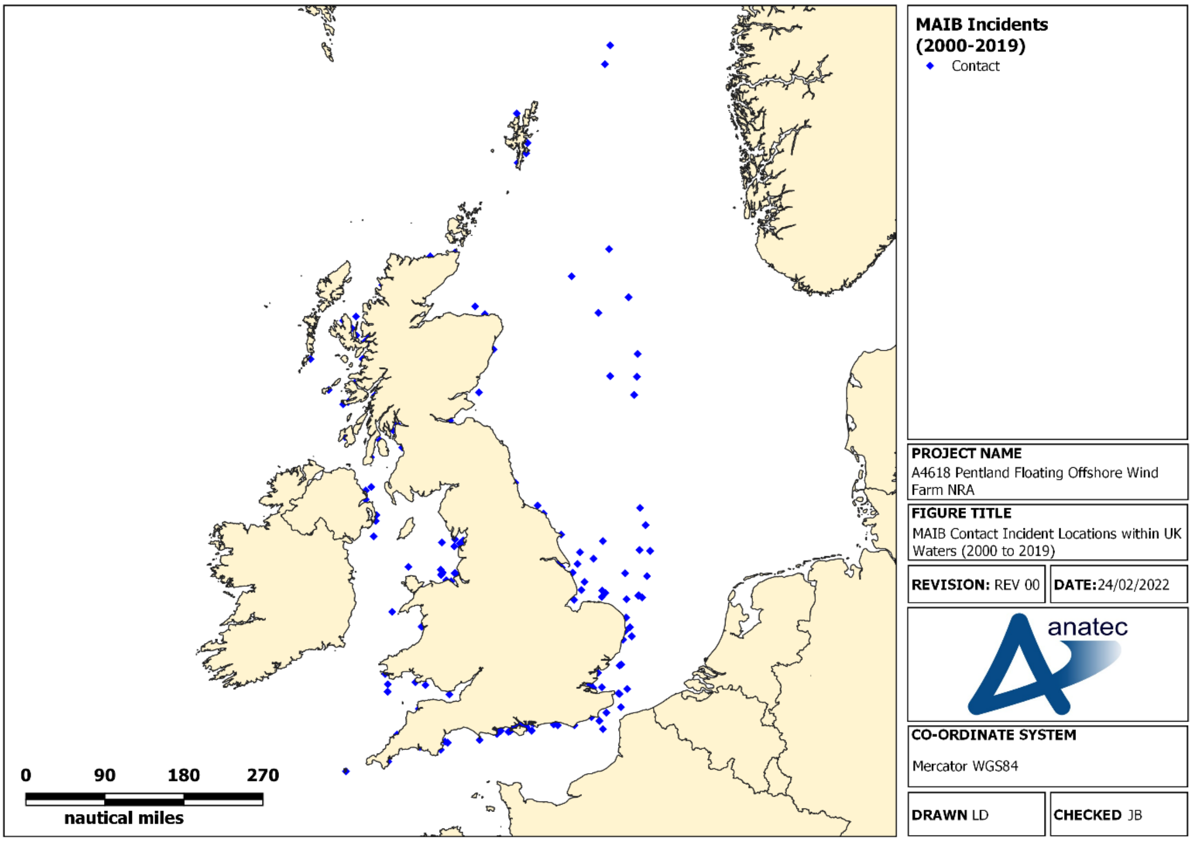

Figure C.10 MAIB Contact Incident Locations within UK waters (2000 to 2019)

385. The distribution of contact incidents per year is presented in Figure C.11.

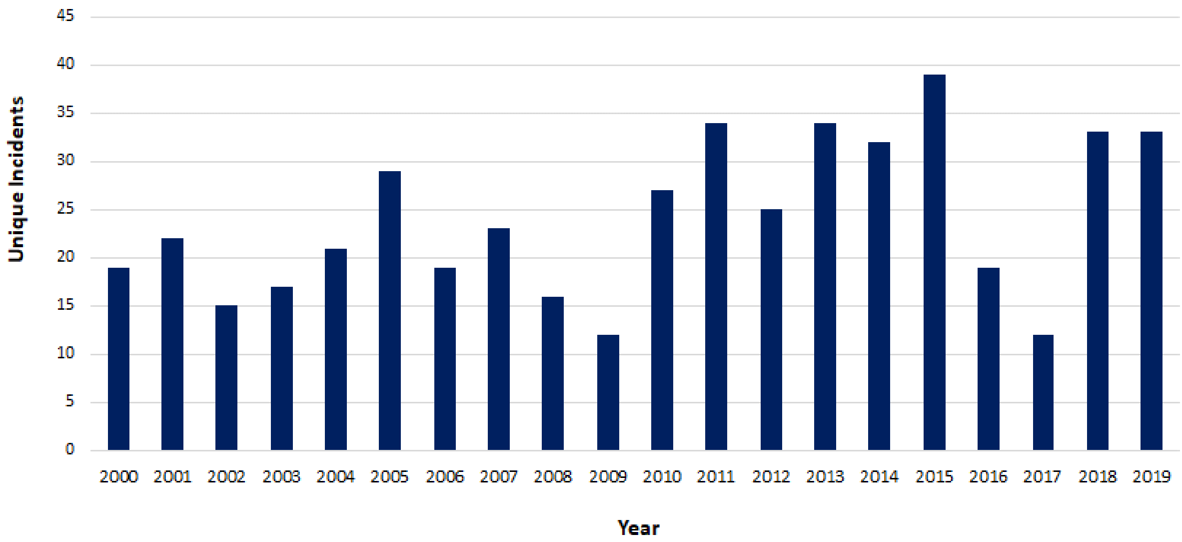

Figure C.11 MAIB Contact Incidents per Year within UK Waters (2000 to 2019)

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

387. The distribution of vessel types involved in contact incidents is presented in Figure C.12.

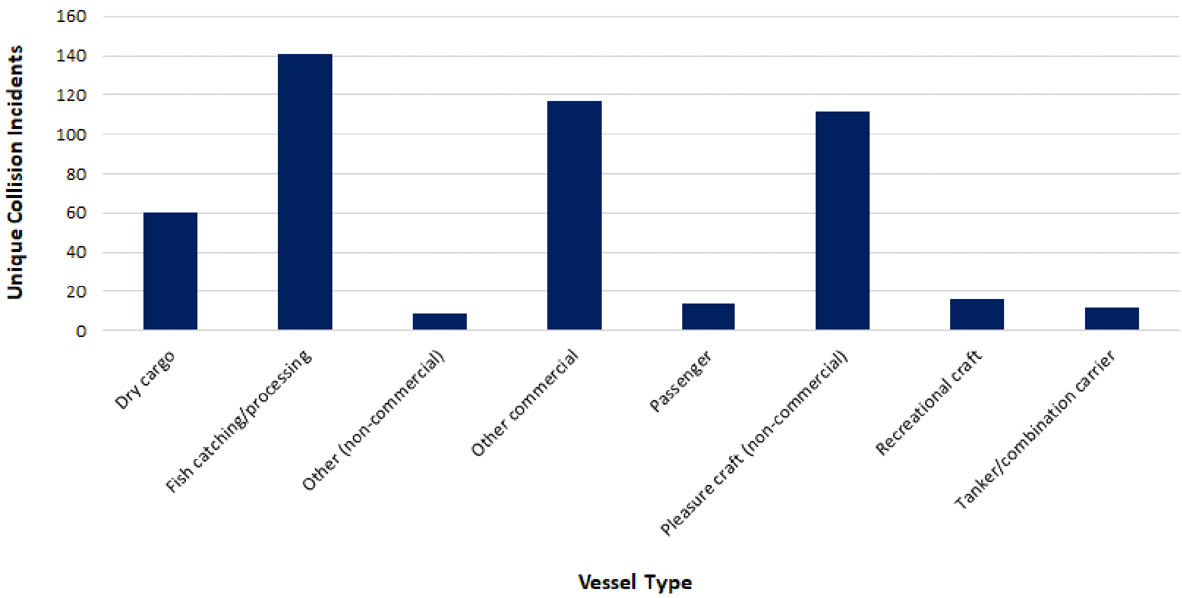

Figure C.12 MAIB Contact Incidents by Vessel Type within UK Waters (2000 to 2019)

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

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

Table C.3 Description of Fatal MAIB Contact Incidents (2000 to 2019)

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

C.4 Fatality Risk

C.4.1 Incident Data

390. This section uses the MAIB incident data along with information on average manning levels per vessel type to estimate the probability of a fatality in a maritime incident associated with the Offshore Development.

391. The Offshore Development is assessed to have the potential to affect the following incidents:

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

392. Of these incident types, only vessel to vessel collisions match the MAIB definition of collisions and hence the fatality analysis presented in Section C.3.2 is considered directly applicable to these types of incidents.

393. The other scenarios of powered vessel to structure allision, drifting vessel to structure allision and fishing vessel to structure allision are technically contacts since they would involve a vessel striking an immobile object in the form of a WTG. From Section C.3.3, only one of the 235 contact incidents reported by the MAIB between 2000 and 2019 resulted in a fatality, with the contact occurring with a jetty in the approaches to a harbour.

394. As the mechanics involved in a vessel contacting a WTG may differ in severity from striking, for example, a buoy, quayside or moored vessel, the MAIB collision fatality risk rate has also been conservatively applied for the allision incident types.

C.4.2 Fatality Probability

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

396. To assess the fatality risk for personnel onboard a vessel (crew, passenger or other) the number of persons involved in the incidents needs to be estimated. Table C.4 presents the average number of POB estimated for each category of vessel navigating in proximity to the Offshore Development. For passenger vessels this is based upon information available for the specific vessels recorded in the vessel traffic survey data. For other vessel categories, this is based upon information available from the MAIB incident data.

Table C.4 Estimated Average POB by Vessel Category

Vessel Category	Sub Categories	Source of Estimated Average POB	Estimated Average POB
Cargo/freight	Dry cargo, other commercial, service ship, etc.	MAIB incident data	15
Tanker	Tanker/combination carrier	MAIB incident data	22
Passenger	Ro-Ro passenger, cruise liner, etc.	Vessel traffic survey data / online information	823
Fishing	Trawler, potter, dredger, etc.	MAIB incident data	3.3
Recreational	Yacht, small commercial motor yacht, etc.	MAIB incident data	3.3

397. It is recognised that these average POB numbers can be substantially higher or lower on an individual vessel basis depending upon the size, subtype, etc. but applying reasonable averages is considered sufficient for this analysis, particularly when noting that the average POB for the dominant vessel category (passenger) is based upon the vessel traffic survey data where possible.

398. Using the average POB, along with the vessel type information involved in collision incidents reported by the MAIB (see Section C.3.2), there was an estimated 17,848 POB the vessels involved in the collision incidents.

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

400. It is considered inappropriate to apply this rate uniformly as the statistics indicate that the fatality probability associated with smaller craft, such as fishing vessels and recreational vessels, is higher. Therefore, the fatality probability has been subdivided into three categories of vessel as presented in Table C.5.

Table C.5 Collision Incident Fatality Probability by Vessel Category (2000 to 2019)

Vessel Category	Sub Categories	Fatalities	People Involved	Fatality Probability
Commercial	Dry cargo, passenger, tanker, etc.	1	16,256	6.2×10^{-5}
Fishing	Trawler, potter, dredger, etc.	2	880	2.3×10^{-3}
Recreational	Yacht, small commercial motor yacht, etc.	3	713	4.2×10^{-3}

401. The risk is higher by two orders of magnitude for POB small craft compared to larger commercial vessels.

C.4.3 Fatality Risk due to the Offshore Development

402. The base case and future case annual collision frequency levels pre and post wind farm for the Offshore Development are summarised in Table C.6.

Table C.6 Summary of Annual Collision and Allision Risk Results

Collision / Allision Risk	Scenario	Annual Frequency (Return Period)		
		Pre-Wind Farm	Post-Wind Farm	Change
Vessel to vessel collision	Base case	1.61×10^{-3} (1 in 623 years)	2.46×10^{-3} (1 in 406 years)	8.54×10^{-4} (1 in 1,170 years)
	Future case (+10%)	1.94×10^{-3} (1 in 516 years)	2.97×10^{-3} (1 in 337 years)	1.03×10^{-3} (1 in 970 years)
	Future case (+20%)	2.30×10^{-3} (1 in 435 years)	3.52×10^{-3} (1 in 284 years)	1.22×10^{-3} (1 in 818 years)
Powered vessel to structure allision	Base case	N/A	1.24×10^{-3} (1 in 809 years)	1.24×10^{-3} (1 in 809 years)
	Future case (+10%)	N/A	1.36×10^{-3} (1 in 736 years)	1.36×10^{-3} (1 in 736 years)

Collision / Allision Risk	Scenario	Annual Frequency (Return Period)		
		Pre-Wind Farm	Post-Wind Farm	Change
	Future case (+20%)	N/A	1.48×10^{-3} (1 in 676 years)	1.48×10^{-3} (1 in 676 years)
Drifting vessel to structure allision	Base case	N/A	3.45×10^{-5} (1 in 28,979 years)	3.45×10^{-5} (1 in 28,979 years)
	Future case (+10%)	N/A	3.79×10^{-5} (1 in 26,374 years)	3.79×10^{-5} (1 in 26,374 years)
	Future case (+20%)	N/A	4.13×10^{-5} (1 in 24,213 years)	4.13×10^{-5} (1 in 24,213 years)
Fishing vessel to structure allision	Base case	N/A	4.11×10^{-2} (1 in 24 years)	4.11×10^{-2} (1 in 24 years)
	Future case (+10%)	N/A	4.47×10^{-2} (1 in 22 years)	4.47×10^{-2} (1 in 22 years)
	Future case (+20%)	N/A	4.84×10^{-2} (1 in 21 years)	4.84×10^{-2} (1 in 21 years)
Total	Base case	1.61×10^{-3} (1 in 623 years)	4.48×10^{-2} (1 in 22 years)	4.32×10^{-2} (1 in 23 years)
	Future case (+10%)	1.94×10^{-3} (1 in 516 years)	4.91×10^{-2} (1 in 20 years)	4.71×10^{-2} (1 in 21 years)
	Future case (+20%)	2.30×10^{-3} (1 in 435 years)	5.34×10^{-2} (1 in 19 years)	5.11×10^{-2} (1 in 20 years)

403. From the detailed results of the collision and allision risk modelling, the distribution of the predicted change in annual collision and allision frequency by vessel type due to the Offshore Development for the base case and future case are presented in Figure C.13.

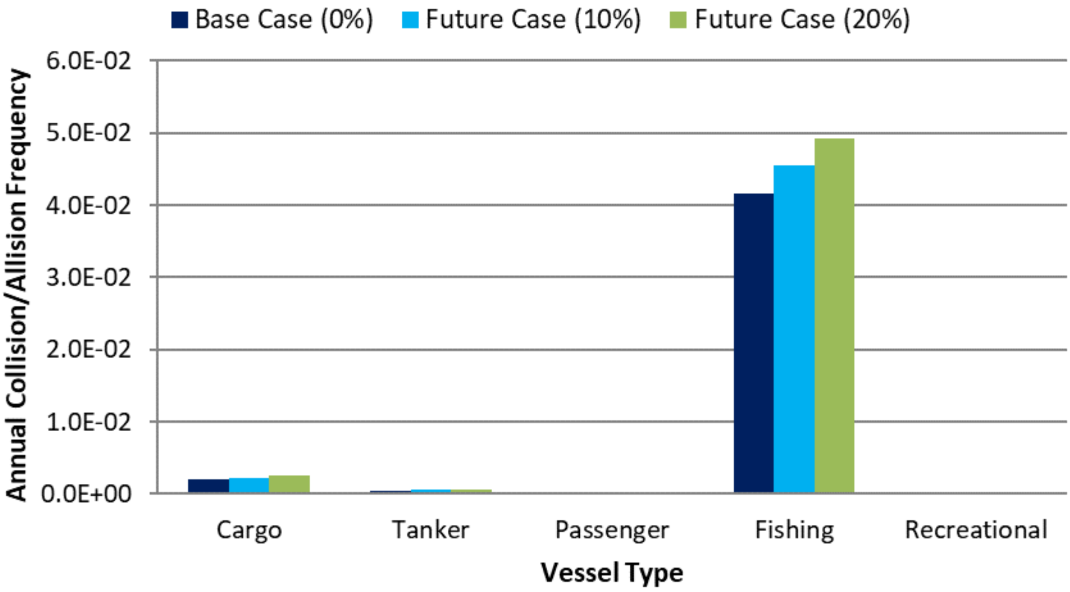

Figure C.13 Estimated Change in Annual Collision and Allision Frequency by Vessel Type

404. The majority of change in collision and allision frequency was observed to be associated with fishing vessels. The fishing allision model conservatism and assumptions with regards to consequences discussed in Section 19.3.4 should be noted in this regard.

405. Combining the annual collision and allision frequency, estimated number of POB for each vessel type and the estimated fatality probability for each vessel type category the annual increase in PLL due to the presence of the Offshore Development for the base case is estimated to be 2.92×10^{-4}, equating to one additional fatality every 3,420 years.

406. The estimated incremental increases in PLL due to the Offshore Development, distributed by vessel type and for the base case and future case, are presented in Figure C.14.

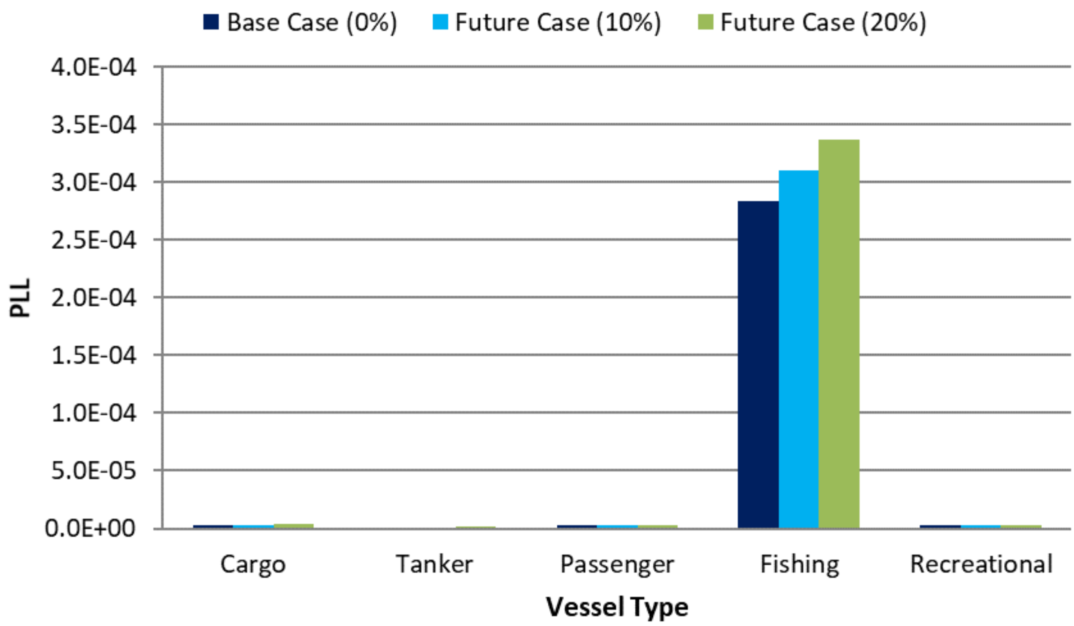

Figure C.14 Estimated Change in Annual PLL by Vessel Type

407. The majority of PLL was observed to be associated with fishing vessels. This is primarily due to fishing vessel allision risk, and the fishing allision model conservatism and assumptions with regards to consequences discussed in Section 19.3.4 should be noted in this regard.

408. Converting the PLL to individual risk based upon the average number of people exposed by vessel type, the results are presented in Figure C.15.

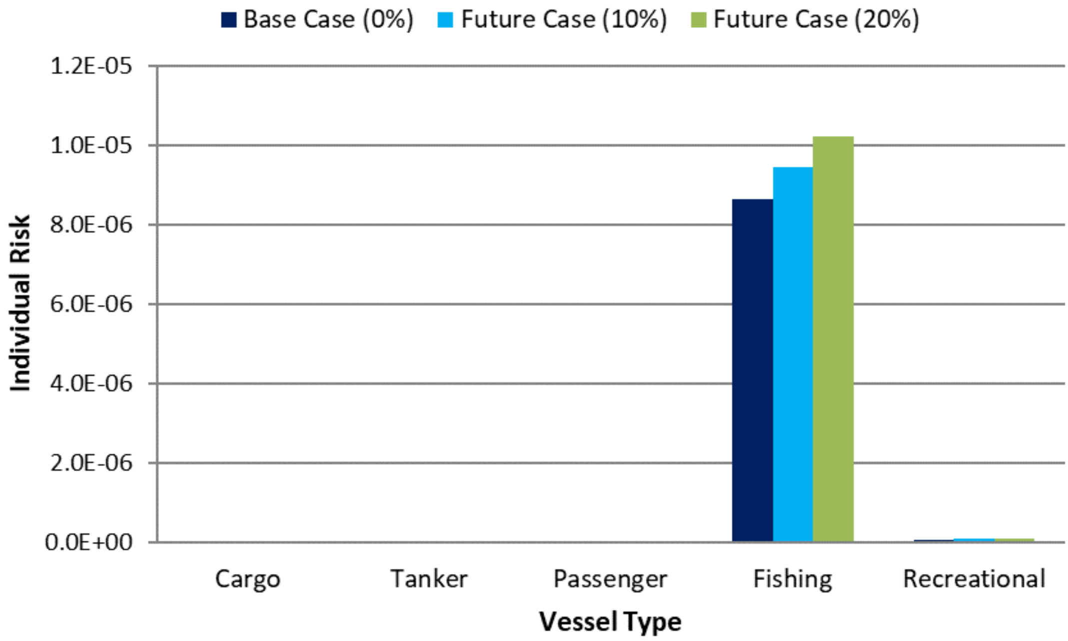

Figure C.15 Estimated Change in Individual Risk by Vessel Type

409. The individual risk was observed to be highest for people on fishing vessels. This is primarily due to fishing vessel allision risk, and the fishing allision model conservatism and assumptions with regards to consequences discussed in Section 19.3.4 should be noted in this regard.

C.4.4 Significance of Increase in Fatality Risk

410. In comparison to MAIB statistics, which indicate an average of 20 fatalities per year in UK territorial waters, the overall increase for the base case in PLL of one additional fatality per 3,420 years represents a very small change.

411. In terms of individual risk to people, the change for commercial vessels attributed to the Offshore Development (approximately 1.99×10^{-8} for the base case) is very low compared to the background risk level for the UK sea transport industry of 2.9×10^{-4} per year.

412. For fishing vessels, the change in individual risk attributed to the Offshore Development (approximately 8.63×10^{-6} for the base case) is very low compared to the background risk level for the UK sea fishing industry of 1.2×10^{-3} per year.

C.5 Pollution Risk

C.5.1 Historical Analysis

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

- Spill probability (i.e. the likelihood of outflow following an incident); and
- Spill size (quantity of oil).

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

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

415. The research undertaken as part of the DfT's MEHRAs project (DfT, 2001) has been used as it was comprehensive and based upon worldwide marine oil spill data analysis. From this research, the overall probability of a spill per incident was calculated based upon historical incident data for each incident type as presented in Figure C.16.

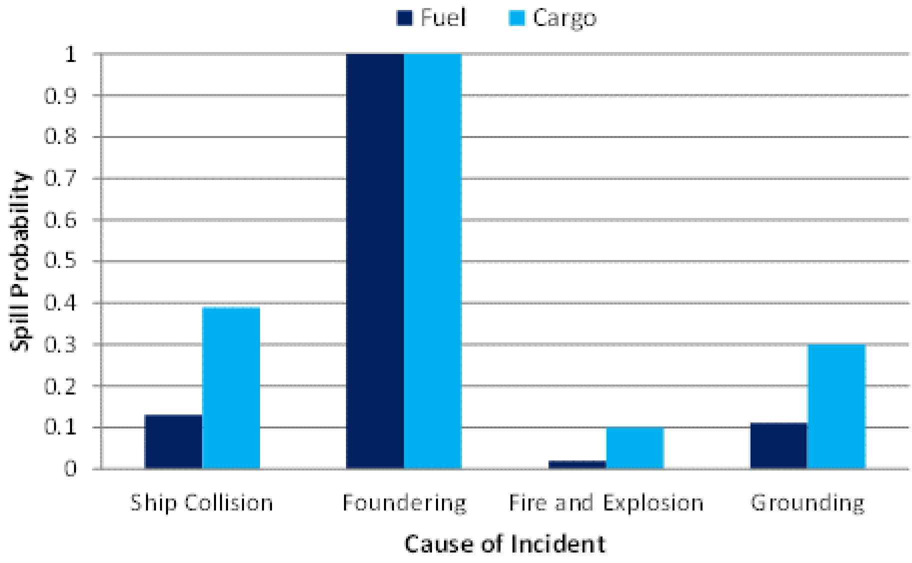

Figure C.16 Probability of an Oil Spill Resulting from an Accident

416. Therefore, it was estimated that 13% of vessel collisions result in a fuel oil spill and 39% of collisions involving a laden tanker result in a cargo oil spill.

417. In the event of a bunker spill, the potential outflow of oil depends upon the bunker capacity of the vessel. Historical bunker spills from vessel have generally been limited to a size below 50% of bunker capacity, and in most incidents much lower.

418. For the types and sizes of vessels exposed to the Offshore Development, an average spill size of 100 tonnes of fuel oil is considered a conservative assumption.

419. For cargo spills from laden tankers, the spill size can vary significantly. The ITOPF reported the following spill size distribution for tanker collisions between 1974 and 2004:

- 31% of spills below seven tonnes;
- 52% of spills between seven and 700 tonnes; and
- 17% of spills greater than 700 tonnes.

420. Based upon this data and the tankers transiting in proximity to the Offshore Development, an average spill size of 400 tonnes is considered a conservative assumption.

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

C.5.2 Pollution Risk due to the Offshore Development

422. Applying the above probabilities to the annual collision and allision frequency by vessel type and the average spill size per vessel, the amount of oil spilled per year due to the impact of the Offshore Development is estimated to be 0.21 tonnes per year for the base case. For the future case scenarios, this estimate increases to 0.23 tonnes and 0.26 tonnes for traffic increases of 10% and 20%, respectively.

423. The estimated increase in tonnes of oil spilled, distributed by vessel type, for the base case and future case are presented in Figure C.17.

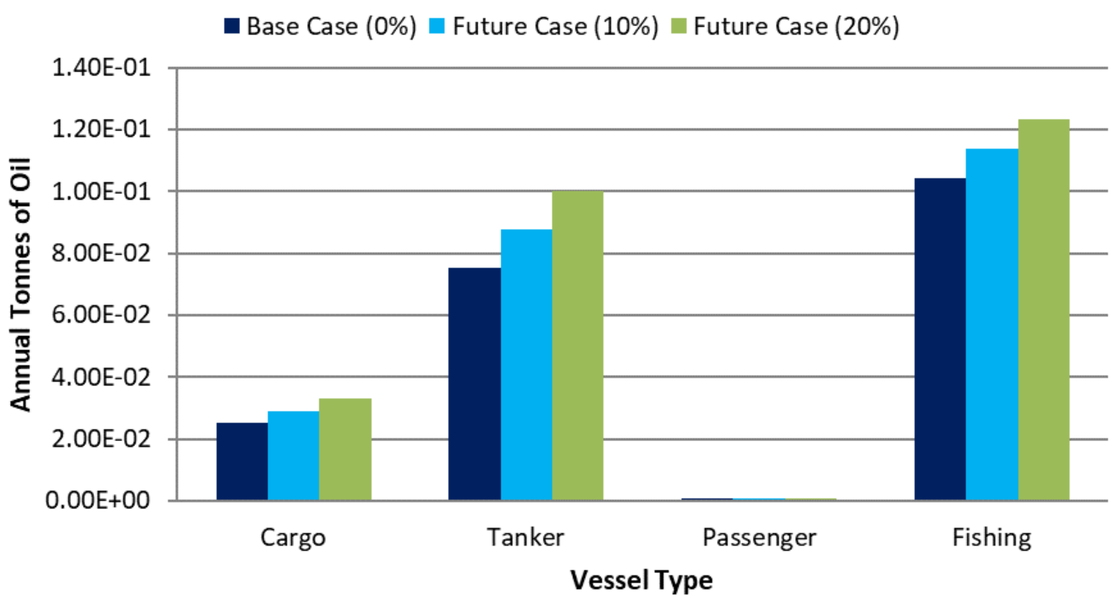

Figure C.17 Estimated Change in Pollution by Vessel Type

424. Fishing vessels contribute the most to the annual oil spill results, due to the higher collision and allision frequency associated with fishing vessels. Tankers also contribute significantly to the annual oil spill results, reflecting the greater expected spillage size associated with incidents involving tankers.

C.5.3 Significance of Increase in Pollution Risk

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

426. From the MEHRAs research, the annual average tonnes of oil spilled in UK waters due to maritime incidents in the 10-year period from 1989 to 1998 was 16,111. This is based upon a total of 146 reported oil pollution incidents of greater than one tonne (smaller spills are excluded as are incidents which occurred within port or harbour areas or resulting from operational errors or equipment failure). Commercial vessel spills accounted for approximately 99% of the total while fishing vessel incidents accounted for less than 1%.

427. The overall increase in pollution estimated due to the Offshore Development of 0.21 tonnes for the base case represents a <0.01% increase compared to the historical average pollution quantities from maritime incidents in UK waters.

C.6 Conclusion

428. This appendix has quantitively assessed the fatality and pollution risk associated with the Offshore Development in the event of a collision or allision incident occurring. The assessment indicates that the fatality and pollution risk associated with fishing vessels is greatest.

429. Overall, the impact of the Offshore Development on people and the environment is relatively low compared to the existing background risk levels in UK waters. However, this is the localised impact of a single offshore wind farm development and there will be additional maritime risks associated with other offshore wind farm developments in the UK as a whole.

430. Discussion of relevant mitigation measures and monitoring is provided in Section 22 of the NRA.

Appendix D Regular Operator Letter

431. As part of the consultation process for the NRA, Regular Operators identified (from vessel traffic surveys and from consultation) that may experience an impact due to the presence of the PFOWF were contacted via email. An example of the correspondence sent to the Regular Operators is presented below.

432. It is noted that the Regular Operator correspondence was conducted when the Demonstrator Project was proposed to be installed ahead of, rather than as part of the PFOWF Array. The correspondence also contains the previous larger site boundary presented at Scoping, compared to the refined PFOWF Array Area and Offshore Export Cable Corridor that is assessed within this EIAR. This will not have any impact on the consultation undertaken, as the current PFOWF Array Area is contained within the displayed site.

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Date: 28th January 2022

Stakeholder Consultation on Impacts Relating to Shipping and Navigation for the Proposed Pentland Floating Offshore Wind Farm

Dear Stakeholder

As you may be aware, Highland Wind Limited (HWL) is the developer of the Pentland Floating Offshore Wind Farm (PFOWF), planned to be located in the Pentland Firth off the north coast of Scotland. The PFOWF Demonstrator, comprising a single moored floating turbine, is currently in the pre-construction phase having been approved for consent in 2017, with an application for variations to the consent currently ongoing. The Pentland Floating Offshore Wind Farm Array is scheduled to follow, with construction planned to begin in 2025, comprising up to 10 floating turbines (including the Demo).

The proposed development is located approximately 3.5nm (6.5km) off the north coast of Scotland and covers an area of 5.8nm^2 (20km^2). The export cable will carry the generated electricity from the array to the cable landfall at Sandside Bay. The location of the proposed array area and export cable corridor associated with the project are shown in Figure 1.1. Note, an ODAS buoy was installed in the area in Q3 2021 to collect metocean data.

Further information on the Pentland Floating Offshore Wind Farm can be found here.

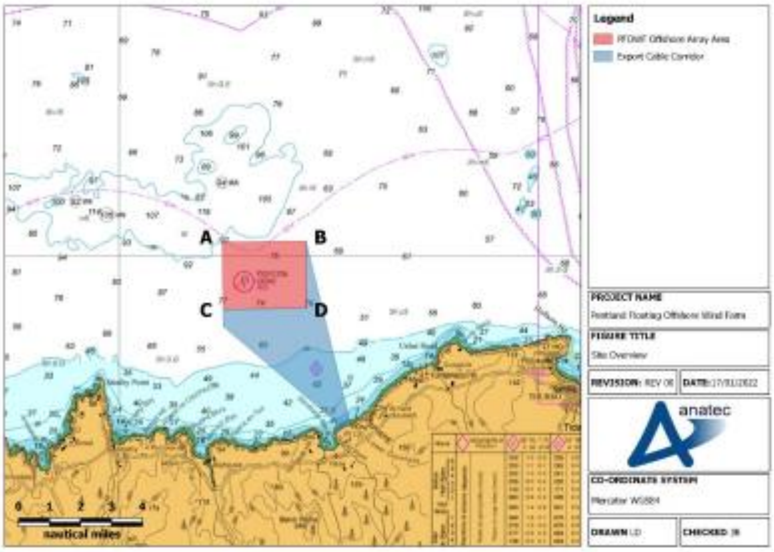

Figure 1.1 Location of the Offshore Array Area and Export Cable Corridor

Table 1.1 presents the coordinates of the Offshore Array Area shown in Figure 1.1.

Table 1.1 Coordinates of the Offshore Array Area

Point	Latitude (Decimal Degree Minutes (DDDMM.mm))	Longitude (DDDMM.mm)
A	58° 40.43" N	003° 53.60" W
B	58° 40.46" N	003° 48.43" W
C	58° 38.27" N	003° 53.54" W
D	58° 38.31" N	003° 48.38" W

Anatec has been contracted by HWL to provide technical support on shipping and navigation during the consent process, and to co-ordinate consultation with stakeholders. Therefore, we are writing to you to kindly request your comments, which will help inform the project.

As part of the Environmental Impact Assessment (EIA), which includes a Navigational Risk Assessment (NRA) required by the Maritime and Coastguard Agency (MCA), HWL are keen to ensure that comprehensive consultation is undertaken and to identify any potential impacts that the Project may have upon shipping and navigation.

According to the assessment of the available datasets including dedicated radar and AIS vessel traffic surveys, and based on local consultation, your company's vessel(s) have been observed on multiple occasions navigating in the vicinity of the array area. We therefore invite your feedback on the potential development including any impact it may have upon the navigation of vessels.

We would be grateful if you could provide us with any comments or feedback that you may have. This will allow us to assess your feedback as part of the NRA which is currently being undertaken. We would also be grateful if you could forward a copy of this information to any vessel operators/owners you feel may be interested in commenting.

In particular, we are keen to receive comments on the following:

1. Whether the construction of the Pentland Floating Offshore Wind Farm is likely to impact the routeing of any specific vessels, including the nature of any change in regular passage;
2. Whether any aspect of the Pentland Floating Offshore Wind Farm poses any safety concerns to your vessels, including any adverse weather routeing; and
3. Whether you would choose to make passage internally within the array or would pass around the outside.

Responses should be sent via email to [redacted] by Friday 11th February.

Should you have any queries about the published information or require any further information to support your review, please do not hesitate to contact us. We are also happy to organise a dedicated virtual meeting to provide further details if you feel this would be helpful.

Yours faithfully,

[redacted]
Anatec Ltd.