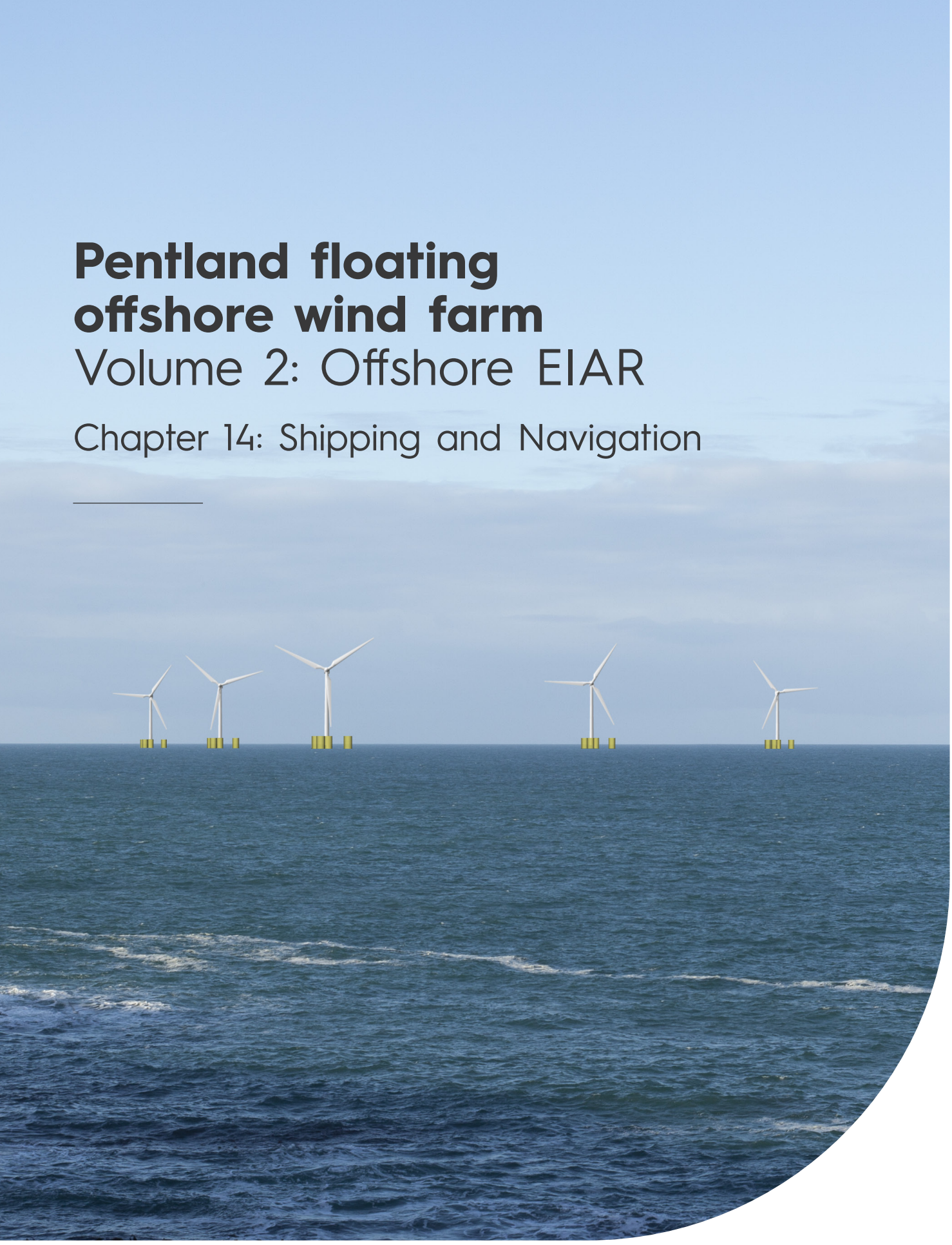
Pentland floating offshore wind farm

Volume 2: Offshore EIAR

Chapter 14: Shipping and Navigation



PENTLAND FLOATING OFFSHORE WIND FARM

OFFSHORE EIAR (VOLUME 2): MAIN REPORT

CHAPTER 14: SHIPPING AND NAVIGATION

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GLOSSARY OF PROJECT TERMS

Key Terms	Definition
Dounreay Trì Floating Wind Demonstration Project (the 'Dounreay Trì Project')	The 2017 consented project that was previously owned by Dounreay Trì Limited (in administration) and acquired by Highland Wind Limited (HWL) in 2020. The Dounreay Trì Project consent was for two demonstrator floating Wind Turbine Generators (WTGs) with a marine licence that overlaps with the Offshore Development, as defined. The offshore components of the Dounreay Trì Project consent are no longer being implemented.
Highland Wind Limited	The Developer of the Project (defined below) and the Applicant for the associated consents and licences.
Landfall	The point where the offshore export cable(s) from the PFOWF Array Area, as defined, will be brought ashore.
Offshore Export Cable(s)	The cable(s) that transmits electricity produced by the WTGs to landfall.
Offshore Export Cable Corridor (OECC)	The area within which the offshore export cable(s) will be located.
Offshore Site	The area encompassing the PFOWF Array Area and OECC, as defined.
Onshore Site	The area encompassing the PFOWF Onshore Transmission Infrastructure, as defined.
Pentland Floating Offshore Wind Farm (PFOWF) Array and Offshore Export Cable(s) (the 'Offshore Development')	All offshore components of the Project (WTGs, inter-array and offshore export cable(s), floating substructures, and all other associated offshore infrastructure) required during operation of the Project, for which HWL are seeking consent. The Offshore Development is the focus of this Environmental Impact Assessment Report.
PFOWF Array	All WTGs, inter-array cables, mooring lines, floating sub-structures and supporting subsea infrastructure within the PFOWF Array Area, as defined, excluding the offshore export cable(s).
PFOWF Array Area	The area where the WTGs will be located within the Offshore Site, as defined.
PFOWF Onshore Transmission Infrastructure (the 'Onshore Development')	All onshore components of the Project, including horizontal directional drilling, onshore cables (i.e. those above mean low water springs), transition joint bay, cable joint bays, substation, construction compound, and access (and all other associated infrastructure) across all project phases from development to decommissioning, for which HWL are seeking consent from The Highland Council.
PFOWF Project (the 'Project')	The combined Offshore Development and Onshore Development, as defined.

ACRONYMS AND ABBREVIATIONS

AIS	Automatic Identification System
ALARP	As Low As Reasonably Practicable
CAST	Coastguard Agreement on Salvage and Towage
CaP	Cable Plan
CBA	Cost Benefit Analysis
CBRA	Cable Burial Risk Assessment
CCC	Clyde Cruising Club
COLREGs	Convention on International Regulations for Preventing Collisions at Sea
DGC	Defence Geographic Centre
DSLP	Design, Specification, and Layout Plan
DfT	Department for Transport
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
ERCoP	Emergency Response Cooperation Plan
ETV	Emergency Towing Vessel
FSA	Formal Safety Assessment
HDD	Horizontal Directional Drilling
IALA	International Association of Marine Aids to Navigation and Lighthouse Authorities
IMO	International Maritime Organization
km	kilometre
LMP	Lighting and Marking Plan
MAIB	Marine Accident Investigation Branch
MCA	Maritime and Coastguard Agency
MGN	Marine Guidance Note
MoD	Ministry of Defence
MRCC	Maritime Rescue Co-ordination Centre
MSL	Mean Sea Level
MS-LOT	Marine Scotland – Licensing Operations Team
m	metre
NLB	Northern Lighthouse Board
nm	nautical mile
NRA	Navigational Risk Assessment
NSP	Navigational Safety Plan
NtM	Notice to Mariners
OECC	Offshore Export Cable Corridor
Offshore EIAR	Environmental Impact Assessment Report
OREI	Offshore Renewable Energy Installation
PFOWF	Pentland Floating Offshore Wind Farm
PLGR	Pre-lay Grapnel Run
RAM	Restricted in its Ability to Manoeuvre
ROV	Remotely Operated Vehicle
RNLI	Royal National Lifeboat Institution
RYA	Royal Yachting Association
RYAS	Royal Yachting Association Scotland
SAR	Search and Rescue
SHE	Scottish Hydro Electric
UK	United Kingdom
UKHO	United Kingdom Hydrographic Office
VMP	Vessel Management Plan
WTG	Wind Turbine Generator

14 SHIPPING AND NAVIGATION

14.1 Introduction

The potential effects of the Pentland Floating Offshore Wind Farm (PFOWF) Array and offshore export cable(s), hereafter referred to as the 'Offshore Development', during construction, operation and maintenance, and decommissioning on Shipping and Navigation are assessed in this chapter. This chapter also includes an assessment of the potential cumulative impacts with other relevant projects.

Anatec Limited has carried out the modelling, assessed the impact, and drafted the Environmental Impact Assessment (EIA) and Navigational Risk Assessment (NRA). Further competency details of the Project Team, including the lead authors for each chapter, are provided in Volume 3: Appendix 1.1: Details of the Project Team of this Offshore Environmental Impact Assessment Report (Offshore EIAR).

Table 14.1 below provides a list of all the supporting studies which relate to the shipping and navigation impact assessment. All supporting studies are appended to this report.

Table 14.1 Supporting studies

Details of Study	Locations of Supporting Studies
PFOWF NRA	Offshore EIAR (Volume 3): Appendix 14.1: NRA

14.2 Legislation, Policy, and Guidance

The following relevant legislation and guidance relating to shipping and navigation were consulted in preparing this chapter:

14.2.1 Legislation

- 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] exit from the EU), an Environmental Impact Assessment Report (EIAR) is required to support the application for the Section 36 Consent for the Offshore Development. As part of the EIAR, the Maritime and Coastguard Agency (MCA) require that an NRA is undertaken to '*inform the shipping and navigation chapter of the EIA Report'*.
- United Nations Convention on the Law of the Sea (UN, 1982) which relates to safety zones;
- Convention on the International Regulations for Preventing Collisions at Sea (COLREGs) (IMO, 1972/77);
- Safety of Life at Sea Chapter V (IMO, 1974); and
- Scotland's National Marine Plan (Scottish Government, 2015).

14.2.2 Guidance

- 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): Highlights the issues which must be considered when assessing the impact on navigational safety from an offshore renewable energy development. MGN 654 also contains an annex which outline the methodology to be used as a template for an NRA;
- Revised guidelines for Formal Safety Assessment (FSA) for Use in the Rule-Making Process (IMO, 2018): Outline the methodology to be followed when undertaking risk analysis which is applied in the impact assessment;

- International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) Guidance Recommendation RO139 and Guidance G1162 relating to The Marking of Offshore Man-Made Structures (IALA, 2021);
- The Royal Yachting Association's (RYA) Position on Offshore Renewable Energy Developments Paper 1 (of 4) – Wind Energy (RYA, 2019a); and
- Regulatory Expectation on Moorings for Floating Wind and Marine Devices (HSE and MCA, 2017).

14.3 Scoping and Consultation

Scoping and consultation have been ongoing throughout the EIA process and have played an important part in ensuring the scope of the baseline characterisation and impact assessment are appropriate with respect to the Offshore Development and the requirements of the regulators and their advisors.

Relevant comments from the EIA Scoping Opinion, Scoping Opinion Addendum, and other relevant consultations specific to Shipping and Navigation provided by Marine Scotland – Licensing Operations Team (MS-LOT), MCA, Ministry of Defence (MoD), Northern Lighthouse Board (NLB), RYA Scotland (RYAS), UK Chamber of Shipping, Cruising Association, Royal National Lifeboat Institution (RNLI), Orkney Harbour Authority, Scrabster Harbour, Pentland Firth Yacht Club, Pentland Canoe Club, Orkney Fisheries Association, Marella Cruises, Celebrity Cruises, and local fishing representatives are summarised in Table 14.2 below, which provides a high-level response on how these comments have been addressed within this Offshore EIAR.

Table 14.2 Summary of consultation responses specific to Shipping and Navigation

Consultee	Comment / Issue Raised	Offshore Development Approach and Section ID
Scoping Opinion		
MS-LOT	*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 14.5 outlines the International Maritime Organization FSA methodology followed in the impact assessment, including the scoping of hazards and. embedded mitigations to be considered in the assessment.
	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.	The RYA Coastal Atlas (RYA, 2019b) has been used to inform the baseline environment as set out in Section 14.4.2.
	Cumulative impacts on shipping routes should be considered.	Cumulative impacts on shipping routes have been considered within Section 14.7.
	A vessel traffic study should be carried out.	Vessel traffic surveys have been carried out in line with MCA requirements (MCA, 2021) and used to inform this Offshore EIAR and NRA (Offshore EIAR [Volume 3]: Appendix 14.1: NRA) as set out in Section 14.4.2.1.
MCA	*The EIAR should consider the impact on navigational issues including:* > *Collision risk* > *Navigational safety* > *Visual intrusion and noise* > *Risk management and emergency response* > *Marking and lighting of site and information to mariners* > *Effect on small craft navigational and communication equipment* > *The risk to drifting recreational craft in adverse weather or tidal conditions* > *The likely squeeze of small craft into the routes of larger commercial vessels.*	An MGN checklist has been completed as part of the NRA to ensure navigational issues have been comprehensively considered. Vessel displacement, collision risk, impact on emergency response resources, and drifting allision risks for recreational vessels are all considered within the impact assessment in Section 14.6. Effects on navigational and communication equipment, visual intrusion, and noise are considered within Section 16 of the NRA (Offshore EIAR [Volume 3]: Appendix 14.1: NRA).

Consultee	Comment / Issue Raised	Offshore Development Approach and Section ID
	The NRA should be produced in accordance with the most up to date guidance from the MCA.	The NRA has been produced in line with current MCA methodology (MGN 654) as noted in Section 14.2 and Section 3 of the NRA (Offshore EIAR [Volume 3]: Appendix 14.1: NRA)
	An MGN compliant survey should be carried out comprising at least 28 days of Automatic Identification System (AIS), radar and visual observation data.	Vessel traffic surveys have been carried out in line with MGN 654 requirements (AIS, Radar, and Visual) and have been used to inform the baseline environment as per Section 14.4.
	Consideration should be given to the impact on Search and Rescue (SAR) resources. An Emergency Response Co-operation Plan (ERCoP) and SAR Checklist will be required in consultation with the MCA.	Emergency resources have been considered within the baseline in Section 14.4.3.3. The impact on SAR resources has been considered within the impact assessment in Section 14.6. As per the requirements of MGN 654, an ERCoP and SAR Checklist will be prepared post-consent as an embedded mitigation (see Section 14.5.5).
	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 in the requested format at the required points in the application and post-consent process.
	The turbine layout design will require MCA approval prior to construction to minimise the risks to surface vessels, including rescue boats, and Search and Rescue aircraft operating within the site. Any additional navigation safety and/or Search and Rescue requirements, as per MGN 543 Annex 5, will be agreed at the approval stage.	As per the embedded mitigations Section 14.5.5, a Design, Specification and Layout Plan (DSLP) will be agreed post-consent prior to construction.
	Attention should be paid to cabling routes and where appropriate burial depth for which a Burial Protection Index study should be completed and, subject to the traffic volumes, an anchor penetration study may be necessary. If cable protection measures are required e.g. rock bags or concrete mattresses, the MCA would be willing to accept a 5% reduction in surrounding depths referenced to Chart Datum. This will be particularly relevant where depths are decreasing towards shore and potential impacts on navigable water increase, such as at the HDD location.	As per the embedded mitigations Section 14.5.5, a Cable Plan and Cable Burial Risk Assessment will be prepared post-consent and agreed with the MCA. Reduction in water depth has been considered in Section 15 of the NRA (Offshore EIAR [Volume 3]:Appendix 14.1.

Consultee	Comment / Issue Raised	Offshore Development Approach and Section ID
	Under section 9.3.3, the HSE/MCA regulatory mooring expectations document is identified for consideration and I can confirm this guidance should be followed and that a Third-Party Verification of the mooring arrangements will be required.	As per Section 14.2, the regulatory mooring expectations document has been considered in the assessment. The mooring arrangements will be detailed and agreed as part of the DSLP required as per the embedded mitigations Section 14.5.5..
NLB	*A Lighting and Marking Plan will be required to be agreed with the NLB and should be in line with the latest guidance.*	A Lighting and Marking Plan (LMP) shall be a condition of consent, should consent be granted, and has been considered within the embedded mitigation and management plan and will be completed in agreement with the NLB (see Section 14.5.5).
RYAS	*The RYA Coastal Atlas of Recreational Boating is considered as the best data source on recreational vessel movements*	The RYA Coastal Atlas (RYA, 2019b) has been used to inform the baseline environment as set out in Section 14.4.2.
	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 updates.	Noted in the embedded mitigations and management plans section of this chapter. Promulgation of information will occur as set out in Section 14.5.5 and will be secured as a consent condition.
MoD	*MOD has concerns with the proposed wind turbines in relation to the proximity to Vulcan Naval Reactor Test Establishment (NRTE) and its surrounding sea approaches in terms of security. In relation to the onshore elements of the proposed development further consultation with the MOD by the developer will be required.*	It is recognised that the Vulcan NRTE will be entering into decommissioning in forthcoming years. There are limited details available on these decommissioning activities. Any impacts relating to the safe navigation of vessels are addressed in Offshore EIAR (Volume 2): Chapter 14: Shipping and navigation. The Offshore Development is not anticipated to cause any significant re-routeing of vessels towards the Vulcan NRTE. HWL will continue to engage with Vulcan NRTE to further understand any upcoming decommissioning activities and to agree on procedures to reduce any disruption. HWL will also continue to engage with MOD regarding any security concerns.

Consultee	Comment / Issue Raised	Offshore Development Approach and Section ID
		The Onshore Development is not considered within this Offshore EIAR, which only deals with all aspects of the proposed development in the marine environment, below MHWS.
	In addition, the impact of marine and road traffic associated with the construction phase and once works are completed and also, offshore construction works may impact upon the MOD. The applicant will need to assess this within their Environmental Statement to ensure Vulcan (NRTE) operations are not affected.	It is recognised that the Vulcan NRTE will be entering into decommissioning in forthcoming years. There are limited details available on these decommissioning activities. Any impacts relating to the safe navigation of vessels are addressed in Offshore EIAR (Volume 2): Chapter 14: Shipping and navigation. Anticipated project vessel numbers are presented in Section 6 of the NRA for the different phases. The base ports and hence routes to be taken are not yet finalised but are not expected to approach close to the Vulcan NRTE. As noted in the embedded mitigations in Offshore EIAR (Volume 2): Chapter 14: Shipping and navigation; Section 14.5.5, a Vessel Management Plan and Navigational Safety Plan will be produced post-consent to safely manage the activities of project vessels. HWL will continue to engage with Vulcan NRTE to further understand any upcoming decommissioning activities and to agree on procedures to reduce any disruption. HWL will also continue to engage with MOD regarding ongoing developments. Given the size and location of the Offshore Development, it is not expected that significant changes are made to vessel routeing, including that of vessels associated with the Vulcan NRTE.
Scoping Opinion Addendum		
MoD	*MOD has concerns with the proposed wind turbines in relation to the proximity to Vulcan Naval Reactor Test Establishment (NRTE) and its surrounding sea approaches in terms of security. In relation to the onshore elements of the proposed development further consultation with the MOD by the developer will be required.*	It is recognised that the Vulcan NRTE will be entering into decommissioning in forthcoming years. There are limited details available on these decommissioning activities. Any impacts relating to the safe navigation of vessels are addressed in Offshore EIAR (Volume 2): Chapter 14: Shipping

Consultee	Comment / Issue Raised	Offshore Development Approach and Section ID
		and navigation. The Offshore Development is not anticipated to cause any significant re-routeing of vessels towards the Vulcan NRTE. HWL will continue to engage with Vulcan NRTE to further understand any upcoming decommissioning activities and to agree on procedures to reduce any disruption. HWL will also continue to engage with MOD regarding any security concerns. The Onshore Development is not considered within this Offshore EIAR, which only deals with all aspects of the proposed development in the marine environment, below MHWS.
	In addition, the impact of marine and road traffic associated with the construction phase and once works are completed and also, offshore construction works may impact upon the MoD. The applicant will need to assess this within their Environmental Statement to ensure Vulcan Naval Reactor Test Establishment (NRTE) operations are not affected.	It is recognised that the Vulcan NRTE will be entering into decommissioning in forthcoming years. There are limited details available on these decommissioning activities. Any impacts relating to the safe navigation of vessels are addressed in Offshore EIAR (Volume 2): Chapter 14: Shipping and navigation. Anticipated project vessel numbers are presented in Section 6 of the NRA for the different phases. The base ports and hence routes to be taken are not yet finalised but are not expected to approach close to the Vulcan NRTE. As noted in the embedded mitigations in Offshore EIAR (Volume 2): Chapter 14: Shipping and navigation; Section 14.5.5, a Vessel Management Plan and Navigational Safety Plan will be produced post-consent to safely manage the activities of project vessels. HWL will continue to engage with Vulcan NRTE to further understand any upcoming decommissioning activities and to agree on procedures to reduce any disruption. HWL will also continue to engage with MOD regarding ongoing developments. Given the size and location of the Offshore Development, it is not expected that significant changes are made to vessel routeing, including that of vessels associated with the Vulcan NRTE.

Consultee	Comment / Issue Raised	Offshore Development Approach and Section ID
Consultation Meetings During Scoping Phase		
MCA	*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.*	Vessel encounters have been discussed within the NRA (Offshore EIAR [Volume 3]: Appendix 14.1: NRA). Encounters may lead to increased collision risk, which has been considered within the impact assessment.
	An ERCoP will be required.	As per the requirements of MGN 654, an ERCoP will be produced post-consent, should consent be granted. This is included within the embedded mitigation and management plan section of this chapter (see Section 14.5.5).
	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, as noted in Section 14.2, which is the successor to MGN 543 (Offshore EIAR [Volume 3]: Appendix 14.1: NRA).
	The Ministry of Defence (MoD) should be consulted, along with other miscellaneous sea users.	A cross-section of sea users was invited to the Hazard Workshop, including local fishing representatives and local RNLI representatives. The MoD and Dounreay Site Restoration Ltd have been consulted elsewhere within the EIA process (see Chapter 4: Stakeholder Engagement and Chapter 15: Aviation and Radar).
Consultation Meetings During NRA Process		
MCA	*Content with the NRA approach, data sources, planned consultation and impacts presented.*	The approach taken in the NRA is summarised in Section 3 of the NRA (Offshore EIAR [Volume 3]: Appendix 14.1: NRA) The vessel traffic survey methodology is described in Section 8 of the NRA (Offshore EIAR [Volume 3]: Appendix 14.1: NRA) Data sources used to inform the NRA and this Offshore EIAR are presented in Section 14.4.2. The consultation carried out and the feedback received is presented in Section 14.3.
	Risk to passing vessels due to the mooring lines to be assessed as part of the NRA.	Risks to surface navigation due to the reduction in under keel clearance and the presence of subsea infrastructure are

Consultee	Comment / Issue Raised	Offshore Development Approach and Section ID
		assessed in Section 14.6 of this Offshore EIAR and Section 15 of the NRA (Offshore EIAR [Volume 3]: Appendix 14.1: NRA)
	Fishing interaction with mooring lines/cables to be addressed in commercial fisheries chapter.	Fishing gear snagging is considered within the impact assessment in Section 14.6, and is also considered in greater detail within Chapter 13: Commercial Fisheries.
	Emergency response to incidents to be addressed as part of the NRA.	The availability of emergency response resources is outlined in Section 14.4.3.3. Embedded mitigations, including the production of an ERCoP (as required by MGN 654), are outlined in Section 14.5.5. Reduction of emergency response capability has been considered within the impact assessment in Section 14.6.
	Third party vessels being unfamiliar with mooring line arrangements may impede emergency response.	Promulgation of information and chart marking will inform users on the location and mooring line arrangements. These are embedded mitigations as per Section 14.5.5. An ERCoP will be produced in line with MGN 654 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 Project, 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 of the NRA (Offshore EIAR [Volume 3]: Appendix 14.1: NRA) and the impact assessment in Section 14.6 of this Offshore EIAR.
	Alternative modes of access to the wind turbine generators (WTG) should be included to facilitate emergency response and access in adverse weather.	As per the requirements of MGN 654 and the SAR Checklist, HWL 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.	Lessons learnt have been noted within Section 5 of the NRA (Offshore EIAR [Volume 3]: Appendix 14.1: NRA) and considered within the impact assessment in Section 14.6.
	Minimum width of SAR lane is 500 metres (m) and must consider the effect of mooring lines on the SAR lanes.	The Design, Specification, and Layout Plan (DSLP) will be agreed upon in consultation with the MCA (see Section 14.5.5), and will consider the inclusion of SAR lanes, as necessary, as per the requirements of MGN 654.

Consultee	Comment / Issue Raised	Offshore Development Approach and Section ID
	WTG movement and nacelle movement should be considered as it may affect tip-to-tip separation and minimum blade clearance.	The DSLP will be agreed upon in consultation with the MCA (see Section 14.5.5), and will consider the inclusion of SAR lanes, as necessary, as per the requirements of MGN 654. Excursion of the floating structures and changes to tip-to-tip separation and minimum blade clearance caused by nacelle movement will be considered as part of this process.
	Minimum blade clearance of 22 m must be maintained at all tidal states.	A 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 (MSL) with degrees of motion considered. This requirement will be met as per Section 14.5.5. It is noted that the Design Envelope includes a minimum 35 m blade clearance from MSL.
	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 in Section 14.5.4 that the maximum number of WTGs is considered worst case. Consideration of small vessels passing within the array has been considered within the quantitative modelling and the assessment in Section 14.6. A minimum WTG spacing of 800 m was considered to allow for small vessels to pass within the PFOWF Array Area.
NLB	*Content with the approach to the NRA, the data sources, planned consultation and impacts presented.*	The approach taken in the NRA is summarised in Section 3 of the NRA. The vessel traffic survey methodology is described in Section 8 of the NRA (Offshore EIAR [Volume 3]: Appendix 14.1: NRA). Data sources used to inform the NRA and EIAR are presented in Section 14.4.2. The consultation carried out and the feedback received is presented in Section 14.3.
	All WTGs in the PFOWF Array Area may require lighting due to the low number of WTGs.	A Lighting and Marking Plan (LMP) shall be a condition of consent, if granted, and has been considered as embedded mitigation; it will be completed in agreement with the NLB as per Section 14.5.5.

Consultee	Comment / Issue Raised	Offshore Development Approach and Section ID
	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 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. Chapter 5: Project Description includes details on how safety zones will relate to the potential excursion of the floating structures. Refer to Section 14.5.5 on safety zones as mitigation.
	NLB would be interested in attending the Hazard Workshop.	The NLB attended the Hazard Workshop.
RYAS	*Recreational traffic in summer 2021 is estimated at between 40% and 50% of a typical year due to the impact of COVID.*	Recreational traffic, including data from previous studies, has been used to inform the baseline characterisation within the NRA (Offshore EIAR [Volume 3]: Appendix 14.1: NRA). It was found that whilst non-UK recreational vessels were largely missing from 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.
	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 have been used to validate 2021 survey data, including on recreational vessels, within Section 14 of the NRA (Offshore EIAR [Volume 3]: Appendix 14.1: NRA) 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, as defined in Section 14.4, in 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 used to inform the baseline environment (see Section 14.4.2).

Consultee	Comment / Issue Raised	Offshore Development Approach and Section ID
	CCC Sailing Directions were updated in 2020 and are a possible additional data source.	The CCC Sailing Directions (CCC, 2020) have been used to inform the baseline environment (see Section 14.4.2).
	Pentland Firth Yacht Club and MoD to be possibly added to the list of consultees.	A representative from Pentland Firth Yacht Club was in attendance at the Hazard Workshop. The MoD have been consulted elsewhere within the EIA process (see 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.	Development within the Port of Stornoway has been considered within Section 18 of the NRA (Offshore EIAR [Volume 3]: Appendix 14.1: NRA) and captured within the future case traffic scenarios within the quantitative modelling.
	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 Section 14.6 that single-engine vessels are more susceptible to drifting, whilst 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 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. Refer to Section 14.5.5 on safety zones as mitigation.
	Pre- and post- COVID recreational vessel data from Orkney Marinas was provided for analysis.	Orkney Marina's statistics have been analysed within Section 14 of the NRA (Offshore EIAR [Volume 3]: Appendix 14.1: NRA)
	Concerns were expressed over over-proliferation of Notices to Mariners, and that Kingfisher is now recommended as the most useful passage planning information source.	Noted in the embedded mitigations as the promulgation of information, including the use of Kingfisher bulletins in addition to Notices to Mariners (NtMs) (see Section 14.5.5).
UK Chamber of Shipping	*Cable touch-down point being within the site would be beneficial in terms of navigational safety.*	The underwater profile of cables is discussed within Section 6 of the NRA (Offshore EIAR [Volume 3]: Appendix 14.1: NRA), noting that the touch-down point of the cable is not yet known.

Consultee	Comment / Issue Raised	Offshore Development Approach and Section ID
	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 14.3).
	Regular Operators to be researched fully once the winter survey has been conducted.	Regular Operators were researched and contacted (see Section 14.3).
	Use of remote sensors was suggested to alert developers to any mooring failures.	Remote sensors and regular visits are 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 WTGs.	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. Refer to Section 14.5.5 on safety zones as mitigation.
CA	*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 have been used to validate 2021 survey data, including on recreational vessels, within Section 14 of the NRA (Offshore EIAR [Volume 3]: Appendix 14.1: NRA) 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 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 considered in Section 14.6.

Consultee	Comment / Issue Raised	Offshore Development Approach and Section ID
	CCC Sailing Directions recommended as a useful data source.	The CCC Sailing Directions (CCC, 2020) have been used to inform the baseline environment as per Section 14.4.2.
	Cumulative impacts of proposed wind farm west of Orkney need to be considered.	The ScotWind sites N1 (West of Orkney), N2, and N3 were not scoped in time for assessment. Given the lack of data confidence about project details, cumulative impacts due to these sites have not been assessed. It is noted that these projects will 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 bunching of vessels at particular times of the day, such as the morning and evening.	Noted. There is no existing regular wind farm traffic in the area to be considered. Peak vessel numbers have been considered within the impact assessment in Section 14.6.
	Spacing of between 800 m and 1000 m would allow for transits through the array.	WTG layout and spacing have not been finalised; a range of scenarios is being considered under the Design Envelope. Allision risk to vessels passing internally within the PFOWF Array Area is considered within the impact assessment in Section 14.6.
	100 m would be a reasonable minimum passing distance for recreational vessels to a WTG.	Noted within the impact assessment in Section 14.6 in relation to both allision risk and interaction with mooring lines.
	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 to pass beyond 50 m. 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. Refer to Section 14.5.5 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 the agreement with the NLB), so vessels being equipped with receive-only AIS are more likely to be aware of the Offshore Development.

Consultee	Comment / Issue Raised	Offshore Development Approach and Section ID
Scrabster Harbour	*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 Chapter 5: Project Description. This includes consultation with local fishermen and 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 effects on vessel numbers.	Scrabster Harbour statistics have been analysed within Section 14 of the NRA (Offshore EIAR [Volume 3]: Appendix 14.1: NRA).
	Dredging tracks in the vicinity of Scrabster Harbour during the summer survey were related to the St Ola Pier development.	Noted, no response required.
	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.	Noted in the characterisation of the baseline. Fishing gear interaction with subsea infrastructure has been considered in the impact assessment in Section 14.6.
	Royal National Lifeboat Institution (RNLI) and a local fishing representative to be invited to the Hazard Workshop.	RNLI representatives and a local fishing representative attended the Hazard Workshop.
	There is little angling and kayaking close to the site, with charity rowing teams generally staying farther inshore.	Recreational traffic has been considered within the baseline characterisation within Sections 13 and 14 of the NRA (Offshore EIAR [Volume 3]: Appendix 14.1: NRA) Angling vessels were recorded within the vessel traffic surveys. Consultation on kayaking and canoeing indicated paddlers 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.	The list of hazards assessed is presented in Section 14.5.1.
Orkney Harbour Authority	*The Scapa Flow tugs have not been requested for support under the MCA Coastguard Agreement on Salvage and Towage (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 of the NRA (Offshore EIAR [Volume 3]: Appendix 14.1: NRA) The tugs may be called upon in the case of a drifting incident to prevent allision. There is also an ETV present in the area should the tugs be otherwise engaged.

Consultee	Comment / Issue Raised	Offshore Development Approach and Section ID
	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 of the NRA (Offshore EIAR [Volume 3]: Appendix 14.1: NRA)
	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 of the NRA and have been modelled for 10% and 20% increases to traffic levels within Section 19 of the NRA (Offshore EIAR [Volume 3]: Appendix 14.1: NRA)
	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 of the NRA and have been modelled for 10% and 20% increases to traffic levels within Section 19 of the NRA (Offshore EIAR [Volume 3]: Appendix 14.1: NRA).
	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 of the NRA and have been modelled for 10% and 20% increases to traffic levels within Section 19 of the NRA (Offshore EIAR [Volume 3]: Appendix 14.1: NRA).
Pentland Canoe Club	*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 14.4.3, 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 impact assessment in Section 14.6. Promulgation of information has been noted as an embedded mitigation measure in Section 14.5.5.
Hazard Workshop		
RNLI	*The incident data shared agreed with the RNLI representatives' experience of working in the area.*	RNLI incident data are summarised in the baseline characterisation in Section 14.4.4 Offshore EIAR and Section 12 of the NRA (Offshore EIAR [Volume 3]: Appendix 14.1: NRA).

Consultee	Comment / Issue Raised	Offshore Development Approach and Section ID
	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.	Noted in the characterisation of the baseline within Section 11 of the NRA (Offshore EIAR [Volume 3]: Appendix 14.1: NRA) and the impact assessment in Section 14.6 of this Offshore EIAR. The presence of the ETV would be useful in the event of a drifting event. If the contract is not extended further, other emergency towing resources are available in 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.	Noted in the embedded mitigations as promulgation of information as per Section 14.5.5. A SAR Checklist and ERCoP will be produced which will include appropriate communication with the MCA who will liaise with other SAR responders.
Orkney Harbour Authority	*The tugs in Scapa Flow are signed up to the MCA Coastguard Agreement for Salvage and Towage (CAST) and may be available for emergency response.*	Noted in the characterisation of the baseline within Section 11 of the NRA (Offshore EIAR [Volume 3]: Appendix 14.1: NRA) and the impact assessment in Section 14.6 of this Offshore EIAR. The tugs may be called upon in the case of a drifting incident to prevent allision. The MCA ETV is also available (though its future is uncertain), whilst the RNLI are also capable of towing certain vessels (dependent on size).
	A drifting incident involving a large commercial vessel would have catastrophic consequences and must be considered within the NRA.	Drifting allision risk has been considered within the impact assessment in Section 14.6, including the use of quantitative modelling. 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.	As agreed with MS-LOT, five months prior to the Offshore Development's consent application and Offshore EIAR production, the ScotWind sites N1, N2, and N3 had not been through their scoping phase. Therefore, cumulative impacts due to these sites have not been assessed. It is noted that these projects will 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.	Port developments at Orkney Harbour are discussed within the NRA (Offshore EIAR [Volume 3]: Appendix 14.1: NRA) and are

Consultee	Comment / Issue Raised	Offshore Development Approach and Section ID
		considered to be captured within the future case traffic scenarios within the quantitative modelling.
Orkney Marinas	*Orkney Marinas are currently upgrading their capacity.*	Port developments at Orkney Marinas are discussed within Section 18 of the NRA (Offshore EIAR [Volume 3]: Appendix 14.1: NRA) and are considered to be captured within the future case traffic scenarios within the quantitative modelling.
Pentland Firth Yacht Club	*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.*	Noted in the impact assessment in Section 14.6. Passing inshore will serve to separate traffic and therefore potentially decrease the rate of encounters and collision risk between small vessels and commercial vessels.
	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.	Remote sensors and regular visits are 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.
	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.	Noted within the embedded mitigations within Section 14.5.5.
Scrabster Harbour	*Scrabster Harbour are hoping to receive more cruise ships and increased renewable energy traffic given the future projects planned in the area.*	Port developments at Scrabster Harbour are discussed within Section 18 of the NRA (Offshore EIAR [Volume 3]: Appendix 14.1: NRA) and are considered to be captured within the future case traffic scenarios within the quantitative modelling.
	Distribution of information to local harbours would be useful as users often ask for advice when plotting their course through the area.	Promulgation of information has been included as an embedded mitigation as per Section 14.5.5.
Local Fishing Representative	*Fishing vessels would likely be comfortable passing through the array.*	Noted in the impact assessment in Section 14.6. Fishing vessels passing internally creates a potential for internal allisions, which has been assessed using quantitative modelling.
	Notices to Mariners, Kingfisher bulletins and marking on Admiralty Charts are important forms of promulgation of information.	Promulgation of information and marking on Admiralty charts have been included as embedded mitigations as per Section 14.5.5.

Consultee	Comment / Issue Raised	Offshore Development Approach and Section ID
Orkney Fisheries Association	*It was questioned whether a second Hazard Workshop would be carried out once further project details were confirmed.*	Under the Design Envelope approach, this Offshore EIAR and NRA (Offshore EIAR [Volume 3]: Appendix 14.1: NRA) have considered the worst-case design for shipping and navigation, and therefore a second Hazard Workshop is not required.
	Kingfisher bulletins would be a useful resource to update to keep mariners informed.	Promulgation of information has been included as an embedded mitigation as per Section 14.5.5, including the use of Kingfisher bulletins in addition to NtMs.
NLB	*NLB will make final decision on the requirement for WTG(s) to broadcast on AIS in the full array.*	An LMP has been considered as embedded mitigation and will be completed in agreement with the NLB as per Section 14.5.5.
Regular Operator Responses		
Marella Cruises	*Marella Cruises do not expect to return to UK waters within the next two years and therefore did not find it appropriate to comment.*	Noted, no response required.
Celebrity Cruises	*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.*	Noted, no response required.
Cumulative Project List		
The Highland Council (THC)	*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 south-west 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 will be placed on marine users, such as Shipping and Navigation users. Given the short duration 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

Consultee	Comment / Issue Raised	Offshore Development Approach and Section ID
		Offshore Development with respect to shipping and navigation is anticipated.

14.4 Baseline Characterisation

The baseline section of the impact assessment includes an analysis of 28 days of Automatic Identification System (AIS), radar, and visual observation vessel traffic data collected over two 14-day shore-based surveys undertaken in July / August and November 2021. To validate the survey data and ensure any COVID-19 effects were taken into account, data from the 2019 scoping report, the 2015/16 Dounreay Trì NRA and 2012 data collected for a Marine Scotland study have also been considered. In addition, relevant navigational features have been assessed, as well as historical incident data from various sources.

14.4.1 Study Area

The focus of the impact assessment is potential impacts on Shipping and Navigation users of the Offshore Site and the surrounding waters. As such, an Offshore Study Area has been defined to encompass a minimum 10 nautical mile (nm) buffer around the PFOWF Array Area and Offshore Export Cable Corridor (OECC), shown on Figure 14.1. The Offshore Study Area is considered to capture relevant passing traffic and activity close to the Offshore Development and was agreed upon in consultation with stakeholders, including the MCA and NLB (see Section 14.3).

The following areas are referred to in this impact assessment:

- PFOWF Array Area: The area where the Wind Turbine Generators (WTG) will be located within the Offshore Site;
- Offshore Export Cable Corridor: The area within which the offshore export cable(s) will be located;
- Offshore Site: The area encompassing the PFOWF Array Area and OECC, within which the applications are being sought; and
- Offshore Study Area: The area encompassing a minimum 10 nm buffer surrounding the PFOWF Array Area and OECC (as shown in Figure 14.1) used to characterise the baseline.

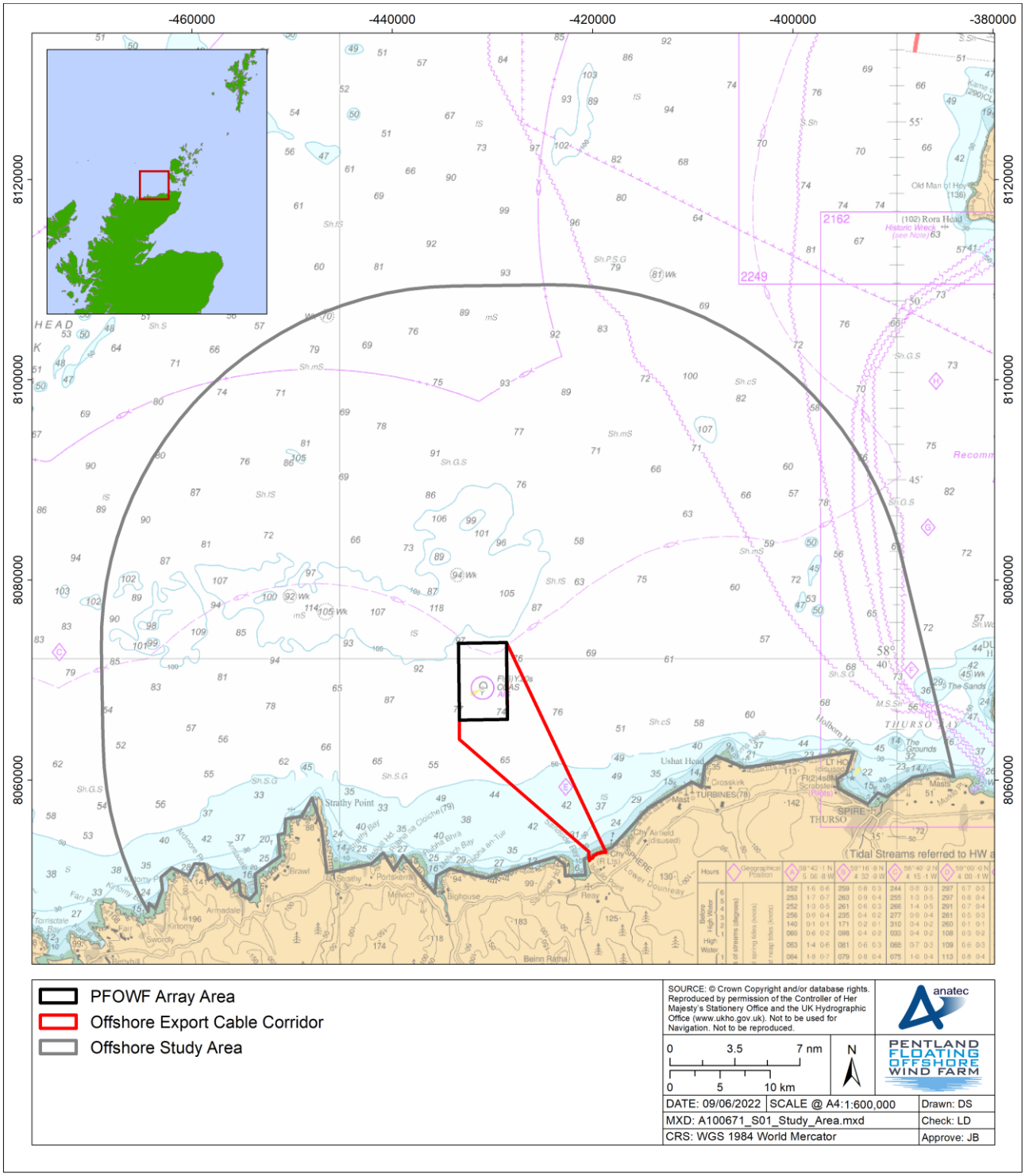

Figure 14.1 Offshore Study Area

14.4.2 Sources of Information

A review was undertaken of the literature and data relevant to this assessment relating to shipping and navigation and was used to give an overview of the existing environment. The primary data sources used in the preparation of this chapter are listed below in Table 14.3.

Table 14.3 Summary of key sources of information pertaining to shipping and navigation

Title	Source	Year	Author
Vessel Traffic Data	28 days of AIS, radar, and visual observation data collected during site-specific surveys over 14 days in July and August 2021, and 14 days in November 2021. Further details on the site-specific surveys are included in Section 14.4.2.1.	2021	Anatec
	28 days of AIS data collected over 14 days in July 2019 and 14 days in December 2019 for the Scoping Report (Recent data, pre-COVID-19, used to validate 2021 surveys).	2019	Anatec
	Dounreay Trì Floating Wind Demonstration Project – Marine Safety NRA presenting 28 days of AIS data collected over 14 days in July 2015 and 14 days in January 2016 (Dounreay Trì Ltd, 2016) (used for validation).	2015/16	Dounreay Trì Limited
	Marine Scotland 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) (Used for validation, especially on recreational and kayaking activity prior to the COVID-19 pandemic.)	2012	Anatec
Recreational Activity	RYA Coastal Atlas of Recreational Boating (RYA, 2019b)	2019	RYA
	CCC Sailing Directions and Anchorages (CCC, 2020)	2020	CCC
Maritime Incidents	Marine Accident Investigation Branch (MAIB) marine incidents database	2000 to 2019	MAIB
	RNLI incident data	2010 to 2019	RNLI
	Department for Transport (DfT) UK civilian SAR helicopter taskings	2015 to 2021	DfT
Other Navigational Features	United Kingdom Hydrographic Office (UKHO) Admiralty Sailing Directions North Coast of Scotland Pilot NP52 (UKHO, 2018)	2018	UKHO
	UKHO Admiralty charts (UKHO, 2021)	2021	UKHO
Weather	UKHO Admiralty Sailing Directions North Coast of Scotland Pilot NP52 (UKHO, 2018)	2018	UKHO
	UKHO Admiralty Chart 1954 (UKHO, 2021)	2021	UKHO
	DHI Metocean Report (DHI, 2021) provided wind and wave data to be used as input to the quantitative modelling.	2021	DHI

14.4.2.1 Site-specific Surveys

Two site-specific surveys were carried out to support the analysis of the baseline environment. These surveys were carried out to collect a total of 28 days of MGN 654 compliant vessel traffic data, using a methodology agreed in consultation with the MCA (during the meeting held on 6th September 2021) and NLB (during consultation on 21st September 2021) (see Section 14.3). The site-specific surveys were shore-based, and undertaken using survey equipment located at the Strathy Point lighthouse on the north coast of Scotland. The site-specific surveys collected AIS, radar, and visual observation data of vessel movements within the Offshore Study Area. Each survey lasted 14 days, with the summer survey taking place in July and August 2021 followed by the winter survey in November 2021. Further information on the methodology can be found in Appendix 14.1.

14.4.3 Baseline Description

14.4.3.1 Navigational features

The key navigational features in proximity to the PFOWF Array Area are presented in Figure 14.2.

The closest major harbour to the PFOWF Array Area is Scrabster Harbour, located 8 nm to the south east. There is also a minor harbour located within Sandside Bay, 4 nautical miles (nm) to the south. Thurso Harbour, 9.5 nm to the east is closed to all but boat traffic according to the United Kingdom Hydrographic Office (UKHO) Sailing Direction (UKHO, 2018). Harbours located throughout Orkney Isles to the north-east also have an influence on the traffic within the Offshore Study Area.

There is an International Maritime Organization (IMO)-adopted Area to be Avoided (ATBA) around Orkney, 12.5 nm north-east of the PFOWF Array Area. The ATBA places a restriction on vessels over 5,000 Gross Tonnage (GT) carrying oil or hazardous cargoes transiting close to Orkney, and covers the entire coastline of Orkney, except for the Pentland Firth and the entrance to Scapa Flow. The coast of Hoy closest to the PFOWF Array Area is also designated as a Marine Environmental High Risk Area.

Five submarine cables intersect the Offshore Study Area, with the closest of these lying approximately 6 nm north-east of the PFOWF Array Area.

Ministry of Defence (MoD) Practice and Exercises Areas (PEXAs) are located 19 nm to the west of the PFOWF Array Area. Charts note that there are no restrictions placed on transiting the area, noting that firing only takes place when the area is clear of all shipping. In addition, the Offshore Study Area lies within the MoD's Northern Managed Danger Area.

There are no charted anchorages within the Offshore Study Area. Traditional anchorages for recreational vessels are found at Sandside Bay and Armadale Bay, according to the Clyde Cruising Club (CCC) Sailing Directions (CCC, 2020), whilst commercial vessels were recorded at anchor in Thurso Bay during the 2019 Scoping surveys.

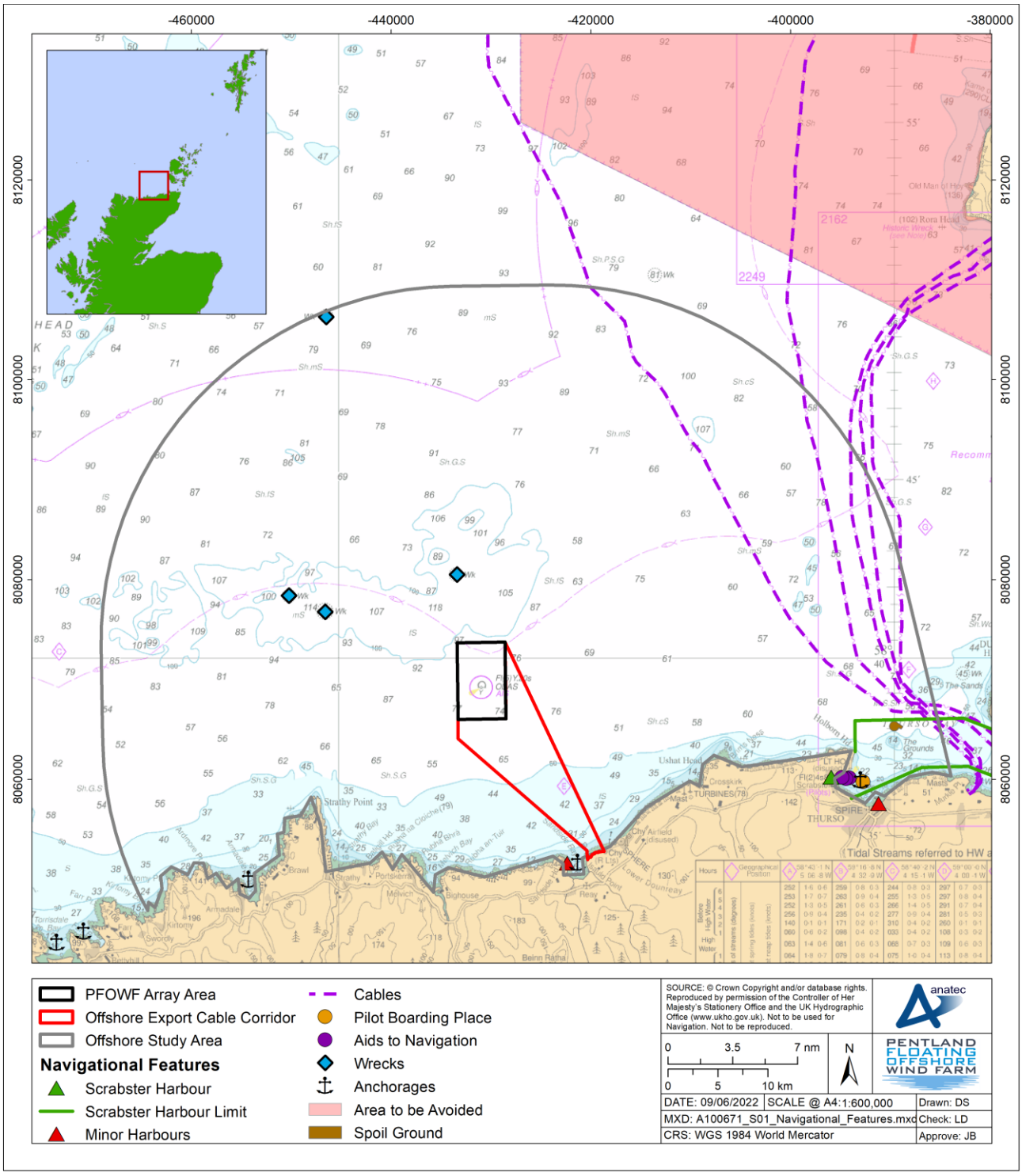

Figure 14.2 Navigational features

14.4.3.2 Vessel traffic data

Vessel traffic data was collected over two site-specific surveys to account for seasonal variations in vessel traffic movements:

- 21st July to 4th August 2021 (14 days in the summer); and
- 9th November to 23rd November 2021 (14 days in the winter).

Figure 14.3 presents the tracks of vessels recorded during the 28 days of AIS, radar, and visual observation data within the Offshore Study Area, colour-coded by vessel type.

During the 28 days analysed, an average of 21 unique vessels per day were recorded within the Offshore Study Area. The most common vessel types recorded within the Offshore Study Area were cargo vessels (38%), fishing vessels (27%) and tankers (9%).

Vessel length information was available for 98% of vessel tracks recorded within the Offshore Study Area, with the average length of vessels being 88 metres (m). The largest vessel recorded within the Offshore Study Area was a 319 m cruise liner. Vessel draught information was available for approximately 83% of vessel tracks recorded within the Offshore Study Area, with the average draught being 5.5 m. The deepest draught of 16.7 m was recorded by a crude oil tanker.

Main routes have been identified using the principles set out in MGN 654. Vessel traffic data has been assessed and vessels transiting at similar headings and locations are identified as a main commercial route. A total of five main commercial routes were identified from the AIS data assessed within the Offshore Study Area. These routes and the corresponding 90th percentile route widths (area in which 90% of vessels transiting a route are situated as per MGN 654) are shown in Figure 14.4.

Relevant details of each route are given in Table 14.4. This includes key destinations, which were based on the most common destinations transmitted via AIS by vessels on those routes. It should not be assumed that a vessel on a given route will necessarily be heading to one of the listed destinations.

No anchored vessels were recorded within the Offshore Study Area during the 2021 survey data. Traditional anchorages were identified within the Offshore Study Area, as discussed in Section 14.4.3.1.

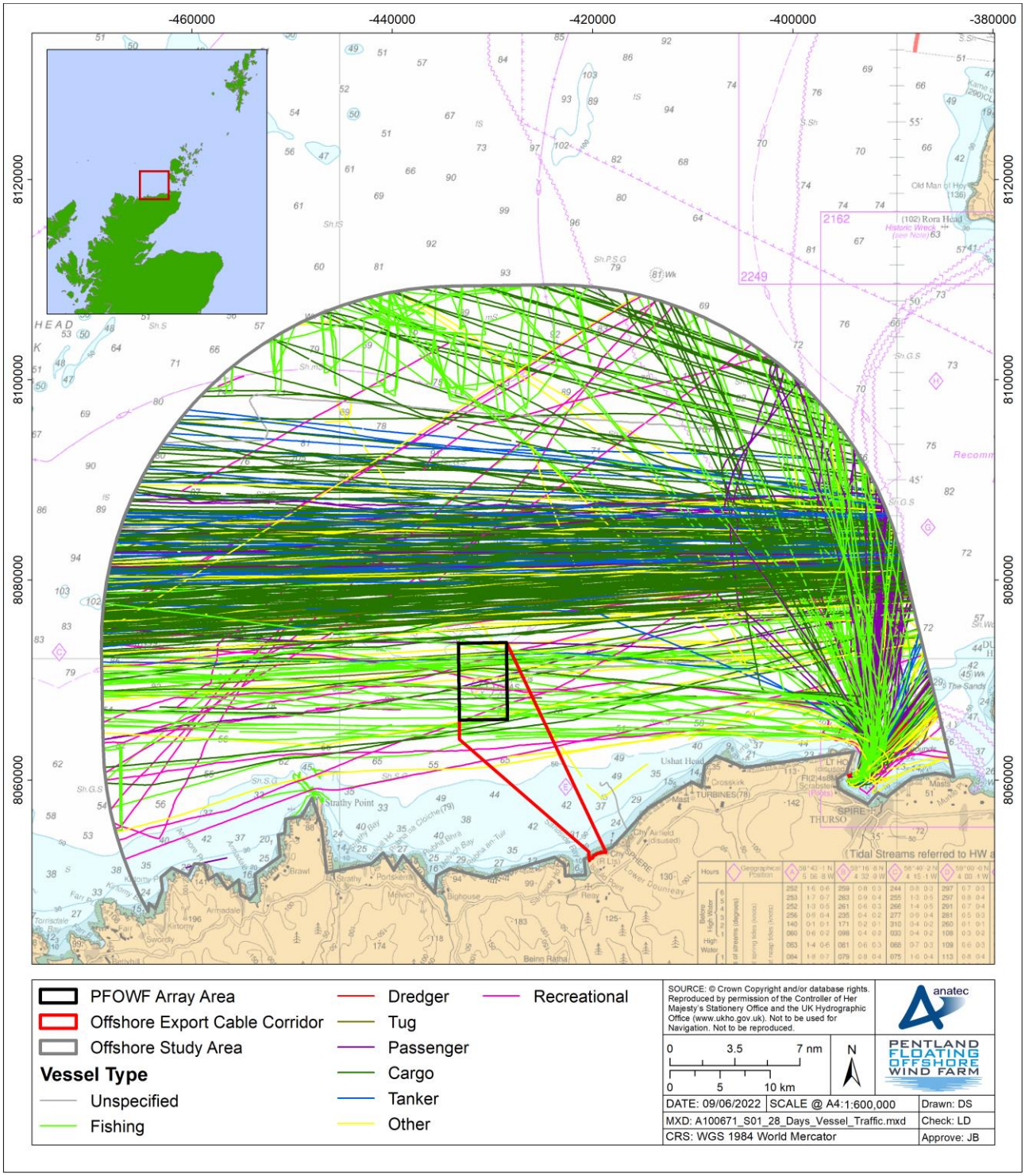

Figure 14.3 Vessel traffic data (28 days)

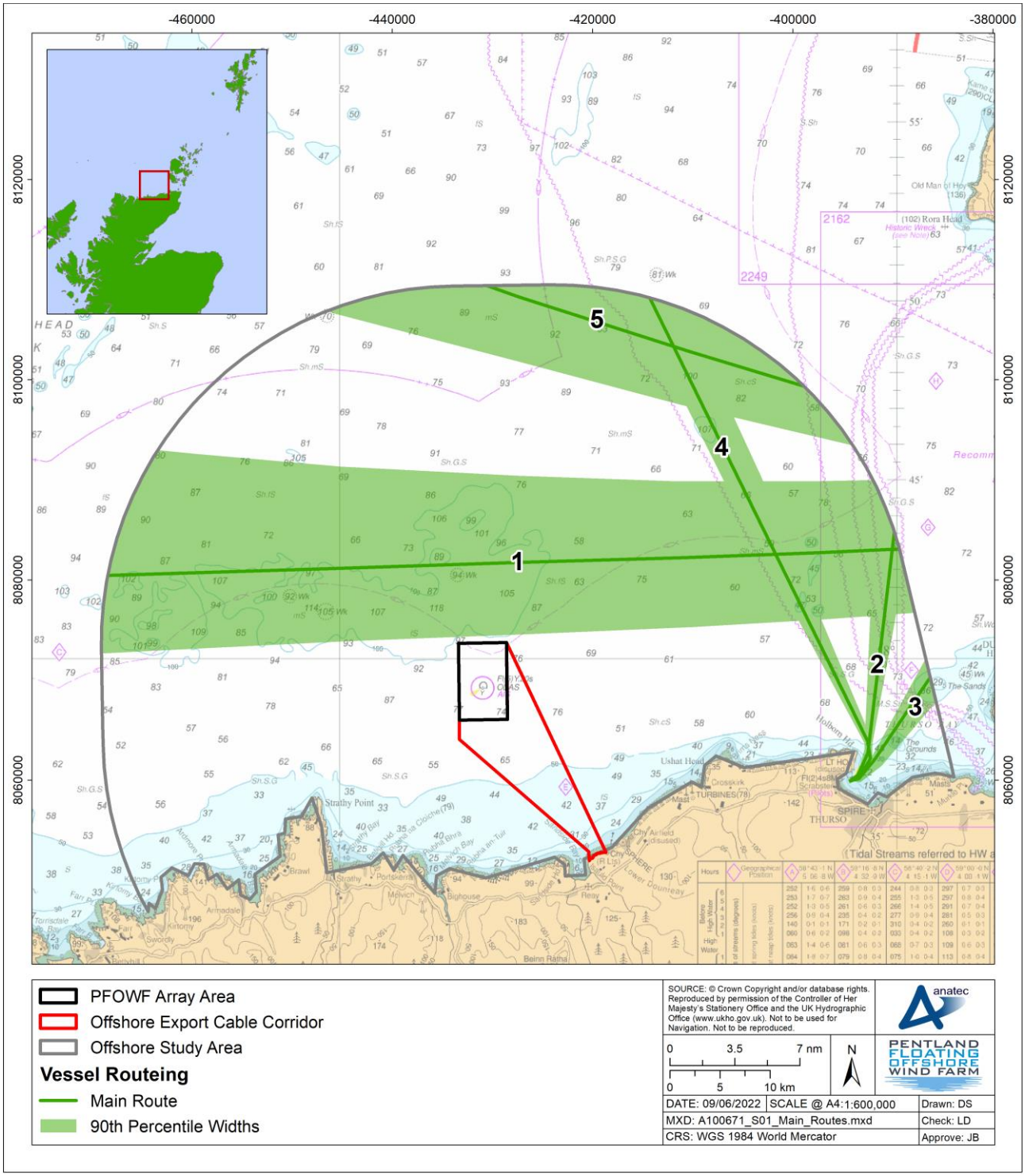

Figure 14.4 Main routes

Table 14.4 Main route details

Route	Key Terminus / Origin Ports	Average Transits per Day	Description
1	Various United States of America 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* (operated by NorthLink Ferries).
3	Scrabster / Immingham	1	Route passing east out of Scrabster.
4	Scrabster / Tórshavn (Faroe Islands)	<1	Route passing north-west from Scrabster.
5	Rotterdam (The Netherlands) / Reykjavik (Iceland)	1	Route passing through the Pentland Firth and the north-east corner of the Offshore Study Area.

14.4.3.3 Emergency response resources and historical incident data

A number of emergency response resources are available to respond to incidents within the Offshore Study Area. Her Majesty's Coastguard is responsible for coordinating Search and Rescue (SAR) operations through a network of Maritime Rescue Coordination Centres (MRCC) and the UK Joint Rescue Coordination Centre. The closest MRCC to the PFOWF Array Area is located in Stornoway, approximately 80 nm to the south-west. It is noted that the Shetland MRCC is likely to be responsible for the area encompassing the Offshore Development and is located approximately 120 nm to the north-east of the PFOWF Array Area.

The UK's SAR helicopter service has been provided by the Bristow Group since April 2015, with the contract for providing the service due for renewal in October 2022. The service is operated out of 10 UK locations, with the closest of these to the PFOWF Array Area being Inverness, approximately 70 nm to the south. Based on feedback from RNLI representatives at the Hazard Workshop, helicopters from Sumburgh and Stornoway may also respond to incidents in proximity to the PFOWF Array Area.

The Emergency Towing Vessel (ETV) *Ievoli Black* currently provides emergency tug support in the north of Scotland, noting that the ETV contract is due for renewal in 2022. It was noted by the MCA during consultation that it cannot be assumed that the ETV will be in place throughout the operational lifetime of the Offshore Development. Three tugs located within Scapa Flow are included in the MCA Coastguard Agreement on Salvage and Towage (CAST), meaning that the MCA may call them into service in an emergency.

The RNLI operate out of more than 230 stations around the UK, with the closest of these to the PFOWF Array Area being 9.6 nm to the east at Thurso. RNLI representatives at the Hazard Workshop noted that lifeboats may also be dispatched to incidents in proximity to the PFOWF Array Area from Longhope and Stromness which are located in Orkney.

Historical incident data from the RNLI, Marine Accident Investigation Branch (MAIB) and Department for Transport has been analysed in detail within Section 12 of the NRA (Offshore EIAR [Volume 3]: Appendix 14.1: NRA).

The RNLI recorded 47 incidents within the Offshore Study Area between 2010 and 2019; however, no incidents were recorded within the PFOWF Array Area. The closest incident involved machinery failure and occurred approximately 2.4 nm to the east. The most common incident types were 'Person in Danger', which accounted for 32% of all incidents in the Offshore Study Area, and 'Machinery Failure', which accounted for 28%. All of the incidents recorded within the Offshore Study Area were responded to by Thurso Lifeboat Station. The incidents recorded by the RNLI between 2010 and 2019, colour-coded by incident type, are presented in Figure 14.5.

The MAIB recorded 13 incidents within the Offshore Study Area between 2010 and 2019; however, no incidents were recorded within the PFOWF Array Area. The closest incident involved machinery failure and occurred approximately 1.9 nm to the east. 'Machinery failure' was the most common incident type, accounting for 46% of incidents, followed by 'Accident to Person', which accounted for 23%.

MAIB data from 2000 to 2019 was also reviewed at the request of the UK Chamber of Shipping. A total of 22 incidents were recorded within the Offshore Study Area in this period, showing that there is a slightly decreasing trend of MAIB reported incidents within the Offshore Study Area over time.

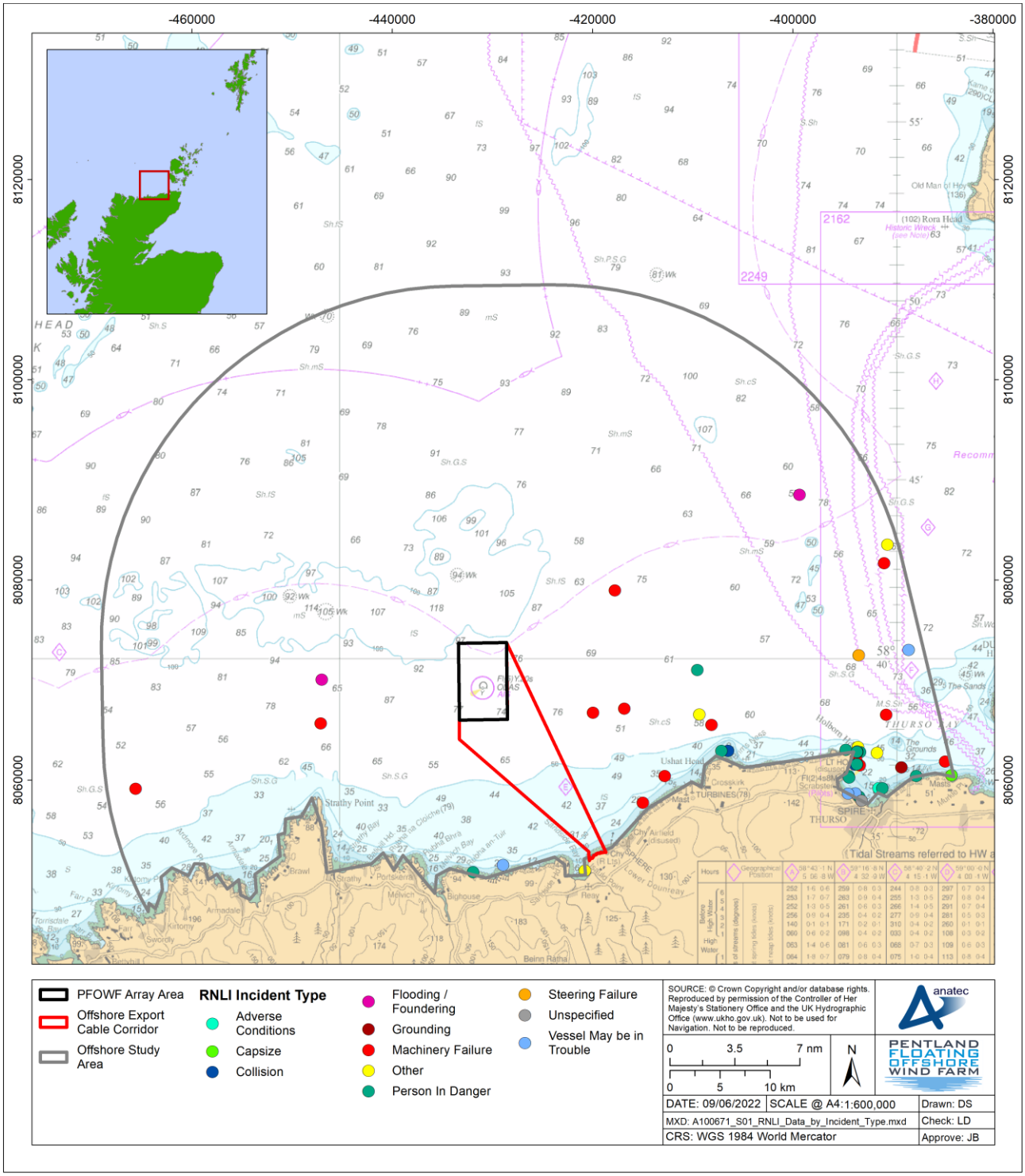

Figure 14.5 RNLI incident data 2010 to 2019

14.4.4 Future Baseline

Based on the available information, it is not expected that the environment would change significantly absent the installation of the Offshore Development. As noted in Section 14.3, consultation was undertaken with local ports and harbours, including Scrabster Harbour, Orkney Marinas, and Orkney Harbour Authority, during which it was noted that local developments may increase the volume of traffic in the area.

To account for the future traffic changes in the quantitative modelling, the models were also run considering traffic levels increased by conservative estimates of 10% and 20% on the recorded baseline traffic. A similar level of increase in background vessel traffic movements would be expected without the implementation of the development. These are standard future traffic estimates for UK NRA and EIA assessments.

14.4.5 Summary of Baseline Environment

The key users from a shipping and navigation perspective who require consideration within the impact assessment are as follows:

- Commercial vessels: Cargo vessels, tankers, passenger vessels, tugs and other offshore support vessels undertaking commercial operations;
- Commercial fishing vessels: Commercial fishing vessels in transit. Fishing gear interaction with subsea infrastructure has been considered from a safety perspective, however active fishing is considered in greater detail within Chapter 13: Commercial Fisheries;
- Recreational vessels: Including yachts, motorboats, and recreational fishing vessels such as angling vessels. Consideration was also given to kayaks / canoes;
- Military vessels: Military vessels in transit; and
- Emergency responders: RNLI lifeboats and SAR helicopters on behalf of the MCA.

Potential receptors and impacts scoped into the assessment and impacts scoped out are provided in Section 14.5 along with justification.

14.4.6 Data Gaps and Uncertainties

14.4.6.1 Marine traffic data

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-19 pandemic data and harbour / marina statistics have been used to assess the impact of the COVID-19 pandemic on vessel activity.

14.4.6.2 RYA Coastal Atlas of Recreational Boating

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.

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.

Consultation has also been carried out with recreational organisations, including on kayaking and canoeing activity.

14.4.6.3 Historical incident data

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

The RNLI incident data cannot be considered comprehensive of all incidents in the 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.

14.4.6.4 UKHO Admiralty charts

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

14.5 Impact Assessment Methodology

14.5.1 Impacts Requiring Assessment

This assessment covers all impacts identified during the scoping process, as well as any further potential impacts that have been highlighted as the EIA has progressed. It should be noted that impacts are not necessarily relevant to all Offshore Development stages.

Table 14.5 below indicates all of the direct and indirect impacts identified and assessed with regard to shipping and navigation and indicates the Offshore Development phases to which they relate. Cumulative impacts are discussed in Section 14.7.

Table 14.5 Potential impacts requiring assessment

Potential Impact	Description
Construction (and Decommissioning)	
Vessel displacement due to construction activities leading to increased collision risk for third-party vessels and/or reduction in port access	Construction and decommissioning activities, including the presence of safety zones, construction buoyage, and construction / decommissioning vessels, may lead to vessels the displacement of third-party vessels, including recreational and fishing vessels. This may cause increased encounters with other third-party vessels, including encounters involving smaller vessels which have been displaced onto commercial routes, leading to an increase in collision risk. Journey times and access to ports may also be impacted.
Vessel-to-vessel collision risk between a third-party vessel and an Offshore Development vessel due to the presence of the Offshore Development vessels	Vessels associated with the construction or decommissioning of the Offshore Development create an additional vessel-to-vessel collision risk.
Vessel to structure allision risk due to the presence of new structures associated with the Offshore Development	The presence of new structures associated with the Offshore Development creates a new vessel to structure allision risk.
Fishing gear interaction with subsea infrastructure	Subsea infrastructure, including mooring lines and cables (including those wet-stored during the construction phase or remaining after the removal of surface structures during decommissioning), creates a risk of fishing gear snagging, leading to potential gear loss and vessel damage.

Potential Impact	Description
Reduction in under keel clearance due to subsea cables / cable protection leading to an increased grounding risk	The presence of subsea infrastructure, such as subsea cables and the associated protection protruding above the seabed, may cause a reduction in under keel clearance available to vessels and hence increases the risk of grounding.
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	Vessels displaced to avoid the PFOWF Array Area, including recreational and fishing vessels, may cause increased encounters with other third-party vessels, including encounters involving smaller vessels which have been displaced onto commercial routes, leading to an increase in collision risk. Journey times and access to ports may also be impacted.
Vessel-to-vessel collision risk between a third-party vessel and an Offshore Development vessel due to the presence of Offshore Development vessels	Vessels associated with operation and maintenance activities associated with the Offshore Development create an additional vessel-to-vessel collision risk.
Vessel to structure allision risk due to the presence of new structures associated with the Offshore Development	The presence of new structures associated with the Offshore Development creates a new vessel to structure allision risk.
Anchor interaction with subsea infrastructure	Subsea infrastructure including mooring lines and cables creates a risk of interaction with vessel anchors, leading to potential damage to the subsea infrastructure or vessel anchors.
Fishing gear interaction with subsea infrastructure	Subsea infrastructure including mooring lines and cables creates a risk of fishing gear snagging, leading to potential gear loss and vessel damage.
Transiting vessel interaction with subsea infrastructure	Subsea infrastructure such as mooring lines and dynamic cable sections may reduce under keel clearance close to WTGs, leading to the risk of transiting vessels interacting with the subsea infrastructure.
Reduction in under keel clearance due to subsea cables / cable protection leading to an increased grounding risk	The presence of subsea infrastructure such as subsea cables and the associated protection protruding above the seabed may cause a reduction in under keel clearance available to vessels and hence increases the risk of grounding.
Loss of WTG station	Failure of the mooring system of a WTG may lead to increased excursion and drifting of the WTG, which may lead to a collision risk for nearby vessels.
Reduction of emergency response capability due to increased incident rates and/or reduced access for SAR responders	Potentially increased incident rates in the vicinity of the Offshore Development may increase demand on emergency responders in the area. The presence of the Offshore Development may also lead to reduced access to incidents within the PFOWF Array Area.

The assessment of impacts on shipping and navigation was a desk-based exercise making use of publicly available data and information gained through consultation. In addition to this, quantitative modelling and analysis of the baseline environment have also informed the assessment of impacts on shipping and navigation.

Impacts relating to safety issues for fishing vessels are also discussed in Chapter 13: Commercial Fisheries.

14.5.2 Impacts Scoped Out of the Assessment

An impact relating to the Offshore Development interfering with equipment used onboard vessels (navigation, communications, and position-fixing equipment) has been scoped out of the impact assessment, based on the findings of the NRA (Offshore EIAR [Volume 3]: Appendix 14.1: NRA). Previous wind farm experience, including studies carried out at existing wind farms, has shown that interference effects have been found to have only minor consequences, which Shipping and Navigation users are able to adapt to. Therefore, the impact was regarded as not likely to lead to a significant effect and was scoped out of the EIAR. No other potential impacts have been scoped out of the impact assessment. The list of impacts was agreed upon with stakeholders including the MCA, NLB, and the attendees at the Hazard Workshop during consultation (see Section 14.3).

14.5.3 Assessment Methodology

The EIA process and methodology are described in detail in Chapter 6: EIA Methodology. In line with MGN 654, the IMO FSA process has been applied to the impact assessment within this chapter and the NRA (Offshore EIAR [Volume 3]: Appendix 14.1: NRA). The FSA process is a structured and systematic methodology based upon risk analysis and Cost Benefit Analysis (CBA) (if applicable) to reduce impacts to As Low as Reasonably Practicable (ALARP). There are five basic steps within this process as 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).

The significance of impacts is determined based on an aggregate of frequency and consequence, with these facets of each impact being ranked based on a number of inputs, including:

- Baseline assessment;
- Relevant embedded mitigation measures;
- Level of stakeholder concern and consultation feedback including that gained at the Hazard Workshop;
- Lessons learnt from other relevant wind farm experiences; and
- Expert opinion.

The rankings used to assess the severity of consequences are presented in Table 14.6.

Table 14.6 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.
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 14.7 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

The risk ranking matrix used to determine the significance of effects from the frequency of occurrence and the severity of consequences is presented in Table 14.8.

Table 14.8 Tolerability matrix and risk rankings

Consequences						
	Major	Tolerable with Mitigation (intermediate risk)	Tolerable with Mitigation (intermediate risk)	Unacceptable (high risk)	Unacceptable (high risk)	Unacceptable (high risk)
	Serious	Broadly Acceptable (low risk)	Tolerable with Mitigation (intermediate risk)	Tolerable with Mitigation (intermediate risk)	Unacceptable (high risk)	Unacceptable (high risk)
	Moderate	Broadly Acceptable (low risk)	Broadly Acceptable (low risk)	Tolerable with Mitigation (intermediate risk)	Tolerable with Mitigation (intermediate risk)	Unacceptable (high risk)
	Minor	Broadly Acceptable (low risk)	Broadly Acceptable (low risk)	Broadly Acceptable (low risk)	Tolerable with Mitigation (intermediate risk)	Tolerable with Mitigation (intermediate risk)
	Negligible	Broadly Acceptable (low risk)	Broadly Acceptable (low risk)	Broadly Acceptable (low risk)	Broadly Acceptable (low risk)	Tolerable with Mitigation (intermediate risk)
		Negligible	**Extremely Unlikely**	**Remote**	**Reasonably Probable**	**Frequent**
		Frequency				

Once identified, the tolerability of an impact is assessed to ensure it is ALARP. Additional mitigations may be needed to further reduce the risk in accordance with ALARP principles. Unacceptable risks are not considered to be ALARP. In EIA terms, impacts which are assessed as being Tolerable with Mitigation or Broadly Acceptable are considered not significant, whilst Unacceptable impacts are considered significant.

14.5.4 Design Envelope Parameters

This assessment considers the Offshore Development parameters (as set out Chapter 5: Project Description) which are predicted to result in the greatest environmental impact, known as the 'realistic worst case scenario'. The realistic worst case scenario represents, for any given receptor and the potential impact on that receptor, the combination of parameters within the Design Envelope that would result in the greatest potential for change to the receptor in question.

Given that the realistic worst case scenario is based on the design option (or combination of options) that represents the greatest potential for change, confidence can be held that the development of any alternative options within the Design Envelope will give rise to no worse effects than those assessed in this impact assessment.

From a shipping and navigation perspective, the worst case design is an array including the maximum number of WTGs spread across the full extent of the PFOWF Array Area. This creates the largest possible obstacle for Shipping and Navigation users and leads to the largest displacement of vessels. Therefore, the worst case design considered within the assessment consisted of seven WTGs spread across the PFOWF Array Area.

Table 14.9 presents the realistic worst case scenario for potential impacts on shipping and navigation during the construction, operational and maintenance, and decommissioning phases of the Offshore Development.

Table 14.9 Design parameters specific to shipping and navigation impact assessment

Potential Impact	Design Envelope Scenario Assessed
Construction Phase	
Vessel displacement due to construction activities leading to increased collision risk for third-party vessels and/or reduction in port access	> Full build-out of the maximum extent of the PFOWF Array Area; > Seven WTGs on floating foundations; > Split construction phase over Stage 1 and Stage 2; > Up to 660 round trips from construction vessels; > Up to two offshore export cables with a maximum length of 12.5 km each, with 50% of this possibly requiring remedial cable protection; > Up to seven inter-array cables with a maximum total length of 20 km, with 50% of this possibly requiring remedial cable protection; and > Application for 500-m safety zones around structures where active construction is ongoing.
Vessel-to-vessel collision risk between a third-party vessel and an Offshore Development vessel due to the presence of Offshore Development related vessels	> Full build-out of the maximum extent of the PFOWF Array Area; > Seven WTGs on floating foundations; > Split construction phase over Stage 1 and Stage 2; > Up to 660 round trips from construction vessels; > A peak of 10 construction vessels; > Up to two offshore export cables with a maximum length of 12.5 km each, with 50% of this possibly requiring remedial cable protection; > Up to seven inter-array cables with a maximum total length of 20 km, with 50% of this possibly requiring remedial cable protection; and > Application for 500-m safety zones around structures where active construction is ongoing.
Vessel to structure allision risk due to the presence of new structures associated with the Offshore Development	> Full build-out of the maximum extent of the PFOWF Array Area; > Seven WTGs on floating foundations; > WTGs on floating foundations (125 m x 125 m at sea level); and > Split construction phase over Stage 1 and Stage 2.
Fishing gear interaction with subsea infrastructure	> Nine mooring lines and anchors per WTG; > Taut mooring system with maximum offset from the floating foundation; > Split construction phase over Stage 1 and Stage 2; > Wet storage of subsea infrastructure between phases of construction; > Seven WTGs on floating foundations; > Up to seven inter-array cables with a maximum total length of 20 km, with 50% of this possibly requiring remedial cable protection; > Up to two offshore export cables with a maximum length of 12.5 km each, with 50% of this possibly requiring remedial cable protection; > Dynamic section of cables extending up to 500 m in the water column per WTG; and > Potential for limited cable burial in areas of rock or at cable crossings, use of external protection as identified via Cable Burial Risk Assessment (CBRA) up to a maximum height above the seabed of 1 m.

Potential Impact	Design Envelope Scenario Assessed
Reduction in under keel clearance due to subsea cables / cable protection leading to an increased grounding risk	> Up to seven inter-array cables with a maximum total length of 20 km, with 50% of this possibly requiring remedial protection; > Up to two offshore export cables with a maximum length of 12.5 km each, with 50% of this possibly requiring remedial protection; > Dynamic section of cables extending up to 500 m in the water column per WTG; > Potential for limited cable burial in areas of rock or at cable crossings, use of external protection as identified via CBRA up to a maximum height above the seabed of 1 m; and > Targeted minimum cable burial depth of 0.6 m
Operational Phase	
Vessel displacement due to presence of new structures leading to increased collision risk for third-party vessels and/or reduction in port access	> Full build-out of the maximum extent of the PFOWF Array Area; > Seven WTGs on floating foundations; > WTGs on floating platforms (125 m x 125 m at sea level); > Up to nine mooring lines and anchors per WTG; > Up to 210 round trips to the Offshore Site annually from Offshore Development vessels; > A peak of 10 Offshore Development vessels on site simultaneously; > Operational life of up to 30 years; and > Application for 500-m safety zones around structures where major maintenance is ongoing.
Vessel-to-vessel collision risk between a third-party vessel and an Offshore Development vessel due to the presence of the Offshore Development vessels	> Full build-out of the maximum extent of the PFOWF Array Area; > Seven WTGs on floating foundations; > Up to 210 round trips to the Offshore Site annually from Offshore Development vessels; > A peak of 10 Offshore Development vessels on site simultaneously; > Operational life of up to 30 years; and > Application for 500-m safety zones around structures where major maintenance is ongoing.
Commercial vessel to structure allision risk for vessels due to the presence of new structures associated with the Offshore Development	> Full build-out of the maximum extent of the PFOWF Array Area; > Seven WTGs on floating foundations; > WTGs on floating platforms (125 m x 125 m at sea level); > Operational life of up to 30 years; and > Minimum blade clearance of 35 m.
Fishing vessel to structure allision risk for vessels due to the presence of new structures associated with the Offshore Development	> Full build-out of the maximum extent of the PFOWF Array Area; > Seven WTGs on floating foundations; > WTGs on floating platforms (125 m x 125 m at sea level); > Operational life of up to 30 years; and > Minimum blade clearance of 35 m.

Potential Impact	Design Envelope Scenario Assessed
Recreational vessel to structure allision risk for vessels due to the presence of new structures associated with the Offshore Development	> Full build-out of the maximum extent of the PFOWF Array Area; > Seven WTGs on floating foundations; > WTGs on floating platforms (125 m x 125 m at sea level); > Operational life of up to 30 years; and > Minimum blade clearance of 35 m.
Reduction of under keel clearance due to the presence of moorings / inter-array cables / export cables / cable protection associated with the Offshore Study Area	> Up to two offshore export cables with a maximum length of 12.5 km each, with 50% of this possibly requiring remedial cable protection; > Up to seven inter-array cables with a maximum total length of 20 km, with 50% of this possibly requiring remedial cable protection; > Dynamic section of cables extending up to 500 m in the water column per WTG; > Operational life of 30 years; > Taut mooring system with maximum offset from the floating foundation; and > Potential for limited cable burial in areas of rock or at cable crossings, use of external protection as identified via CBRA up to a maximum height above the seabed of 1 m.
Vessel interaction with subsea cables and mooring lines associated with the Offshore Development	> Up to two offshore export cables with a maximum length of 12.5 km each, with 50% of this possibly requiring cable remedial protection; > Up to seven inter-array cables with a maximum total length of 20 km, with 50% of this possibly requiring remedial cable protection; > Dynamic section of cables extending up to 500 m in the water column per WTG; > Nine mooring lines per WTG; > Taut mooring system with maximum offset from the floating foundation; > Operational life of 30 years; > Potential for limited cable burial in areas of rock or at cable crossings, use of external protection as identified via CBRA up to a maximum height above the seabed of 1 m; and > Minimum cable burial depth of 0.6 m.
Anchor interaction with subsea infrastructure	> Nine mooring lines and anchors per WTG; > Taut mooring system with maximum offset from the floating foundation; > Seven WTGs on floating foundations; > Up to seven inter-array cables with a maximum total length of 20 km, with 50% of this possibly requiring remedial cable protection; > Up to two offshore export cables with a maximum length of 12.5 km each, with 50% of this possibly requiring remedial cable protection; > Dynamic section of cables extending up to 500 m in the water column per WTG; > Potential for limited cable burial in areas of rock or at cable crossings, use of external protection as identified via CBRA up to a maximum height above the seabed of 1 m; and > Operational life of 30 years.

Potential Impact	Design Envelope Scenario Assessed
Fishing gear interaction with subsea infrastructure	> Nine mooring lines and anchors per WTG; > Taut mooring system with maximum offset from the floating foundation; > Seven WTGs on floating foundations; > Up to seven inter-array cables with a maximum total length of 20 km, with 50% of this possibly requiring remedial cable protection; > Up to two offshore export cables with a maximum length of 12.5 km each, with 50% of this possibly requiring remedial cable protection; > Potential for limited cable burial in areas of rock or at cable crossings, use of external protection as identified via CBRA up to a maximum height above the seabed of 1 m; and > Operational life of 30 years.
Transiting vessel interaction with subsea infrastructure	> Nine mooring lines and anchors per WTG; > Taut mooring system with maximum offset from the floating foundation; > Seven WTGs on floating foundations; > Up to seven inter-array cables with a maximum total length of 20 km, with 50% of this possibly requiring remedial cable protection; > Up to two offshore export cables with a maximum length of 12.5 km each, with 50% of this possibly requiring remedial cable protection; > Potential for limited cable burial in areas of rock or at cable crossings, use of external protection as identified via CBRA up to a maximum height above the seabed of 1 m; and > Operational life of 30 years.
Reduction in under keel clearance due to subsea cables / cable protection leading to an increased grounding risk	> Up to seven inter-array cables with a maximum total length of 20 km, with 50% of this possibly requiring remedial cable protection; > Up to two offshore export cables with a maximum length of 12.5 km each, with 50% of this possibly requiring remedial cable protection; > Potential for limited cable burial in areas of rock or at cable crossings, use of external protection as identified via CBRA up to a maximum height above the seabed of 1 m; and > Minimum cable burial depth of 0.6 m.
Loss of WTG station	> Nine mooring lines per WTG; > Seven WTGs on floating foundations; and > Operational life of up to 30 years.
Reduction of emergency response capability due to increased incident rates and/or reduced access for SAR responders	> Seven WTGs on floating foundations; > Up to 210 round trips to the Offshore Site annually from Offshore Development vessels; and > A peak of 10 Offshore Development vessels on site simultaneously.
Decommissioning	
The decommissioning process is expected to follow the reverse process of the construction phase and therefore the parameters are expected to be the same. From a shipping and navigation perspective, the activities during both phases are expected to be similar. The decommissioning plan will be continually reviewed throughout the operational lifetime of the Offshore Development, so variations from the construction phase are possible. However, based on the currently available information, the impacts to be assessed and the maximum design parameters are expected to be largely as per the construction phase (but in reverse).	

14.5.5 Embedded Mitigation and Management Plans

As part of the Offshore Development design process, a number of designed-in measures and management plans have been included to reduce the potential for impacts on Shipping and Navigation users (Table 14.10). As there is a commitment to implementing these measures which will likely be secured through Section 36 Consent and Marine Licence Conditions, they are considered inherently part of the design of the Offshore Development and have therefore been considered in the assessment presented below (i.e. the determination of the magnitude of impact and therefore the significance of effects assumes implementation of these measures). These measures are considered standard industry practise for this type of development.

Table 14.10 Embedded mitigation measures specific to Shipping and Navigation for the Offshore Development

Embedded Mitigation Measures and Management Plans	Justification
Management Plans	
Cable Plan (CaP) / Cable Burial Risk Assessment	A CaP 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 the 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.
Navigation Safety Plan (NSP)	An NSP will be developed for the Offshore Development which will detail all navigational safety measures, construction exclusion zones, if required, notices to mariners (NtMs) and radio navigation warnings, anchoring areas, lighting and marking requirements, and emergency response procedures during all phases of 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 and maintenance. This will also detail the ports and transit corridors proposed.
Lighting and Marking Plan	An 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 and MoD aviation lighting policy and guidance. The LMP will also detail the navigational lighting requirements detailed in IALA R139 and G1162.
Design, Specification, and Layout Plan	A DSLP will allow stakeholders to see the specifics of the Offshore Development (e.g. WTG positions within the array and mooring arrangement position).
Embedded Mitigations	
MGN 654 compliance	The Offshore Development will comply with MGN 654 and its annexes as per its consent conditions to ensure that impacts on navigational safety and emergency response are considered, assessed, and mitigated. This includes post-consent completion of the SAR Checklist which includes the production of an ERCoP.

Embedded Mitigation Measures and Management Plans	Justification
The use of guard vessels and Offshore Fisheries Liaison Officers, 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, at a minimum, will be Scottish vessels.
Minimum Air Gap	MGN 654 requires that the minimum air gap will be at least 22 m above mean high water springs noting that for floating foundations the value is calculated above MSL 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.
Target depth of lowering	Static cables will be trenched and buried to a minimum target depth of 0.6 m. Where this cannot be achieved, remedial cable protection will be applied. The cable burial target depth will be informed by a Cable Burial Risk Assessment and implemented through the Cable Plan produced post-consent.
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 through the LMP.
Charting requirements	Prior to construction, the final WTG positions and height 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 10 weeks prior to construction. Further to this, HWL will sign up for the Kingfisher Information Service – Offshore Renewable & Cable Awareness project. This is a joint initiative between the European Subsea Cables Association and the Kingfisher Information Service of Seafish. The Offshore Development infrastructure, including cables mooring lines, anchoring points, as well as WTGs 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 NtMs, Kingfisher notifications, and other navigational warnings, as required and in a timely and efficient manner. This will ensure navigational safety and minimise the risk of equipment snagging through the appropriate propagation of notices to other sea users.
Post-consent application for safety zones	Five-hundred-metre 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 safe passing distance will also be requested around the Offshore Development vessels (e.g. during cable-laying). 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.

14.6 Assessment of Environmental Effects

14.6.1 Effects During Construction

14.6.1.1 Vessel displacement due to construction activities leading to increased collision risk for third-party vessels and/or reduction in port access

Offshore construction works are planned to occur over a split construction phase with two distinct stages in which subsea infrastructure will be installed in Stage 1, and stored on the seabed, with the rest of the Offshore Development being installed in Stage 2. The maximum number of Offshore Development vessels expected onsite simultaneously is 10. Vessels onsite during the construction works will include a cable install vessel (which may be restricted in its ability to manoeuvre [RAM]), three anchor handling tugs (which may be RAM), a Remotely Operated Vehicle (ROV) support vessel, a pre-lay grapnel run (PLGR) vessel, a rock placement vessel, guard vessels (if required), a survey vessel, two geotechnical drilling vessel, and crew transfer vessels.

Depending on the planned construction method and programme, a buoyed construction area may be required to mitigate against disjointed construction phases (i.e. anchors and/or mooring lines being in place prior to foundations being installed).

Should a buoyed construction area be required, there will be no restrictions on entry into the buoyed construction area, other than active construction or pre-commissioning safety zones; however, experience at previous offshore wind farm developments under construction suggests that commercial vessels will choose not to navigate within the buoyed construction area. Therefore, the construction activities and the presence of the buoyed construction area to protect partially installed structures and construction activities during the construction period may result in the displacement of vessels.

14.6.1.1.1 Vessel displacement

Given the location of the PFOWF Array Area relative to the main commercial routes, it is expected that commercial vessel displacement will be limited. The main commercial route passing in proximity to the PFOWF Array Area is Route 1 (see Figure 14.4), passing east-west to the north, which is used by an average of 10 vessels per day. The route is expected to narrow and the mean route position is expected to shift north slightly as vessels utilise the available sea room to the north of the PFOWF Array Area, to ensure a safe passing distance. The overall effect on vessel routeing is expected to be minimal, noting that vessels on Route 1 are predominantly on long-distance, international voyages.

The choice of port to be used for construction is yet to be determined; however, Scrabster Harbour is likely to be utilised for personnel loadout during construction. Given the location of PFOWF Array Area, outside of the main access routes to Scrabster, it is unlikely that access to the harbour is restricted by the construction activities. Considering that Scrabster is the most likely affected harbour, it is considered unlikely that access to any other ports or harbours would be reduced due to construction activities.

Noting that these are predominantly commercial issues with no impact on navigational safety, they are not predicted to have a significant impact on Shipping and Navigation users given the minor changes to routeing.

14.6.1.1.2 Increased collision risk between third-party vessels

Vessel displacement may also lead to increased vessel densities in certain areas, as vessels displaced from the PFOWF Array Area use the remaining available sea room. This increase in vessel density increases the number of encounters between vessels and therefore increases the likelihood of a vessel-to-vessel collision. The most significant increase in vessel density is likely to be to the north of the PFOWF Array Area on Route 1, where vessels will be displaced further north to avoid the PFOWF Array Area and any buoyed construction area that is required. This displacement may lead to increased encounters and therefore a greater probability of collisions; however, there is ample sea room available north of the route. Therefore, collision risk is not expected to significantly increase during the construction phase of the Offshore Development.

14.6.1.1.3 Displacement of small vessels onto main commercial routes

Again, experience at offshore wind farm developments that were previously under construction suggests that smaller vessels (recreational and fishing vessels) will choose not to navigate within a buoyed construction area if one is required. Therefore, smaller vessels may be displaced into the routes used by larger commercial vessels. There was considerable fishing and recreational vessel presence recorded within the PFOWF Array Area; however, based on feedback gathered throughout from the Pentland Firth Yacht Club at the Hazard Workshop, the risk to recreational vessels due to their displacement into commercial routes is thought to be low, due to the traffic levels and available sea room in proximity to the PFOWF Array Area. It was also noted by the Pentland Firth Yacht Club that smaller craft may choose to pass inshore of the PFOWF Array Area, whilst the representative from the RNLI noted that the water depths and sea room available inshore made it likely that grounding would not pose a significant risk.

14.6.1.1.4 Relevant embedded mitigation measures

The following embedded mitigation measures will reduce the frequency and/or consequence of the effect resulting in a lower significance of effect:

- Promulgation of information as per consent requirements and standard industry practice;
- Buoyed construction area;
- LMP; and
- Guard vessel(s) where required.

14.6.1.1.5 Assessment of significance

The potential for vessel displacement due to construction activities leading to increased collision risk for third-party vessels and/or reduction in port access is overall considered to have a frequency of **Extremely Unlikely**, and the consequences are considered to be **Moderate**. Therefore, the significance of the effect is considered **Broadly Acceptable** which is **Not Significant** in EIA terms.

14.6.1.2 Vessel-to-vessel collision risk between a third-party vessel and an Offshore Development vessel due to the presence of Offshore Development vessels

The construction phase of the Offshore Development is proposed to be split into two stages as described in Section 14.6.1.1.1 above. A maximum of 660 transits by construction vessels may be made throughout the planned construction phase and will include vessels such as cable-laying vessels which are RAM. Offshore Development vessels will be managed by marine coordination, including the use of designated routes to and from the PFOWF Array Area. Offshore Development vessels will carry AIS and will be compliant with relevant Flag State regulations, including the COLREGs (IMO, 1972/77) and MGN 372 (MCA, 2008).

Safety zones will be applied for during the construction phase of the Offshore Development which will cover up to 500 m around the structures where construction work is ongoing. Safety zones will protect the Offshore Development vessels working onsite, particularly those which may be RAM. Guard vessel(s) will also assist in monitoring the safety zones when present onsite. In addition, advisory 500-m safe passing distances will be requested around the Offshore Development vessels.

Promulgation of information, including the use of Notices to Mariners (NtMs) and Kingfisher bulletins, will help to inform mariners in the area of planned and ongoing construction works, and therefore allow courses to be planned to avoid Offshore Development vessels. Similarly, the construction area will be marked on Admiralty charts prior to the commencement of construction.

The agreement of an LMP with the NLB will maximise awareness of the construction area. If deemed necessary, a buoyed construction area will act as additional protection for onsite Offshore Development vessels, as third-party vessels tend not to enter buoyed construction areas, reducing the likelihood of any encounters between Offshore Development vessels and third-party vessels.

Given the embedded mitigation measures mentioned above, in addition to a relatively short construction phase in which Offshore Development vessels will be present, it is seen as unlikely that any close encounters between third-party vessels and Offshore Development vessels will occur. In the event of an encounter, collision avoidance action as per the COLREGs will be followed, reducing the risk of the encounter developing into a collision.

14.6.1.2.1 Relevant embedded mitigation measures

The following embedded mitigation measures will reduce the frequency and/or consequence of the effect resulting in a lower significance of effect:

- Charting Requirements;
- Buoyed construction area;
- Promulgation of information as per consent requirements and standard industry practice;
- LMP;
- Guard vessel(s) where required;
- Navigational Safety Plan (NSP);
- Vessel Management Plan (VMP); and
- Safety zones (subject to separate application prior to construction).

14.6.1.2.2 Assessment of significance

The potential for vessel-to-vessel collision risk between a third-party vessel and an Offshore Development vessel due to the presence of the Offshore Development vessels is overall considered to have a frequency of **Extremely Unlikely**, and the consequences are considered to be **Moderate**. Therefore, the significance of the effect is considered **Broadly Acceptable** which is **Not Significant** in EIA terms.

14.6.1.3 Vessel to structure allision risk due to the presence of new structures associated with the Offshore Development

As the construction phase involves the towing of structures to the PFOWF Array Area before hooking them up to the mooring lines, it is not anticipated that there will be any partially constructed structures located within the PFOWF Array Area. However, there will be periods during the six-month construction period where some of the structures have been installed whilst work on others is ongoing, creating an allision risk for vessels. Three distinct types of allision risk are considered:

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

14.6.1.3.1 Powered allision risk

Powered allision risk may be caused by human or navigational error, lack of awareness of the Offshore Development, or failure of an aid to navigation. Experience from previous under-construction offshore wind farms shows that Masters regularly choose to transit at distances greater than 1 nm from ongoing construction works, meaning that vessels are unlikely to transit close enough to structures to create an allision risk.

From historical incident data, no instances have been recorded of a powered allision involving a third-party vessel with a pre-commissioned wind farm structure in the UK.

As noted in the collision risk between Offshore Development vessels and third-party vessels it is unlikely that third-party vessels will enter a buoyed construction zone (if one is required), further reducing the risk of allision. Embedded mitigation measures such as application for safety zones, guard vessels, marking on Admiralty charts and promulgation of information will also help to reduce the risk of powered allision. During the Hazard Workshop, it was agreed by the attendees that promulgation of information was an important form of mitigation against allision risk.

A local fishing representative noted that NtMs were important to keep local users informed, whilst the Orkney Fisheries Association emphasised the value of Kingfisher bulletins. A representative of the Pentland Firth Yacht Club also noted that the CCC publish Sailing Directions for recreational users which should be kept updated.

14.6.1.3.2 Drifting allision risk

Drifting allision may be caused by technical or mechanical failure, adverse weather, or a navigational system error. A vessel adrift may only develop into an allision situation if in proximity to a structure associated with the Offshore Development. This covers the case where an adrift vessel is in proximity to the PFOWF Array Area and the wind and/or tide directs the vessel towards a structure.

From historical incident data, there have been no reported instances of a drifting allision involving a third-party vessel and a wind farm structure during the construction phase in the UK.

During the Hazard Workshop, Orkney Harbour Authority emphasised the need to consider the risk of a large commercial vessel, such as a stone carrier or a cruise ship, drifting in proximity to the PFOWF Array Area. It was noted that the probability of such an occurrence is low, but given the severity of the potential consequences, this has been considered. The availability of an ETV as well as the Orkney Harbour Authority's tugs under the MCA CAST reduces the likelihood of a drifting vessel developing into a drifting allision, noting also that the PFOWF Array Area is located approximately 8.3 nm from the RNLI's Thurso Lifeboat Station, which would also be able to provide support in such a situation.

A minimum blade clearance of not less than 22 m above mean sea level for floating foundations taking into account pitch, roll, etc. has been considered as an embedded mitigation (as per MGN 654), noting that the Design Envelope has been updated to include a minimum 35 m blade clearance. This reduces the likelihood of the WTG blades interacting with the sail of a drifting recreational vessel. During consultation, the Pentland Firth Yacht Club noted that 22 m was considered sufficient and noted that recreational vessels would likely aim to remain sufficiently far away from floating structures that blade clearance would not be relevant.

Based on the above, it is expected that it is unlikely that a drifting vessel allides with any structure associated with the Offshore Development during the construction phase. Any drifting allision is likely to have less severe consequences than a powered allision, given that the speeds are likely to be slower, and therefore impact energies lower.

14.6.1.3.3 Internal allision risk

As noted in the discussion of vessel displacement, it is not anticipated that third-party vessels would enter a buoyed construction area, if one is required. In the case that the construction phase is taking place over a single six-month period, the presence of the Offshore Development vessels and structures within the PFOWF Array Area is likely to discourage vessels from entering the PFOWF Array Area. Therefore, internal allision risk is not considered relevant to the construction phase of the Offshore Development.

14.6.1.3.4 Relevant embedded mitigation measures

The following embedded mitigation measures will reduce the frequency and/or consequence of the effect resulting in a lower significance of effect:

- Charting requirements;
- Promulgation of information as per consent requirements and standard industry practice;
- Buoyed construction area;
- LMP;
- Guard vessel(s) where required;
- Safety zones (subject to a separate application prior to construction); and
- Minimum blade clearance.

14.6.1.3.5 Assessment of significance

The potential for vessel to structure allision risk, encompassing powered, drifting, and internal allision risk as discussed above, due to the presence of new structures associated with the Offshore Development is overall considered to have a frequency of **Extremely Unlikely**, and the consequences are considered to be **Moderate**. Therefore, the significance of the effect is considered **Broadly Acceptable** which is **Not Significant** in EIA terms.

14.6.1.4 Fishing gear interaction with subsea infrastructure

During the construction phase, it is planned that subsea infrastructure such as mooring lines and anchors are installed in advance of the WTGs. These would then be stored *in situ* on the seabed before being hooked up to the floating foundations later in the construction phase. It is therefore possible that mooring lines would pose a snagging risk to fishing vessels in the area.

No fishing vessel activity characteristic of active fishing was observed within the PFOWF Array Area during the two 14-day vessel traffic surveys. Some active fishing was recorded on the northern edge of the Offshore Study Area, whilst a potter was recorded working close to the shore. It was noted during the Hazard Workshop by local fishing representatives that vessels may fish around the north-west corner of the PFOWF Array Area when adverse weather prevents going further offshore.

As noted in the discussion of vessel displacement, vessels do not tend to pass within buoyed construction areas. If such an area is required, this would therefore serve to prevent snagging risks during construction. Promulgation of information would also inform fisherman of potential subsea hazards and discourage fishing within the PFOWF Array Area. It was noted by a local fishing representative that fishermen prefer to carry out their own risk assessments and would prefer to avoid subsea hazards anyway.

Active fishing activity is considered in more detail in Chapter 13: Commercial Fisheries.

14.6.1.4.1 Relevant embedded mitigation measures

The following embedded mitigation measures will reduce the frequency and/or consequence of the effect resulting in a lower significance of effect:

- Charting Requirements;
- Promulgation of information as per consent requirements and standard industry practice; and
- LMP.

14.6.1.4.2 Assessment of significance

The potential for fishing gear interaction with subsea infrastructure is overall considered to have a frequency of **Extremely Unlikely**, and the consequences are considered to be **Moderate**. Therefore, the significance of the effect is considered **Broadly Acceptable** which is **Not Significant** in EIA terms.

14.6.1.5 Reduction in under keel clearance due to subsea cables / cable protection leading to an increased grounding risk

A significant change in water depth would reduce the under keel clearance available to vessels, and potentially lead to a grounding risk being created.

The Design Envelope for the Offshore Development includes up to two offshore export cables each up to 12.5 km in length. The offshore export cables are planned to be buried to a minimum depth of 0.6 m where technically possible. Where burial is not possible, cable protection will be installed rising to a maximum height of 1 m above the seabed. It is anticipated that HDD will be used to install the cable close to the landfall, beginning at 400 m to 700 m from the shore. Therefore, it is not anticipated that any installed cable protection shall reduce the water depth by more than 5%. In the event that the water depth is likely to be reduced by more than 5%, this will be discussed with the MCA and NLB. It is noted that each cable also has a dynamic portion extending up to 500 m in the water column which will be neither buried nor protected, including the section which connects the WTGs to the static cable on the seabed. The dynamic portion of the cable is unlikely to be close enough to the surface to affect surface navigation.

Water depths throughout the OECC and the PFOWF Array Area are generally deep enough that a 1 m decrease in water depth would not be significant. A 1-m increase only represents an increase of 5% or more within 600 m of the shore, where HDD is likely to be utilised. Therefore, it is not anticipated that water depth is affected in a significant way at any point within the Offshore Study Area.

Areas in which the water depth may be affected, particularly along the offshore export cable route, will be marked on Admiralty charts. In addition, any marking requirements deemed necessary, such as a cable marker board, will be agreed upon in consultation with the NLB.

14.6.1.5.1 Relevant embedded mitigation measures

The following embedded mitigation measures will reduce the frequency and/or consequence of the effect resulting in a lower significance of effect:

- Charting Requirements;
- Promulgation of information as per consent requirements and standard industry practice; and
- LMP.

14.6.1.5.2 Assessment of significance

The reduction in under keel clearance due to subsea cables / cable protection leading to an increased grounding risk is overall considered to have a frequency of **Negligible**, and the consequences are considered to be **Minor**. Therefore, the significance of the effect is considered **Broadly Acceptable** which is **Not Significant** in EIA terms.

14.6.1.6 Summary of effects during construction

A summary of the assessment of effects during construction is provided in Table 14.11.

Table 14.11 Summary of significance of effects from construction impacts

Summary of Effect	User	Frequency	Consequence	Rationale	Significance	Additional Mitigation Requirements	Significance of Residual Effect
Vessel displacement due to construction activities; leading to increased collision risk for third-party vessels and/or reduction in port access	All vessels	Extremely Unlikely	Moderate	Given the location 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 additional collisions will 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.	Broadly Acceptable (Not Significant)	No additional mitigation measures have been identified for this effect above and beyond the embedded Offshore Development mitigation listed in Section 14.5.5 as it was concluded that the effect was not significant.	Broadly Acceptable (Not Significant)
Vessel-to-vessel collision risk between a third-party vessel and an Offshore Development vessel due to the presence of Offshore Development vessels	All vessels	Extremely unlikely	Moderate	Offshore Development vessels will be managed via marine coordination, with mitigation including safety zones, which will also serve to protect Offshore Development vessels from collision. Given the duration for which construction vessels will be onsite and the mitigations in place, collisions are considered unlikely.	Broadly Acceptable (Not Significant)	No additional mitigation measures have been identified for this effect above and beyond the embedded Offshore Development mitigation listed in Section 14.5.5 as it was concluded that the effect was not significant.	Broadly Acceptable (Not Significant)

Summary of Effect	User	Frequency	Consequence	Rationale	Significance	Additional Mitigation Requirements	Significance of Residual Effect
Vessel to structure allision risk due to the presence of new structures associated with the Offshore Development	All vessels	Extremely Unlikely	Moderate	Structures are unlikely to be present onsite for an extended period during the construction phase. This, combined with the presence of any buoyed construction area that is required, means that an allision is considered unlikely.	Broadly Acceptable (Not Significant)	No additional mitigation measures have been identified for this effect above and beyond the embedded Offshore Development mitigation listed in Section 14.5.5 as it was concluded that the effect was not significant.	Broadly Acceptable (Not Significant)
Fishing gear interaction with subsea infrastructure	Commercial fishing vessels	Extremely Unlikely	Moderate	Subsea infrastructure may be in place before surface structures have been installed. Ensuring fishermen are aware of the subsea hazard should ensure that any interaction is unlikely. Promulgation of information will include information about subsea hazards including mooring lines.	Broadly Acceptable (Not Significant)	No additional mitigation measures have been identified for this effect above and beyond the embedded Offshore Development mitigation listed in Section 14.5.5 as it was concluded that the effect was not significant.	Broadly Acceptable (Not Significant)

Summary of Effect	User	Frequency	Consequence	Rationale	Significance	Additional Mitigation Requirements	Significance of Residual Effect
Reduction in under keel clearance due to subsea cables / cable protection leading to an increased grounding risk	All vessels	Negligible	Minor	Water depths are deep enough in the majority of the OECC 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.	Broadly Acceptable (Not Significant)	No additional mitigation measures have been identified for this effect above and beyond the embedded Offshore Development mitigation listed in Section 14.5.5 as it was concluded that the effect was not significant.	Broadly Acceptable (Not Significant)

14.6.2 Effects During Operation and Maintenance

14.6.2.1 Vessel displacement due to the presence of new structures leading to increased collision risk for third-party vessels and/or reduction in port access

14.6.2.1.1 Vessel displacement

As in the construction phase, during the operation and maintenance phase, it is anticipated that any displacement of commercial vessel routes due to the PFOWF Array Area or any active major maintenance safety zones will be limited. Route 1 is expected to narrow and be slightly displaced into the available sea room north of the PFOWF Array Area; however, this deviation is anticipated to be very minor and is unlikely to have any noticeable impact on schedules, noting that vessels using the route tend to be on international voyages.

As per the construction phase, given the location of the PFOWF Array Area, it is not anticipated that access to port is reduced due to the Offshore Development.

These impacts are predominantly commercial concerns and are negligible in effect, so are considered insignificant noting that they have no bearing on navigational safety.

14.6.2.1.2 Increased collision risk between third-party vessels

The displacement of vessels may also lead to an increase in vessel-to-vessel collision risk, due to the creation of regions of increased vessel density, and therefore increase in vessel encounters. The greatest increase in collision risk is anticipated on Route 1, where the route was conservatively assumed to narrow in the post-wind farm base case. In the quantitative modelling, the Offshore Development was estimated to cause an increase in collision risk of one additional collision per 1,170 years in the base case following the construction of the Offshore Development. This results in a predicted collision return period of one collision every 406 years. It is noted that this is a conservative estimate of the collision risk following the construction of the Offshore Development based on the assumption of Route 1 narrowing, whereas in practice vessels are likely to choose to utilise the available sea room further north of the PFOWF Array Area, therefore reducing the likelihood of collisions.

Appropriate marking on Admiralty charts and effective promulgation of information are considered important to allow mariners to account for the presence of the Offshore Development in course planning to avoid last-minute changes of course, which are more likely to result in unexpected encounters. Similarly, appropriate lighting and marking will help to make mariners aware of the PFOWF Array Area early enough that late avoidance action is not required.

14.6.2.1.3 Displacement of small vessels onto main commercial routes

As discussed for the construction phase, the PFOWF Array Area will also lead to the displacement of smaller vessels such as recreational and fishing vessels. Some of these may be displaced onto main commercial routes, in particular Route 1, leading to an increase in encounters between smaller vessels and larger commercial vessels. As noted for construction, the Pentland Firth Yacht Club mentioned during consultation that recreational vessels are likely to choose to pass inshore of the PFOWF Array Area, whilst a local fishing representative at the Hazard Workshop noted that fishing vessels would likely be comfortable passing through between structures. Therefore, the risk to smaller vessels due to their displacement onto main commercial routes is considered to be low.

14.6.2.1.4 Relevant embedded mitigation measures

The following embedded mitigation measures will reduce the frequency and/or consequence of the effect resulting in a lower significance of effect:

- Charting Requirements;
- Promulgation of information as per consent requirements and standard industry practice; and
- LMP.

14.6.2.1.5 Assessment of significance

The potential for vessel displacement due to the presence of new structures leading to increased collision risk for third-party vessels and/or reduction in port access is overall considered to have a frequency of **Extremely Unlikely**, and the consequences are considered to be **Moderate**. Therefore, the significance of the effect is considered **Broadly Acceptable** which is **Not Significant** in EIA terms.

14.6.2.2 Vessel-to-vessel collision risk between a third-party vessel and an Offshore Development vessel due to the presence of Offshore Development vessels

There will be a maximum of 210 transits per year by maintenance vessels associated with the Offshore Development, with the maximum number of vessels onsite simultaneously being 10. Vessel types required may include cable install vessels, anchor handling tugs, ROV support vessels, PLGR vessels, rock placement vessels, guard vessels and crew transfer vessels. Some Offshore Development vessels may be RAM. As described during the construction phase, Offshore Development vessels during the operation and maintenance phase will also be managed by marine coordination, in particular, they will use designated routes to and from the PFOWF Array Area, carry AIS and will be compliant with relevant Flag State regulations. This risk is present throughout the 30-year operational lifetime of the Offshore Development.

Safety zones will be applied for during any periods of major maintenance and will extend 500 m from structures being worked on. In addition to this, advisory 500-m safe passing distances will be requested around Offshore Development vessels carrying out major maintenance. Operational safety zones are under consideration. If required by risk assessment, guard vessels will be used to assist in monitoring safety zones to ensure safe passing distances are maintained between third-party vessels and Offshore Development vessels.

As in the construction phase, promulgation of information will be used to ensure maximum awareness of planned and ongoing maintenance works.

14.6.2.2.1 Relevant embedded mitigation measures

The following embedded mitigation measures will reduce the frequency and/or consequence of the effect resulting in a lower significance of effect:

- Charting Requirements;
- Promulgation of information as per consent requirements and standard industry practice;
- LMP;
- Guard vessel(s) where required;
- NSP and VMP which will include marine coordination; and
- Safety zones (subject to a separate application prior to construction).

14.6.2.2.2 Assessment of significance

The potential for vessel-to-vessel collision risk between a third-party vessel and an Offshore Development vessel due to the presence of the Offshore Development vessels is overall considered to have a frequency of **Extremely Unlikely**, and the consequences are considered to be **Moderate**. Therefore, the significance of the effect is considered **Broadly Acceptable** which is **Not Significant** in EIA terms.

14.6.2.3 Commercial vessel to structure allision risk due to the presence of new structures associated with the Offshore Development

The installation of new structures within the PFOWF Array Area creates an allision risk for vessels. As in the construction phase, there are three distinct types of allision risk. As the risk profiles vary significantly between various vessel types, this risk will specifically discuss the allision risk to commercial vessels. The risk of allision risk will be present throughout the 30-year expected operational lifetime of the Offshore Development.

14.6.2.3.1 Powered allision risk

As discussed in relation to the construction phase, powered allision may be the result of human or navigational error, lack of awareness of the Offshore Development or the failure of an aid to navigation. Experience from previous operational offshore wind farms shows that Masters regularly choose to transit at distances greater than 1 nm from constructed wind farms, with sufficient sea room available to the north of the PFOWF Array Area to do so. By maintaining this distance, it is unlikely that any passing commercial vessels will pass close enough to create a powered allision risk.

Appropriate marking on Admiralty charts and effective promulgation of information will increase awareness of the Offshore Development thereby reducing the likelihood of vessels passing at unsafe distances and creating an allision risk. It is also noted that application for operational safety zones is being considered.

Quantitative modelling was undertaken to assess the risk of a powered allision. The model estimated that one powered allision would occur every 809 years for the post-wind farm base case. This is relatively high compared to other UK wind farms, with the proximity of Route 1 to the PFOWF Array Area being the main reason for the high frequency. Most of the powered allision risk was associated with the structures on the northern edge of the PFOWF Array Area, closest to the busy commercial route.

14.6.2.3.2 Drifting allision risk

Drifting allision may be caused by technical or mechanical failure, adverse weather, or a navigational system error. A vessel adrift may develop into an allision in the event that the weather or tide directs the vessel towards a structure within the PFOWF Array Area. It is noted that due to the lower speeds and impact energies associated with drifting, the consequences of a drifting allision are likely to be less severe than those of a powered allision.

During the Hazard Workshop, Orkney Harbour Authority emphasised the need to consider the risk of a large commercial vessel drifting in proximity to the PFOWF Array Area. It was noted that the probability of such an occurrence is low, but with potentially severe consequences. The availability of an ETV, as well as the Orkney Harbour Authority's tugs under the MCA CAST reduces the likelihood of a drifting vessel developing into a drifting allision, noting also that the PFOWF Array Area is located approximately 8.3 nm from the RNLI's Thurso Lifeboat Station, which would also be able to provide support in such a situation.

Quantitative modelling was also taken to assess the drifting allision risk to commercial vessels. A drifting incident was estimated to occur once per 28,979 years in the post-wind farm base case. Similarly, to the powered allision result, the risk was predominantly associated with the structures along the northern edge of the PFOWF Array Area, closest to Route 1.

From historical incident data, no drifting allision incidents involving third-party vessels alliding with an operational wind farm structure have been reported within the UK. It is noted that the MAIB and RNLI data record incidents involving machinery failures (which in some cases may lead to a vessel drifting) around the PFOWF Array Area mainly involving fishing vessels.

14.6.2.3.3 Internal allision risk

Based on experience at existing offshore wind farms, it is not anticipated that commercial vessels will choose to pass through the PFOWF Array Area, particularly given the available sea room to the north. Therefore, internal allision risk is not considered a risk to commercial vessels.

14.6.2.3.4 Relevant embedded mitigation measures

The following embedded mitigation measures will reduce the frequency and/or consequence of the effect resulting in a lower significance of effect:

- Charting Requirements;
- Promulgation of information as per consent requirements and standard industry practice;
- LMP; and
- Safety zones (subject to a separate application prior to construction).

14.6.2.3.5 Assessment of significance

The potential for commercial vessel to structure allision risk, encompassing powered, drifting and internal allision risk as discussed above, due to the presence of new structures associated with the Offshore Development is overall considered to have a frequency of **Extremely Unlikely**, and the consequences are considered to be **Moderate**. Therefore, the significance of the effect is considered **Broadly Acceptable** which is **Not Significant** in EIA terms.

14.6.2.4 Fishing vessel to structure allision risk due to the presence of new structures associated with the Offshore Development

As noted in the discussion of allision risk to commercial vessels, the allision risk to fishing vessels is significantly different than that to commercial vessels. Fishing vessels do not adhere to route-based transit as much as commercial vessels and may choose to pass internally within the PFOWF Array Area. Also, due to the greater likelihood of non-steel construction of vessels, the consequences to the vessel of an allision may be more severe. Allision risk to fishing vessels will be present throughout the 30-year operational lifetime of the wind farm.

14.6.2.4.1 Powered allision risk

As previously noted, a powered allision may occur due to human or navigational error, lack of awareness of the Offshore Development, or the failure of an aid to navigation. Based on experience at existing offshore wind farms, fishing vessels are likely to pass closer to structures within the PFOWF Array Area than commercial vessels. Therefore, promulgation of information and marking on Admiralty charts are likely to be particularly important forms of mitigation to ensure users are aware of the layout of the structures within the PFOWF Array Area. Lighting and marking will also be key to ensure users can visually see structures which pose a risk.

From historical incident data, there has been one reported instance of a fishing vessel alliding with an operational wind farm structure in the UK. A crew member had left the autopilot on, resulting in an allision which was attended by an RNLI lifeboat. Appropriate marking and promulgation of information would help to ensure that users are aware of the Offshore Development, and therefore may be less likely to use autopilot in proximity to the PFOWF Array Area.

In the event that operational safety zones are applied for these would also serve to encourage safe passing distances and reduce the likelihood of a powered allision incident.

14.6.2.4.2 Drifting allision risk

Based on historical incident data from the RNLI and MAIB, there have been machinery failure incidents involving fishing vessels recorded within the Offshore Study Area. These incidents may lead to a vessel losing power and drifting. In the event of a drifting fishing vessel, the RNLI lifeboat stationed at Thurso is likely to be first responder and may attempt to take the vessel in tow if there is a risk of allision. There is also the possibility of a drifting vessel regaining power before the situation develops into an allision risk. Therefore, it is considered unlikely that a fishing vessel is involved in a drifting incident which develops into an allision.

14.6.2.4.3 Internal allision risk

Unlike commercial vessels, fishing vessels have been observed at existing wind farms within arrays, including at existing floating wind farms, so there is a risk of fishing vessels alliding internally within the PFOWF Array Area.

Quantitative modelling has been undertaken to assess the risk of allision for fishing vessels transiting within the PFOWF Array Area. The modelling was undertaken under the conservative assumption that the fishing activity would not change due to the presence of the Offshore Development, and therefore that fishing vessels would continue to transit within the PFOWF Array Area. Based on the modelling, it was estimated that there would be one fishing vessel allision with a wind farm structure every 24 years. It is noted that the majority of allision incidents would be a minor contact with only superficial damage to the vessel and structure. The frequency of a serious allision with impact energy sufficient to threaten safety would be much lower than this.

The modelling did not account for any mitigation measure being in place or any change in the behaviour of fishing vessels. In particular, the use of promulgation of information and marking on Admiralty charts would be important to communicate safe passing distances to users. The possible implementation of safety zones or advisory safe passing distances would further ensure awareness of safe passing distances. As a floating installation, fishing vessels may likely maintain larger passing distances than at fixed-bottom wind farms. Increased passing distances would reduce the risk of an allision.

14.6.2.4.4 Relevant embedded mitigation measures

The following embedded mitigation measures will reduce the frequency and/or consequence of the effect resulting in a lower significance of effect:

- Charting Requirements;
- Promulgation of information as per consent requirements and standard industry practice;
- LMP; and
- Safety zones (subject to a separate application prior to construction).

14.6.2.4.5 Assessment of significance

The potential for fishing vessel to structure allision risk, encompassing powered, drifting, and internal allision risk as discussed above, due to the presence of new structures associated with the Offshore Development is overall considered to have a frequency of **Remote**, and the consequences are considered to be **Moderate**. Therefore, the significance of the effect is considered **Tolerable with Mitigation**[i] which is **Not Significant** in EIA terms.

14.6.2.5 Recreational vessel to structure allision risk due to the presence of new structures associated with the Offshore Development

14.6.2.5.1 Powered allision risk

As in the case of fishing vessels, recreational vessels may choose to pass closer to wind farm structures than commercial vessels. During consultation with the Cruising Association (CA), it was estimated that recreational vessels would tend to consider 100 m as a safe passing distance to a structure.

It was also raised by the Pentland Firth Yacht Club during consultation that solo yachts heading through the area may be on autopilot having navigated the challenging portion of the Pentland Firth located to the east of the PFOWF Array Area. The mariners may be asleep or attending to other matters. Therefore, effective promulgation of information, such as the use of Kingfisher bulletins, will be important to ensure maximum awareness of the Offshore Development when course planning. Marking on Admiralty charts will also be important for this purpose. RYAS noted during consultation that recreational users in the area are likely to be experienced sailors. It was noted by Scrabster Harbour that users often ask for advice from the harbourmaster, so keeping local harbours and marinas informed would help them pass information on to users. RYAS noted during consultation that recreational users in the area are likely to be experienced sailors. In terms of kayakers, the Offshore Development will not be routinely crossed by paddlers due to its distance from shore, although some individuals could cross at times.

14.6.2.5.2 Drifting allision risk

Drifting allision incidents may also affect recreational vessels due to mechanical or technical failures, adverse weather, or a navigational system error. It was noted during consultation with RYAS that the majority of yachts in the area would only have one engine, but that most vessels would choose to transit the area under sail in order to save fuel. The lack of a second engine increases the chances of drifting occurring in the event of a mechanical failure leaving a vessel without power.

[i] 'Tolerable with Mitigation' refers to the embedded mitigation measures, rather than indicating that additional mitigation measures are required.

14.6.2.5.3 Internal allision risk

As with fishing vessels, recreational users may choose to pass within the PFOWF Array Area. During consultation, the Cruising Association noted that it is anticipated that recreational vessels will become more comfortable passing within wind farms as they become more familiar and added that recreational users would need to understand the areas of danger due to subsea infrastructure when choosing whether or not to pass within the PFOWF Array Area. The Cruising Association also noted that the indicative minimum spacing of 800 m would potentially allow for transits within the PFOWF Array Area.

The masts of yachts also create a risk of allision due to the potential interaction with the WTG blades. It was agreed during consultation with both RYAS and the Pentland Firth Yacht Club that a minimum blade clearance would be sufficient to avoid any interaction between masts and blades and noted that recreational vessels would likely choose to pass far enough away that the blade clearance did not become a factor (noting at the time this consultation took place, the minimum blade clearance was 22 m, and has since been increased to 35 m).

For kayakers, consultation indicated the Offshore Development would not be routinely crossed by paddlers and circulation of information to the relevant contacts would be the most effective mitigation.

14.6.2.5.4 Relevant embedded mitigation measures

The following embedded mitigation measures will reduce the frequency and/or consequence of the effect resulting in a lower significance of effect:

- Charting Requirements;
- Promulgation of information as per consent requirements and standard industry practice;
- LMP;
- Minimum blade clearance; and
- Safety zones (subject to a separate application prior to construction).

14.6.2.5.5 Assessment of significance

The potential for recreational vessel to structure allision risk, encompassing powered, drifting and internal allision risk as discussed above, due to the presence of new structures associated with the Offshore Development is overall considered to have a frequency of **Extremely Unlikely**, and the consequences are considered to be **Moderate**. Therefore, the significance of the effect is considered **Broadly Acceptable** which is **Not Significant** in EIA terms.

14.6.2.6 Anchor interaction with subsea infrastructure

The presence of subsea cables, mooring lines, and anchors associated with the Offshore Development creates a risk of vessel anchors becoming snagged. The Offshore Development will include up to 90 mooring lines and anchors (9 per floating structure), as well as up to 25 km of inter-array cables and up to two offshore export cables, each with a length of up to 12.5 km. Both inter-array and offshore export cables are planned to be buried to a minimum depth of 0.6 m where technically possible. Where burial is not possible, cable protection will be installed rising to a maximum height of 1 m above the seabed. It is anticipated that Horizontal Directional Drilling (HDD) will be used to protect the cable close to the landfall, beginning at 400 m to 700 m from the shore. It is noted that each cable also has a dynamic portion extending up to 500m in the water column which will be neither buried nor protected. It is not expected that vessels would be anchoring close enough to WTGs to interact with the dynamic section of the cables.

No anchored vessels were recorded within the Offshore Study Area during the 28 days of survey data. However, historical anchorages were noted at Sandside Bay, Armadale Bay, and Thurso Bay. Sandside Bay is adjacent to the offshore export cable(s) landfall and therefore is likely the greatest risk of anchor interaction. However, given the plans to utilise HDD and the sheltered nature of Sandside Bay, it is not anticipated that vessels anchored within the bay would interact with the offshore export cable(s). Given the low levels of anchoring activity, no issues are anticipated involving anchor interaction with subsea infrastructure.

To ensure users are aware of the locations of subsea infrastructure, any infrastructure associated with the Offshore Development should be included on Admiralty charts. Promulgation of information should also be utilised to ensure users are aware of locations where anchoring may not be safe or may cause damage to the subsea infrastructure. In the event of any major maintenance being carried out on subsea infrastructure, it may also be appropriate to apply for major maintenance safety zones.

14.6.2.6.1 Relevant embedded mitigation measures

The following embedded mitigation measures will reduce the frequency and/or consequence of the effect resulting in a lower significance of effect:

- Charting Requirements;
- Promulgation of information as per consent requirements and standard industry practice; and
- Safety zones (subject to a separate application prior to construction).

14.6.2.6.2 Assessment of significance

The potential for anchor interaction with subsea infrastructure is overall considered to have a frequency of **Extremely Unlikely**, and the consequences are considered to be **Moderate**. Therefore, the significance of the effect is considered **Broadly Acceptable** which is **Not Significant** in EIA terms.

14.6.2.7 Fishing gear interaction with subsea infrastructure

Details of the subsea infrastructure associated with the Offshore Development are as per those discussed in the anchor interaction impact. Mooring lines and dynamic cables close to the floating structures are most likely to interact with fishing gear, given that the subsea infrastructure in this area may be relatively high in the water. Fishing gear becoming snagged may lead to a variety of consequences, ranging from potential loss or damage to fishing gear to severe cases such as vessel capsize. Experience from previous offshore wind farms indicates that fishing vessels do continue to transit, and in some cases fish, within offshore wind farms.

No fishing vessel activity characteristic of active fishing was observed within the PFOWF Array Area during the two vessel traffic surveys. Some active fishing was recorded on the northern edge of the Offshore Study Area, whilst a potter was recorded working close to the shore. It was noted during the hazard Workshop by local fishing representatives that vessels may fish around the north-west corner of the PFOWF Array Area when adverse weather prevents going further offshore.

If applied for, safety zones may deter fishermen from fishing close to structures and therefore reduce the risk of fishing gear interaction with subsea infrastructure. Local fishing representatives at the Hazard Workshop stated that fishermen would prefer to carry out their own risk assessment and decide where they felt comfortable fishing, as opposed to having statutory safety zones applied to structures.

It is noted that active fishing activity is considered in more detail in Chapter 13: Commercial Fisheries.

14.6.2.7.1 Relevant embedded mitigation measures

The following embedded mitigation measures will reduce the frequency and/or consequence of the effect resulting in a lower significance of effect:

- Charting Requirements;
- Promulgation of information as per consent requirements and standard industry practice; and
- LMP.

14.6.2.7.2 Assessment of significance

The potential for fishing gear interaction with subsea infrastructure is overall considered to have a frequency of **Remote**, and the consequences are considered to be **Moderate**. Therefore, the significance of the effect is considered **Tolerable with Mitigation** which is **Not Significant** in EIA terms.

14.6.2.8 Transiting vessel interaction with subsea infrastructure

As a floating offshore wind project, there will be a significant amount of subsea infrastructure associated with the Offshore Development. The Offshore Development is planned to include up to 90 mooring lines (nine per structure). The worst case design in terms of risk to transiting vessels is likely to be the use of taut mooring lines, which remain closer to the water surface at greater horizontal offsets from the floating structure than other mooring configurations such as catenary. Taut mooring lines also remain closer to the water surface than the dynamic section of inter-array and offshore export cables and therefore will cause a greater reduction in under keel clearance than the cables.

Vessel draught analysis was carried out for the PFOWF Array Area using both the 28 days of survey data from 2021 and the 2019 scoping AIS data. The analysis revealed that the average draught of vessels (for which draught information was available) recorded within the PFOWF Array Area was 4.6 m The deepest draught recorded within the PFOWF Array Area was 6.4 m, recorded by a cargo vessel. For comparison, the average draught of vessels using the busy commercial Route 1 during the 2021 survey data was 6.6 m, with the deepest draught of 16.7 m from a crude oil tanker. This was also the deepest draught recorded within the Offshore Study Area. It is noted that these values measure the static draught of vessels, whereas a vessel could interact with mooring lines deeper than this due to dynamic motion due to the waves, etc.

To estimate the range of potential interaction of vessels with the mooring lines, a conservative 50% has been added to estimate the dynamic draught of vessels. Based on the deepest static draught within the PFOWF Array Area of 6.4 m, this gives an assumed dynamic draught of 9.6 m. Based on the estimated draught of taut mooring lines, the range of potential interaction would be approximately 100 m from the surface structure. Similarly, the deepest static draught recorded within the Offshore Study Area was 16.7 m, equating to an estimated dynamic draught of approximately 25 m. This gives a potential range of interaction of approximately 270 m. It is noted that these vessels were both commercial vessels and would therefore likely choose to maintain a larger passing distance from the structure anyway. Therefore, they are likely to only interact with mooring lines under a drifting scenario. The consequences of a large vessel interacting with the mooring lines are likely to be limited to minor vessel damage, with greater damage to the mooring line.

As previously noted in the discussion of fishing allision risk, fishing vessels are likely to pass internally within the PFOWF Array Area during the operation and maintenance phase. The deepest draught among the fishing vessels recorded within the PFOWF Array Area was 5 m, giving an estimated dynamic draught of 7.5 m. An estimated potential range of interaction for this vessel is approximately 80 m from the surface structure. Therefore, it is important that promulgation of information and appropriate chart marking are utilised to ensure fishermen are aware of the subsea hazards associated with the Offshore Development. It was noted by a local fishing representative at the Hazard Workshop that fishermen preferred to carry out their own risk assessments on where to transit and fish, however ensuring this assessment is fully informed will help to prevent unsafe passing distances and potential mooring line interactions. The consequences of an interaction between a mooring line and a fishing vessel are likely to be more severe than for a commercial vessel,

Recreational vessels may also choose to pass within the PFOWF Array Area. During consultation, the Cruising Association indicated that 100 m would be a reasonable passing distance for yachts. Given the shallow draught of most yachts, this distance would likely provide a safe under keel clearance.

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.

14.6.2.8.1 Relevant embedded mitigation measures

The following embedded mitigation measures will reduce the frequency and/or consequence of the effect resulting in a lower significance of effect:

- Charting Requirements;
- Safety zones (subject to a separate application prior to construction);
- Promulgation of information as per consent requirements and standard industry practice; and
- LMP.

14.6.2.8.2 Assessment of significance

The potential for transiting vessel interaction with subsea infrastructure is overall considered to have a frequency of **Remote**, and the consequences are considered to be **Moderate**. Therefore, the significance of the effect is considered **Tolerable with Mitigation** which is **Not Significant** in EIA terms.

14.6.2.9 Reduction in under keel clearance due to subsea cables / cable protection leading to an increased grounding risk

The Design Envelope for the Offshore Development includes up to 25 km of inter-array cables and up to two offshore export cables each up to 12.5 km in length. Both inter-array and offshore export cables are planned to be buried to a minimum depth of 0.6 m where technically possible. The target burial depth for both inter-array and offshore export cables is 0.6 m. Where burial of static cables is not possible, cable protection will be used, with a maximum height above the seabed of 1 m. As noted in the construction phase assessment, HDD is anticipated to be used between 400 m and 700 m from the cable landfall. It is noted that there each cable also has a dynamic portion extending up to 500 m in the water column which will be neither buried nor protected. The dynamic portion of the cable is unlikely to be close enough to the surface to affect surface navigation, noting that the cable would sit deeper in the water than a taut mooring line.

A significant change in water depth would reduce the under keel clearance available to vessels, and potentially lead to a grounding risk being created. As noted in the construction phase, it is not anticipated that water depth is affected in a significant way at any point within the Offshore Study Area, due to the intended use of HDD to route the cable through the area of shallow water close to shore.

Areas in which the water depth may be affected, particularly along the offshore export cable(s) route, will be marked on Admiralty charts. In addition, any marking requirements deemed necessary, such as a cable marker board, will be agreed upon in consultation with the NLB.

14.6.2.9.1 Relevant embedded mitigation measures

The following embedded mitigation measures will reduce the frequency and/or consequence of the effect resulting in a lower significance of effect:

- Charting Requirements; and
- LMP.

14.6.2.9.2 Assessment of significance

The reduction in under keel clearance due to subsea cables / cable protection leading to an increased grounding risk is overall considered to have a frequency of **Negligible**, and the consequences are considered to be **Minor**. Therefore, the significance of the effect is considered **Broadly Acceptable** which is **Not Significant** in EIA terms.

14.6.2.10 Loss of WTG station

A loss of station incident may occur due to the failure of the mooring system, resulting in the floating structure being allowed to drift beyond the maximum excursion zone outlined in Chapter 5: Project Description. A partial loss of station (the failure of some but not all mooring lines) may lead to an increased excursion of the floating structure, resulting in the structure being in an unexpected location and creating a hazard for vessels passing within the PFOWF Array Area. A total loss of station may see the structure drifting beyond the PFOWF Array Area, posing a hazard to commercial traffic transiting nearby.

A total loss of station is considered to be unlikely given the layers of design included to prevent it. In particular, the mooring lines will be monitored using installed sensors which will detect and alert the Offshore Development to any issues. In addition to this, regular visual inspection of the mooring lines using ROVs will be carried out to monitor marine growth upon the mooring lines and the condition of the lines. This will allow failures to be detected and responded to promptly, or even prevented by identifying potential damage in advance. Contingency plans will also be in place outlining response and recovery actions to be taken in the event of a loss of station.

Promulgation of information is also considered important mitigation in the event of a loss of station to ensure users are aware of the risks posed by a potentially out-of-place floating structure. Lighting and marking will also help users to spot potential danger with sufficient time to react and avoid a collision.

14.6.2.10.1 Relevant embedded mitigation measures

The following embedded mitigation measures will reduce the frequency and/or consequence of the effect resulting in a lower significance of effect:

- Promulgation of information as per consent requirements and standard industry practice; and
- LMP.

14.6.2.10.2 Assessment of significance

The potential for loss of WTG station is overall considered to have a frequency of **Negligible**, and the consequences are considered to be **Serious**. Therefore, the significance of the effect is considered **Broadly Acceptable** which is **Not Significant** in EIA terms.

14.6.2.11 Reduction of emergency response capability due to increased incident rates and/or reduced access for SAR responders

The presence of the Offshore Development may increase the number of incidents in the area and result in reduced access for emergency responders. This may result in a reduced ability to respond to incidents.

The most likely emergency responder to an incident in the area is the RNLI, given that Thurso Lifeboat Station is approximately 9.6 nm to the east. A total of 47 incidents were recorded within the Offshore Study Area between 2010 and 2019, with the closest to the PFOWF Array Area being a machinery failure recorded approximately 2.4 nm to the east. All 47 incidents within the Offshore Study Area were responded to by Thurso. It was noted by RNLI representatives at the Hazard Workshop that lifeboats from Longhope and Stromness (21.5 nm and 24.5 nm to the north-east, respectively) may also respond to an incident in the area. Emergency towing resources are also available including the ETV *Ievoli Black* and the tugs in Scapa Flow.

During the Hazard Workshop it was also noted by the RNLI that the presence of the Offshore Development would block a straight-line path between Scrabster and any incident occurring west of the PFOWF Array Area. It was noted that the RNLI would typically choose to navigate around an array, particularly when towing a vessel. Therefore, the presence of the Offshore Development may lead to delays in emergency response; however, given the location and size of the PFOWF Array Area, any changes to response time are likely to be minor.

The final layout and design of the Offshore Development will be finalised in consultation with the MCA to ensure that access to the PFOWF Array Area during SAR operations is not impeded. This will include agreement on the minimum spacing between structures to ensure SAR lanes are considered. Furthermore, an Emergency Response Cooperation Plan and Design, Specification, and Layout Plan will be produced in agreement with the MCA. It was noted by the RNLI during consultation that they should be kept informed on any changes relating to the Offshore Development to ensure their response was not impeded.

14.6.2.11.1 Relevant embedded mitigation measures

The following embedded mitigation measures will reduce the frequency and/or consequence of the effect resulting in a lower significance of effect:

- Promulgation of information as per consent requirements and standard industry practice;
- LMP;
- MGN 654 compliance; and
- Design, Specification, and Layout Plan.

14.6.2.11.2 Assessment of significance

The potential for a reduction of emergency response capability due to increased incident rates and/or reduced access for SAR responders is overall considered to have a frequency of **Extremely Unlikely**, and the consequences are considered to be **Minor**. Therefore, the significance of the effect is considered **Broadly Acceptable** which is **Not Significant** in EIA terms.

14.6.2.12 Summary of effects during operation and maintenance

A summary of the assessment of effects during operation and maintenance is provided in Table 14.12.

Table 14.12 Summary of significance of effects from operation and maintenance impacts

Summary of Effect	User	Frequency	Consequence	Rationale	Significance	Additional Mitigation Requirements	Significance of Residual Effects
Vessel displacement due to the presence of new structures leading to increased collision risk for third-party vessels and/or reduction in port access	All vessels	Extremely Unlikely	Moderate	Given the location 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.	Broadly Acceptable (Not Significant)	No additional mitigation measures have been identified for this effect above and beyond the embedded Offshore Development mitigation listed in Section 14.5.5 as it was concluded that the effect was not significant.	Broadly Acceptable (Not Significant)
Vessel-to-vessel collision risk between a third-party vessel and an Offshore Development vessel due to the presence of Offshore Development vessels	All vessels	Extremely Unlikely	Moderate	Offshore Development vessels will be managed via marine coordination, with mitigation including safety zones, which will serve to protect Offshore Development vessels from collision.	Broadly Acceptable (Not Significant)	No additional mitigation measures have been identified for this effect above and beyond the embedded Offshore Development mitigation listed in Section 14.5.5 as it was concluded that the effect was not significant.	Broadly Acceptable (Not Significant)

Summary of Effect	User	Frequency	Consequence	Rationale	Significance	Additional Mitigation Requirements	Significance of Residual Effects
Commercial vessel to structure allision risk due to the presence of new structures associated with the Offshore Development	Commercial vessels	Extremely Unlikely	Moderate	Quantitative modelling was undertaken to assess the likelihood of powered or drifting allision. 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.	Broadly Acceptable (Not Significant)	No additional mitigation measures have been identified for this effect above and beyond the embedded Offshore Development mitigation listed in Section 14.5.5 as it was concluded that the effect was not significant.	Broadly Acceptable (Not Significant)
Fishing vessel to structure allision risk due to the presence of new structures associated with the Offshore Development	Commercial fishing vessels	Remote	Moderate	Quantitative modelling estimates the internal allision risk to fishing vessels at one allision every 24 years based on conservative assumptions. Allisions are most likely to be minor contacts resulting in only minor vessel damage.	Tolerable with Mitigation (Not Significant)	No additional mitigation measures have been identified for this effect above and beyond the embedded Offshore Development mitigation listed in Section 14.5.5 as it was concluded that the effect was not significant.	Tolerable with Mitigation (Not Significant)

Summary of Effect	User	Frequency	Consequence	Rationale	Significance	Additional Mitigation Requirements	Significance of Residual Effects
Recreational vessel to structure allision risk due to the presence of new structures associated with the Offshore Development	Recreational vessels	Extremely unlikely	Moderate	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; however, WTG spacing should be sufficient to allow this safely. Kayakers tend to keep closer to shore.	Broadly Acceptable (Not Significant)	No additional mitigation measures have been identified for this effect above and beyond the embedded Offshore Development mitigation listed in Section 14.5.5 as it was concluded that the effect was not significant.	Broadly Acceptable (Not Significant)
Anchor interaction with subsea infrastructure	All vessels	Extremely unlikely	Moderate	No anchoring activity was recording within the Offshore Study Area during the vessel traffic surveys. A historical anchorage was recorded close to the OECC which was not thought to be of concern.	Broadly Acceptable (Not Significant)	No additional mitigation measures have been identified for this effect above and beyond the embedded Offshore Development mitigation listed in Section 14.5.5 as it was concluded that the effect was not significant.	Broadly Acceptable (Not Significant)

Summary of Effect	User	Frequency	Consequence	Rationale	Significance	Additional Mitigation Requirements	Significance of Residual Effects
Fishing gear interaction with subsea infrastructure	Commercial fishing vessels	Remote	Moderate	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 assessments rather than be excluded.	Tolerable with Mitigation (Not Significant)	No additional mitigation measures have been identified for this effect above and beyond the embedded Offshore Development mitigation listed in Section 14.5.5 as it was concluded that the effect was not significant.	Tolerable with Mitigation (Not Significant)
Transiting vessel interaction with subsea infrastructure	All vessels	Remote	Moderate	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. The consequences of interaction with the mooring lines are likely to be minor.	Tolerable with Mitigation (Not Significant)	No additional mitigation measures have been identified for this effect above and beyond the embedded Offshore Development mitigation listed in Section 14.5.5 as it was concluded that the effect was not significant.	Tolerable with Mitigation (Not Significant)

Summary of Effect	User	Frequency	Consequence	Rationale	Significance	Additional Mitigation Requirements	Significance of Residual Effects
Reduction in under keel clearance due to subsea cables / cable protection leading to an increased grounding risk	All vessels	Negligible	Minor	Water depths are deep enough in the majority of the OECC 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.	Broadly Acceptable (Not Significant)	No additional mitigation measures have been identified for this effect above and beyond the embedded Offshore Development mitigation listed in Section 14.5.5 as it was concluded that the effect was not significant.	Broadly Acceptable (Not Significant)
Loss of station	All vessels	Negligible	Serious	A loss of station incident is considered unlikely given the design layers to protect against it. The most likely consequences are a single mooring line failure leading to a temporary increase in the maximum excursion of the structure.	Broadly Acceptable (Not Significant)	No additional mitigation measures have been identified for this effect above and beyond the embedded Offshore Development mitigation listed in Section 14.5.5 as it was concluded that the effect was not significant.	Broadly Acceptable (Not Significant)

Summary of Effect	User	Frequency	Consequence	Rationale	Significance	Additional Mitigation Requirements	Significance of Residual Effects
Reduction of emergency response capability due to increased incident rates and/or reduced access for SAR responders	Emergency responders	Extremely unlikely	Minor	The RNLI noted that the PFOWF Array Area would block a straight-line tow to Scrabster, potentially leading to delays in emergency response.	Broadly Acceptable (Not Significant)	No additional mitigation measures have been identified for this effect above and beyond the embedded Offshore Development mitigation listed in Section 14.5.5 as it was concluded that the effect was not significant.	Broadly Acceptable (Not Significant)

14.6.3 Effects During Decommissioning

14.6.3.1 Vessel displacement due to decommissioning activities; leading to increased collision risk for third-party vessels and/or reduction in port access

The decommissioning programme is expected to follow a process which is largely the reverse of the construction process. Throughout the lifetime of the Offshore Development, a Decommissioning Programme will be kept and updated every five years, with the final revision which will detail the final decommissioning strategy beginning two years prior to decommissioning activities. As such, it is expected that the impact due to vessel displacement associated with the decommissioning phase is likely to be similar to the analogous impact in the construction phase. In particular, a buoyed decommissioning area, if required, would be similar to a buoyed construction area, and therefore would lead to a similar displacement of vessels.

Given the similarity between the decommissioning and construction phases, it is expected that the timeline and number of vessels involved in decommissioning activities will be similar.

14.6.3.1.1 Vessel displacement

As noted in the analogous construction phase impact, the location of the PFOWF Array Area means that of the main commercial routes within the Offshore Study Area, Route 1 is the only one likely to be displaced. Route 1 is only likely to deviate a small distance further north of the PFOWF Array Area, and therefore any increase in journey times and distances are expected to be negligible.

As per the construction phase, the PFOWF Array Area does not obstruct the main access routes to Scrabster Harbour, and therefore it is not anticipated that access to the harbour is restricted by decommissioning activities.

As noted in construction, these are predominantly commercial issues and are not thought to have a significant impact on Shipping and Navigation users given the minor routeing changes.

14.6.3.1.2 Increased collision risk between third-party vessels

Vessel displacement may also lead to increased vessel densities as vessels displaced from the PFOWF Array Area and any required buoyed decommissioning area occupy other available sea room. As noted in the construction phase, this increase in vessel densities leads to increased encounters between vessels and therefore increases the likelihood of vessel-to-vessel collisions. As per the construction phase, vessels using Route 1 are likely to be displaced due to the presence of the PFOWF Array Area and any buoyed decommissioning area; however, there is sufficient sea room that any increase in collision risk is expected to be small.

14.6.3.1.3 Displacement of small craft onto main commercial routes

As per the construction phase, it is not expected that vessels, including fishing and recreational vessels, would choose to navigate within a buoyed decommissioning area if one is required. Therefore, smaller vessels may be displaced into the routes used by larger commercial vessels, particularly further offshore to the north of the PFOWF Array Area. Based on feedback from the RNLI and Pentland Firth Yacht Club at the Hazard Workshop, it is expected that vessels may utilise the available sea room inshore of the PFOWF Array Area to avoid this. The Pentland Firth Yacht Club also noted that due to the nature of the traffic in the area, the risk to recreational vessels due to displacement is thought to be low.

14.6.3.1.4 Relevant embedded mitigation measures

The following embedded mitigation measures will reduce the frequency and/or consequence of the effect resulting in a lower significance of effect:

- Charting Requirements;
- Promulgation of information as per consent requirements and standard industry practice;
- LMP; and
- Guard vessel(s) where required.

14.6.3.1.5 Assessment of significance

The potential for vessel displacement due to decommissioning activities leading to increased collision risk for third-party vessels and/or reduction in port access is overall considered to have a frequency of **Extremely Unlikely**, and the consequences are considered to be **Moderate**. Therefore, the significance of the effect is considered **Broadly Acceptable** which is **Not Significant** in EIA terms.

14.6.3.2 Vessel-to-vessel collision risk between a third-party vessel and an Offshore Development vessel due to the presence of the Offshore Development vessels

As the decommissioning programme is planned to be largely a reversal of the construction process, the risk associated with the decommissioning phase is largely similar. Assuming the decommissioning requires a similar number of vessels and similar types of vessels, this is expected to apply to collision risk between third-party vessels and the Offshore Development vessels. The mitigation measures considered in the construction phase, including marine coordination and promulgation of information, are also considered relevant to the decommissioning phase.

14.6.3.2.1 Relevant embedded mitigation measures

The following embedded mitigation measures will reduce the frequency and/or consequence of the effect resulting in a lower significance of effect:

- Charting Requirements;
- Promulgation of information as per consent requirements and standard industry practice;
- LMP;
- Guard vessel(s) where required;
- NSP and VMP which will include marine coordination; and
- Safety zones (subject to a separate application prior to construction).

14.6.3.2.2 Assessment of significance

The potential for vessel-to-vessel collision risk between a third-party vessel and an Offshore Development vessel due to the presence of the Offshore Development vessels is overall considered to have a frequency of **Extremely Unlikely**, and the consequences are considered to be **Moderate**. Therefore, the significance of the effect is considered **Broadly Acceptable** which is **Not Significant** in EIA terms.

14.6.3.3 Vessel to structure allision risk due to the presence of new structures associated with the Offshore Development

Similar to the construction phase, the decommissioning phase will include periods where some of the structures are present whilst others have been removed. Therefore, the risks of allision are considered similar to those in the construction phase. It is noted that by the time of the decommissioning phase, the Offshore Development will have been in place for up to 30 years, and therefore it is likely that users will be familiar with the Offshore Development and therefore will be maintaining safe passing distances to structures anyway.

14.6.3.3.1 Relevant embedded mitigation measures

The following embedded mitigation measures will reduce the frequency and/or consequence of the effect resulting in a lower significance of effect:

- Charting Requirements;
- Promulgation of information as per consent requirements and standard industry practice;
- LMP;
- Guard vessel(s) where required;
- Safety zones (subject to a separate application prior to construction); and
- Minimum blade clearance.

14.6.3.3.2 Assessment of significance

The potential for vessel to structure allision risk, encompassing powered, drifting, and internal allision risk, due to the presence of new structures associated with the Offshore Development is overall considered to have a frequency of **Extremely Unlikely**, and the consequences are considered to be **Moderate**. Therefore, the significance of the effect is considered **Broadly Acceptable** which is **Not Significant** in EIA terms.

14.6.3.4 Fishing gear interaction with subsea infrastructure

During decommissioning, the subsea infrastructure will be removed after the surface structures, meaning that there will be a period where subsea infrastructure such as mooring lines will remain on the seabed without floating structures on the surface. Therefore, these may pose a snagging risk as in the construction phase of the Offshore Development.

As noted in the construction phase, there was active fishing within the Offshore Study Area; however, none of this was located within the PFOWF Array Area. At the Hazard Workshop, it was noted that the north-west corner of the PFOWF Array Area may be fished in adverse weather.

Mitigations against fishing gear snagging during the decommissioning phase are as per the construction phase, notably the presence of a buoyed decommissioning area (if required) and promulgation of information.

It is noted that fishing activity is considered in more detail in Chapter 13: Commercial Fisheries.

14.6.3.4.1 Relevant embedded mitigation measures

The following embedded mitigation measures will reduce the frequency and/or consequence of the effect resulting in a lower significance of effect:

- Charting Requirements;
- Promulgation of information as per consent requirements and standard industry practice; and
- LMP.

14.6.3.4.2 Assessment of significance

The potential for fishing gear interaction with subsea infrastructure is overall considered to have a frequency is considered **Extremely Unlikely**, and the consequences are considered to be **Moderate**. Therefore, the significance of the effect is considered **Broadly Acceptable** which is **Not Significant** in EIA terms.

14.6.3.5 Reduction in under keel clearance due to subsea cables / cable protection leading to an increased grounding risk

Subsea cables may remain within the Offshore Site after the floating structures have been removed. This includes up to 25 km of inter-array cables and up to two offshore export cables each up to 12.5 km in length. Both inter-array and offshore export cables are planned to be buried to a minimum target depth of 0.6 m where technically possible. Where burial of static cables Is not possible, cable protection will be used, with a maximum height above the seabed of 1 m. As noted in the construction phase, HDD is anticipated to be used from between 400 m and 700 m from the cable landfall up to the onshore landfall point. It is noted that there each cable also has a dynamic portion extending up to 500 m in the water column which will be neither buried nor protected. The dynamic portion of the cable is unlikely to be close enough to the surface to affect surface navigation.

A significant change in water depth would reduce the under keel clearance available to vessels, and potentially lead to a grounding risk being created. As noted in the construction phase, it is not anticipated that water depth is affected in a significant way at any point within the Offshore Study Area. Therefore, the risk of grounding is not expected to be increased.

Areas in which the water depth may be affected, particularly along the offshore export cable(s) route, will be marked on Admiralty charts. In addition, any marking requirements deemed necessary, such as a cable marker board, will be agreed upon in consultation with the NLB.

14.6.3.5.1 Relevant embedded mitigation measures

The following embedded mitigation measures will reduce the frequency and/or consequence of the effect resulting in a lower significance of effect:

- Charting Requirements;
- Promulgation of information as per consent requirements and standard industry practice; and
- LMP.

14.6.3.5.2 Assessment of significance

The potential for reduction in under keel clearance due to subsea cables / cable protection leading to an increased grounding risk is overall considered to have a frequency of **Negligible**, and the consequences are considered to be **Minor**. Therefore, the significance of the effect is considered **Broadly Acceptable** which is **Not Significant** in EIA terms.

14.6.3.6 Summary of effects during decommissioning

A summary of the assessment of effects during decommissioning is provided in Table 14.13.

Table 14.13 Summary of significance of effects from decommissioning impacts

Summary of Effect	User	Frequency	Consequence	Rationale	Significance	Additional Mitigation Requirements	Significance of Residual Effect
Vessel displacement due to decommissioning activities; leading to increased collision risk for third-party vessels and/or reduction in port access	All vessels	Extremely Unlikely	Moderate	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 of port access anticipated. Small vessels being displaced into commercial routes is not thought to be a concern.	Broadly Acceptable (Not Significant)	No additional mitigation measures have been identified for this effect above and beyond the embedded Offshore Development mitigation listed in Section 14.5.5 as it was concluded that the effect was not significant.	Broadly Acceptable (Not Significant)
Vessel-to-vessel collision risk between a third-party vessel and an Offshore Development vessel due to the presence of Offshore Development vessels	All vessels	Extremely Unlikely	Moderate	Offshore Development vessels will be managed via the NSP and VMP marine coordination, with mitigation including safety zones, which will serve to protect Offshore Development vessels from collision. Given the length of the decommissioning phase and mitigations in place, collisions are considered unlikely.	Broadly Acceptable (Not Significant)	No additional mitigation measures have been identified for this effect above and beyond the embedded Offshore Development mitigation listed in Section 14.5.5 as it was concluded that the effect was not significant.	Broadly Acceptable (Not Significant)

Summary of Effect	User	Frequency	Consequence	Rationale	Significance	Additional Mitigation Requirements	Significance of Residual Effect
Vessel to structure allision risk due to the presence of new structures associated with the Offshore Development	All vessels	Extremely Unlikely	Moderate	Structures are unlikely to be present onsite for an extended period during the decommissioning phase. This combined with the presence of any buoyed decommissioning area that is required means that an allision is considered unlikely.	Broadly Acceptable (Not Significant)	No additional mitigation measures have been identified for this effect above and beyond the embedded Offshore Development mitigation listed in Section 14.5.5 as it was concluded that the effect was not significant.	Broadly Acceptable (Not Significant)
Fishing gear interaction with subsea infrastructure	Commercial fishing vessels	Extremely Unlikely	Moderate	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.	Broadly Acceptable (Not Significant)	No additional mitigation measures have been identified for this effect above and beyond the embedded Offshore Development mitigation listed in Section 14.5.5 as it was concluded that the effect was not significant.	Broadly Acceptable (Not Significant)

Summary of Effect	User	Frequency	Consequence	Rationale	Significance	Additional Mitigation Requirements	Significance of Residual Effect
Reduction in under keel clearance due to subsea cables / cable protection leading to an increased grounding risk	All vessels	Negligible	Minor	Water depths are deep enough in the majority of the OECC 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.	Broadly Acceptable (Not Significant)	No additional mitigation measures have been identified for this effect above and beyond the embedded Offshore Development mitigation listed in Section 14.5.5 as it was concluded that the effect was not significant.	Broadly Acceptable (Not Significant)

14.7 Assessment of Cumulative Effects

14.7.1 Introduction

The consideration of which projects could result in potential cumulative effects is based on the results of the Offshore Development specific impact assessment together with the expert judgement of the specialist consultant.

Projects within 50 km of the Offshore Site are considered to have the potential to result in cumulative impacts on Shipping and Navigation users. This distance was deemed an appropriate radius as it 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 northern coastline of Scotland. The projects that have the potential to cause cumulative effects are listed in Table 14.14 and shown in Figure 14.6.

The approach to the assessment of projects includes:

- Quantitative assessment of projects submitted to Scoping up to six months prior to PFOWF application submission;
- Qualitative assessment of projects submitted to Scoping up to five months prior to PFOWF application submission; and
- Acknowledgement of projects submitted to Scoping between five and two months prior to PFOWF application submission.

This approach was shared and agreed upon with MS-LOT and the 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 approach and list of cumulative projects screened into assessment were provided to MS-LOT and consultees and comments were received on 16 May 2022. These comments have been taken into account within this assessment.

It is noted that the ScotWind sites N1, N2, and N3 were not scoped in time for assessment and due to low data confidence, the sites have not been assessed in terms of cumulative impacts. It is noted that these projects will have to carry out their own cumulative assessments, including the Offshore Development if appropriate. It is expected that these projects will change the nature of shipping traffic at a localised level in the vicinity of the projects, including an increase in wind farm-related traffic, but is not expected to affect the main shipping routes in the vicinity of the Offshore Site.

Table 14.14 List of projects considered for the Shipping and Navigation cumulative impact assessment

Development Type	Project Name	Status	Phase	Location	Data Confidence	Relevant Receptors
Cable	SHE Transmission Orkney-Caithness Project	Consented	Consented (construction timelines unknown)	Pentland Firth (overlap with OECC)	Medium	All

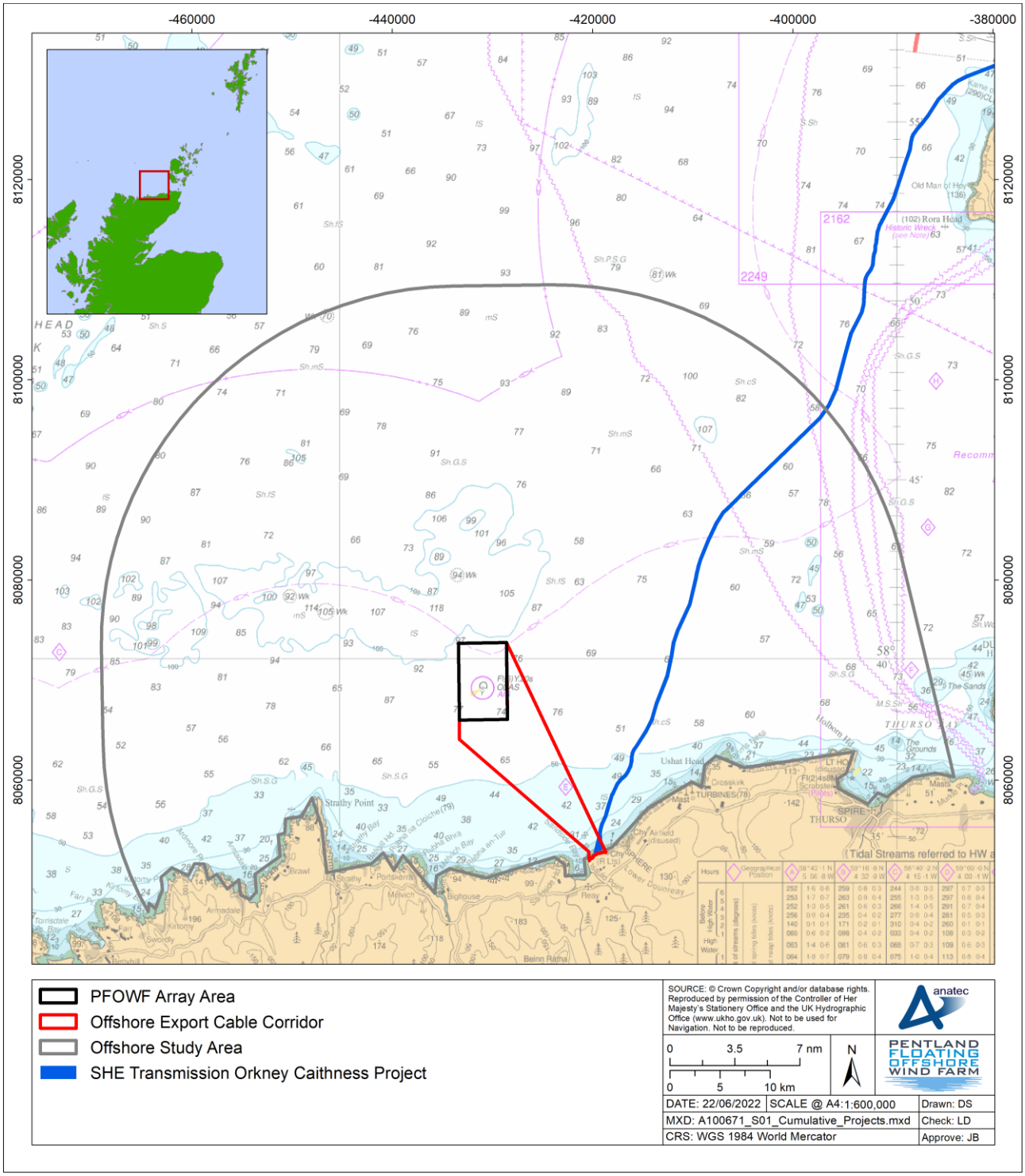

Figure 14.6 Projects considered for the Shipping and Navigation cumulative impact assessment

The following sections summarise the nature of the potential cumulative impacts for each stage of the Offshore Development.

The following impacts have been taken forward for the cumulative assessment:

- Construction / Decommissioning:
  - Vessel displacement due to the presence of Offshore Development vessels; and
  - Reduction in under keel clearance due to subsea cables / cable protection leading to an increased grounding risk.
- Operation and Maintenance:
  - Vessel displacement due to the presence of Offshore Development vessels; and
  - Reduction in under keel clearance due to subsea cables / cable protection leading to an increased grounding risk.

14.7.2 Cumulative Construction Effects

14.7.2.1 Vessel displacement due to the presence of Offshore Development vessels

The main effect on surface navigation users due to the SHE Transmission Orkney-Caithness Project is likely to be during the construction phase or any periods of major maintenance for the SHE Transmission Orkney-Caithness Project when a cable laying vessel, which is likely to be RAM, is working. It is noted that data confidence regarding the timing and nature of construction works is low.

Given the short-term nature of the construction works, it is likely that the impact will be limited to a temporary, localised displacement of traffic. By implementing standard industry practice mitigation measures it is expected that the risk to Shipping and Navigation users would be temporary, minor, and not significant.

14.7.2.1.1 Relevant embedded mitigation measures

The following embedded mitigation measures will reduce the frequency and/or consequence of the effect resulting in a lower significance of effect:

- Promulgation of information as per consent requirements and standard industry practice.

14.7.2.1.2 Assessment of significance

The potential for vessel displacement due to the presence of Offshore Development vessels is overall considered to have a frequency of the effect that is considered **Extremely Unlikely**, and the consequences are considered to be **Minor**. Therefore, the significance of the effect is considered **Broadly Acceptable** which is **Not Significant** in EIA terms.

14.7.2.2 Reduction in under keel clearance due to subsea cables / cable protection leading to an increased grounding risk

The cable landfall for the SHE Transmission Orkney-Caithness Project is adjacent to the landfall for the offshore export cable(s) associated with the Offshore Development. Given the respective cable routes, a cable crossing may be required, with adequate protection installed. This protection may extend above the seabed, reducing the under keel clearance available to vessels. Potential cable crossings will be identified within a Cable Burial Risk Assessment (CBRA), and adequate protections agreed upon and risk assessed. Cable routes will be marked on Admiralty charts for both the Offshore Development and the SHE Transmission Orkney-Caithness Project to ensure users are aware of potentially reduced under keel clearance. Any reduction in water depth of greater than 5% would require consultation with the MCA on appropriate mitigations.

14.7.2.2.1 Relevant embedded mitigation measures

The following embedded mitigation measures will reduce the frequency and/or consequence of the effect resulting in a lower significance of effect:

- CBRA; and
- Promulgation of information as per consent requirements and standard industry practice.

14.7.2.2.2 Assessment of significance

The reduction in under keel clearance due to subsea cables / cable protection leading to an increased grounding risk is overall considered to have a frequency of **Extremely Unlikely**, and the consequences are considered to be **Minor**. Therefore, the significance of the effect is considered **Broadly Acceptable** which is **Not Significant** in EIA terms.

14.7.3 Cumulative Operation and Maintenance Effects

14.7.3.1 Vessel displacement due to the presence of Offshore Development vessels

As per the construction phase, the main effect on surface navigation users due to the SHE Transmission Orkney-Caithness Project is likely to be during the construction or maintenance works for the SHE Transmission Orkney-Caithness Project. The presence of structures associated with the Offshore Development may increase vessel displacement due to the presence of Offshore Development vessels associated with the SHE Transmission Orkney-Caithness Project.

As per the construction phase, given the short-term nature of the works, it is likely that the risk to Shipping and Navigation users would be temporary, minor, and not significant.

14.7.3.1.1 Relevant embedded mitigation measures

The following embedded mitigation measures will reduce the frequency and/or consequence of the effect resulting in a lower significance of effect:

- Promulgation of information as per consent requirements and standard industry practice.

14.7.3.1.2 Assessment of significance

The potential for vessel displacement due to the presence of Offshore Development vessels is overall considered to have a frequency of the effect that is considered **Extremely Unlikely**, and the consequences are considered to be **Minor**. Therefore, the significance of the effect is considered **Broadly Acceptable** which is **Not Significant** in EIA terms.

14.7.3.2 Reduction in under keel clearance due to subsea cables / cable protection leading to an increased grounding risk

As per the construction phase, the SHE Transmission Orkney-Caithness Project cable route overlaps with the OECC, meaning that there is a possibility that a cable crossing is required. This may result in protection being installed rising above the seabed, reducing under keel clearance available to vessels.

14.7.3.2.1 Relevant embedded mitigation measures

The following embedded mitigation measures will reduce the frequency and/or consequence of the effect resulting in a lower significance of effect:

- CBRA; and
- Promulgation of information as per consent requirements and standard industry practice.

14.7.3.2.2 Assessment of significance

The reduction in under keel clearance due to subsea cables / cable protection leading to an increased grounding risk is overall considered to have a frequency of **Extremely Unlikely**, and the consequences are considered to be **Minor**. Therefore, the significance of the effect is considered **Broadly Acceptable** which is **Not Significant** in EIA terms.

14.7.4 Cumulative Decommissioning Effects

14.7.4.1 Vessel displacement due to the presence of the Offshore Development vessels

As per the construction phase, the main effect on surface navigation users due to the SHE Transmission Orkney-Caithness Project is likely to be during the maintenance works for the SHE Transmission Orkney-Caithness Project. Project vessels carrying out maintenance on the SHE Transmission Orkney-Caithness Project may cause vessel displacement which may be exacerbated by decommissioning works associated with the Offshore Development.

As per the construction phase, given the short-term nature of the works, it is likely that the risk to Shipping and Navigation users would be temporary, minor, and not significant.

14.7.4.1.1 Relevant embedded mitigation measures

The following embedded mitigation measures will reduce the frequency and/or consequence of the effect resulting in a lower significance of effect:

> Promulgation of information as per consent requirements and standard industry practice.

14.7.4.1.2 Assessment of significance

The potential for vessel displacement due to the presence of Offshore Development vessels is overall considered to have a frequency of the effect that is considered **Extremely Unlikely**, and the consequences are considered to be **Minor**. Therefore, the significance of the effect is considered **Broadly Acceptable** which is **Not Significant** in EIA terms.

14.7.4.2 Reduction in under keel clearance due to subsea cables / cable protection leading to an increased grounding risk

As per the construction phase, the SHE Transmission Orkney-Caithness Project cable route overlaps with the Offshore Export Cable Corridor, meaning that there is a possibility that a cable crossing is required. This may result in protection being installed rising above the seabed, reducing under keel clearance available to vessels.

14.7.4.2.1 Relevant embedded mitigation measures

The following embedded mitigation measures will reduce the frequency and/or consequence of the effect resulting in a lower significance of effect:

> CBRA; and

> Promulgation of information as per consent requirements and standard industry practice.

14.7.4.2.2 Assessment of significance

The reduction in under keel clearance due to subsea cables / cable protection leading to an increased grounding risk is overall considered to have a frequency of **Extremely Unlikely**, and the consequences are considered to be **Minor**. Therefore, the significance of the effect is considered **Broadly Acceptable** which is **Not Significant** in EIA terms.

14.8 Assessment of Transboundary Effects

There is a potential transboundary effect during all phases of the Offshore Development, due to displacement of vessel traffic using the Pentland Firth, which includes vessels routeing to and from international ports such as those in North America and the Baltic Sea. Based on the localised extent of the potential displacement, any changes in the overall route length used by vessels transiting the area are expected to be very small (i.e. less than 1% to 2% of the total journey length). Therefore, the transboundary effect of any changes to vessel routeing is expected to be very minor given there will not be a significant impact on journey time and ability to make port calls as planned. The effect is assessed to be **Broadly Acceptable**, which is **Not Significant** in EIA terms.

14.9 Assessment of Impacts Cumulatively with the Onshore Development

The Onshore Development components are summarised in Chapter 5: Project Description. These Project aspects have been considered in relation to the impacts assessed within this chapter.

No aspects of the Onshore Development were considered to have an impact on Shipping and Navigation users, as these are wholly terrestrial and as such will not affect Shipping and Navigation users of the marine environment.

14.10 Mitigation and Monitoring Requirements

There is no requirement for additional mitigation over and above the embedded Offshore Development measures proposed in Section 14.5.5 and consent conditions.

14.11 Inter-relationships

Interrelated effects describe the potential interaction of multiple project impacts upon one receptor which may interact to create a more significant impact on a receptor than when considered in isolation. Interrelated effects may have a temporal or spatial element and may be short-term, temporary, or longer-term over the lifetime of the Offshore Development.

In line with the Scoping Opinion and Scoping Opinion Addendum received, this chapter has assessed all impacts that are relevant to Shipping and Navigation receptors during the construction, operation and maintenance, and decommissioning phases of the Offshore Development. Therefore, it is considered that the assessment and conclusions presented in Section 14.12 provide a complete and robust assessment of all potential impacts relevant to Shipping and Navigation receptors. The assessment has also considered the potential for inter-related effects in relation to Shipping and Navigation, and no additional inter-related effects beyond those presented in Section 14.6 have been identified.

Where the assessment contained in this chapter is considered within other assessment chapters, a summary of these interrelationships is presented below in Table 14.15.

Table 14.15 Inter-relationships identified with Shipping and Navigation and other receptors in this Offshore EIAR

Receptor	Impact	Description
Commercial Fisheries	Fishing gear interaction with subsea infrastructure	The potential for fishing vessel gear to become entangled or snagged on infrastructure when the vessel is engaged in active fishing is assessed in Chapter 13: Commercial Fisheries.

14.12 Summary of Residual Effects

Table 14.16 below summarises the effects for all impacts assessed within this chapter and for the purposes of MGN 654 requirements is considered a risk control log.

All of the impacts have been assessed as tolerable with mitigation or broadly acceptable with embedded mitigation measures in place. No additional mitigation measures were identified as being necessary during the assessment process. All impacts are therefore considered **Not Significant** in EIA terms.

Table 14.16 Summary of residual effects for Shipping and Navigation

Predicted Effect	User	Frequency	Consequence	Assessment of Significance	Additional Mitigation Identified	Significance of Residual Effect
Construction						
Vessel displacement due to construction activities; leading to increased collision risk for third-party vessels and/or reduction in port access	All vessels	Extremely Unlikely	Moderate	Broadly Acceptable (Not Significant)	No mitigation measures have been identified for this effect above and beyond the embedded Offshore Development mitigation listed in Section 14.5.5 as it was concluded that the effect was not significant.	Broadly acceptable and therefore not significant in EIA terms.
Vessel-to-vessel collision risk between a third-party vessel and an Offshore Development vessel due to the presence of the Offshore Development vessels	All vessels	Extremely Unlikely	Moderate	Broadly Acceptable (Not Significant)	No mitigation measures have been identified for this effect above and beyond the embedded Offshore Development mitigation listed in Section 14.5.5 as it was concluded that the effect was not significant.	Broadly acceptable and therefore not significant in EIA terms.
Vessel to structure allision risk due to the presence of new structures associated with the Offshore Development	All vessels	Extremely Unlikely	Moderate	Broadly Acceptable (Not Significant)	No mitigation measures have been identified for this effect above and beyond the embedded Offshore Development mitigation listed in Section 14.5.5 as it was concluded that the effect was not significant.	Broadly acceptable and therefore not significant in EIA terms.
Fishing gear interaction with subsea infrastructure	All vessels	Extremely Unlikely	Moderate	Broadly Acceptable (Not Significant)	No mitigation measures have been identified for this effect above and beyond the embedded Offshore Development mitigation listed in Section 14.5.5 as it was concluded that the effect was not significant.	Broadly acceptable and therefore not significant in EIA terms.

Predicted Effect	User	Frequency	Consequence	Assessment of Significance	Additional Mitigation Identified	Significance of Residual Effect
Reduction in under keel clearance due to subsea cables / cable protection leading to an increased grounding risk	All vessels	Negligible	Minor	Broadly Acceptable (Not Significant)	No mitigation measures have been identified for this effect above and beyond the embedded Offshore Development mitigation listed in Section 14.5.5 as it was concluded that the effect was not significant.	Broadly acceptable and therefore not significant in EIA terms.
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	All vessels	Extremely Unlikely	Moderate	Broadly Acceptable (Not Significant)	No mitigation measures have been identified for this effect above and beyond the embedded Offshore Development mitigation listed in Section 14.5.5 as it was concluded that the effect was not significant.	Broadly acceptable and therefore not significant in EIA terms.
Vessel-to-vessel collision risk between a third-party vessel and an Offshore Development vessel due to the presence of the Offshore Development vessels	All vessels	Extremely Unlikely	Moderate	Broadly Acceptable (Not Significant)	No mitigation measures have been identified for this effect above and beyond the embedded Offshore Development mitigation listed in Section 14.5.5 as it was concluded that the effect was not significant.	Broadly acceptable and therefore not significant in EIA terms.
Commercial vessel to structure allision risk due to the presence of new structures associated with the Offshore Development	All vessels	Extremely Unlikely	Moderate	Broadly Acceptable (Not Significant)	No mitigation measures have been identified for this effect above and beyond the embedded Offshore Development mitigation listed in Section 14.5.5 as it was concluded that the effect was not significant.	Broadly acceptable and therefore not significant in EIA terms.

Predicted Effect	User	Frequency	Consequence	Assessment of Significance	Additional Mitigation Identified	Significance of Residual Effect
Fishing vessel to structure allision risk due to the presence of new structures associated with the Offshore Development	All vessels	Remote	Moderate	Tolerable with Mitigation (Not Significant)	No mitigation measures have been identified for this effect above and beyond the embedded Offshore Development mitigation listed in Section 14.5.5 as it was concluded that the effect was not significant.	Tolerable with mitigation and therefore not significant in EIA terms.
Recreational vessel to structure allision risk due to the presence of new structures associated with the Offshore Development	All vessels	Extremely Unlikely	Moderate	Broadly Acceptable (Not Significant)	No mitigation measures have been identified for this effect above and beyond the embedded Offshore Development mitigation listed in Section 14.5.5 as it was concluded that the effect was not significant.	Broadly acceptable and therefore not significant in EIA terms.
Anchor interaction with subsea infrastructure	All vessels	Extremely Unlikely	Moderate	Broadly Acceptable (Not Significant)	No mitigation measures have been identified for this effect above and beyond the embedded Offshore Development mitigation listed in Section 14.5.5 as it was concluded that the effect was not significant.	Broadly acceptable and therefore not significant in EIA terms.
Fishing gear interaction with subsea infrastructure	All vessels	Remote	Moderate	Tolerable with Mitigation (Not Significant)	No mitigation measures have been identified for this effect above and beyond the embedded Offshore Development mitigation listed in Section 14.5.5 as it was concluded that the effect was not significant.	Tolerable with mitigation and therefore not significant in EIA terms.
Transiting vessel interaction with subsea infrastructure	All vessels	Remote	Moderate	Tolerable with Mitigation (Not Significant)	No mitigation measures have been identified for this effect above and beyond the embedded Offshore Development mitigation listed in Section 14.5.5 as it was concluded that the effect was not significant.	Tolerable with mitigation and therefore not significant in EIA terms.

Predicted Effect	User	Frequency	Consequence	Assessment of Significance	Additional Mitigation Identified	Significance of Residual Effect
Reduction in under keel clearance due to subsea cables / cable protection leading to an increased grounding risk	All vessels	Negligible	Minor	Broadly Acceptable (Not Significant)	No mitigation measures have been identified for this effect above and beyond the embedded Offshore Development mitigation listed in Section 14.5.5 as it was concluded that the effect was not significant.	Broadly acceptable and therefore not significant in EIA terms.
Loss of WTG station	All vessels	Negligible	Serious	Broadly Acceptable (Not Significant)	No mitigation measures have been identified for this effect above and beyond the embedded Offshore Development mitigation listed in Section 14.5.5 as it was concluded that the effect was not significant.	Broadly acceptable and therefore not significant in EIA terms.
Reduction of emergency response capability due to increased incident rates and/or reduced access for SAR responders	All vessels	Extremely Unlikely	Minor	Broadly Acceptable (Not Significant)	No mitigation measures have been identified for this effect above and beyond the embedded Offshore Development mitigation listed in Section 14.5.5 as it was concluded that the effect was not significant.	Broadly acceptable and therefore not significant in EIA terms.
Decommissioning						
Vessel displacement due to decommissioning activities; leading to increased collision risk for third-party vessels and/or reduction in port access	All vessels	Extremely Unlikely	Moderate	Broadly Acceptable (Not Significant)	No mitigation measures have been identified for this effect above and beyond the embedded Offshore Development mitigation listed in Section 14.5.5 as it was concluded that the effect was not significant.	Broadly acceptable and therefore not significant in EIA terms.

Predicted Effect	User	Frequency	Consequence	Assessment of Significance	Additional Mitigation Identified	Significance of Residual Effect
Vessel-to-vessel collision risk between a third-party vessel and an Offshore Development vessel due to the presence of the Offshore Development vessels	All vessels	Extremely Unlikely	Moderate	Broadly Acceptable (Not Significant)	No mitigation measures have been identified for this effect above and beyond the embedded Offshore Development mitigation listed in Section 14.5.5 as it was concluded that the effect was not significant.	Broadly acceptable and therefore not significant in EIA terms.
Vessel to structure allision risk due to the presence of new structures associated with the Offshore Development	All vessels	Extremely Unlikely	Moderate	Broadly Acceptable (Not Significant)	No mitigation measures have been identified for this effect above and beyond the embedded Offshore Development mitigation listed in Section 14.5.5 as it was concluded that the effect was not significant.	Broadly acceptable and therefore not significant in EIA terms.
Fishing gear interaction with subsea infrastructure	All vessels	Extremely Unlikely	Moderate	Broadly Acceptable (Not Significant)	No mitigation measures have been identified for this effect above and beyond the embedded Offshore Development mitigation listed in Section 14.5.5 as it was concluded that the effect was not significant.	Broadly acceptable and therefore not significant in EIA terms.
Reduction in under keel clearance due to subsea cables / cable protection leading to an increased grounding risk	All vessels	Negligible	Minor	Broadly Acceptable (Not Significant)	No mitigation measures have been identified for this effect above and beyond the embedded Offshore Development mitigation listed in Section 14.5.5 as it was concluded that the effect was not significant.	Broadly acceptable and therefore not significant in EIA terms.

Predicted Effect	User	Frequency	Consequence	Assessment of Significance	Additional Mitigation Identified	Significance of Residual Effect
Cumulative (All Phases)						
Vessel displacement due to the presence of project vessels associated with the SHE Transmission Orkney-Caithness Project	All vessels	Extremely Unlikely	Minor	Broadly Acceptable (Not Significant)	No mitigation measures have been identified for this effect above and beyond the embedded Offshore Development mitigation listed in Section 14.5.5 as it was concluded that the effect was not significant.	Broadly acceptable and therefore not significant in EIA terms.
Reduction in under keel clearance due to subsea cables / cable protection associated with the SHE Transmission Orkney-Caithness Project	All vessels	Extremely Unlikely	Minor	Broadly Acceptable (Not Significant)	No mitigation measures have been identified for this effect above and beyond the embedded Offshore Development mitigation listed in Section 14.5.5 as it was concluded that the effect was not significant.	Broadly acceptable and therefore not significant in EIA terms.

14.13 References

Anatec (2012). *Shipping Study of the Pentland Firth and Orkney Waters*. Anatec: Aberdeen.

Clyde Cruising Club (CCC) (2020). *CCC Sailing Directions and Anchorages: Orkney and Shetland including North & Northeast Scotland*. Wych House, St Ives, Cambridgeshire: Imray, Laurie, Norie & Wilson.

DHI (2021). *Pentland Floating Offshore Wind Demonstrator Metocean Hindcast Data and Analysis Report*. Hørsholm, Denmark: DHI A/S.

Dounreay Trì Ltd (2016). *Dounreay Trì Floating Wind Demonstration Project Marine Safety Navigational Risk Assessment*. Dounreay Tri Ltd: Stromness.

Health and Safety Executive and Maritime and Coastguard Agency (HSE and MCA) (2017). *Regulatory Expectations on Moorings for Floating Wind and Marine Devices*. Bootle: HSE and MCA.

International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) (2021). *International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) Guidance RO139 / G1162 The Marking of Offshore Man-Made Structures*. Edition 2. Saint-Germain en Laye, France: IALA.

International Maritime Organization (IMO) (1972/77). *Convention on International Regulations for Preventing Collisions at Sea (COLREGs) – Annex 3*. London: IMO.

International Maritime Organization (IMO) (1974). *International Convention for the Safety of Life at Sea (SOLAS).* London: IMO.

International Maritime Organization (IMO) (2018). *Revised Guidelines for Formal Safety Assessment (FSA) for Use in the Rule-Making Process*. MSC-MEPCC.2/Circ.12/Rev.2. London: IMO.

Maritime and Coastguard Agency (MCA) (2008). *Marine Guidance Note 372 (Merchant and Fishing) Offshore Renewable Energy Installations (OREIs): Guidance to Mariners Operating in the Vicinity of UK OREIs*. Southampton: MCA.

Maritime and Coastguard Agency (MCA) (2021). *MGN 654 (Merchant and Fishing) Safety of Navigation: Offshore Renewable Energy Installations (OREIs) – Guidance on UK Navigational Practice, Safety and Emergency Response*. Southampton: MCA.

Royal Yachting Association (RYA) (2019a). *The RYA's Position on Offshore Renewable Energy Developments: Paper 1 (of 4) – Wind Energy*. 5th revision. Southampton: RYA.

Royal Yachting Association (RYA) (2019b). *UK Coastal Atlas of Recreational Boating* 2.1. Southampton: RYA.

Scottish Government (2015). *Scotland's Marine Plan*.

United Kingdom Hydrographic Office (UKHO) (2018). *Admiralty Sailing Directions North Coast of Scotland Pilot NP52*. 10th Edition. Taunton: UKHO.

United Kingdom Hydrographic Office (UKHO) (2021). *Admiralty Nautical Charts*. Taunton: UKHO.

United Nations (UN) (1982). *United Nations Convention on the Law of the Sea.*