moray offshore renewables ltd

Environmental Statement

Technical Appendix 5.2 D - Navigational Risk Assessment (Wind Farm Sites)

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This study has been carried out by Anatec Ltd (Anatec) on behalf of Moray Offshore Renewables Ltd (MORL). The assessment represents Anatec's best judgment based on the information available at the time of preparation. Any use which a third party makes of this report is the responsibility of such third party. Anatec accepts no responsibility for damages suffered as a result of decisions made or actions taken in reliance on information contained in this report.

TABLE OF CONTENTS

1. INTRODUCTION....6
1.1 Background....6
1.2 Scope of the Assessment and Methodology....6
1.3 Secondary and Sensitivity Assessments....8
1.4 Abbreviations....8
2. REGULATIONS AND GUIDANCE....11
2.1 Introduction....11
2.2 MCA Marine Guidance Notice 371....11
2.3 MCA Wind Farm: "Shipping Route" Template....11
2.4 DECC Methodology....13
2.5 Aids to Navigation....14
3. WIND FARM DEVELOPMENT DETAILS....15
3.1 Introduction....15
3.2 Eastern Development Area Boundary....15
3.3 Structure Details....18
3.4 Offshore Cable Routes....20
4. MARINE NAVIGATIONAL MARKINGS....21
4.1 Introduction....21
4.2 Construction/Decommissioning....21
4.3 Marking of Individual Structures....21
4.4 Proposed Markings....21
4.5 Superintendence and Management....22
5. CONSULTATION....23
5.1 Introduction....23
5.2 Marine Coastguard Agency and Department for Transport....23
5.3 Chamber of Shipping....24
5.4 Northern Lighthouse Board....24
5.5 Royal Yacht Association and Cruising Association....26
5.6 Royal Yacht Association Scotland....27
5.7 Local Ports and Ship Operators....27
5.8 Hazard Review Workshop....28
5.9 Oil and Gas Consultation....29
6. EXISTING ENVIRONMENT....31
6.1 Introduction....31
6.2 Geographical Scope....31
6.3 Port Facilities/Services....32
6.4 Navigational Aids....35
6.5 Sailing Directions....37
6.6 Wrecks....39
6.7 Oil & Gas Infrastructure....40
6.8 Other Wind Farm Developments....42
6.9 Exercise Areas....43

6.10 Metocean Data 44

7. MARITIME INCIDENTS 48

7.1 MAIB 48
7.2 RNLI 51
7.3 Conclusions 55

8. MARITIME TRAFFIC SURVEYS 56

8.1 Introduction 56
8.2 Survey Details 56
8.3 Survey Analysis 58
8.4 Site-Specific Review 69
8.5 Anchored Vessels 76
8.6 Detailed Analysis of Main Shipping Lanes 78

9. IMPACT ON COMMERCIAL SHIPPING NAVIGATION 81

9.1 Passing Ships 81

10. RECREATIONAL VESSEL ACTIVITY 83

10.1 Introduction 83
10.2 RYA Data 83
10.3 Survey Data 86
10.4 Impact Assessment 87

11. FISHING VESSEL ACTIVITY 88

11.1 Introduction 88
11.2 Survey Tracks 88
11.3 Commercial Fisheries Assessment 90
11.4 Impact Assessment 91

12. FORMAL SAFETY ASSESSMENT 92

12.1 Introduction 92
12.2 Hazard Identification 93
12.3 Key Findings 93
12.4 Risk and Mitigation Measures 94
12.5 Risk Analysis 99
12.6 Risk Control Measures 99

13. RISK ASSESSMENT 100

13.1 Introduction 100
13.2 Without Wind Farm Risk 100
13.3 With Wind Farm Risk (Base Case) 104
13.4 Cable Interaction – Anchor and Trawl 111
13.5 Future Case Level of Risk 112
13.6 Risk Results Summary 116
13.7 Consequences 117

14. SECONDARY AND SENSITIVITY ASSESSMENTS 119

14.1 Introduction 119
14.2 Secondary Assessment – Individual Wind Farms 119

14.3 Sensitivity Assessment 121

15. CONSTRUCTION AND DECOMMISIONING IMPACTS 123

15.1 Introduction 123
15.2 Hazards during Construction/Decommissioning 123
15.3 Risk Control/Mitigation during Construction/Decommissioning 124

16. IMPACT ON MARINE RADAR SYSTEMS 125

16.1 Introduction 125
16.2 Beatrice Demonstrator Turbine Project Radar Impacts Study 125
16.3 Impact on Collision Risk 126

17. CUMULATIVE AND IN-COMBINATION EFFECTS 131

17.1 Introduction 131
17.2 Developments Considered in the Cumulative and In-Combination Assessment 131
17.3 Predicted Impacts 132
17.4 Wind Farm Developments 134
17.5 Subsea Cables 135
17.6 Oil and Gas Industry Infrastructure 135

18. SAFETY ZONES 136

18.1 Guidance on Applications for Safety Zones 136
18.2 Construction/Decommissioning & Major Maintenance Phases 136
18.3 Operational Phase 137
18.4 Summary 138

19. SEARCH AND RESCUE (SAR) 139

19.1 Introduction 139
19.2 SAR Resources 139
19.3 Wind Farm SAR Matters 143

20. ADDITIONAL NAVIGATION ISSUES 146

20.1 Introduction 146
20.2 Visual Navigation and Collision Avoidance 146
20.3 Potential Effects on Waves and Tidal Currents 146
20.4 Impacts of Structures on Wind Masking/Turbulence or Sheer 146
20.5 Sedimentation/Scouring Impacting Navigable Water Depths in Area 147
20.6 Structures and Generators affecting Sonar Systems in Area 147
20.7 Electromagnetic Interference on Navigation Equipment 147
20.8 Impacts on Communications and Position Fixing 147
20.9 Noise Impact 148

21. RISK MITIGATION MEASURES & MONITORING 150

21.1 Mitigation 150
21.2 Future Monitoring 151

22. CONCLUSIONS 152

23. REFERENCES 154

APPENDIX A Hazard Review Workshop

APPENDIX B **Consequences Assessment**

APPENDIX C: **Eastern Development Area Wind Farms MGN 371 Checklist**

1. INTRODUCTION

1.1 Background

Anatec was commissioned by Moray Offshore Renewables Ltd (MORL) to perform a shipping and navigation assessment of the three proposed wind farms located in MORL Eastern Development Area (EDA), located in the Moray Firth off the coastline of Caithness. It is planned that the EDA will contain three wind farms called Telford, Stevenson and MacColl.

The report presents information on the Telford, Stevenson and MacColl developments relative to the baseline navigational activity and features for the area. Following this, an assessment of the impact of the proposed sites on navigation is presented.

1.2 Scope of the Assessment and Methodology

The assessment methodology principally followed the Department of Energy and Climate Change (DECC) Risk Assessment Methodology (Ref. i) and the Maritime and Coastguard Agency's (MCA) Marine Guidance Notice 371 (MGN 371) (Ref. ii).

An overview of the general methodology applied in the assessment is presented in Figure 1.1. (More information on the regulations and guidance being addressed is presented in Section 2.)

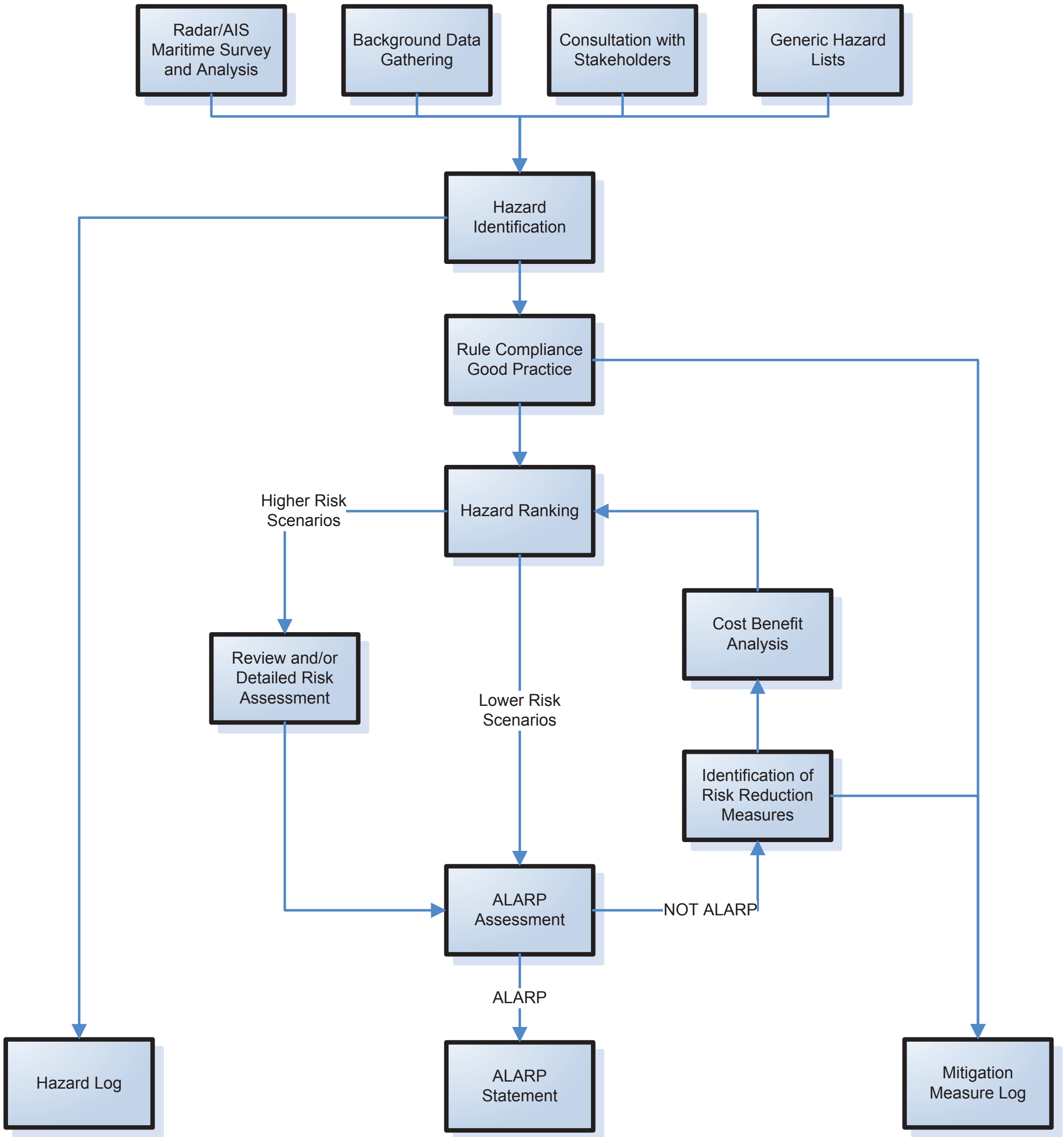


Figure 1.1 Overview of Methodology for Navigation Assessment

The main part of the assessment (primary assessment) considers the impact of the surface structures associated with the operational phase of the wind farm on the following maritime activities:

- Commercial Shipping
- Fishing
- Recreational Sailing

In addition to these activities, consideration is given to the following:

- Impacts of Structures on Marine Radar
- Impact of Subsea cables
- Impacts associated with Construction / Decommissioning phases
- Cumulative Impacts with other nearby developments

1.3 Secondary and Sensitivity Assessments

The NRA has focused on a primary assessment of the entire EDA (the worst case scenario); however as part of the consent application, a secondary assessment will be presented for the individual wind farms (Telford, Stevenson and MacColl).

In addition, a sensitivity assessment for the various permutations of the developments will carried out. The permutations of the sensitivity assessments are as follows:

- Telford plus Stevenson
- Telford plus MacColl
- Stevenson plus MacColl

1.4 Abbreviations

The following abbreviations are used in this report:

AC	-	Alternating Current
AIS	-	Automatic Identification System
ALARP	-	As Low as Reasonably Practicable
ALB	-	All-Weather Lifeboat
AtoN	-	Aid to Navigation
ARPA	-	Automatic Radar Plotting Aid
AtoN	-	Aid to Navigation
BERR	-	Department for Business Enterprise & Regulatory Reform
BOWF	-	Beatrice Offshore Wind Farm
BWEA	-	British Wind Energy Association
CA	-	Cruising Association
CAA	-	Civil Aviation Authority
CBA	-	Cost Benefit Analysis
CDM	-	Construction Design and Management Regulations
CIADD	-	Cumulative Impact Assessment Discussion Document
COLREGS	-	International Regulations for Preventing Collisions at Sea
CPA	-	Closest Point of Approach
DC	-	Direct Current
DECC	-	Department of Energy and Climate Change
DfT	-	Department for Transport
DSC	-	Digital Selective Calling
DTI	-	Department of Trade and Industry
DWT	-	Dead Weight Tonnes
ECDIS	-	Electronic Chart Display and Information Systems
EDA	-	Eastern Development Area
EIA	-	Environmental Impact Assessment
ERCoP	-	Emergency Response Cooperation Plan
ERRV	-	Emergency Response and Rescue Vessel
ES	-	Environmental Statement
ETV	-	Emergency Towing Vessel
FSA	-	Formal Safety Assessment
GPS	-	Global Positioning System

GRP	-	Glass Reinforced Plastic
GT	-	Gross Tonnes
HAT	-	Highest Astronomical Tide
HF	-	High Frequency
HSC	-	High Speed Craft
HSE	-	Health and Safety Executive
HW	-	High Water
IALA	-	International Association of Marine Aids to Navigation and Lighthouses
ILB	-	Inshore Lifeboat
ICES	-	International Council for the Exploration of the Seas
IMO	-	International Maritime Organisation
ITOPF	-	International Tanker Owners Pollution Federation Limited
km	-	Kilometre
LORAN	-	Long Range Navigation
MAIB	-	Marine Accident Investigation Branch
MBS	-	Maritime Buoyage System
MCA	-	Maritime and Coastguard Agency
MDA	-	Managed Danger Area
MEHRA	-	Marine Environmental High Risk Area
MFOWDG	-	Moray Firth Offshore Wind Developers Group
MGN	-	Marine Guidance Notice
MHWN	-	Mean High Water Neaps
MHWS	-	Mean High Water Springs
MLWN	-	Mean Low Water Neaps
MLWS	-	Mean Low Water Springs
MODU	-	Mobile Offshore Drilling Unit
MORL	-	Moray Offshore Renewables Ltd
MRCC	-	Maritime Rescue Co-ordination Centre
MRSC	-	Maritime Rescue Sub-Centre
MSL	-	Mean Sea Level
MW	-	Mega-Watt
nm	-	Nautical Miles
NUC	-	Not Under Command
NVG	-	Night Vision Goggle
OREI	-	Offshore Renewable Energy Installations
OSP	-	Offshore Substation Platform
OWF	-	Offshore Wind Farm
PLL	-	Potential Loss of Life
PLN	-	Port Letter Number
PPE	-	Personal Protective Equipment
RAF	-	Royal Air Force
RCM	-	Risk Control Measure
RIB	-	Rigid Inflatable Boat
RNLI	-	Royal National Lifeboat Institution
Ro-Ro	-	Roll-on, Roll-off
RYA	-	Royal Yachting Association
SAR	-	Search and Rescue
SCADA	-	Supervisory Control and Data Acquisition

SEA	-	Strategic Environmental Assessment
SHEFA	-	SHEtland and FAroe Islands (communication cable)
SFF	-	Scottish Fishermen's Federation
SHETL	-	Scottish Hydro Electric Transmission Limited
SPS	-	Significant Peripheral Structure
SRR	-	Search and Rescue Region
STW	-	Scottish Territorial Waters
TSS	-	Traffic Separation Scheme
UHF	-	Ultra High Frequency
UKCS	-	United Kingdom Continental Shelf
UKHO	-	United Kingdom Hydrographic Office
VHF	-	Very High Frequency
VMS	-	Vessel Monitoring Service
VTS	-	Vessel Traffic Services

2. REGULATIONS AND GUIDANCE

2.1 Introduction

This section briefly summarises the key regulations and guidance relevant when considering the navigation safety issues associated with offshore wind farm developments in the UK.

2.2 MCA Marine Guidance Notice 371

This guidance notice (Ref. ii) highlights issues that need to be taken into consideration when assessing the impact on navigational safety from offshore renewable energy developments, proposed for United Kingdom internal waters, territorial sea or Renewable Energy Zones.

There are five annexes containing recommendations (1-4) and regulatory extract (5) as follows:

- Annex 1: Considerations on site position, structures and safety zones.
- Annex 2: Navigation, collision avoidance and communications.
- Annex 3: MCA shipping template, assessing wind farm boundary distances from shipping routes.
- Annex 4: Safety and mitigation measures recommended for OREI during construction, operation and decommissioning.
- Annex 5: Standards and procedures for generator shutdown and other operational requirements in the event of a search and rescue, counter pollution or salvage incident in or around an OREI.

A checklist referencing the sections in this report which address MCA requirements is presented in Appendix C.

2.3 MCA Wind Farm: "Shipping Route" Template

A trial performed by the Maritime & Coastguard Agency at the North Hoyle Offshore Wind Farm (Ref. iii) indicated that turbines provide erroneous returns to radar transceivers. Multiple side echoes may be generated that have the potential to mask real targets. This has been validated by more recent trials carried out by the industry on the Kentish Flats Wind Farm in the Thames estuary (Ref. iv). The onset range from the turbines of these returns is about 1.5 Nautical Miles (nm), with a progressive deterioration in the radar picture as the turbines are closed to about 500 metres. Adjustment of the radar controls can filter out some of these unwanted radar returns but comes at the cost of potentially losing small radar cross sectional targets such as buoys or small craft.

The MCA's Wind farm Shipping Route Template (Annex 3 of Ref. ii), reproduced in Figure 2.1, indicates that turbines within 0.5nm of a route will be Very High Risk. Close scrutiny and potentially mitigation will be needed between 0.5nm and 5nm to ensure risks are ALARP, particularly between 0.5nm and 2nm which is considered Medium to High Risk. Beyond 2nm is Low Risk although an adjacent wind farm or Traffic Separation Scheme (TSS) introduces cumulative effects which have to be scrutinised.

The template is not a prescriptive tool but needs intelligent application to explore where the distance should be measured from, e.g., route centre, 90% traffic level, nearest ship, etc. The potential boundaries are illustrated in Figure 2.2.

Marine traffic survey information collected for the Moray Firth area has been analysed in this study to inform such boundaries and investigate influencing factors such as route bias, vessel type, size, cargo, etc.

WIND FARM: "SHIPPING ROUTE" Template

Distance in miles (nm) of Turbine Boundary from Shipping Route	Factors	Risk	Tolerability
< 0.25nm (500m)	500m inter-turbine spacing = small craft only recommended	**VERY HIGH**	**INTOLERABLE**
0.25nm (500m)	X band radar interference	**VERY HIGH**	
0.45nm (800m)	Vessels may generate multiple echoes on shore based radars	**VERY HIGH**	
0.5nm (926m)	Mariners' high traffic density domain	**HIGH**	TOLERABLE IF ALARP (As Low As Reasonably Practicable)* * Descriptions of ALARP can be found in a) Great Britain Health and Safety Executive (2001) Reducing risks protecting people b) IMO (2002) MSC Circ 1023 dated 5th April 2002 Formal Safety Assessment c) IMO (2007) MSC 83-21-INF2 Consolidated guidelines for Formal Safety Assessment
0.8nm (1481m)	Mariners' ship domain	**HIGH**	
1 nm (1852m)	Minimum distance to parallel boundary of TSS	**MEDIUM**	
1.5nm (2778m)	S band radar interference ARPA affected	**MEDIUM**	
2 nm (3704m)	Compliance with COLREGS becomes less challenging	**MEDIUM**	
>2nm > (3704m)	But not near TSS	**LOW**	
3.5nm (6482m)	Minimum separation distance between turbines opposite sides of a route	**LOW**	
5nm (9260m)	Adjacent wind farm introduces cumulative effect Distance from TSS entry/exit	**VERY LOW**	**BROADLY ACCEPTABLE**
10nm (18520m)	No other wind farms	**VERY LOW**	

Figure 2.1 Wind Farm "Shipping Route" Template (Ref. ii)

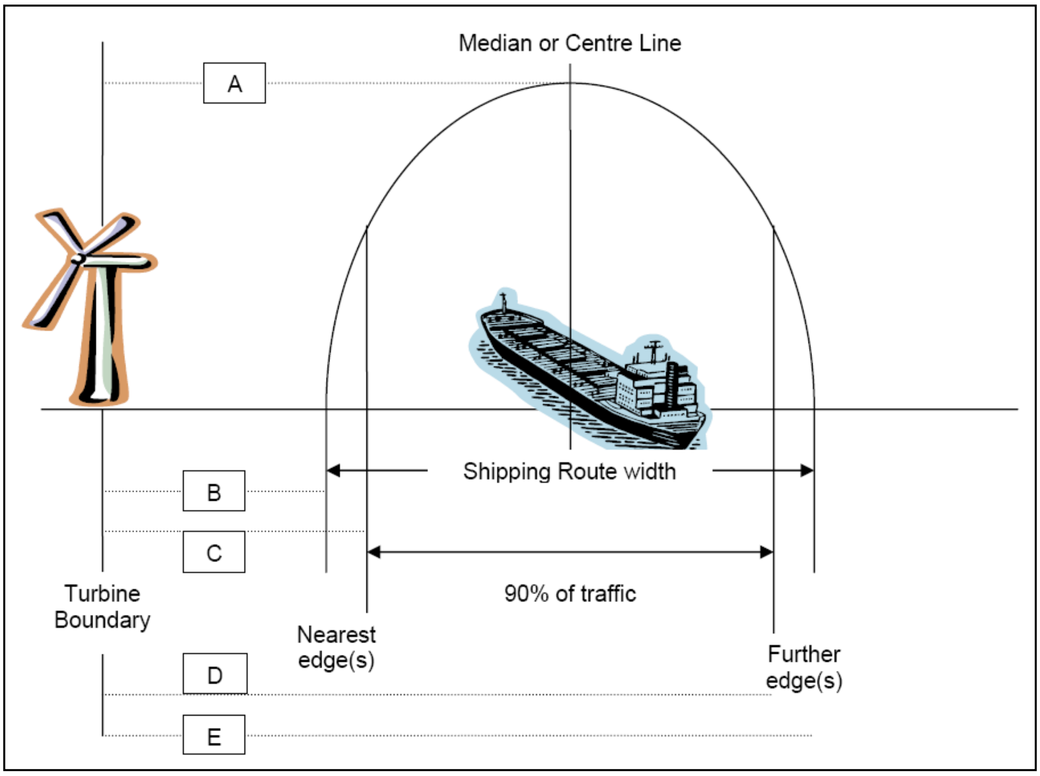


Figure 2.2 Interactive Boundaries (require Interpretative Flexibility, where:

A = Turbine boundary to the shipping route median or centre line
B = Turbine boundary to nearest shipping route edge
C = Turbine boundary to nearest shipping 90% traffic level*
D = Turbine boundary to further shipping 90% traffic level*
E = Turbine boundary to further shipping route edge
(* = or another % to be determined)

2.4 DECC Methodology

DECC produced a Methodology for Assessing the Marine Navigational Safety Risks of Offshore Wind Farms in association with the MCA and the DfT (Ref. i).

Its purpose is to be used as a template by Developers in preparing their navigation risk assessments, and for Government Departments to help in the assessment of these.

The Methodology is centred around risk controls and the feedback from risk controls into risk assessment. It requires a submission that shows that sufficient risk controls are, or will be, in place for the assessed risk to be judged as broadly acceptable or tolerable with further controls or actions.

The key features of the Marine Safety Navigational Risk Assessment Methodology are risk assessment (supported by appropriate techniques and tools), creating a hazard log, defining the risk controls (in a Risk Control Log) required to achieve a level of risk that is broadly acceptable (or tolerable with controls or actions), and preparing a submission that includes a Claim, based on a reasoned argument, for a positive consent decision.

Table 2.1 Key Features of the DECC Methodology (Ref. i)

1	Define a scope and depth of the submission proportionate to the scale of the development and the magnitude of the risk
2	Estimate the "base case" level of risk
3	Estimate the "future case" level of risk
4	Create a hazard log
5	Define risk control and create a risk control log
6	Predict "base case with wind farm" level of risk
7	Predict "future case with wind farm" level of risk
8	Submission

2.5 Aids to Navigation

The Telford, Stevenson and MacColl wind farms will be marked according to International Association of Marine Aids to Navigation and Lighthouses (IALA) guidelines. The Northern Lighthouse Board (NLB) is the statutory body advising on the marking of Renewable Energy Installations in Scottish waters.

The Aids to Navigation (AtoN) required for the site during the different phases of construction, operation and decommissioning will be agreed with the NLB.

3. WIND FARM DEVELOPMENT DETAILS

3.1 Introduction

This section presents details on the proposed sites, including the Telford, Stevenson and MacColl offshore wind farms which are located in the Moray Firth, in the north east of Scotland.

3.2 EDA Boundary

The proposed sites are located approximately 12nm south east of Sarclet Head (4nm south of Wick).

The total area of the development area is approximately 85.8nm^2 (294km^2), comprising of Telford 27.1nm^2 (93km^2), Stevenson 22.5nm^2 (77km^2) and MacColl 36.2nm^2 (124km^2). The corner coordinates of the EDA are presented below in Table 3.1.

Table 3.1 Corners of EDA Boundary

Corner	Latitude	Longitude
Northern Point (A)	58° 19' 24.89" N	002° 44' 21.35" W
South western Point (C)	58° 03' 52.52" N	002° 54' 59.21" W
Eastern Point (B)	58° 08' 04.80" N	002° 34' 11.01" W
North western Point (D)	58° 12' 35.11" N	002° 52' 28.42" W

A chart of the site boundary and three wind farms is presented in Figure 3.1.

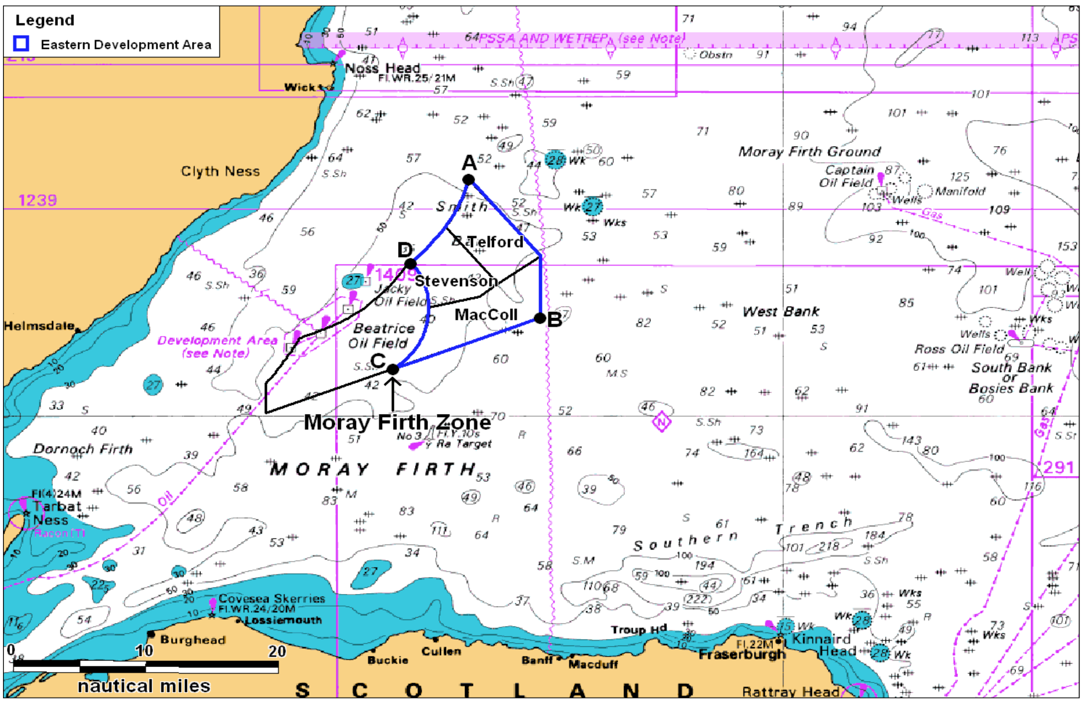


Figure 3.1 Chart Overview of Moray Firth Zone and Proposed sites

The charted water depth of the proposed sites ranges from approximately 37-57m (lowest astronomical tide (LAT)).

The positions of turbines and offshore substations in three indicative layouts for risk modelling within the three wind farm areas are presented in Figure 3.2 to Figure 3.4. It is noted that the three indicative layouts include the maximum number of turbines in scenario 1 to the lowest number of turbines in scenario 3.

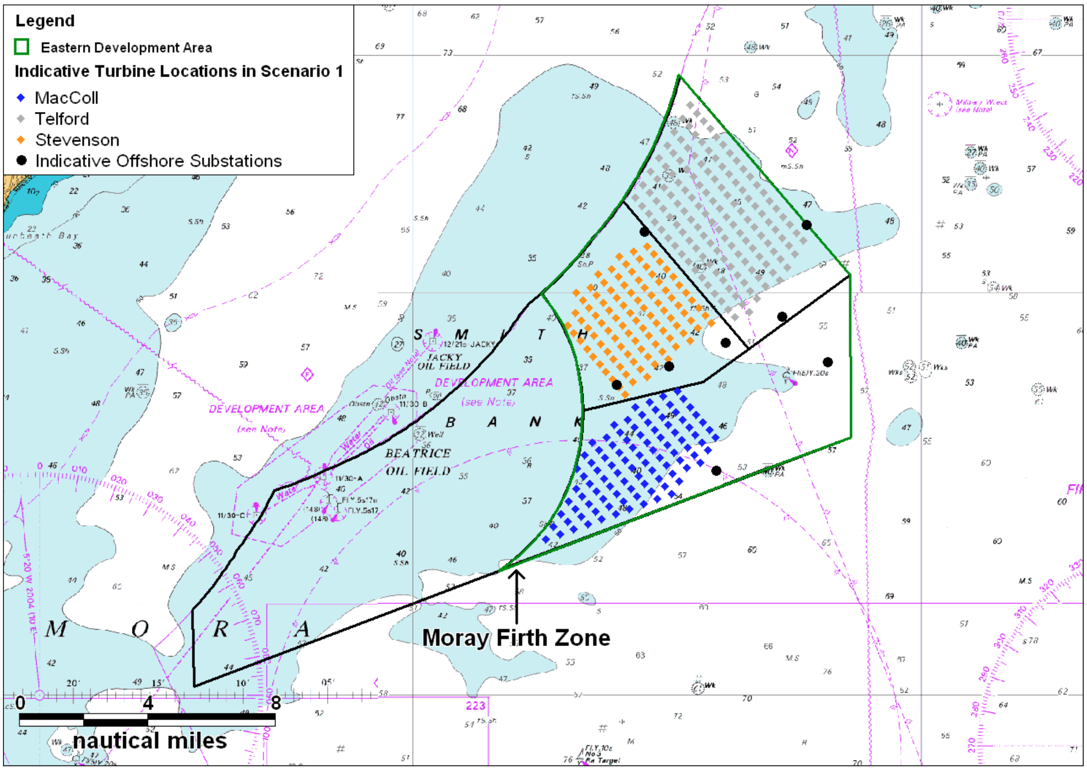


Figure 3.2 Scenario 1 Turbines and Substations

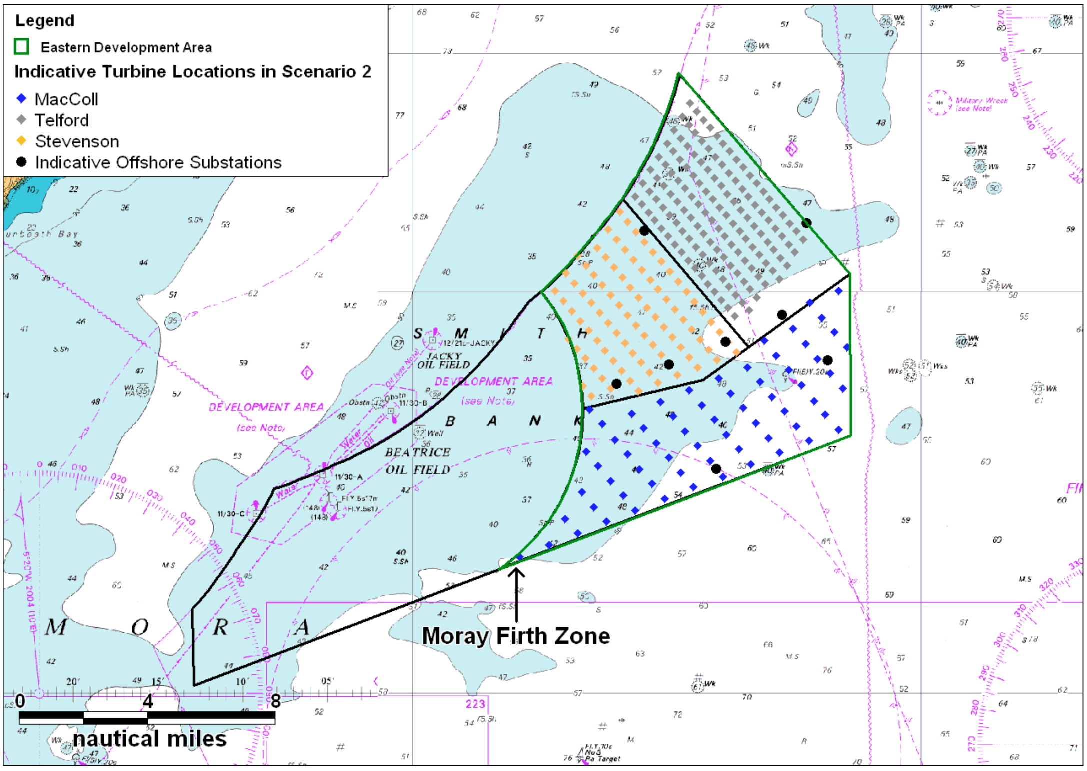


Figure 3.3 Scenario 2 Turbines and Substations

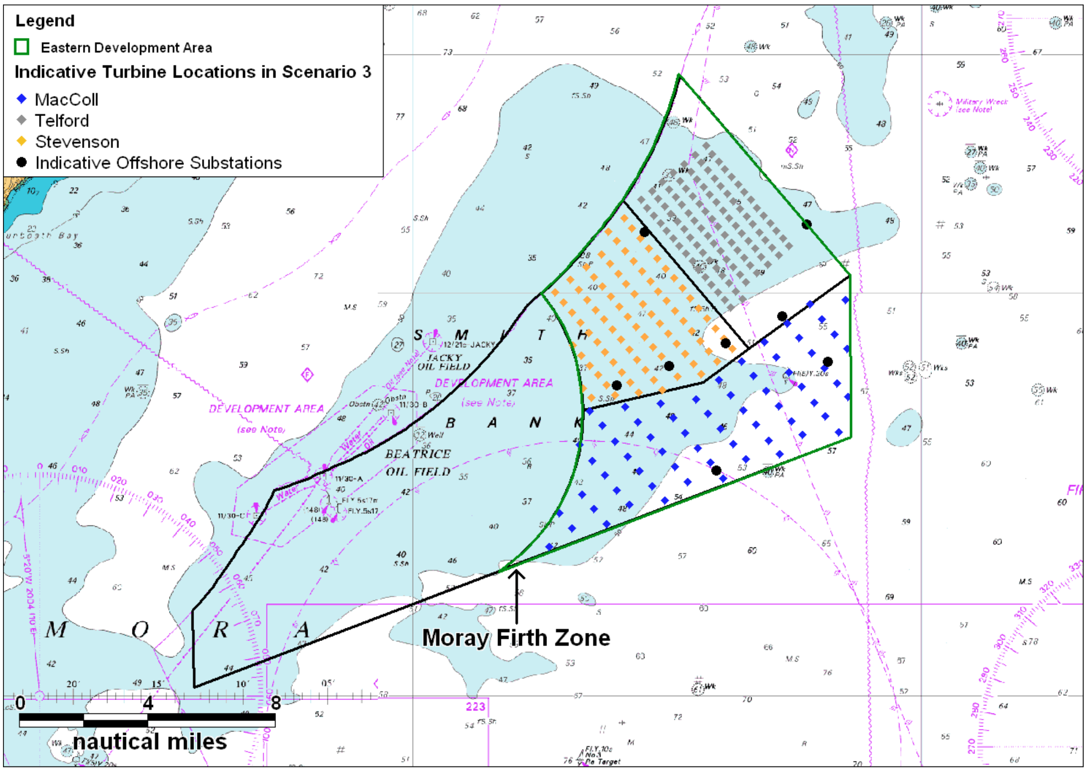


Figure 3.4 Scenario 3 Turbines and Substations

3.3 Structure Details

The navigational assessment has used three turbine layouts consisting of the maximum number of turbines in scenario 1 (339) to the lowest number of turbines in scenario 3 (249) (see Figure 3.2 to Figure 3.4).

Table 3.2 summarises the power in Mega-Watts (MW) and dimensions of the smallest and largest possible machines.

Table 3.2 Dimensions for Minimum and Maximum Size Machines

Wind Turbine Size	Approx. Hub Height above LAT (m)	Max Rotor Diameter (m)	Maximum Tip Height above LAT (m)
3.6 MW	97	130	162
5 MW	99.5	135	167
7 or 8 MW	118	172	204

For the Rochdale Envelope (worst case) collision risk assessment, the maximum turbine foundation of 45x45m has been assumed (largest jacket foundation).

In addition, for the collision risk modelling it is assumed that there will be 3 to 6 Alternating Current (AC) Offshore Substation Platforms (OSPs) and up to two Direct Current (DC) OSPs, however it is noted that the final number of offshore substations will vary in type and size/foundations.

For the Rochdale Envelope, a maximum of eight OSP foundations will comprise of jacket structures (100x100m).

A typical design of a wind turbine is represented in Figure 3.5. There will be a minimum 22m rotor blade tip clearance (air draught) over Highest Astronomical Tide (HAT), which exceeds the MCA’s recommendation of 22m above Mean High Water Springs (MHWS).

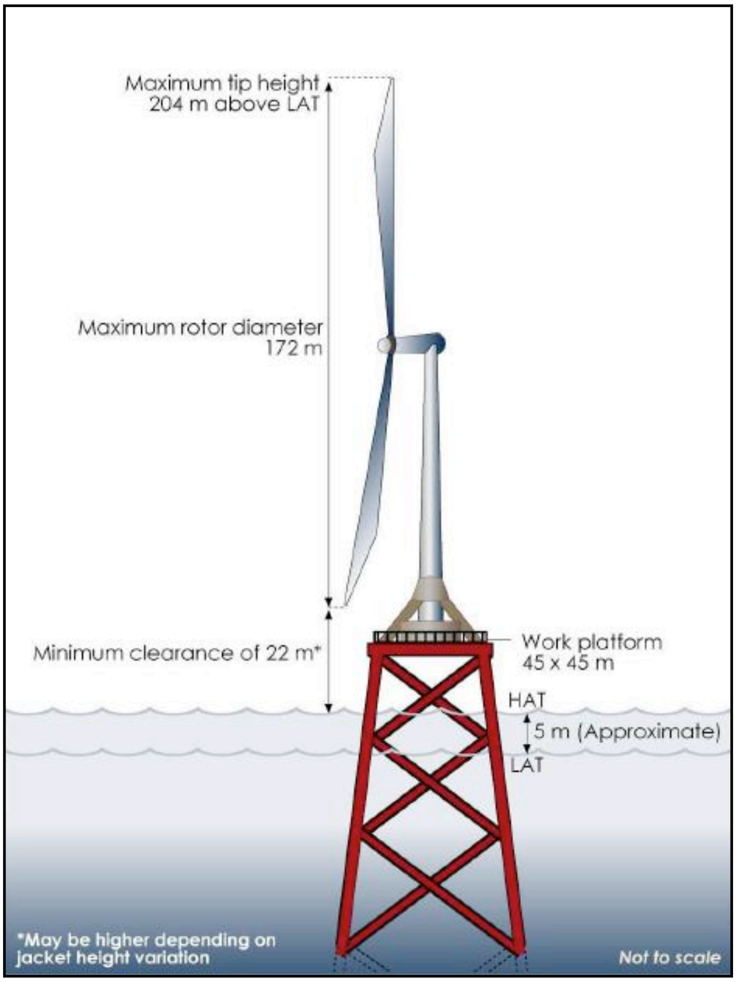


Figure 3.5 Outline Turbine Structure (Jacket)

One rating of turbine will be used within each site; however, different ratings of turbines may be used in the three wind farms.

Each of the wind farms has a maximum target capacity of 500MW and the order of the construction is unconfirmed. The final designs are expected to comprise of between 72-139 turbines in each wind farm.

3.4 Offshore Cable Routes

An overview of the cable corridor and two initial land fall options is presented in Figure 3.6.

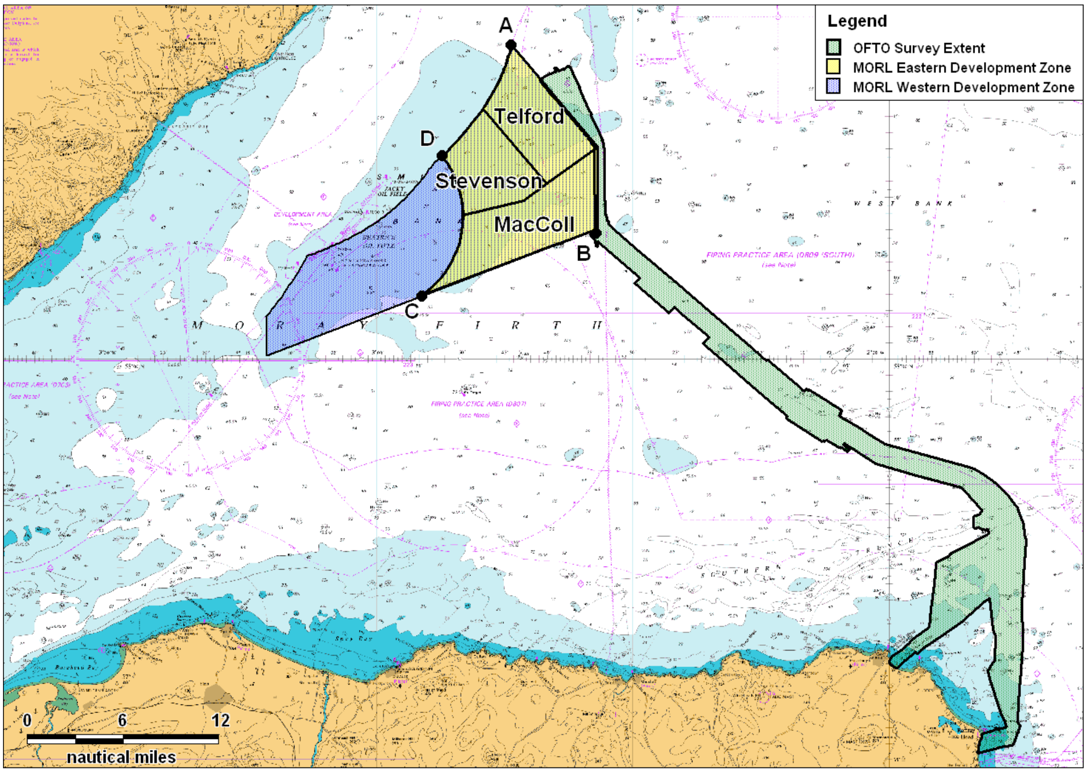


Figure 3.6 Export Cable Route associated with the Wind Farm Sites

The Rochdale Envelope for the project states that the export and inter-array cables will be buried to a target depth of 1 m and a maximum depth of 3m. However, it is noted that in some instances it will not be possible to bury the cables. It may also be necessary to target deeper burial, and so this is being assessed at the time of writing (Spring 2012).

In some instances it will not be possible to bury the cables and it may also be necessary to target deeper burial or other forms of protection. However, the final cable routes and burial/protection will be based on on-going risk assessment and a burial protection study.

The offshore export cable route runs for approximately 46nm south and east from the MORL Zone.

The final land fall option was selected to be located at Fraserburgh Beach running for 8nm from the main cable route, south of the Southern Trench.

4. MARINE NAVIGATIONAL MARKINGS

4.1 Introduction

Throughout the project marine navigational markings will be provided in accordance with the NLB requirements, which will comply with IALA Recommendation 0-139, 'Marking of Offshore Wind Farms' (Ref. v), and the additional requirements of MCA MGN 371 (Ref. ii). It is also noted that there is a requirement to mark selected structures with lights for aviation as per Civil Aviation Authority (CAA) requirements.

NLB have advised that final marking and lighting recommendations will be made in a formal response through Section 36 of the Scottish Electricity Act 1989 (consents for renewable energy projects) and the Marine (Scotland) Act 2010. All navigational marking and lighting of the site or its associated marine infrastructure will require the Statutory Sanction of the NLB prior to deployment.

4.2 Construction/Decommissioning

During the construction / decommissioning of an offshore wind farm, working areas will be established and marked in accordance with the IALA Maritime Buoyage System (MBS). In addition to this, where advised by NLB, additional temporary marking will be applied.

Notices to Mariners, Radio Navigational Warnings-NAVTEX and/or broadcast warnings as well as Notices to Airmen will be promulgated in advance of and during construction / decommissioning of any individual structure/farm.

4.3 Marking of Individual Structures

The tower of every wind generator will be painted yellow all around from between 3.9m above the of LAT to 18.9m above LAT.

As per the MCA requirements, each of the structures will be marked with clearly visible unique identification characteristics at a location that is easily and readily serviceable. The identifications characteristics will each be illuminated by a low-intensity light, so that the sign is visible from a vessel thus enabling the structure to be detected at a suitable distance to avoid a collision with it. This will be such that under normal conditions of visibility and all known tidal conditions, they are clearly readable by an observer (with naked eye), stationed 3 metres above sea levels, and at a distance of at least 150 metres from the turbine. The light will be either hooded or baffled so as to avoid unnecessary light pollution or confusion with navigation marks.

4.4 Proposed Markings

The markings for the projects will be agreed in consultation with NLB once the final turbine layout has been selected. Based on IALA guidelines it is likely that the lighting of each wind farm and the overall EDA will be:

- All corner towers will be marked as Significant Peripheral Structures (SPSs) and where necessary, depending on spacing, intermediate towers on each of the north, west, east and south facing boundaries will be marked as Intermediate Structures (IPS).

- In all the layouts, towers designated as SPS are to exhibit Flashing Yellow 5 second (Fl Y 5s) lights of 5nm nominal range and omnidirectional fog signals with a character of 1 blast of 2 seconds duration every 30 seconds and an IALA usual range of 2nm. Towers designated as IPS are to exhibit Fl Y 2.5s lights of 2nm nominal range.

- All the lights are to be visible to shipping through 360 degrees and if more than 1 lantern is required on a tower to meet the all-round visibility requirement, then all the lanterns on that tower should be synchronised.

- All the lights are to be exhibited at the same height at least 12 metres above Highest Astronomical Tide (HAT) and below the arc the turbine blades.

- All the lights are to be exhibited at least at night and when the visibility is reduced to 2nm or less. Fog signals are to be sounded at least when the visibility is 2nm or less.

- All the structures in the boundary of the turbine towers are to be coloured yellow from at least HAT to the height of the lights (the equivalent height on the unlighted structures).

- Any lighting required for aeronautical purposes is to be shielded / arranged such that it is not visible to shipping. If this cannot be achieved, then the requirement will be considered as having been met if the aviation light is reduced to 10% of its peak intensity when the visibility is more than 5km.

4.5 Superintendence and Management

MORL will ensure that they have a reliable maintenance and casualty response regime in place such that the required availability targets are met.

5. CONSULTATION

5.1 Introduction

Consultation on navigational issues has been carried out for stakeholders during the project. This section briefly summarises the key consultation meetings.

It is noted that given the proximity of the Beatrice Offshore Wind Farm development to the MORL Zone a number of joint consultation meetings were carried out.

During the Offshore Operators meeting and Hazard Review Workshop, a number of navigational and non-navigational concerns (i.e. engineering and emergency response issues) were raised. At the time of preparing this report there is on-going consultation through MORL and Beatrice Offshore Windfarm Limited (BOWL) to ensure comments are addressed with relevant stakeholders and considered within the final NRA(s).

5.2 Marine Coastguard Agency and Department for Transport

Two meetings were held at Department for Trade (DfT) offices in London on 23rd September 2010 and 6th September 2011.

The objective of the first meeting was to consult and discuss the plans for the Beatrice Offshore Wind Farm and MORL Zone projects in relation to the potential impacts on the safe navigation of shipping. The second meeting discussed progress made to date on the projects in relation to identifying the potential impacts on the safe navigation of shipping.

A summary of the initial meeting is provided below:

- In terms of MORL Zone, the main issue was to address possible cumulative issues for the two projects, combined with the oil and gas developments in the area.
- Marine Coastguard Agency (MCA) stated that analysis required should include 90% lanes, encounters, and collision risks.
- MCA/DFT also stated their preference for phase construction safety zones and operational safety zones to be based on experience gained during the construction phase. Justification would require to be made for operational safety zones. The Cable route(s) require to be included within the NRA and MORL should consider Search & Rescue issues in the area.
- In addition, Marine Environmental High Risk Areas (MEHRAs) should be assessed and relative proximity to the site.

A summary of the second meeting is provided below:

- MCA suggested consulting with users on the tanker route going to Wick.
- They stated that they would like to see the MGN checklist completed together with the applications with the relevant sections where the different issues are addressed cross referenced to the Navigation Risk Assessment report.
- MCA did not see any ‘show stoppers’ from a shipping and navigation perspective of the Beatrice and the three proposed wind farms within the MORL Zone.

5.3 Chamber of Shipping

Two meetings were held at the Chamber of Shipping (CoS) in London on 24th September 2010 and 5th of September 2011.

The objective of the first meeting was to consult and discuss based on the initial plans for the Beatrice Offshore Wind Farm and MORL Zone projects in relation to the potential impacts on shipping. The second meeting discussed progress made to date on the projects in relation to identifying the potential impacts on shipping in the area.

A summary of the initial meeting is provided below:

- In terms of MORL Zone CoS stated that they would like to see a straight edge on the eastern side of the Moray site. It was also indicated that the route passing to the north east maybe too close to the zone and would like to see a greater separation distance.
- CoS also noted that one of the key issues would be the oil and gas operational vessels passing through the site and that there should be on-going consultation/dialogue with vessels and that the Chamber should be kept informed.

A summary of the second meeting is provided below:

- CoS questioned the consenting route being followed by the projects and if they were going to issue Preliminary Environmental Reports.
- CoS asked if any consultation would take place with vessels anchoring in the vicinity of the proposed offshore export cable route.
- The Chamber and mariners would be much more concerned regarding any proposals to install floating turbines, especially as they would be an unproven technology within UK waters. CoS stated that developers may have to approach the MCA to ask if they would be revising MGN 371 and 372 (should such turbines be proposed).
- It was stated that the given the distance between the sites and the coastline they would not be concerned regarding the amount of sea room between the sites and the coast.
- They would be concerned regarding the deviation for oil and gas service vessels with proposed developments within the Western Development Area.

5.4 Northern Lighthouse Board

A meeting was held at EDP Renewables offices in Edinburgh on 17th September 2010. The objective of the meeting was to consult and discuss the plans for the Beatrice Offshore Wind Farm and MORL Zone projects in relation to the potential impacts on the safe navigation of shipping.

- The MORL Zone was considered not to be in area of high shipping. NLB mentioned about the strong tides running down into the Zone, these can cause difficult conditions when there are strong south easterly winds against the tides, with very large waves in flood tide.
- They stated that over lifetime of these projects, given the number of turbines drifting vessel collisions may well be an issue.
- NLB also noted that they would like to see the cable route considered in the Navigational Risk Assessment and would also like to see Rochdale envelope approach with the maximum number of turbines being considered.

A second meeting took place with NLB in MORL's offices in Edinburgh on 5th March 2012. A summary of the second meeting is provided below:

- MORL outlined the objectives of the meeting: to discuss the draft ES baseline and impact assessments and to discuss any concerns raised in the draft ES that can be addressed in the final ES.
- MORL summarised the shipping and navigation assessment, showing vessel movement through and in the vicinity of the Zone and offshore export cable route, incident data, hazard workshop findings, affected routes and anticipated re-routing, impacts on SAR and helicopters, impacts on anchoring. All impacts are assessed as of minor significance.
- Key issues were highlighted - operational safety zones, ongoing consultation with marine stakeholders, alignment of turbines between the wind farm sites (which may each have different turbine sizes and spacing), and anchoring risk to cables.
- Overall, it was felt by the NLB that the proposals avoid major navigational routes and therefore there are no serious concerns.
- MORL discussed operational safety zones and the uncertainty over whether MORL will apply for, or be granted, these.
- NLB was doubtful whether MORL would be granted operational safety zones, and agreed with our assumption that MORL won't have these in place.
- It is NLB's preference that, if operational safety zones cannot be effectively policed (which would be very difficult throughout the entire EDA), it is not worth having them in place. Advisory operational safety zones are not really worthwhile.
- No preference was expressed for the grid or diamond layouts, but these regular patterns are preferable to other options.
- MORL confirmed that no navigational channels are proposed through the Telford, Stevenson or MacColl wind farms, but stated that there may potentially be either channels between the wind farms or "wind regeneration zones" (excluding turbines) within one or more of the wind farms.
- NLB stated that this is not a problem and, in some ways, it is preferable for there to be no navigational channels and instead to keep the wind farm more compact and therefore easier to navigate around rather than through.
- Navigational marking of the wind farms will change over the construction period as the individual wind farms (Telford, Stevenson and MacColl) are constructed. The marking of the met mast will also need to change, as it will no longer be a solitary structure.
- Lighting guidance (139) generally stipulated a range of 5nm for navigational lighting, but this could vary marginally. Lighting should be agreed once the layout is confirmed (i.e. post consent).
- Lighting is required to be available 99% of the time, which is likely to require redundancy in the system and failures need to be repaired within 24 hours.
- Aviation lighting guidelines have changed and it is now requested that these flash a red Morse "W" instead of a constant red light as it is now.
- For the offshore substation platform's out with the MORL zone, these may have to be marked as individual structures (rather than as part of the wind farms); depending on distance (guidance on recollection is 3km or more).

5.5 Royal Yacht Association and Cruising Association

Two meetings were held at Cruising Association (CA) House in London on 24th September 2010 and 6th September 2011.

The objective of the first meeting was to consult and discuss the plans for the Beatrice Offshore Wind Farm and MORL Zone projects in relation to the potential impacts on the safe navigation of shipping. The second meeting discussed progress made to date on the projects in relation to identifying the potential impacts on recreational sailing in the area.

The main notes from the first meeting are provided below:

- RYA/CA stated that yachts can get pushed into the area by the tide when sailing up towards the Pentland Firth, i.e. sailing vessels on the outer routes in the area;
- It was acknowledged that the area wasn't particularly busy from a recreational sailing perspective with medium use cruising routes through the general area;
- RYA/CA noted that the activity is very weather dependent and the busiest routes are mainly coastal - along the Moray and Caithness coastlines. In addition, very few vessels go north to the Pentland having come through the Caledonian Canal;
- On entering Peterhead in the Summer there could be 10 vessels there at the same time, heading for the Pentland Firth Area (circumnavigation of the UK);
- Need to check the visibility conditions in the area in relation to the north sea haar;
- RYA/CA would like to see a VHF repeater installed at the site as MCA coverage tends to be patchy further offshore. Additionally, they would like a weather station to transmit data on VHF to assist vessels in the area;
- Both parties would be interested in the shaping of the sites as they prefer squares and rectangles which are easily distinguishable as well as the alignment between the different sites. Also it was recognised that they would like to see cables buried, particularly near port approaches.

A summary of the second meeting is provided below:

- RYA/CA were concerned that different types of turbines could be used in adjacent sites and that the sites may not be aligned and the fact they may not be regular grid patterns. However, the consultees understood the reasons why the developers could not guarantee that this would be the case.
- RYA/CA stated that complaints were being received as the recreational vessels found it difficult to make out the numbering/names of the turbines.
- In the event of floating turbines being used, they would be concerned that the area could become a no go area for recreational vessels. They requested further details from MORL regarding the Floating turbine concept.
- It was acknowledged that the area wasn't particularly busy from a recreational sailing perspective with medium cruising routes through the area. In addition, it was noted that activity is very weather dependent and the busiest routes are coastal along the Morayshire coast and the coast of Caithness.
- RA/CA would like a weather station to transmit data on VHF to assist vessels in the area. This would be very useful in term of wind direction and speed.
- Both parties would like to see cables buried, particularly near port approaches. This is not considered an issue where water depths are less than 10m.

- It was stated that as the projects move forward with multiple surveys, met masts etc., that they establish an email distribution list such as the one being operated by the North Irish Sea developers for the Walney and Ormonde developments.

5.6 Royal Yacht Association Scotland

As well as meeting RYA/CA in London, a meeting took place with RYA Scotland in MORL's offices in Edinburgh on 5th March 2012. A summary of the meeting is presented below:

- MORL outlined the objectives of the meeting: to discuss the draft ES baseline and impact assessments and to discuss any concerns raised in the draft ES that can be addressed in the final ES.
- MORL summarised the shipping and navigation assessment, showing vessel movement through and in the vicinity of the Zone and export cable route, incident data, hazard workshop findings, affected routes and anticipated re-routing, impacts on SAR and helicopters, impacts on anchoring. All impacts are assessed as of minor significance.
- Key issues were highlighted - operational safety zones, ongoing consultation with marine stakeholders, alignment of turbines between the wind farm sites (which may each have different turbine sizes and spacing), and anchoring risk to cables.
- RYA Scotland stated that most of the RYA's concerns relate generally to all offshore wind farm proposals and would like to see greater assessment of potential cumulative impacts of offshore wind developments (e.g. the cumulative impact on a vessel travelling the length of the UK's east coast).
- RYA Scotland felt operational safety zones are not effective and they are not recommended. Excluding boats from these areas is not effective mitigation as not all vessels are necessarily aware of the operational safety zones and it is impractical to police these across a site as large as this (and could potentially harm relations with other sea users). For the floating offshore substation platforms, this may be different as the structure extends further under sea than above and is therefore not visible.
- RYA Scotland agrees with the export cable route option. It wasn't felt there was any anchoring risk to recreational vessels as their anchors only run to about 20cm depth.
- If rock placement is utilised in areas where export cables can't be buried, these areas need to be clearly identified: it would be helpful to include these areas in *The Yachtsman's Pilot to North and East Scotland* by Martin Lawrence.
- SE-NW recreation vessel routingrouting is the key route. RYA Scotland stated it would be good to have a channel through the zone.
- MORL said that, whilst a specific navigation channel as such was not proposed, it was likely that there would be channels between the wind farms, and also potentially "wind regeneration zones" with a row of turbines missing.
- Also, spacing between turbines will be a minimum of 580m and up to 1.7 km.
- Marking and lighting should be agreed with the NLB.

5.7 Local Ports and Ship Operators

A number of local ports and the operator of a tanker route through the area were consulted in the Moray Firth due to the proximity to the site.

A summary of the port/harbour consultation meetings are given below:

- **Inverness** – was noted for potential to accommodate support vessels up to 6m draught and the harbour has no exposure to swell (open all year).
- **Invergordon** – was noted for potential to accommodate support vessels and harbour access is generally not affected by swell/weather. Invergordon Harbour stated that the cable route would be of interest outside the harbour limits around the south west extents of the Moray Firth as this was used for vessel moorings.
- **Wick** – was noted for potential to accommodate support vessels up to 4.5m draught; however the harbour had limited access in south easterly gales. It was noted that it would be necessary to notify Wick Harbour when offshore surveys were planned through Notice to Mariners.

From analysis of the shipping survey data it was observed that a Vadero Tank AB oil and chemical products tanker (*Vedrey Hallarna*) was recorded regularly navigating within the area of the proposed wind farm developments and as a result were registered as a Marine Stakeholder for the project.

Feedback on the potential development including any impact it may have on the navigation of Vadero Tank AB vessels was requested and no reply was received at the time of writing.

5.8 Hazard Review Workshop

A hazard review workshop held in Inverness on the 6th July 2011 (see Appendix A for further details). The purpose of the workshop was to identify and review the potential navigational hazards associated with joint developments in the MORL Zone, EDA and Beatrice Offshore Wind Farm.

More details on the workshop are provided in Section 12; however the key notes from the meeting are as follows:

- A question was raised as to whether there will be no anchorage zones around the offshore export cable route. It was noted that it is not good practice to anchor in the vicinity of cables and that where feasible the cables will be buried as well as being marked on hydrographic charts.
- It was asked what the maximum height of the turbines above sea level could be. (The maximum tip height above sea level is approximately 204m).
- It was pointed out that shuttle tankers associated with the Athena Field visiting the Cromarty Firth may pass in the vicinity of the development. It was also pointed out that Ithaca Energy is looking at the possibility of bringing in LNG regasification vessels to do transfer operations at the Nigg Terminal.
- A question was asked whether they will be allowed to fish in amongst the turbines. It was stated that this is unknown at the present (July 2011).
- A question was raised as to how the fisheries liaison is to be carried out, and whether guard vessels will be used during the construction of the developments. It was stated that liaison will be carried out with the groups having been set up. It is not known as yet if guard vessels will be used.
- It was pointed out that vessels sometimes have the cable layer switched off in the Electronic Chart Display and Information Systems (ECDIS) system which has led to them anchoring over pipelines and cable routes.

- During severe weather in the North Sea, vessels may anchor for shelter off the Moray coast. This includes shuttle tankers, supply vessels, survey and cable laying vessels.
- It was stated that Mobile Offshore Drilling Units (MODU's) under tow into Cromarty Firth need to be considered. The Hutton TLP went astray when under tow from Murmansk to Nigg.
- In terms of floating turbines, the possibility of the turbine base moving on the seabed, and therefore the exact position of the turbine being unknown, was identified as being a concern.
- It was noted that submarine activity within the Moray Firth needs to be considered.
- It was pointed out that the Beatrice Alpha platform already has a radar fitted.
- In terms of ship-to-ship collision it was noted that potential collisions between traffic routingrouting around the wind farm and vessels exiting the wind farm (such as a maintenance vessel) could be an issue. Radar interference could also be an issue in this situation.
- It was noted that the Beatrice safety case will need to be updated due to the addition of the wind farms in the area.

5.9 Oil and Gas Consultation

A meeting was held in Aberdeen on the 7th July 2011 to identify and review the potential navigational issues associated with the proposed MORL Zone and Beatrice Offshore Wind Farm developments in relation to adjacent offshore oil and gas operations. Key notes recorded at the meeting are provided below:

- Talisman asked if AIS marking was to be used on any of the proposed wind farms. It was noted that this is not currently a requirement, but it is something which would be discussed with NLB as the projects are being considered for marking. AIS would not be used on individual turbines, if used as Aids to Navigation (AtoN) on the sites.
- Wood Group pointed out that both companies may wish to consider boat access platforms on the Substations. They are used on the Jacky platform and work well, with the Wind Cats able to access the platform in up to 2.4m wave heights.
- The Wind Cats approach the Jacky platform from Buckie, so access will not be an issue for them as a result of the developments.
- A key issue is the access to the Jacky platform from helicopters, for both search and rescue as well as when a rig is working over the platform. Access will also be required to bring the rig in, with around 3 support vessels. Turbines 0.5nm from the installation could be too close and this will need to be discussed in more detail with Ithaca a (on-going consultation will ensure issues are addressed).
- Recent rig operations at Jacky could be reviewed to assess what the likely requirements would be for bringing a rig in.
- It was also pointed out that Jacky could be decommissioned in 2014/15, but this is largely dependent on what else happens in the area, future possible tie-ins and the Polly development. The Polly location is approximately 2nm to the south east of the Beatrice Field[1].
- Access will also be required for bringing heavy lift vessels to decommission the installation. In addition, the decommissioning of the Beatrice Field could be an issue for Talisman.

[1] It is noted that revised plans in 2012 indicate that the Polly drilling location may not go ahead.

- There is also the possibility of tanker offloading in the area. There are no current plans, but it remains a potential future option.
- MCA noted the importance of working with the offshore operators and the MCA on Emergency Response Plans, and to note that helicopter SAR operations may not always be possible within the site and the SAR operations may be surface only.
- A question was raised as to how the wind farms would react in the event of an environmental incident in the Moray Firth, such as a Deepwater Horizon oil spill type incident. The potential impact of the developments on oil spill response plans was also raised. There would need to be some form of collaboration on this. (As noted above, on-going consultation is planned to ensure all issues are addressed between stakeholders with a collaborative approach planned between the two developers, BOWL and MORL).
- The MCA are happy to assist with the formulation of any emergency response plans for the area.

6. EXISTING ENVIRONMENT

6.1 Introduction

This section presents the following baseline information relating to navigation in the Moray Firth area:

- Ports
- Navigational Aids
- Sailing Directions
- Wrecks
- Oil & Gas Infrastructure
- Exercise Areas
- Metocean data

6.2 Geographical Scope

Moray Firth comprises of the sea area stretching from a line joining Duncansby Head and Rattray Head. Moray Firth also encompasses a number of coastal harbours and two important water ways:

- Cromarty Firth (for access to Nigg and Invergordon)
- Inverness Firth (leads to the Port of Inverness and to the northern entrance of the Caledonian Canal)

A chart of Moray Firth relative to the main ports and harbours is presented in Figure 6.1.

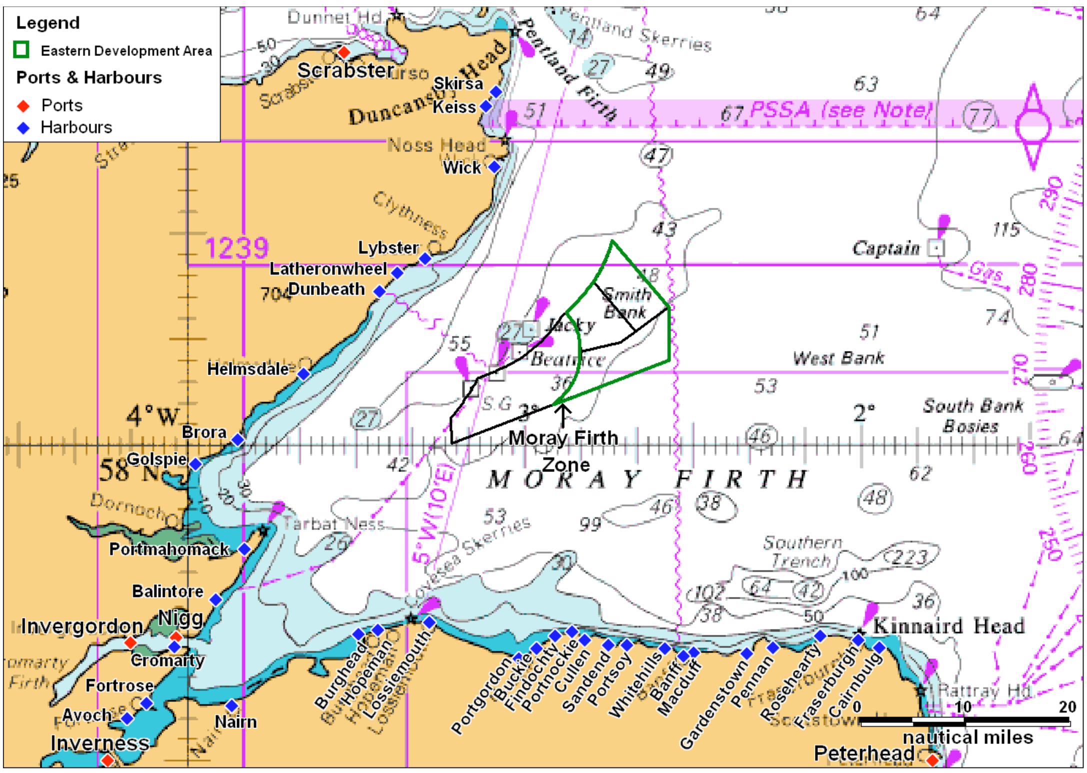


Figure 6.1 Overview of Moray Firth Ports and Harbours

6.3 *Port Facilities/Services*

Wick Harbour is the nearest port to the three wind farm sites which handles commercial vessels, located approximately 13nm north east of the Telford wind farm.

Figure 6.2 Overview Image of Wick Harbour

The following sub-sections give details on port approaches and facilities at Wick Harbour.

6.3.1 Port Information

Wick Harbour consists of three basins:

- The Inner Harbour - the main fishing and leisure berthing area and gives access to a 70 berth Marina. The Lifeboat berth is adjacent to the Royal Navy Lifeboat Institution (RNLI) Station.

- The Outer Harbour - is used for temporary berthing, fuelling, smaller cargo vessels and leisure berthing.

- The River Harbour - is the main commercial quay, in regular use, and larger vessels wishing to use this area should consult the local information board or the Harbourmaster about shipping movements.

6.3.2 Wick Port Approaches

Admiralty Chart 1462 gives details on approaches into Wick; however the following description gives information on approaches to the Outer and River Harbours.

The Outer Harbour is identified from the South Pier Sector Light flashing **Green**/**White**/**Red** every 3 seconds. Leading lights into the Outer Basin are two fixed **Red** lights in line, 20 metres apart, near the end of South Pier, (not visible until the entrance is accessed).

The River Harbour and Harbour Bridge is marked by a **White**/**Red**/**Green** 4 second light. Entrance between the North and South River Piers is marked by double **Red** and **Green** vertical fixed lights.

Port Closed Signal - A **black** ball is hoisted by day, or a fixed **Green** light shown by night, on a prominent mast at the South Head.

6.3.3 Limiting Conditions

The maximum length of vessels is 85m. (Vessels over 85m must consult the Harbour master for restrictions). Details of the limiting conditions of the harbour are given below:

- Total quays = 1,366 metres.
- Depth alongside-Inner/Outer = 1.71m
- River Basin = 4.2m

It is noted that there is a sandbar outside the River Basin which has a charted depth of 2.6m (March 2010).

6.3.4 Pilotage & Tugs

Pilotage is compulsory in Wick Harbour for vessels over 90 gross tonnes (GT), except fishing vessels and yachts. Pilots normally board about 4.5 cables (830m) north east of South Head from a dark hulled motor boat with yellow super-structure on which the word 'PILOTS' is painted in black.
No tugs are available at Wick or nearby Scrabster; however JP Knight (Caledonian) operates four tugs that work out of Cromarty Firth (approximately 45nm south west of the three proposed wind farm sites).

An example image of a tug operated by JP Knight is shown in Figure 6.3.

Figure 6.3 Tug Vessel *Kintore*

6.3.5 Anchorage

Within Wick Bay there is an outer anchorage, which offers a sheltered haven on a sandy bottom during winds from south to south west through north to north east.

In addition, in calmer weather conditions Sinclair's Bay gives a location for anchorage, however it is not safe if sea state and weather is rough. The best anchorage is in the southern part of the bay in a depth of 16m, during winds from the south west and south east.

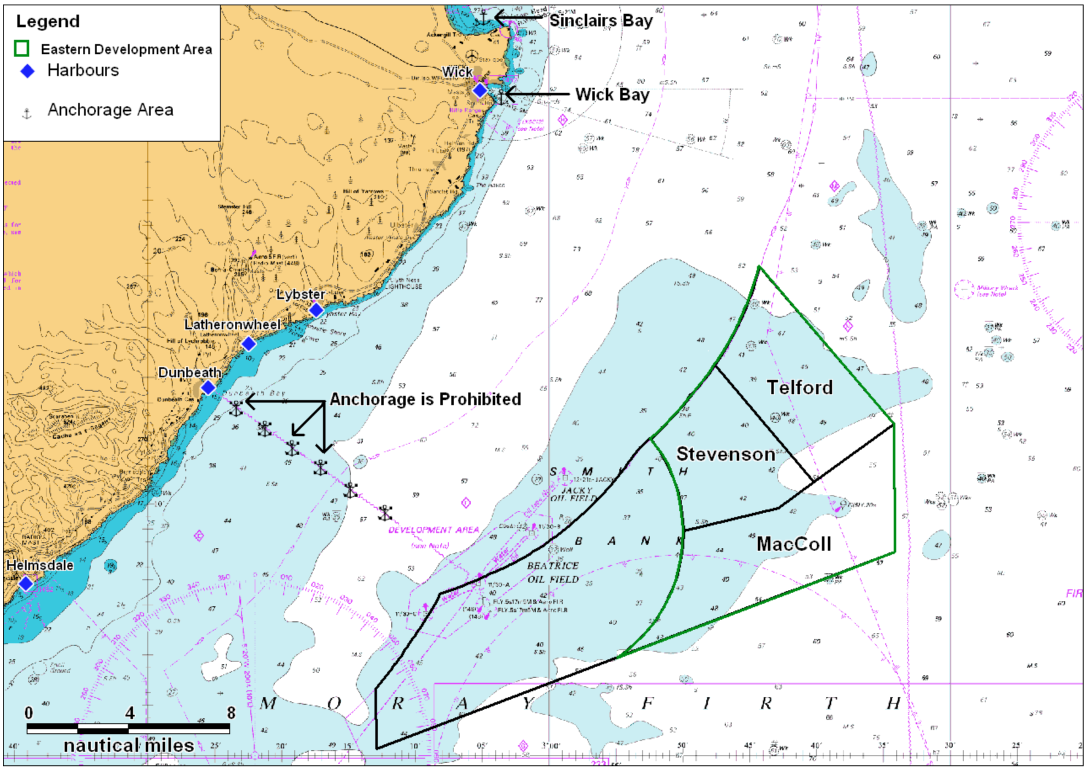


Figure 6.4 Anchorage Areas and Ports/Harbours relative to the EDA

It is noted that anchorage is prohibited in the vicinity of a submarine power cable from Beatrice Oil Field which lands in Dunbeath Bay. An analysis of anchoring within the Moray Firth is presented in Section 8.5.

6.4 Navigational Aids

A plot of the principal navigational aids within the inner Moray Firth presented in Figure 6.5.

The principal lights and buoys are those listed in Admiralty Sailing Directions for the area (Ref. vi). The buoy and light positions are taken from Admiralty Charts of the area.

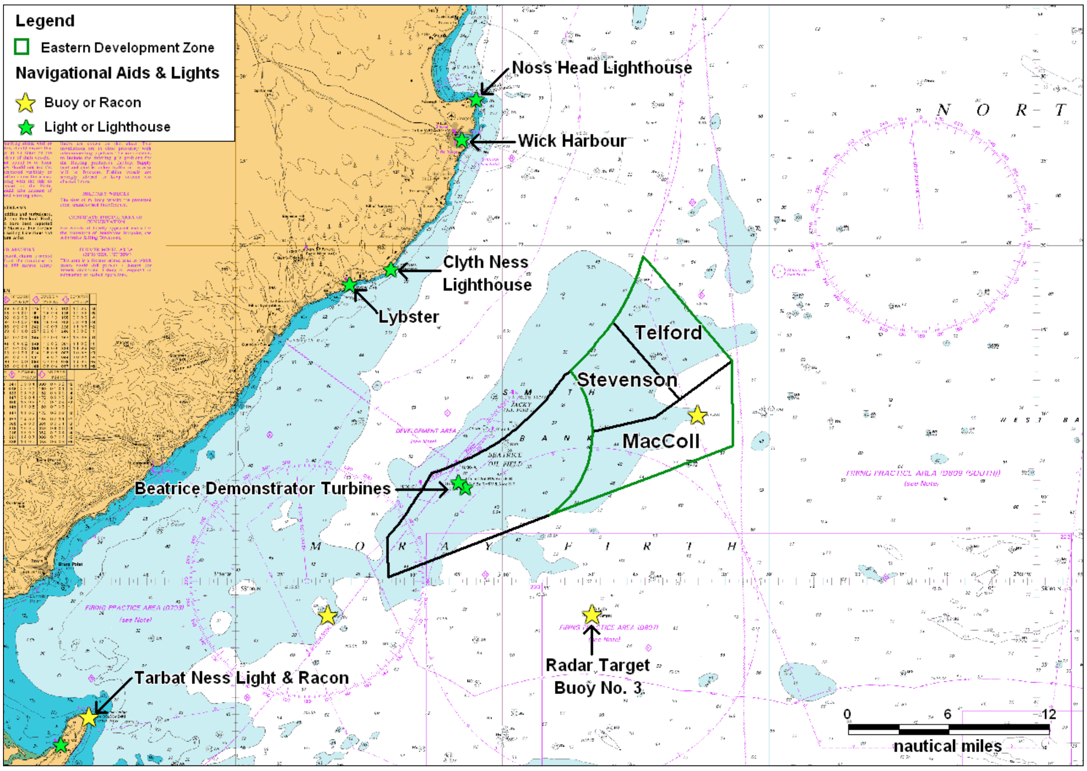


Figure 6.5 Overview of Navigational Aids in Moray Firth

The main navigational aids in the area are lights marking the two demonstrator wind turbines at Beatrice Oil Field (approximately 5.3nm west). In addition, there are three lighthouses located at Clyth Ness, Noss Head and Wick, within 12 to 14nm of the Stevenson and Telford wind farm boundaries.

It is noted that the Radar Target Buoy Number 3 (located approximately 6.5nm south of MacColl wind farm) in the centre of Firing Practice Area D807 is used for RAF weapons targeting and training purposes.

6.4.1 Marine Environmental High Risk Areas

There are two Marine Environmental High Risk Areas (MEHRAs) located within 40nm of the three proposed wind farm sites, a chart of these is presented in Figure 6.6.

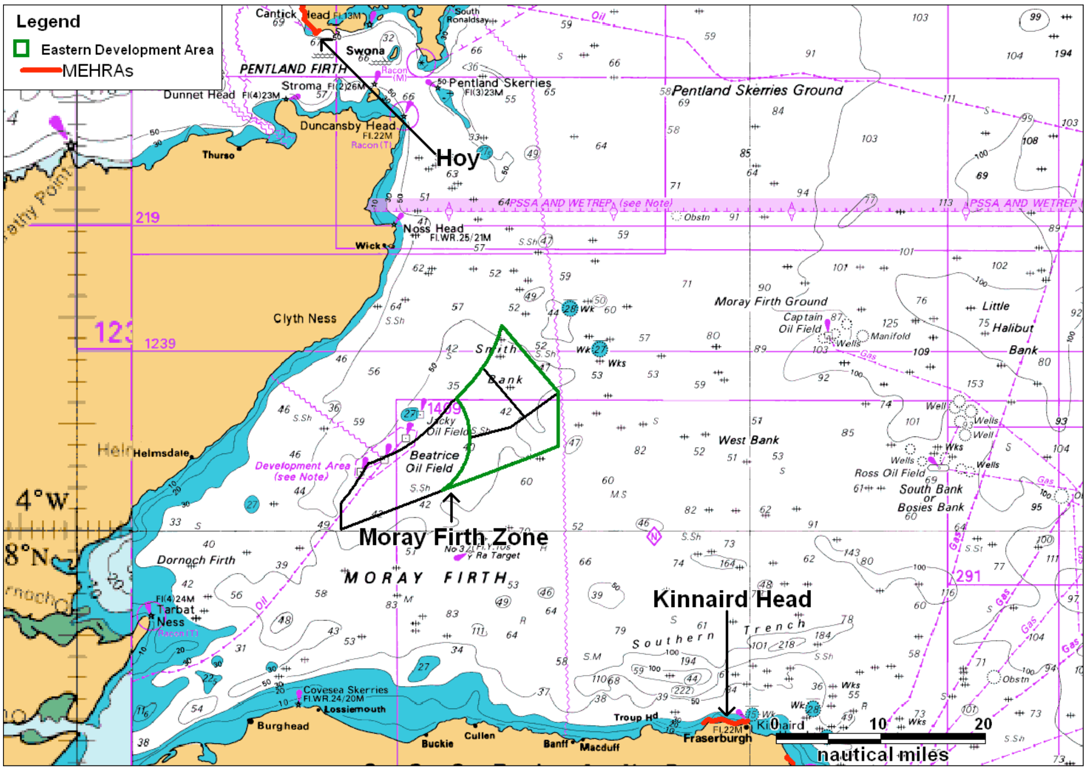


Figure 6.6 Overview of Nearby MEHRAs

Tor Ness in Hoy (part of the Orkney archipelago) and Kinnaird Head (between Rosehearty and Fraserburgh) have been identified as a MEHRAs by the UK Government, (i.e. an area of environmental sensitivity and at high risk of pollution from ships.)

The Government expects mariners to take note of MEHRAs and either keep well clear or, where this is not practicable, exercise an even higher degree of care than usual when passing nearby.

6.5 Sailing Directions

Sailing directions for the area are presented in the North Sea (West) Pilot (Ref. vi). A plot of the routes for vessels bound from Rattray Head and Duncansby Head to Inverness is presented in Figure 6.7.

The arrows are not accurate if superimposed on a chart but they illustrate the general passages used by ships. A description of the route passing the wind farm area from Duncansby Head to Tarbat Ness is given below.

- (4.20) From a position 2.25 East of Duncansby Head (58° 39' N, 3° 01' W) on the alignment (328°) of Swona Light (58° 44' N, 3° 04' W) and Cantick Head light (3.5nm north by north west) the coastal passage leads south passing east of the Stacks of Duncansby (8 cables south), a group of detached rock pinnacles lying close under the cliffs; the rugged top of the highest stack, which is also the outermost, can be seen projecting above the adjacent land. Then, East of Fast Geo Head (2nm south) which is fringed by dangerous rocks. Then, East of Skirza Head (2.75nm south), an abrupt cliff, 30m high, with several caves in its base. Then, east of Noss Head (10nm south). Then, east of Wick Bay (12.5nm south), noting dangerous wrecks lying respectively 8 cables north east and 2.5 cables south east of South Head; a harbour signal station stands on the South Head (7.5 cables south by south west of North Head), and the ruins of Castle of Old Wick, a prominent square tower,, stand on the cliff edge about 5 cables farther south by south west. Thence: East of Clyth Ness (58° 19' N, 3° 13' W) on which stands a light (white tower, red band, 13m in height). The headland is fringed by a detached and partly drying rock ledge.
- (4.44) The route from Clyth Ness to Tarbat Ness leads south west for 32nm passing north west of the Beatrice Oil Field and associated offshore development area.

APPENDIX 5.2 D

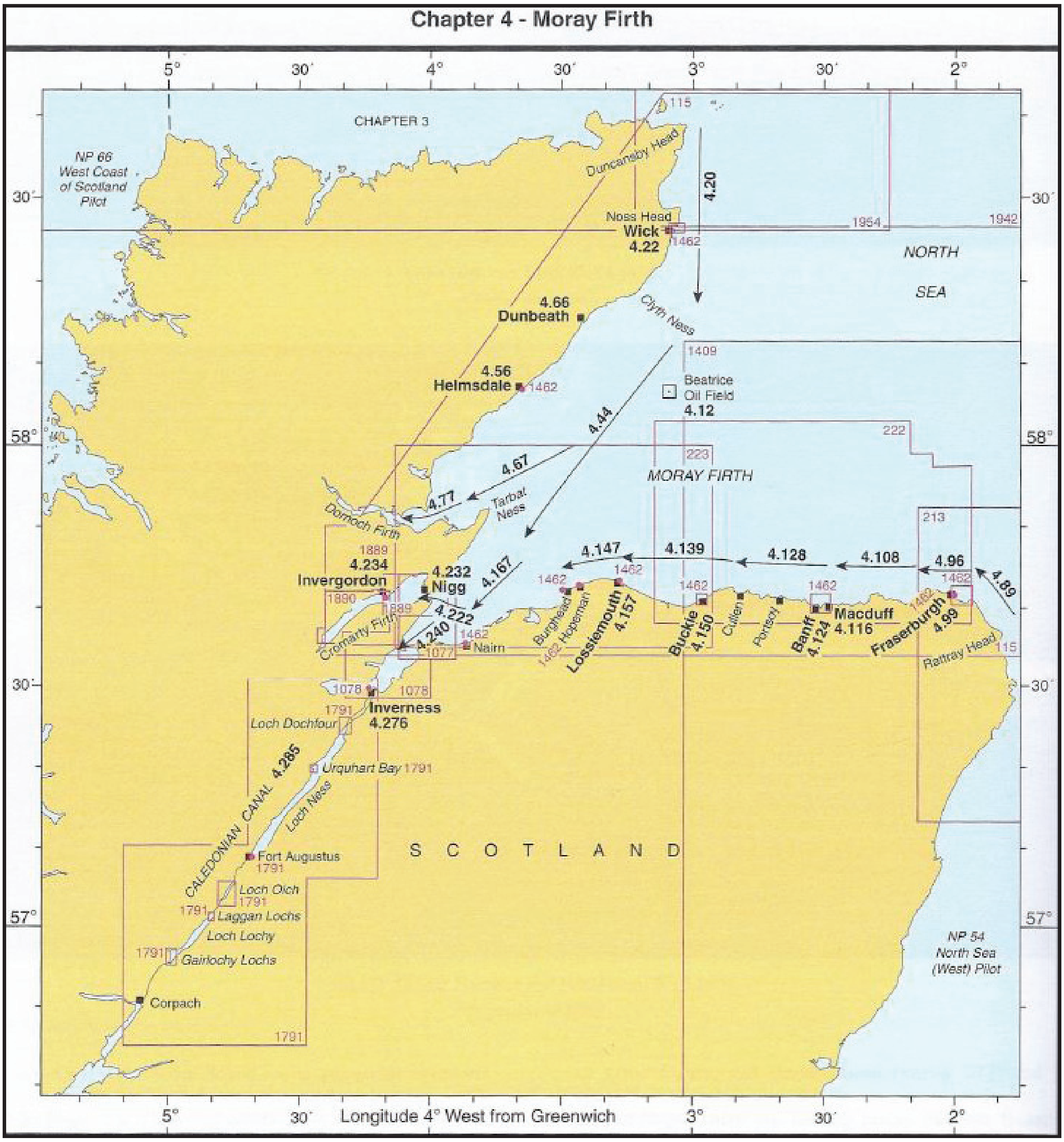


Figure 6.7 Routes from Duncansby and Rattray Head to Inverness (Ref. vi)

6.6 Wrecks

Based on the admiralty charts of the area there are three wrecks are marked within the Telford wind farm boundary and one wreck approximately 220m south of the MacColl wind farm boundary, as show in Figure 6.8.

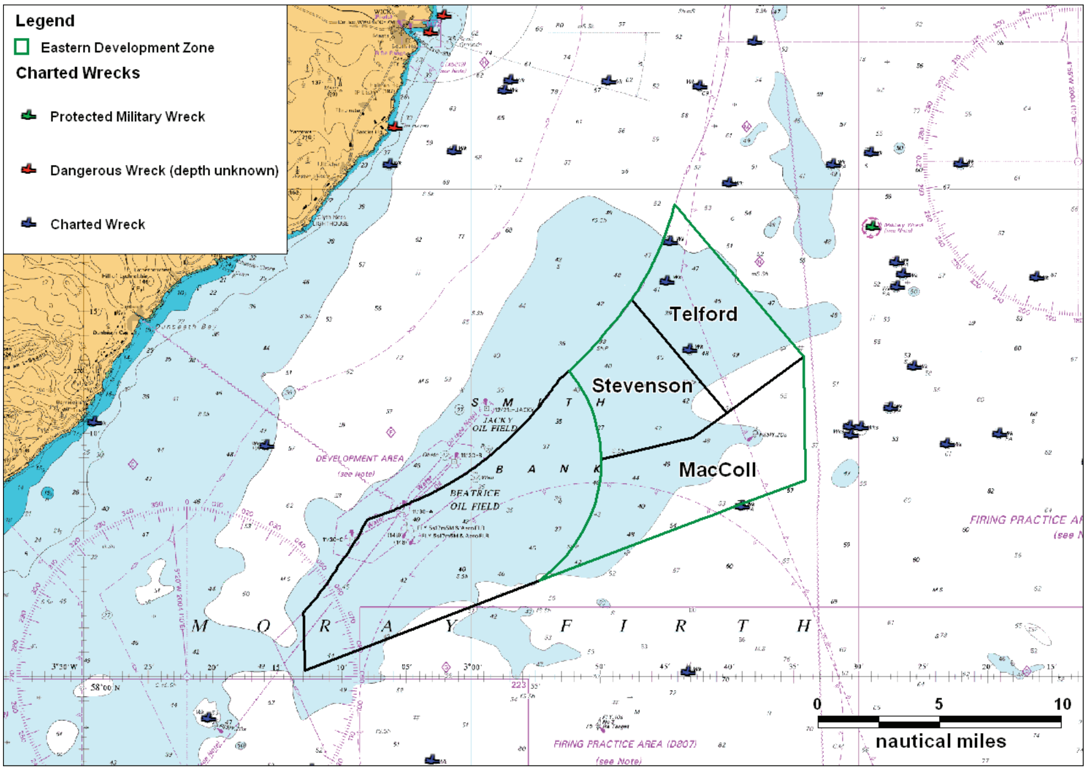


Figure 6.8 Charted Wrecks relative to Proposed Sites

There are also three wrecks located 2.3nm east of the MacColl wind farm and a protected military wreck 5.6nm north east of the Telford wind farm.

APPENDIX 5.2 D

6.7 Oil & Gas Infrastructure

The licence blocks in the area of the proposed wind farm are presented in Figure 6.9.

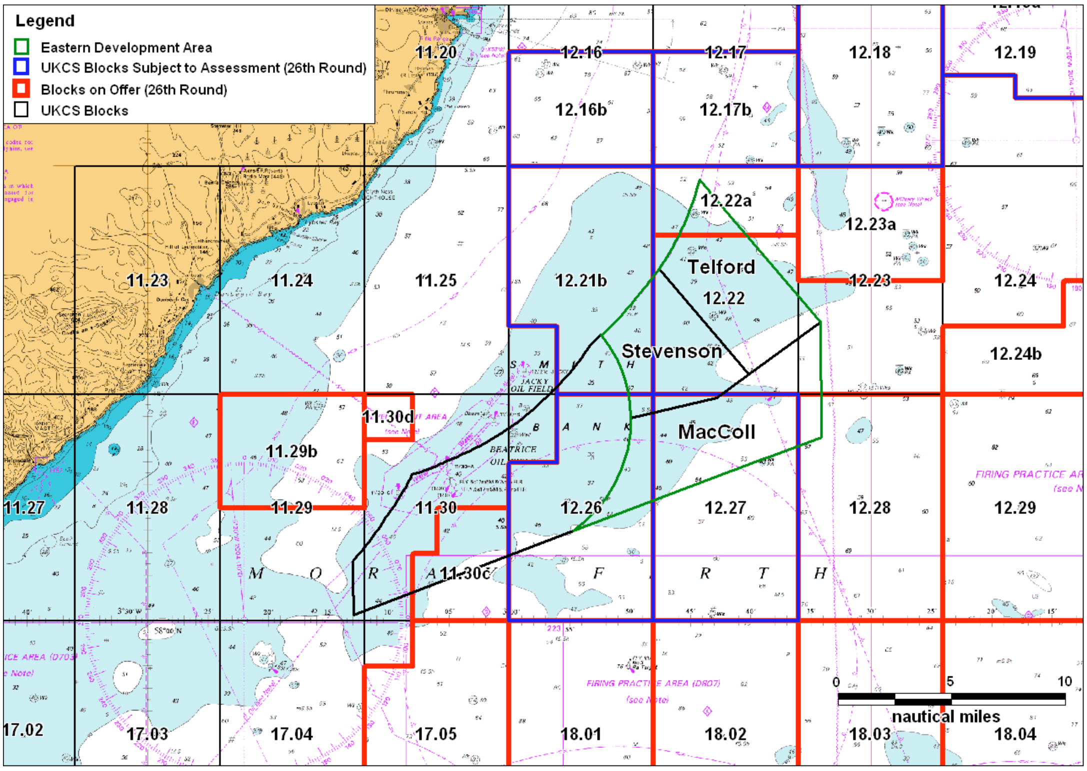


Figure 6.9 Oil & Gas UKCS Blocks, Installations and Licence Areas

The proposed sites intersect UKCS Blocks 12/21b, 12/22, 12/23, 12/26, 12/27 and 12/28. A number of these blocks were on offer as part of the 26th round of UKCS licensing. At the time of writing (January 2012) a number of UKCS blocks intersecting the proposed sites were only to be licensed following an appropriate assessment and could be withheld from offer (subject to environmental consideration).

The nearest existing offshore surface installation is at the Jacky Field which lies 3.7nm east of the Stevenson wind farm boundary.

It is noted that Blocks 11/24, 11/25 & 11/28 are of concern to the MoD as they lie within training ranges.

Figure 6.10 presents a detailed overview of the nearby oil fields (Beatrice and Jacky) and wells (appraisal, exploration and development) relative to the proposed sites.

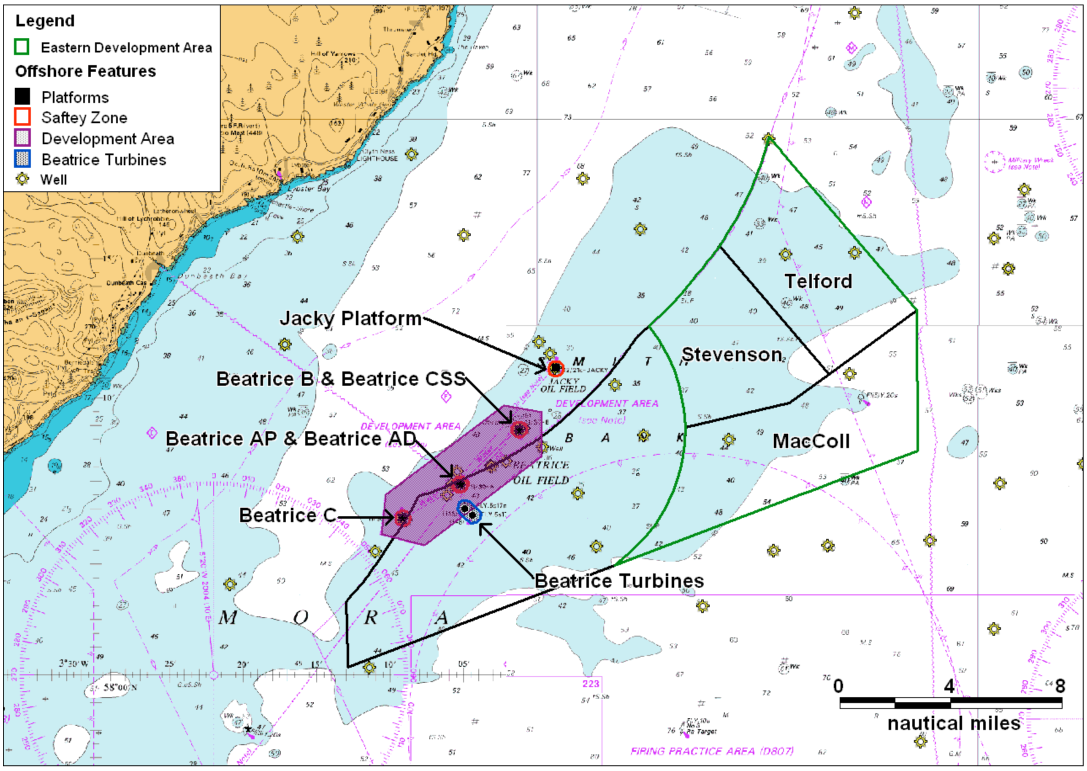


Figure 6.10 Detailed plot of Oil & Gas Installations and Wells in the Area

There are five exploration wells located within the proposed sites (two originally operated by BP Exploration, one Premier Oil Exploration, one Talisman Energy and one through Total). The most recent exploration well was drilled by Talisman in 2002 within the eastern area of MacColl wind farm; however at the time of writing (December 2011) this well was plugged and abandoned.

It is noted that during May 2011 the Jack-up drilling rig *Energy Enhancer* was located over the Jacky Platform working on the J03 well. However, drilling of the well was suspended and work is been carried out to determine whether to re-instate the operation.

6.8 Other Wind Farm Developments

Figure 6.11 presents the nearby offshore wind farm developments within the Moray Firth.

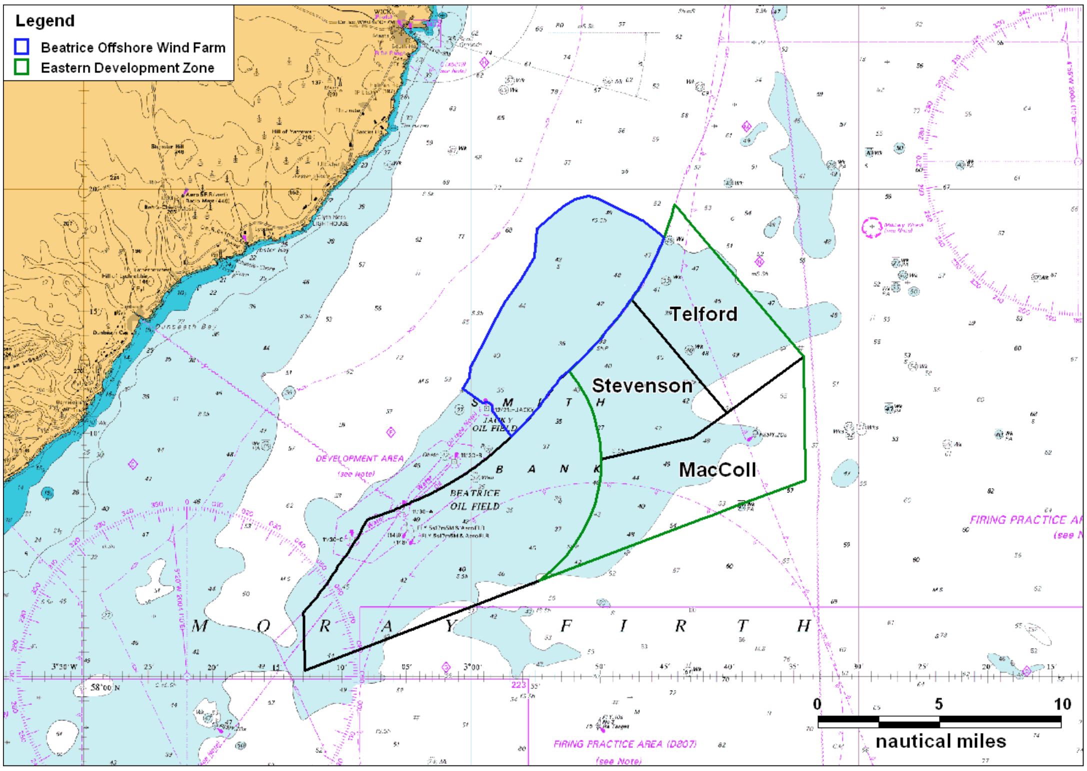


Figure 6.11 Other Wind Farm in proximity to the Moray Firth Round 3 Zone

MORL Zone is located along the south western boundary of the Beatrice Offshore Wind Farm.

It is also noted that a Scottish Hydro Electric Transmission Limited (SHETL) interconnector cable from Shetland Islands and associated substation (hub) is planned to the east of the MORL Zone. This cable is been developed to link possible renewable energy projects in Shetland and northern Scotland to the mainland.

Furthermore, the SHEtland and FAroe Islands (SHEFA) communications cable is planned to run through the Moray Firth, from Manse Bay (Orkney Islands) to Banff on the Aberdeenshire coastline.

The cumulative impact on shipping and navigation from the proposed wind farms and SHETL / SHEFA cables is discussed within the cumulative impact assessment, Section 17.

6.9 Exercise Areas

The entire Moray Firth area is encompassed in the Royal Air Force (RAF) Northern Managed Danger Area (MDA), which is a military practice zone for high altitude RAF training exercises. Figure 6.12 presents the main military and practice areas in the region relative to the proposed sites.

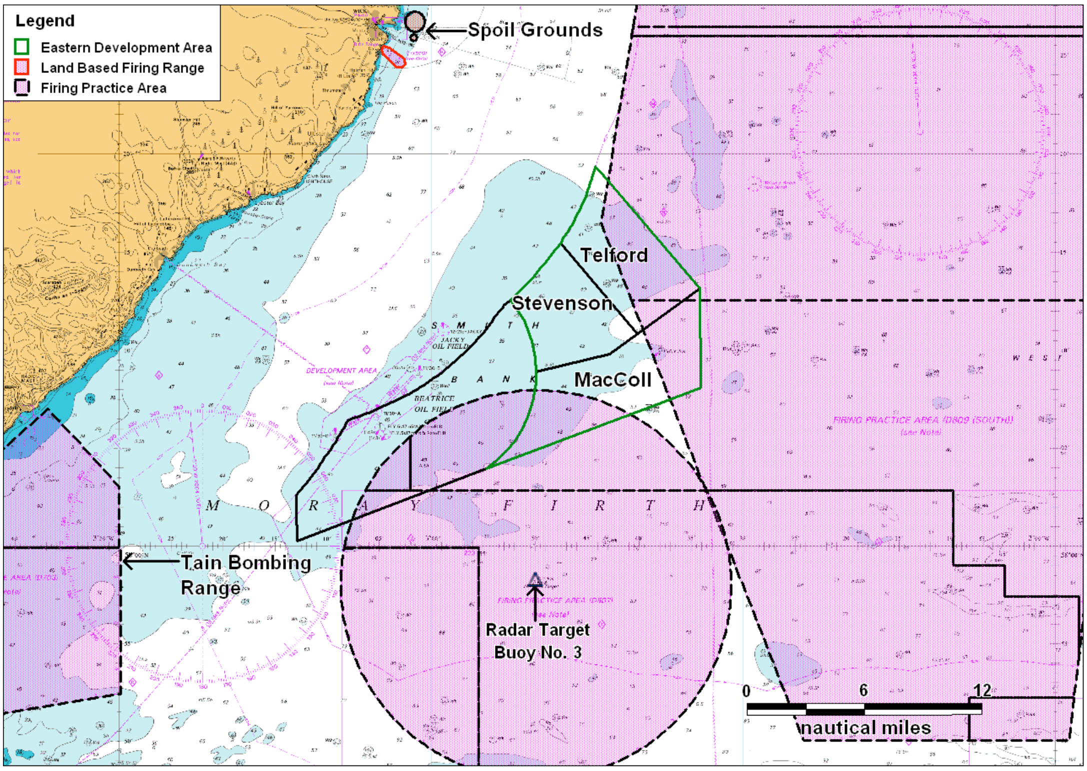


Figure 6.12 Military Practice Areas relative to the Proposed Sites

The main military navigational features relate to the RAF military Practice and Exercise Areas (PEXA's). Firing Practice Areas D807 and D809 intersect part of the MacColl and Telford areas. Tain Bombing Range is also located approximately 20nm south west of the MacColl wind farm.

There is a rifle firing range in Wick (Old Wick) which is 11nm north west of the Telford wind farm, as shown in Figure 6.12. No restrictions are placed on the right to transit the Wick (X5819) firing practice area at any time and they operate a clear range procedure with exercises only taking place when the area is clear of shipping.

6.10 Metocean Data

6.10.1 Introduction

This section presents Metocean statistics for the Moray Firth area which have been used as input to the risk assessment.

According to the Admiralty Sailing Directions (Ref. vi), the west North Sea region enjoys a generally mild climate. Winds blow from between the south and south west most usually, and are often fresh or strong. Gales are more common in the winter months, although they still may occur during the summer.

Rainfall is not considerable, and there is little variation throughout the year. Squally showers with winds between north west and north east are often accompanied by snow in winter. It is frequently cloudy throughout the year; however, the winter months are more susceptible to overcast skies.

Fog (or haar) occasionally affects the east cost of the UK, particularly in the north. In winter, the coastal areas of the Moray Firth are subject to radiation fog that forms inland and is generally most dense around dawn.

6.10.2 Wind and Wave

Meteorological wind and wave data for the area has been summarised from wind data recorded in the area (Ref. vii) and (Ref. viii).

The wind direction distribution is presented in Figure 6.13. It can be seen that the predominant wind direction is from the south to west.

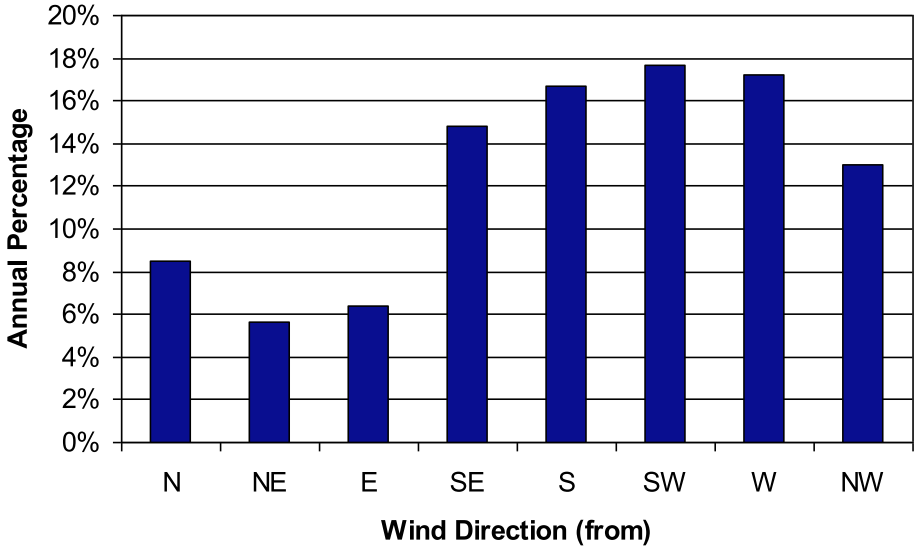


Figure 6.13 Average Annual Wind Direction Distribution

The percentage exceedence distribution of significant wave height for the Moray Firth area is presented in Figure 6.14.

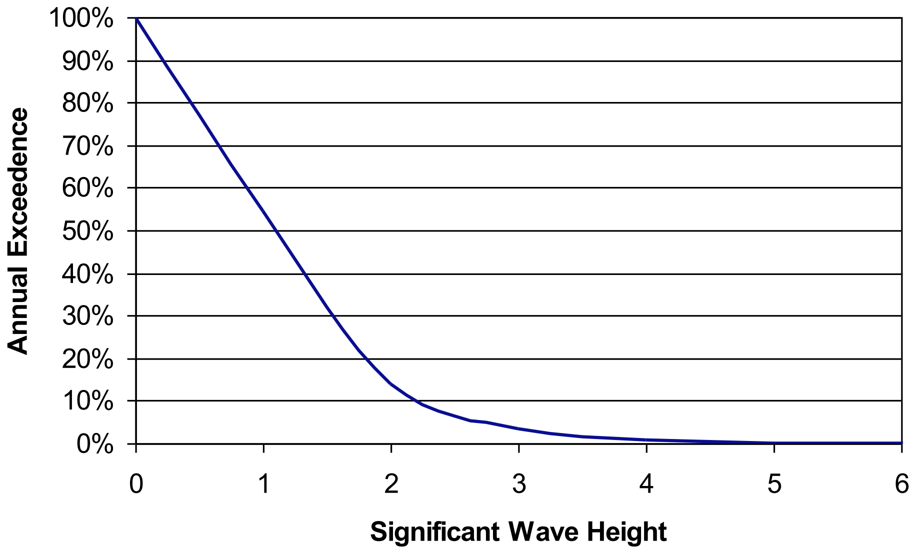


Figure 6.14 Annual Wave Height Exceedence Curve for the Area

The frequency of severe sea states (significant wave height exceeding 5m) is approximately 0.1% per year.

6.10.3 Visibility

Historically, visibility has been shown to have a major influence on the risk of ship collision.

Visibility data was obtained from Wick. The number of days with fog per month over 11 years of data is presented in Figure 6.15.

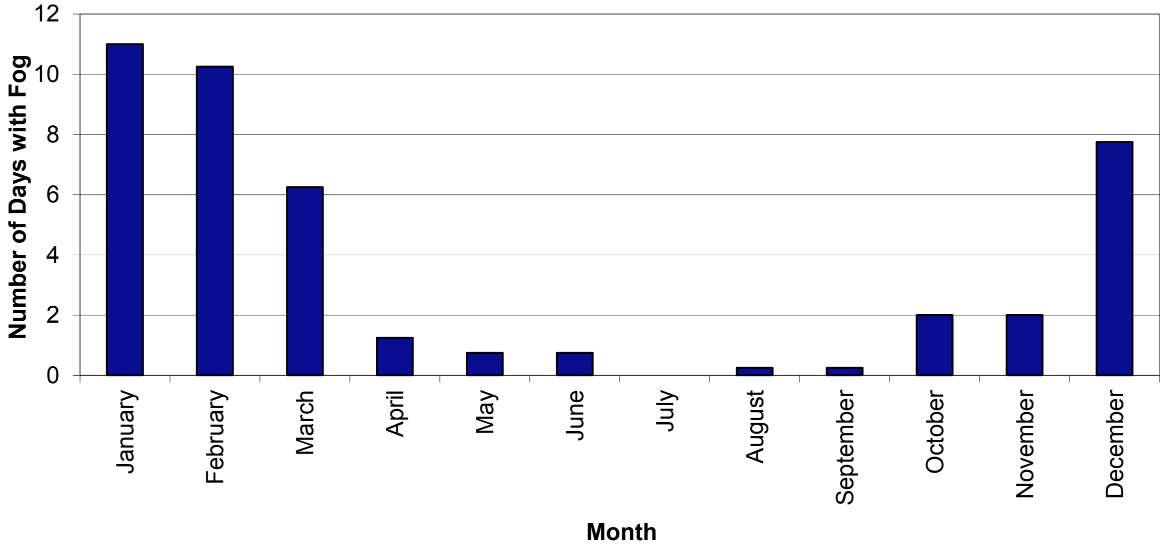


Figure 6.15 Monthly Distribution of Days with Fog (1995-2005)

It can be seen from the above figure that fog is more common between December and March and occurs less frequently from July to September. It is noted that days with fog at Wick are likely to be higher due to geography (land meeting sea and subsequent temperature differences) therefore offshore visibility data was more relevant for ship collision modelling.

APPENDIX 5.2 D

The annual probability of visibility less than 1km for the UK North Sea is approximately 0.03, i.e., approximately 3% of the year.

6.10.4 Tide

A description of the tidal streams in the general area is provided below (Ref. vi):

> The tide on the north coast of Scotland is predominantly semi-diurnal and progresses east along the north coast and through the Orkney and Shetland Island thence south down the East coast. Ranges are about 3m in the Orkney Islands, 2m in the Shetlands Islands and 4m at the head of the Moray Firth.
>
> Tidal streams are very strong of Duncansby Head and fairly strong off Rattray Head and in the inner part of the firth, they are generally weak elsewhere, both in the eastern approaches to and within, Moray Firth.
>
> Currents in the North Sea are generally very variable and much affected by existing, and recent, local weather. There is a very weak clockwise circulation around the shore of the Moray Firth. When there is high snow melt in spring, and during and after heavy rain or western gales, temporary but quite appreciable local currents emerge from the Dornoch, Cromarty and Inverness Firths.

Chart Datum and Ordnance Datum for the proposed sites based on values recorded at Wick are presented below.

Table 6.1 Chart Datum and Ordnance Datum Figures from Wick

Tidal Level	Height above Chart Datum
HAT	4m
MHWS	3.5m
Mean Sea Level (MSL) (approx.)	2.1m
Mean Low Water Springs (MLWS)	0.7m
LAT	0.1m

Admiralty Chart 115 (Tidal Diamond "N" approximately 1.1nm north east of the Telford wind farm area) indicates that currents in the area set in a generally south easterly direction on the flood and northerly direction on the ebb, with a peak spring tidal rate of 1.2 knots and peak neap rate of 0.6 knots.

During consultation with NLB (see Section 5.4) it was noted that strong tides can run south into the EDA and combined with a strong south easterly wind against the tide, can result in large waves during the flood tide.

RYA/CA consultation (Section 5.5) also highlighted that sailing yachts can be pushed into the development zone by the tide when sailing north towards Pentland Firth.

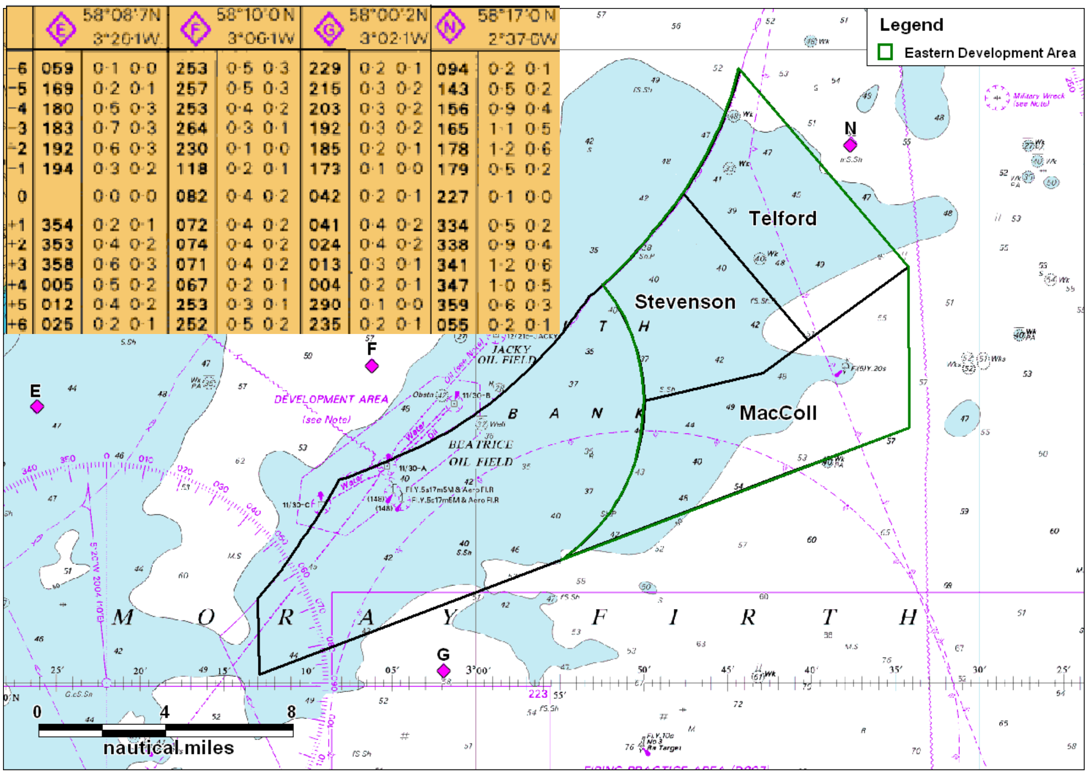


Figure 6.16 Tidal Stream Data for the Proposed Sites (Tide Point "E, F, G and N")

7. MARITIME INCIDENTS

This section reviews maritime incidents that have occurred in the vicinity of the Moray Firth Zone and proposed sites in the last ten years.

The analysis is intended to provide a general indication as to whether the area of the proposed development is currently a low or high risk area in terms of maritime incidents. If it was found to be a particular high risk area for incidents, this may indicate that the development could exacerbate the existing maritime safety risk in the area.

Data from the following sources has been analysed:

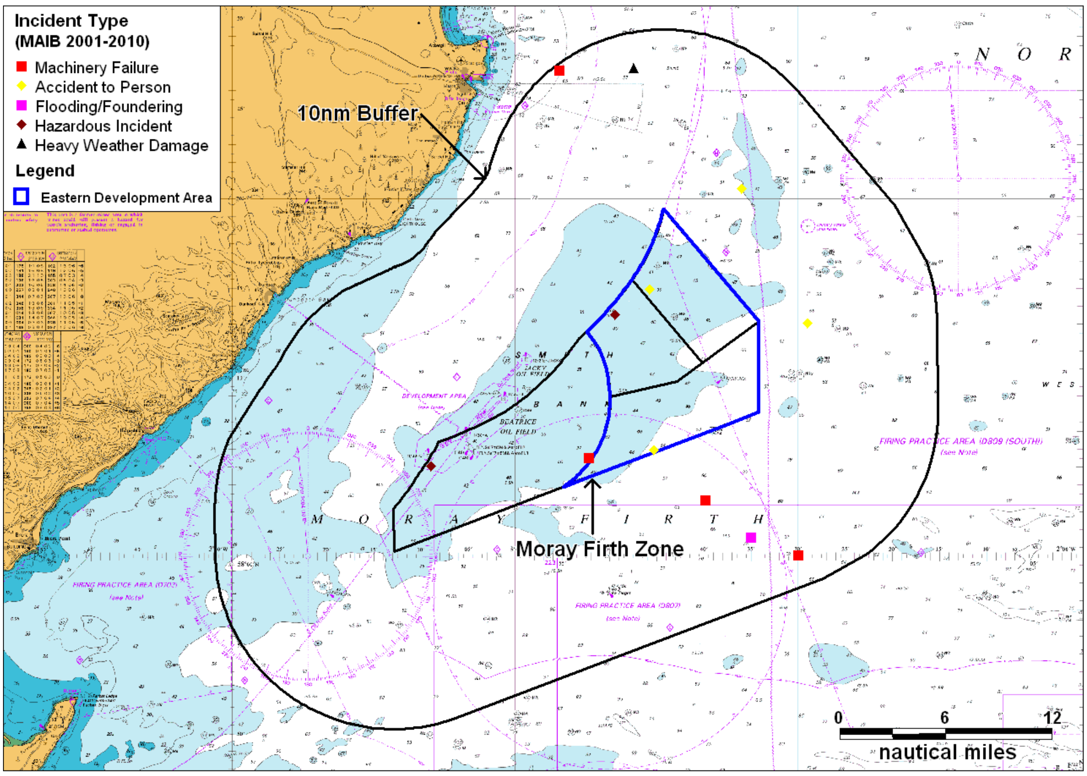
- Marine Accident Investigation Branch (MAIB)
- Royal National Lifeboat Institution (RNLI)

(It is noted that the same incident may be recorded by both the sources.)

7.1 MAIB

All UK commercial vessels are required to report accidents to MAIB. Non-UK vessels do not have to report unless they are in a UK port or are in 12 mile territorial waters and carrying passengers to a UK port. There are no requirements for non-commercial recreational craft to report accidents to MAIB.

The locations[1] of accidents, injuries and hazardous incidents reported to MAIB within 10nm of the MORL Zone for the last ten years between January 2001 and December 2010 are presented in Figure 7.1, colour-coded by type.



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

Figure 7.1 MAIB Incident by Type within 10nm of Morl Zone

A total of 12 unique incidents involving 12 vessels were reported in the area, corresponding to an average of just over 1 per year.

The overall distribution by incident type is presented in Figure 7.2.

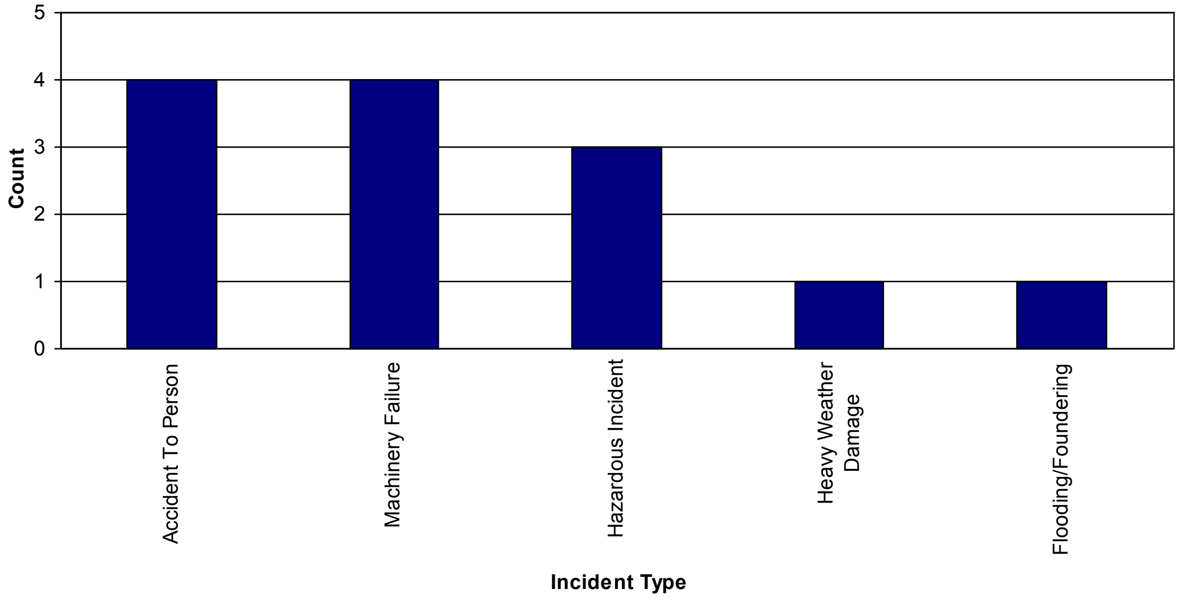


Figure 7.2 MAIB Incidents by Type within 10nm of Morl zone (2001-10)

The most common incident types recorded within 10nm of the MORL Zone were accident to person, machinery failure and hazardous incident representing 85% of all incidents over the ten year period.

Figure 7.3 presents the distribution of incidents per year in the area.

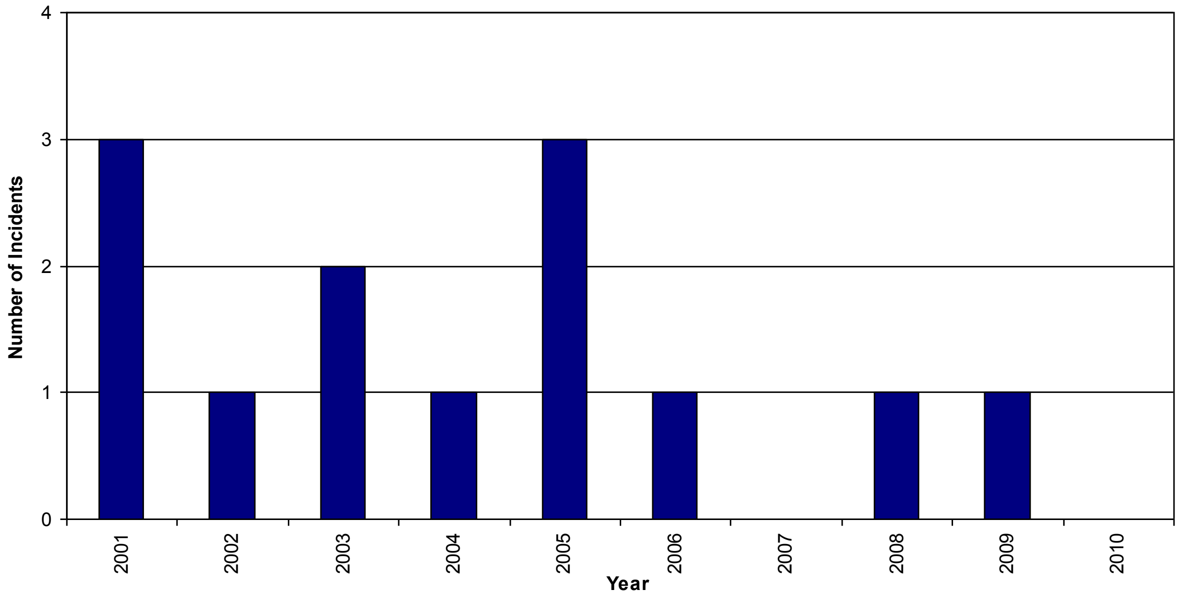


Figure 7.3 MAIB Incidents by Year within 10nm of MORL Zone (2001-10)

The highest number of incidents within 10nm of the MORL Zone was recorded in 2001 and 2005 with 3 incidents reported. It is noted that no incidents were recorded during 2007 and 2010.

Three incidents were reported within the proposed sites. One incident was reported as a 'Hazardous Incident' in May 2005 involving a 21m fishing vessel which had a near miss with another vessel which was not identified.

The other two incidents were reported as 'Accidents to People.' One incident occurred in September 2003 onboard a UK registered 15m (in length) scallop dredger involving an injury to a crew member. The other incident also involved an injury to a crew member whilst the unspecified 24m UK registered vessel was on passage.

It is noted that no collisions were recorded within 10nm of the MORL zone boundary.

7.2 RNLI

Data on RNLI lifeboat responses within 10nm of the MORL Zone in the ten-year period between 2001 and 2010 have been analysed. A total of 21 launches to 21 unique incidents were recorded by the RNLI (excluding hoaxes and false alarms).

Figure 7.4 presents the geographical location of incidents colour-coded by casualty type.

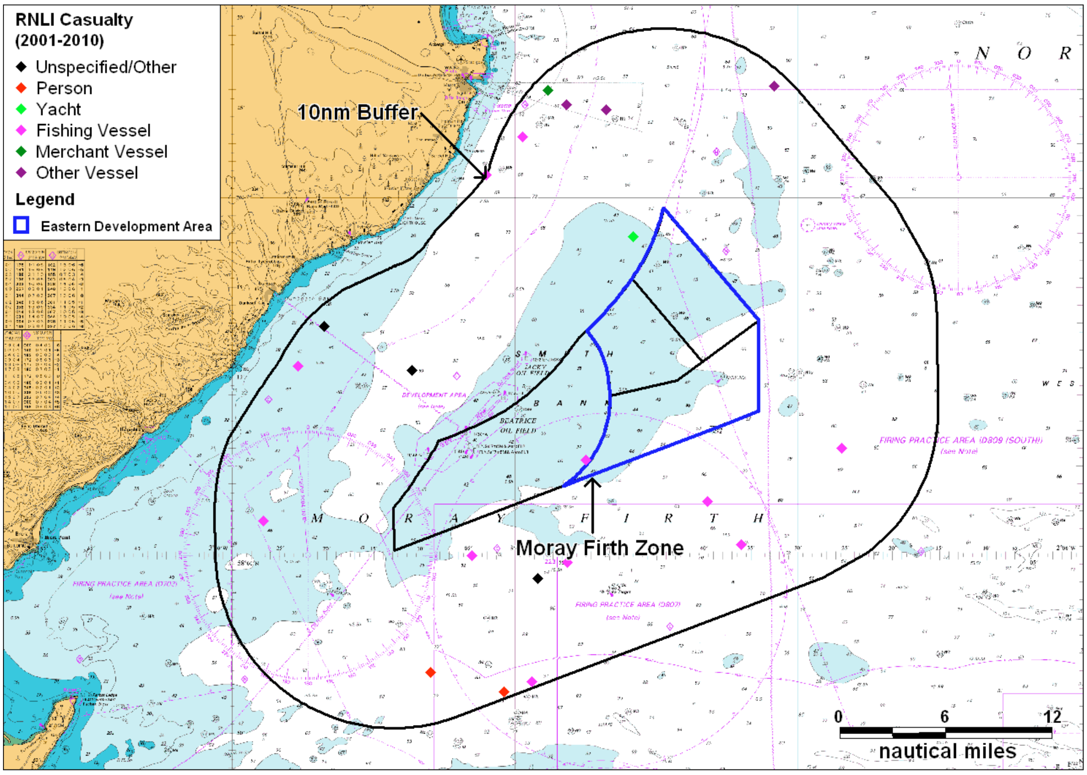


Figure 7.4 RNLI Incidents by Casualty Type within 10nm of MORL Zone

There were no incidents recorded within the proposed sites over the 10 year period analysed. The closest incident was recorded approximately 300m west of the MacColl site and involved a large fishing vessel in April 2003. A machinery failure occurred on the fishing vessel and Wick all-weather lifeboat (ALB) assisted the vessel.

The second closest incident occurred 1nm north west of proposed sites and involved a leak/swamping onboard a sailing yacht in wind force 6 in September 2010. Royal Air Force (RAF) and Wick all-weather lifeboat (ALB) Search and Rescue (SAR) units were involved in assisting the vessel to safety.

The overall distribution by casualty type is summarised in Figure 7.5.

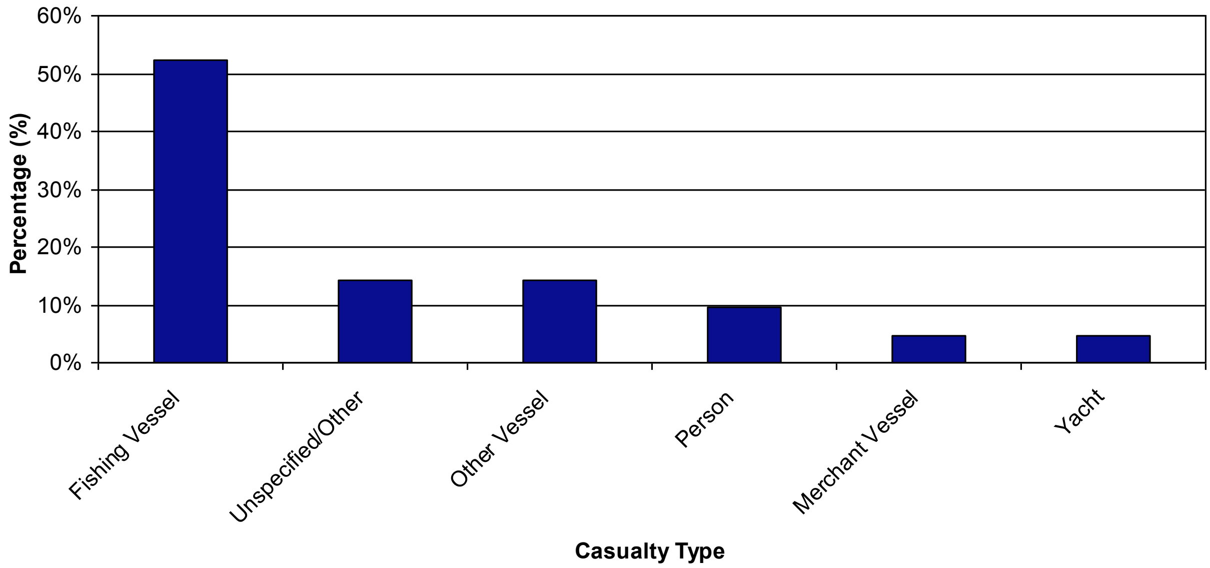


Figure 7.5 RNLI Incidents by Casualty within 10nm of MORL Zone (2001-2010)

The most common vessel types involved were fishing vessels (52%), unspecified/other (2 planes and an animal (14%)) and other vessels (14%). Person represented 10% with the remaining incidents (10%) made up of merchant vessels and sailing yachts.

A chart of the incidents colour-coded by cause is presented in Figure 7.6.

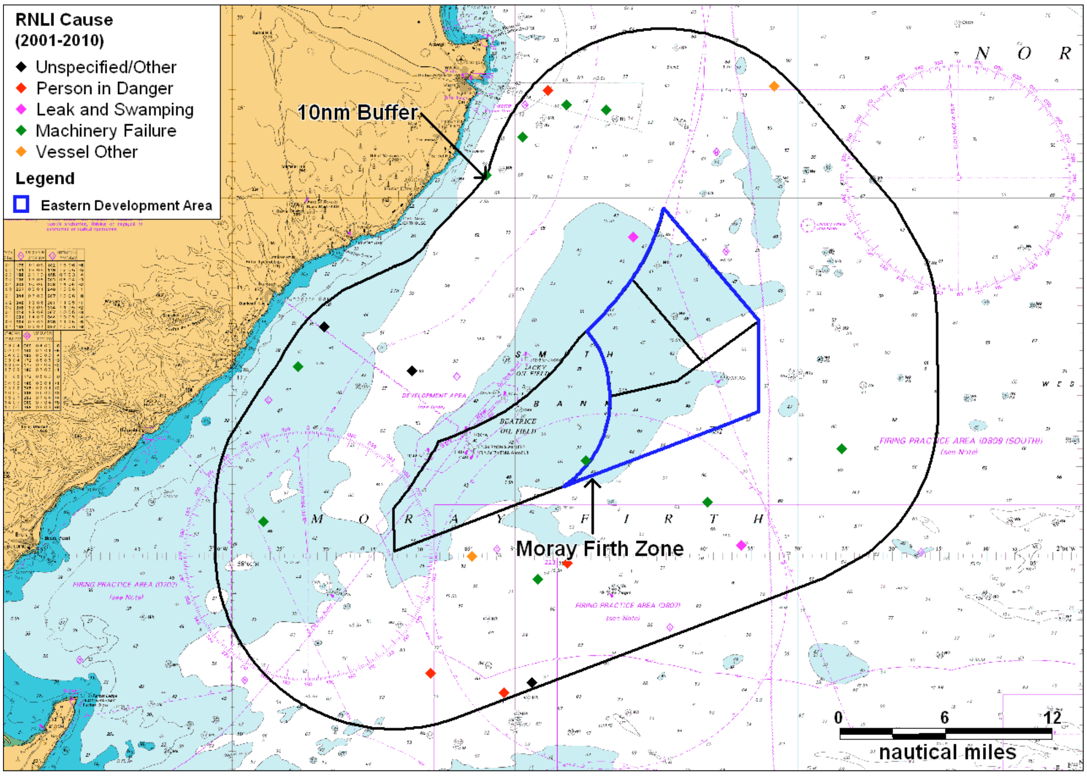


Figure 7.6 RNLI Incidents by Cause within 10nm of MORL Zone

The reported causes are summarised in Figure 7.7.

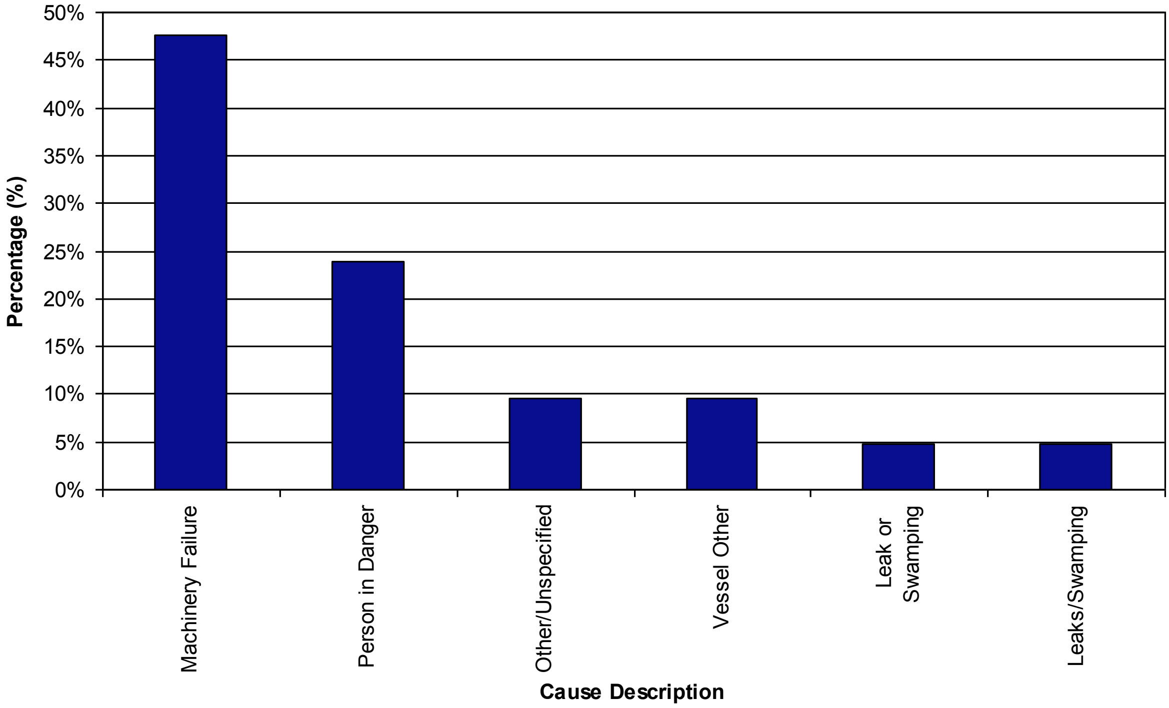


Figure 7.7 RNLI Incidents by Cause within 10nm MORL Zone (2001-10)

The two main causes were machinery failure (48%) and person in danger (24%). The annual rate of incidents in the past ten years is summarised in Figure 7.8.

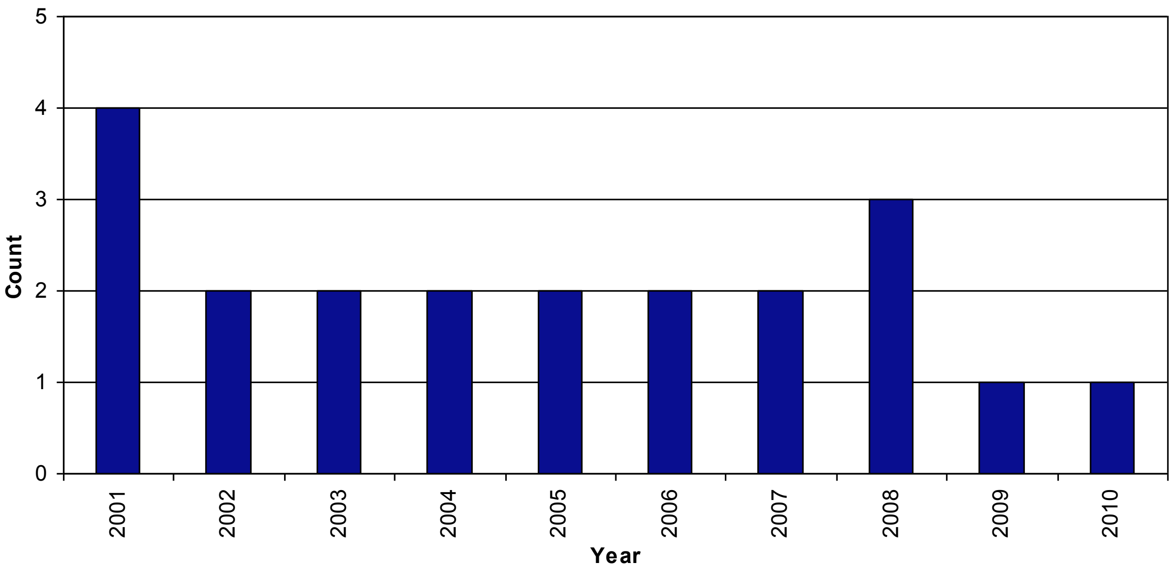


Figure 7.8 RNLI Incidents by Year within 10nm of MORL Zone (2001-10)

There was an average of 2 RNLI incidents recorded within 10nm of the MORL Zone from 2001-2010.

The stations and types of lifeboat responding to incidents (ALB) and ILB (inshore lifeboat) are illustrated in Figure 7.9.

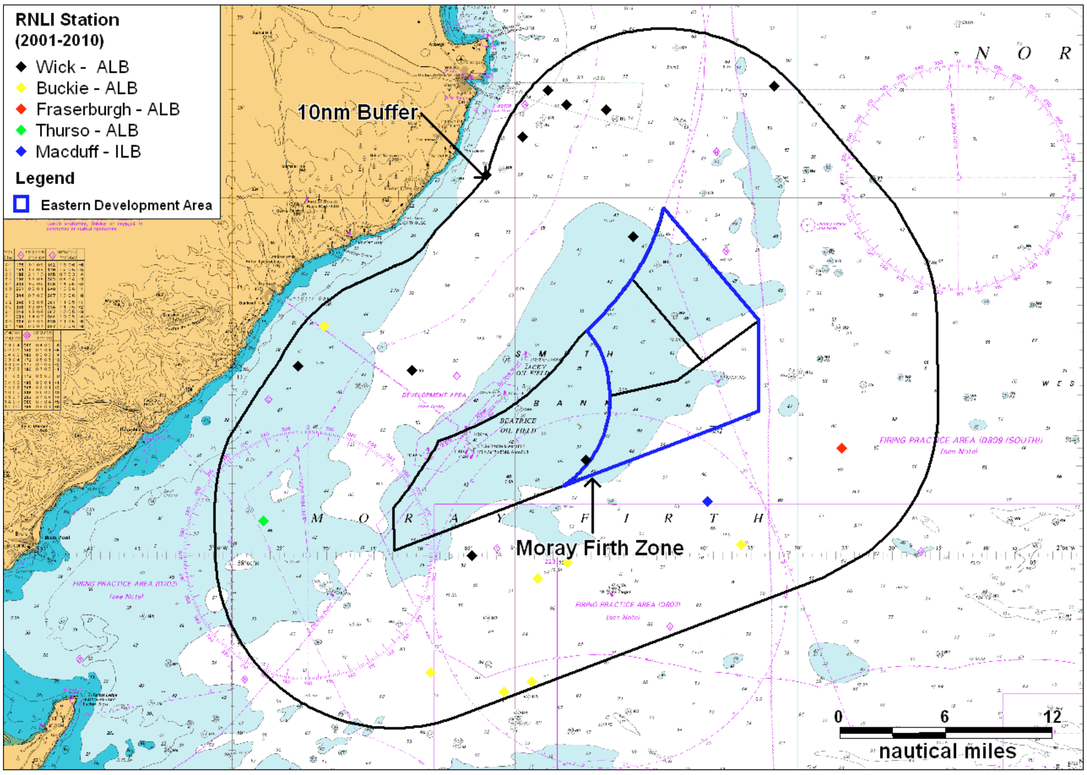


Figure 7.9 RNLI Incidents by Station within 10nm of MORL Zone (2001-10)

Figure 7.10 presents a percentage break-down of stations responding to incidents in the area from 2001 to 2010.

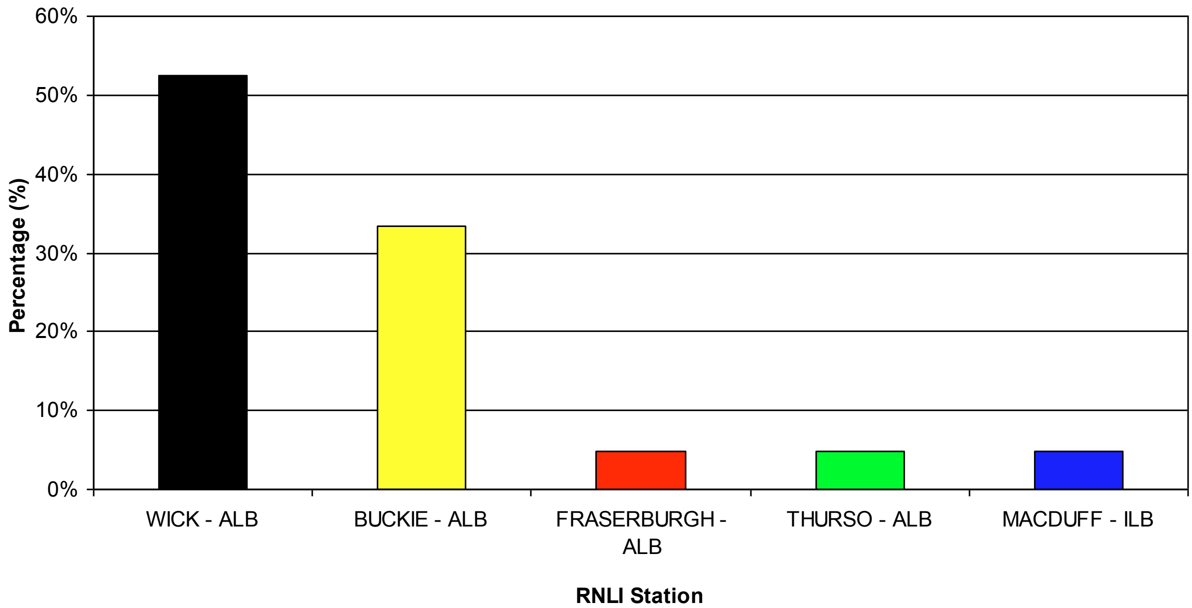


Figure 7.10 RNLI Incidents by Station (percentage)

The majority of incidents within the area were responded to by Wick ALB (52%) and Buckie ALB (33%). Three other RNLI stations responded to one incident each within 10nm of the Moray Firth Zone (Fraserburgh, Thurso and Macduff).

Figure 19.2 in the following section presents the RNLI lifeboat stations and other SAR resources relative to the proposed sites.

7.3 Conclusions

Based on the review of incidents, it can be seen that the proposed wind farms within the EDA and its immediate vicinity has experienced a relatively low rate of accidents in recent years. Most incidents in the area tend to occur in more coastal area, i.e. in and around Wick Bay.

8. MARITIME TRAFFIC SURVEYS

8.1 Introduction

This section summarises the results of the maritime traffic surveys carried out in the Moray Firth for the MORL Zone and proposed sites, using a combination of shore-based AIS, AIS / radar ship data and visual observations.

8.2 Survey Details

Two survey vessels recorded shipping data for the proposed sites while working in the Moray Firth. The first survey took place from spring to summer 2010 from *Chartwell* with a winter survey taking place from the geo-technical vessel *Gargano*:

8.2.1 Chartwell Survey

The *Chartwell* survey recorded data from 1st April to 31st July 2010. An image of this vessel is presented below.

Figure 8.1 Picture of the Survey Vessel *Chartwell*

The area of operation of the survey vessel during the shipping traffic survey is presented in Figure 8.2.

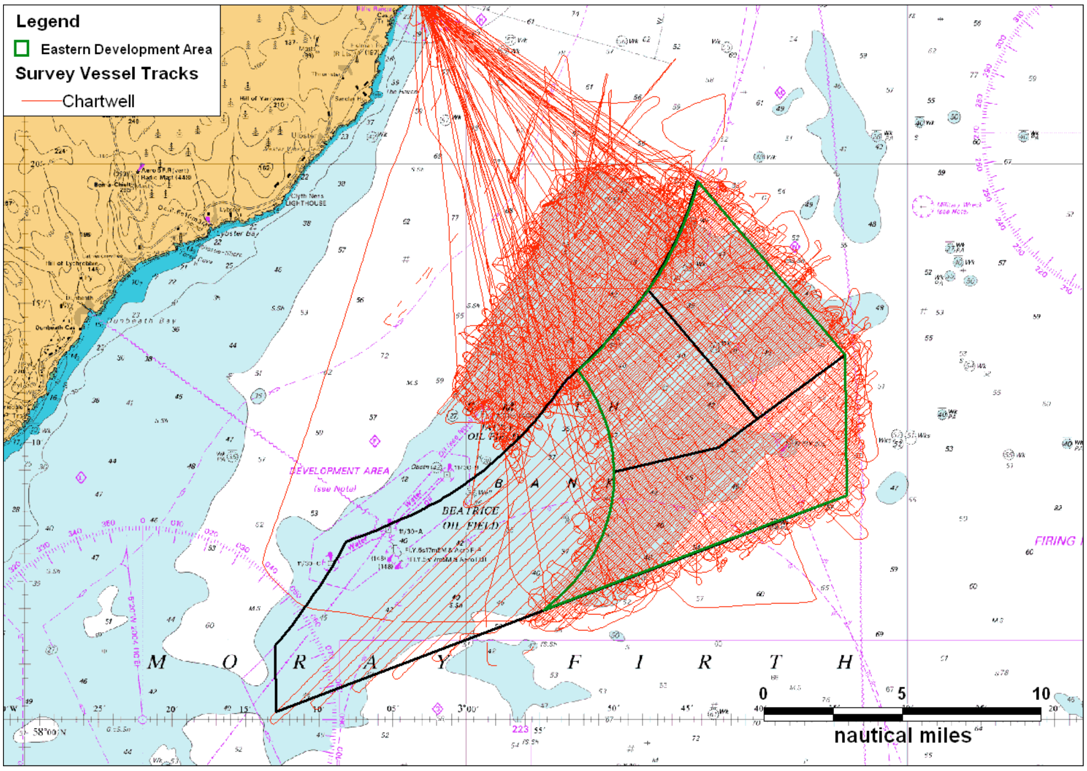


Figure 8.2 Tracks of Survey Vessel relative to MORL Zone

Full details of the *Chartwell* survey are presented in the separate report prepared by Anatec (Ref. ix).

8.2.2 Gargano Survey

The winter survey recorded data during two periods (2nd November to 13th December 2010) and (31st December 2010 to 9th January 2011.) An image of the survey vessel is presented below.

Figure 8.3 Picture of the Survey Vessel *Gargano*

The area of operation of the survey vessel during the shipping traffic survey is presented in Figure 8.2.

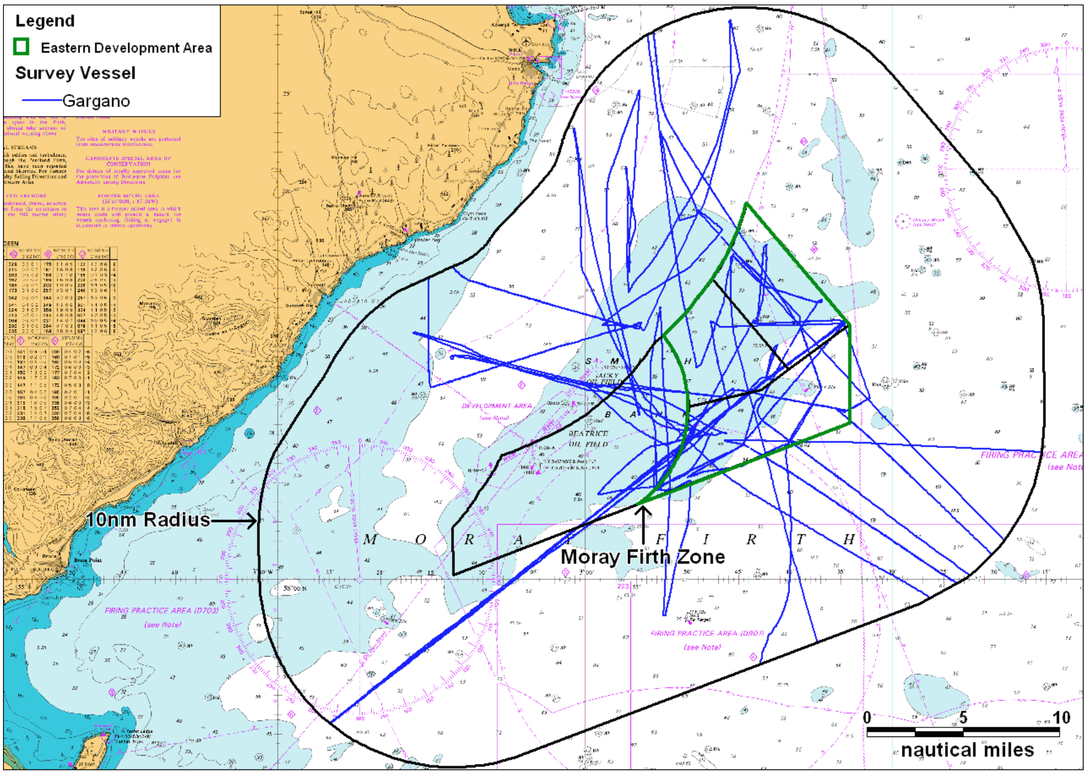


Figure 8.4 Tracks of Survey Vessel relative to Moray Firth Zone

Given the size of the Moray Firth, AIS coverage occasionally dropped-off at the extremities of the area during survey lines, etc., therefore Anatec supplemented the *Chartwell* and *Gargano* survey data with coastal based AIS to improve and provide comprehensive AIS coverage for the entire area.

It is noted that the shore based AIS data served to fill in the areas of AIS coverage that were partly recorded due to the survey vessels moving around the Moray Firth and/or due to weather and crew changes.

The non-AIS radar data was recorded from the ARPA systems onboard the survey vessels, with radar data logging equipment set-up to record each target acquired on radar. The target positional data was recorded from a feed from the radar to the serial port of the survey laptops.

The radar surveys were conducted during periods when the bridge was manned. The radar range varied based on weather and sea conditions, however visual target details were logged in survey log forms and vessels were generally tracked over 6nm from the survey vessels and some targets beyond 15nm.

8.3 Survey Analysis

The *Chartwell* survey data is presented in monthly plots (April, May and June 2010) and *Gargano* survey data is presented for the combined period (November 2010 to January 2011). Both datasets are analysed in terms of:

- Ship Type plots within 10nm
- Type Distribution

- Ship Size (Length and Draught)

It is noted that the tug / survey vessel *Keverne* was recorded operating within the Moray Firth area during the surveys and this vessel was excluded from the analysis.

Plots of the vessels recorded on AIS and radar colour-coded by ship type are presented in Figure 8.5 to Figure 8.8.

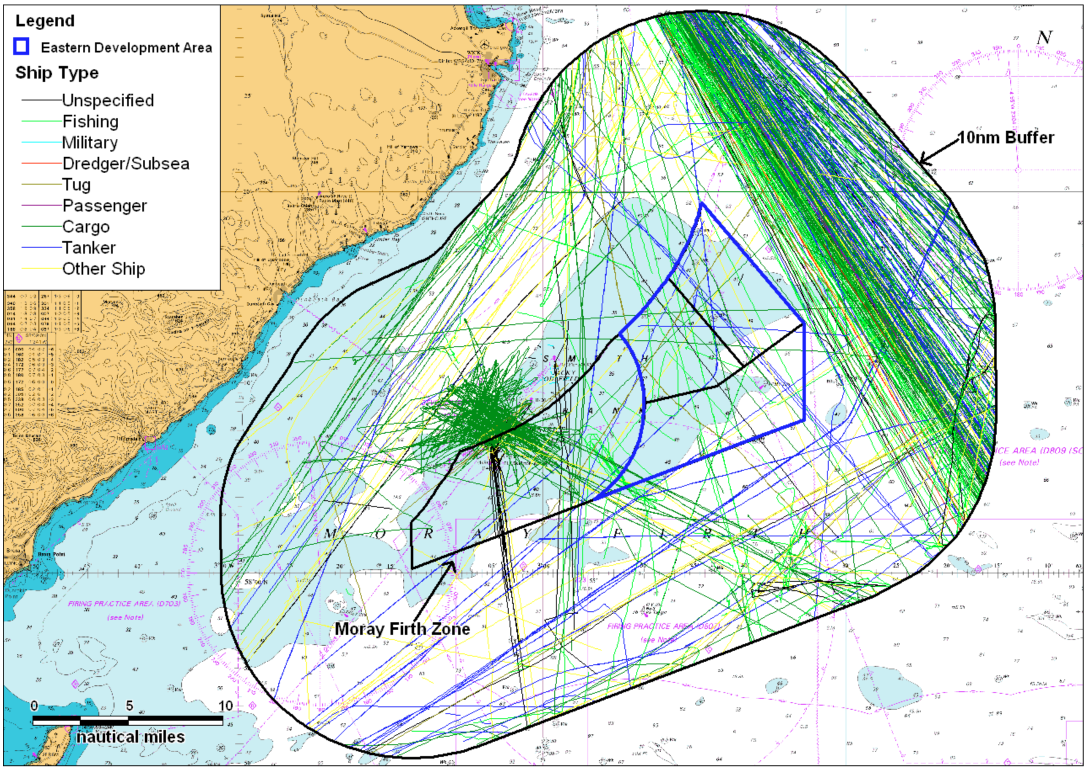


Figure 8.5 Combined *Gargano* Survey November to January 2011 (38 Days)

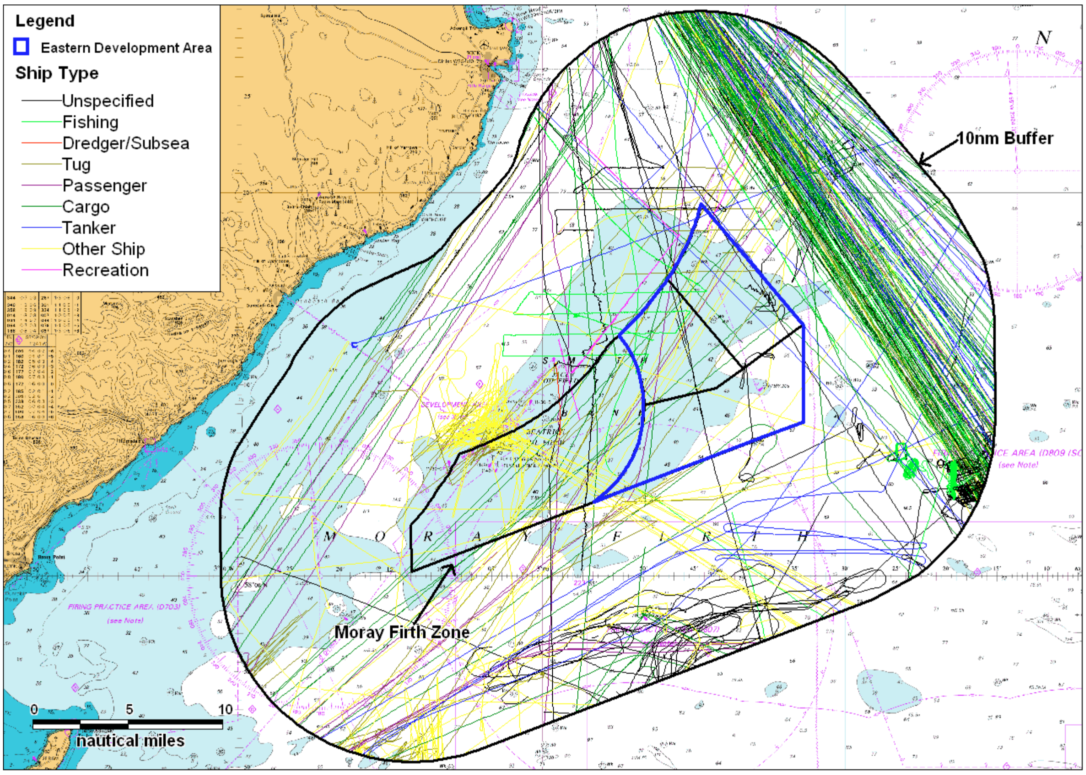


Figure 8.6 **Combined *Chartwell* Survey May 2010 (30 days)**

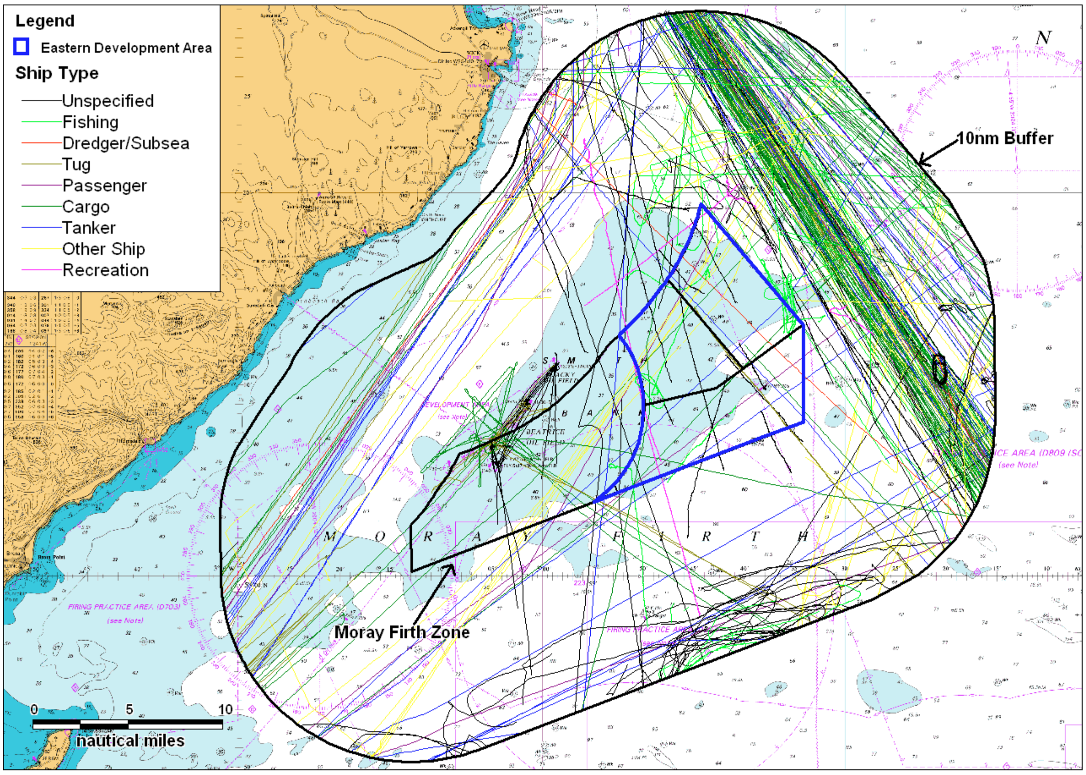


Figure 8.7 **Combined *Chartwell* Survey June 2010 (28 days)**

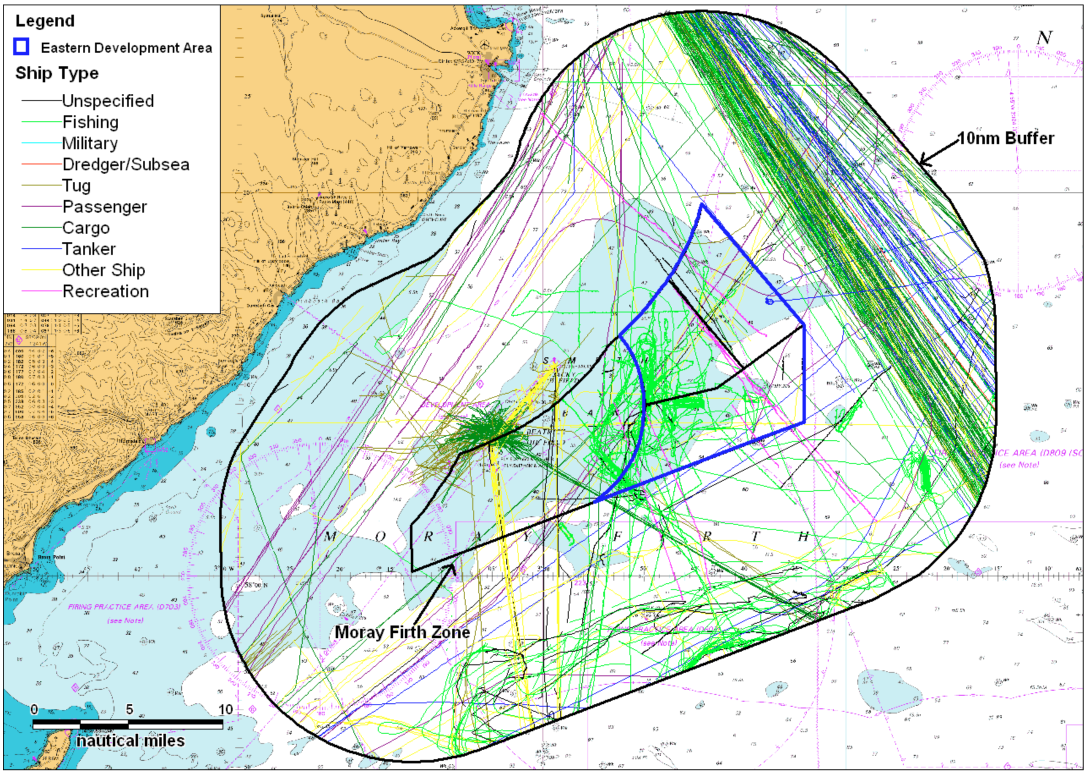


Figure 8.8 Combined *Chartwell* Survey Tracks July 2010 (31 Days)

The number of vessels within 10nm of the MORL Zone averaged 14 vessels per day. As can be observed from the figure the large majority of tracks are associated with Pentland Firth route.

To put the traffic into a daily context, the tracks recorded on the busiest days recorded from the two survey vessels are presented in Figure 8.9 and Figure 8.10.

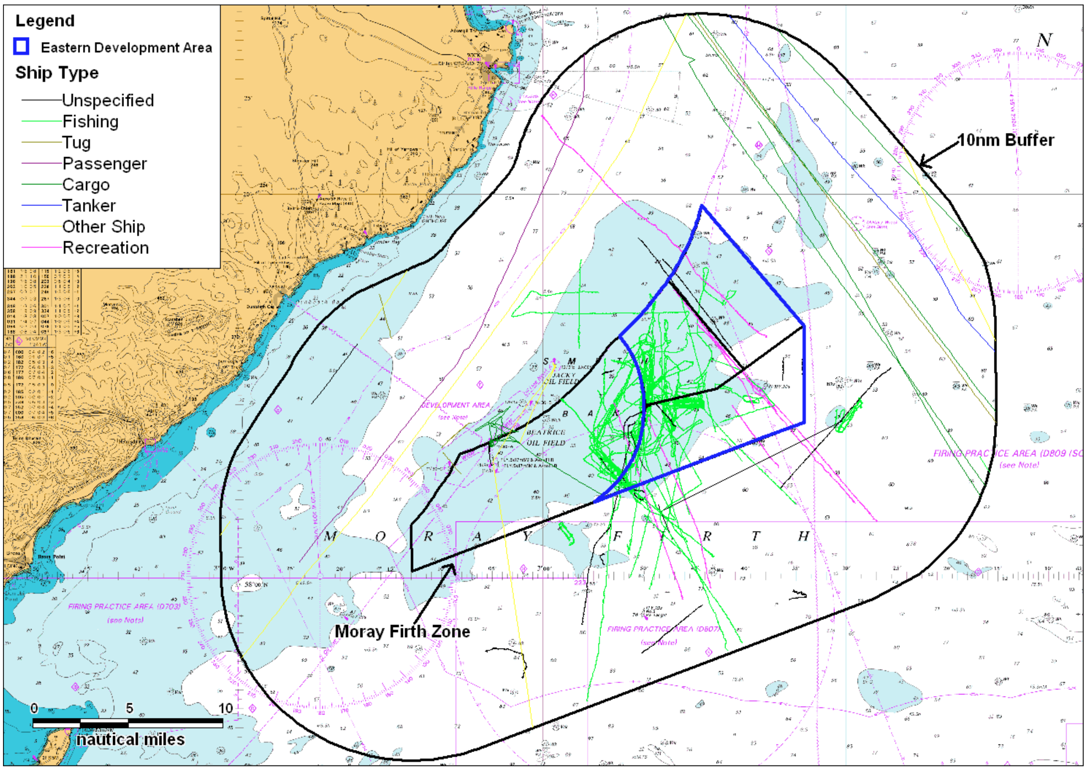


Figure 8.9 ***Chartwell*** **Survey Busiest Day – 30th July 2010 (30 Unique Tracks)**

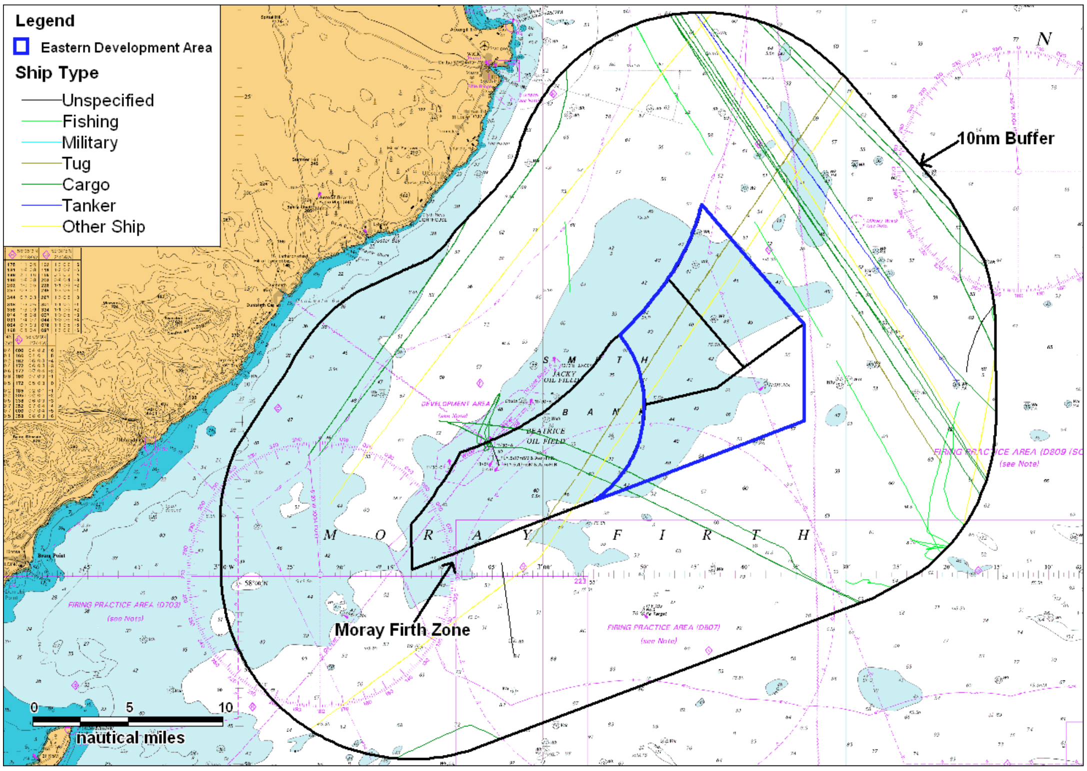


Figure 8.10 ***Gargano*** **Survey Busiest Day – 6th November 2010 (30 Unique Tracks)**

The breakdown of ships by type for vessels within 10nm of the MORL Zone is presented in Figure 8.11. This considers all vessels recorded during the two survey periods presented above (127 days), however excludes unspecified vessels which represented 19% of vessel tracks.

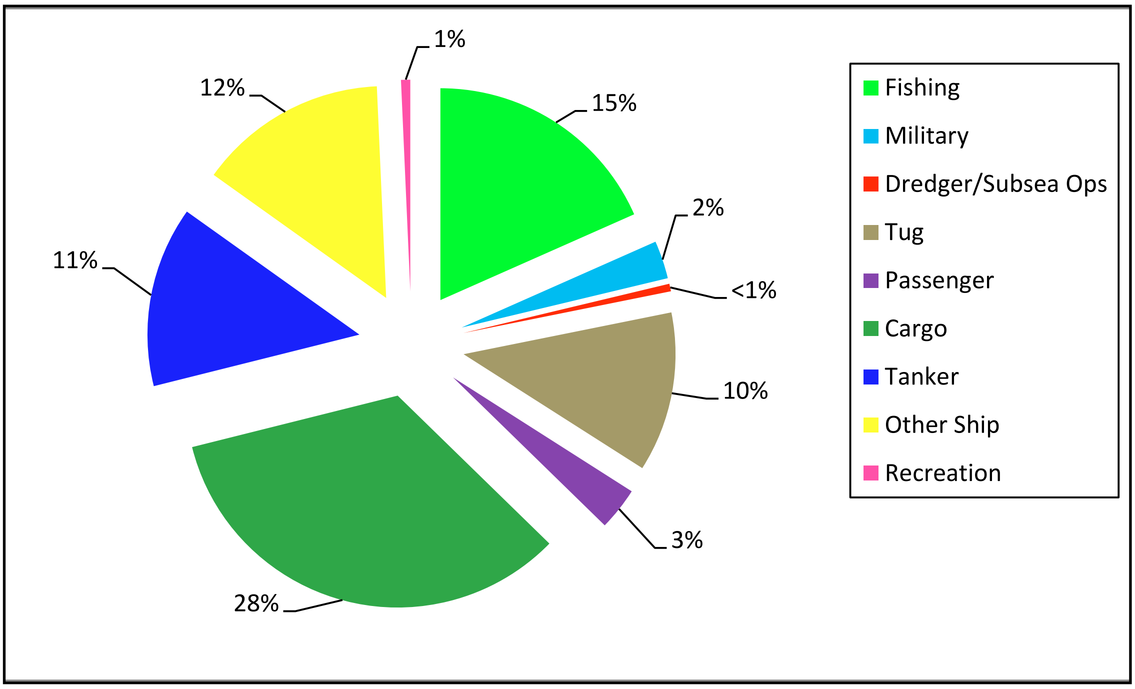


Figure 8.11 Vessel Types identified during the Combined Surveys

The most common vessel types recorded during the two surveys were cargo ships (28%) and fishing vessels (15%). Other ships and tugs represented 12% and 10%, respectively, and it is likely that the majority of these vessels were offshore industry related.

The distribution of vessels by draught (excluding unspecified) for the two combined survey periods is presented in Figure 8.12.

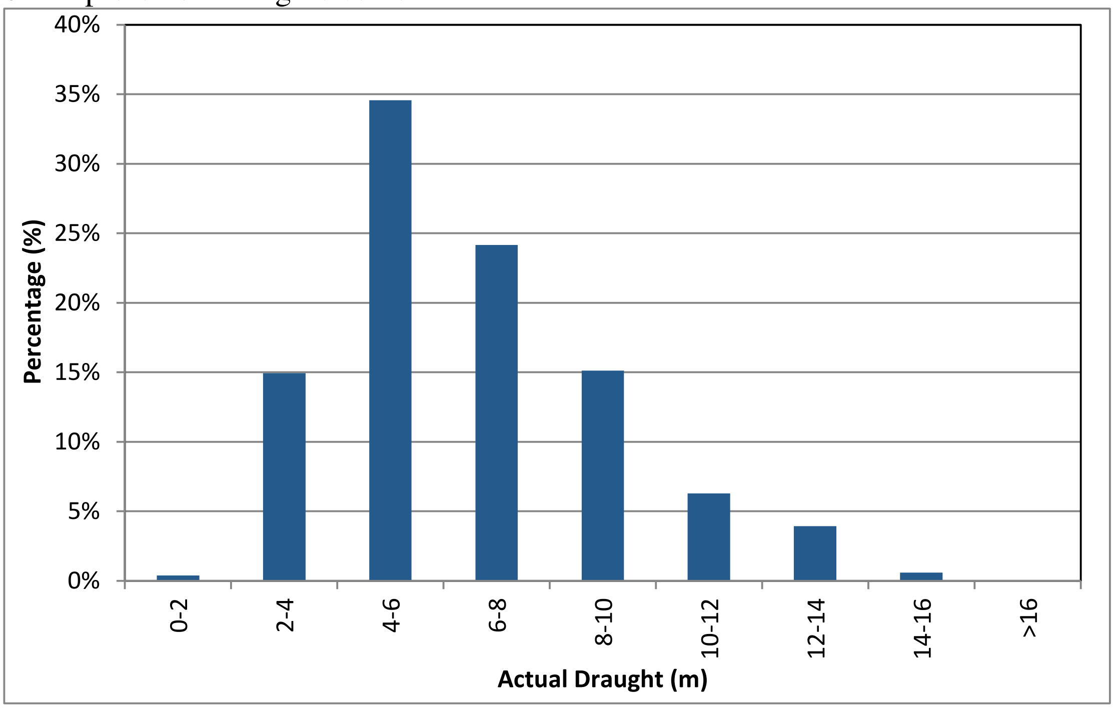


Figure 8.12 Distribution of Vessels by Actual Draught for the Combined Surveys

The average draught recorded over the combined survey periods was 6.5m. It can be seen that the majority of vessels had draughts between 4 to 8m (59%), with most vessels associated with the Pentland Firth route.

Plots of the tracks colour-coded by draught for the *Gargano* survey and the most recent data from *Chartwell* (July 2010) are presented in Figure 8.13 and Figure 8.14.

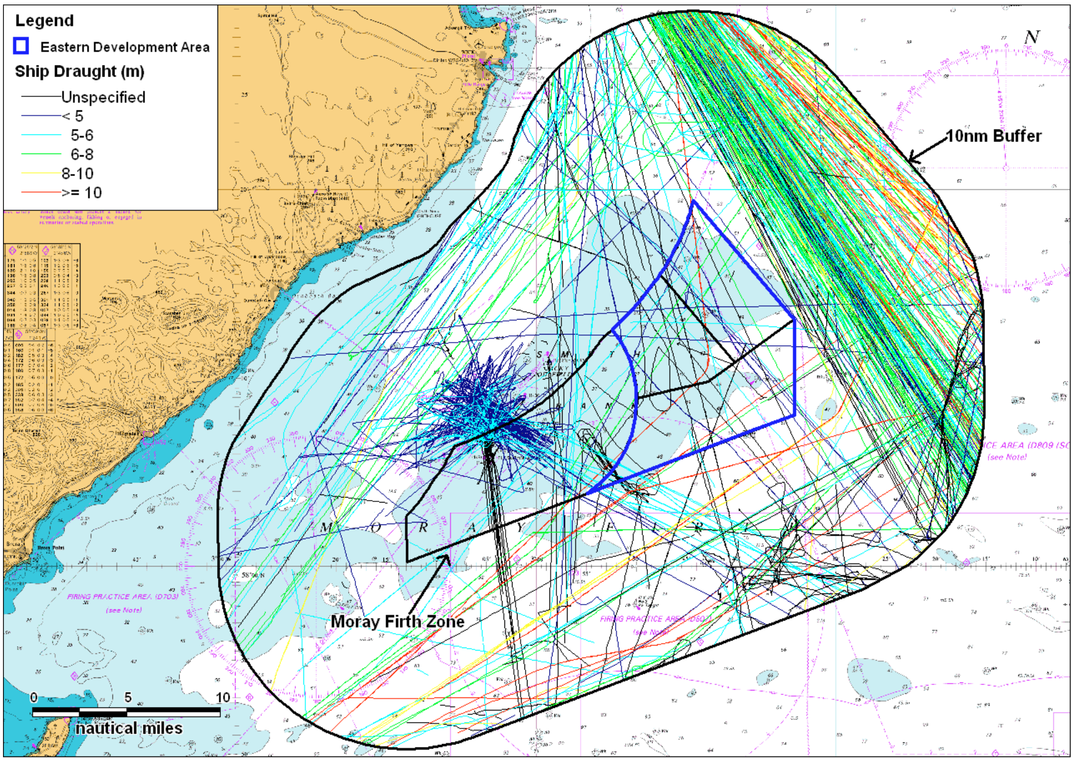


Figure 8.13 *Gargano* **Survey Tracks by Ship Draught**

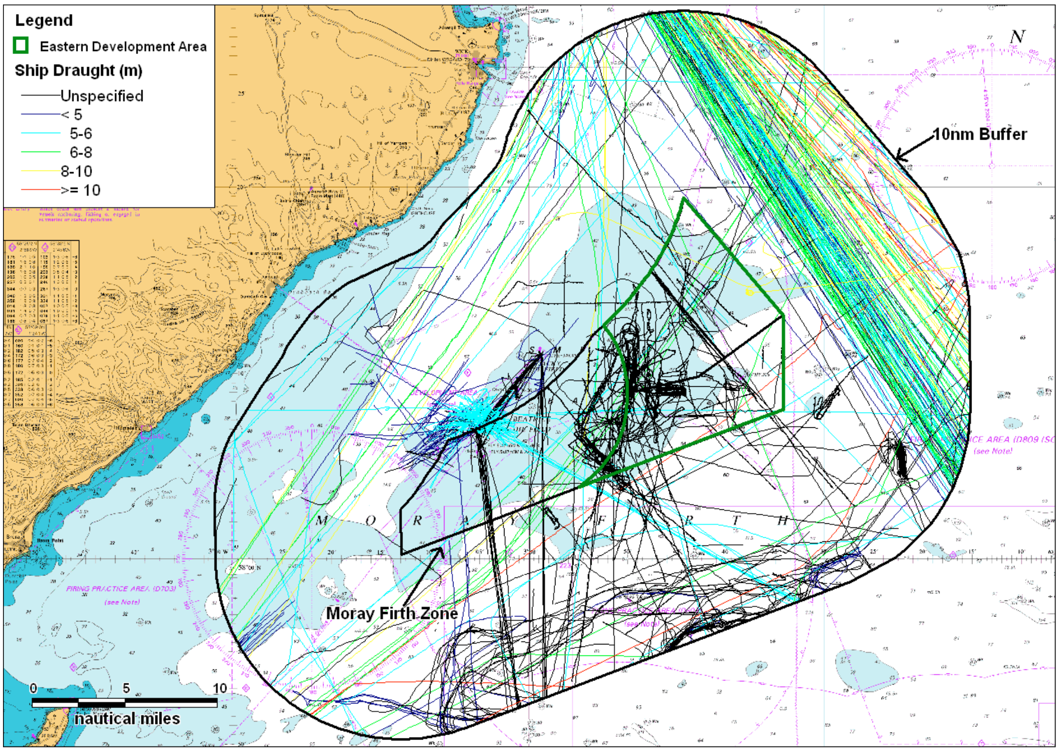


Figure 8.14 *Chartwell* **July 2010 Survey Tracks by Ship Draught**

The vessel with the deepest draught overall was the bulk carrier *Yeoman Bridge* (Figure 8.15) which broadcasted a draught of 14.7m on 4th January 2011 (*Gargano* Survey) and has deadweight tonnage (DWT) of 96,772 tonnes. This vessel passed 4.4nm north west of the proposed sites (in the Pentland Firth route) and was bound for Rotterdam.

APPENDIX 5.2 D

It is noted that *Yeoman Bridge* was recorded five times during the *Gargano* survey, transiting between the Glensanda quarry on the west coast of Scotland and Holland (Amsterdam or Rotterdam).

Figure 8.15 Bulk Carrier *Yeoman Bridge* (Library Picture)

The distribution of vessels by length (excluding unspecified) for the two combined surveys is presented in Figure 8.16.

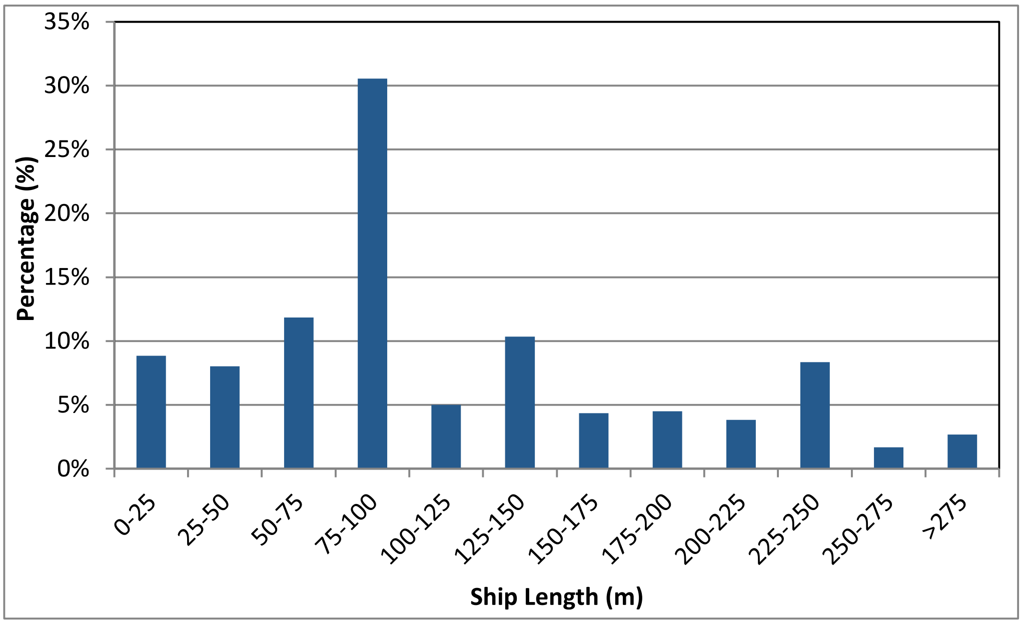


Figure 8.16 Distribution of Vessels by Length for the Combined Surveys

The average length of vessels recorded over the combined survey periods was 115m. It can be that a large portion of vessels had lengths between 75 to 100m (31%), with most vessels associated with offshore/fishing and shipping using the Pentland Firth route.

Plots of all tracks colour-coded by length for the entire *Gargano* survey and the July 2010 *Chartwell* data are presented in Figure 8.17 and Figure 8.18.

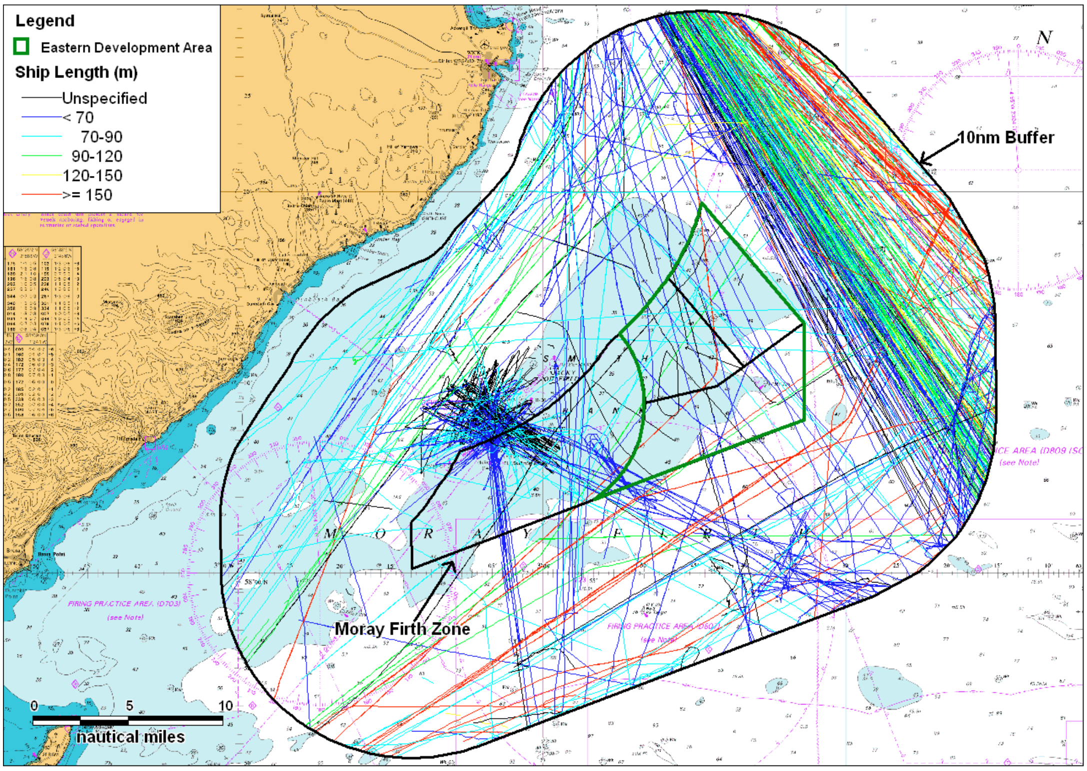


Figure 8.17 ***Gargano* Survey Tracks by Ship Length**

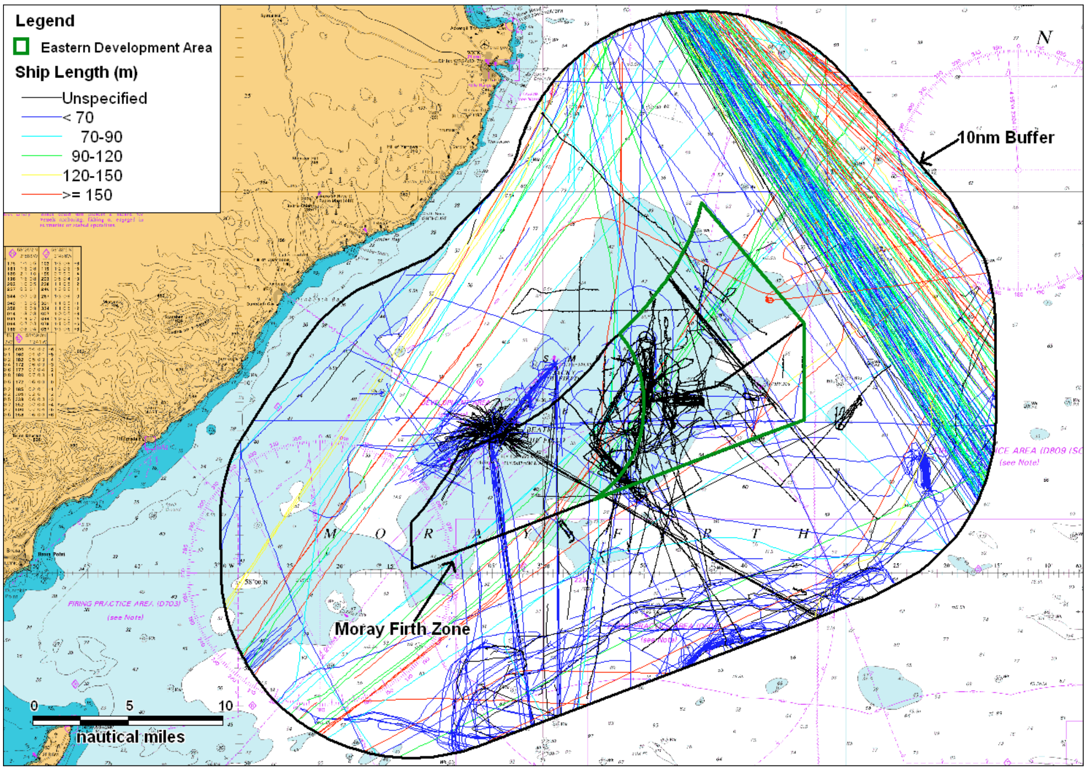


Figure 8.18 ***Chartwell* July 2010 Survey Tracks by Ship Length**

The longest vessel tracked was the container ship *MSC ELA* (Figure 8.19) which is 294m in length and passed 9nm north east of the proposed sites, with a destination set to Hamburg.

Figure 8.19 Container Ship *MSC ELA* (Library Picture)

Figure 8.20 presents the distribution of average speeds for vessels recorded during the two shipping surveys.

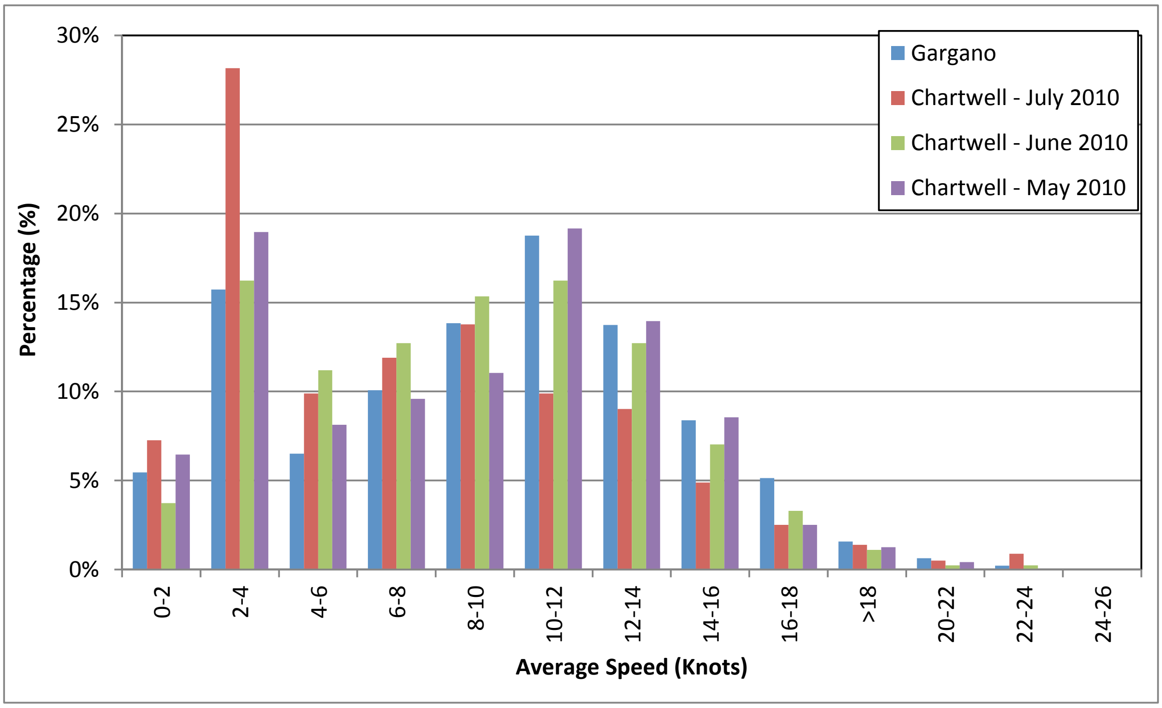


Figure 8.20 Average Speed Distributions for *Chartwell* and *Gargano* Surveys

The average speeds during the two survey periods ranged from 7 to 9 knots. The relatively high number of vessels recorded over 10 knots (approximately 50%) can be explained by the vessels on passage (steaming) through the NNW / SSE route from Pentland Firth.

8.4 Site-Specific Review

This section presents detailed plots of 69 days survey tracks (*Chartwell* 31 days July 2010 and *Gargano* 38 days November 2010 to January 2011). The survey data is presented in Figure 8.21 relative to the largest number of turbines in scenario 1 (including offshore substations).

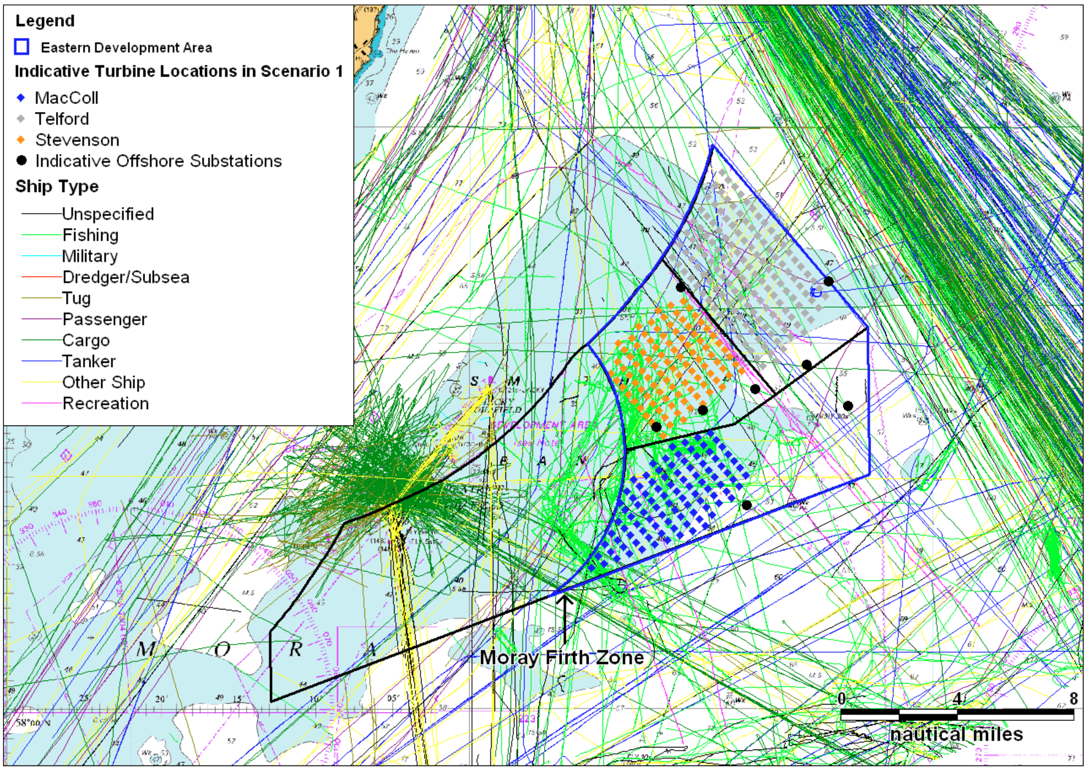


Figure 8.21 Detailed Plot of the Combined Surveys Tracks Passing the Wind Farms

Charts of the main vessel types passing in close proximity to the turbines are presented in the following sub-sections. The vessel types considered are presented below:

- Tankers (Figure 8.22)
- Cargo Vessels (Figure 8.23)
- Passenger Ships (Figure 8.24)
- Other Vessels (consisting mainly of cargo and ‘other’ ships on AIS) (Figure 8.25)
- Fishing Vessels (Figure 8.26)
- Recreational Vessels (Figure 8.27)

8.4.1 Tankers

A plot of close passing tankers recorded within 10nm of the development area over 69 days is presented in Figure 8.22.

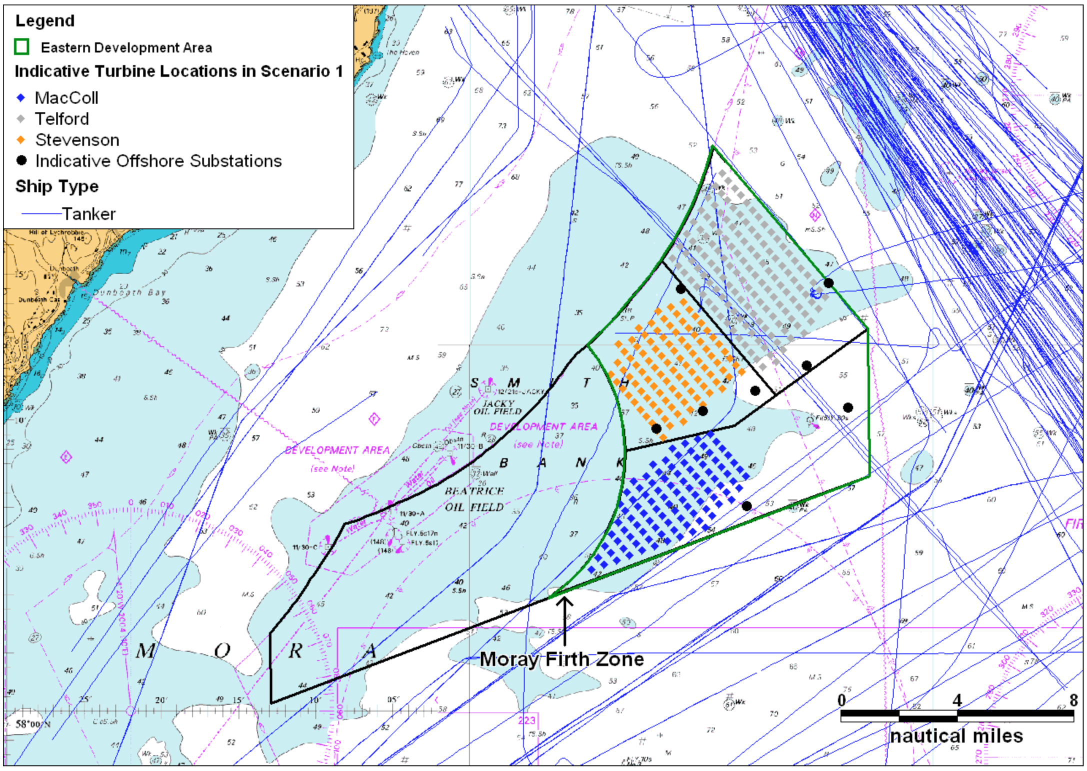


Figure 8.22 Plot of Tanker Tracks Passing Close to the Proposed Turbines

Eight tankers intersected the proposed wind farms:

- *Henty Pioneer*
- *M/T Petronordic*
- *Shannon Fisher*
- *Solway Fisher*
- *Stellar Voyager*
- *Tordis Knutsen*
- *Vedrey Hallarna*
- *Whitstar*.

Vedrey Hallarna and *Whitstar* were recorded headed to/from Wick, with *Tordis Knutsen* recorded at anchor within the Telford wind farm area for two days with a destination set to Captain Oil Field.

8.4.2 Cargo Vessels

A plot of close passing cargo vessels recorded within 10nm of the three proposed wind farm sites over 69 days is presented in Figure 8.23.

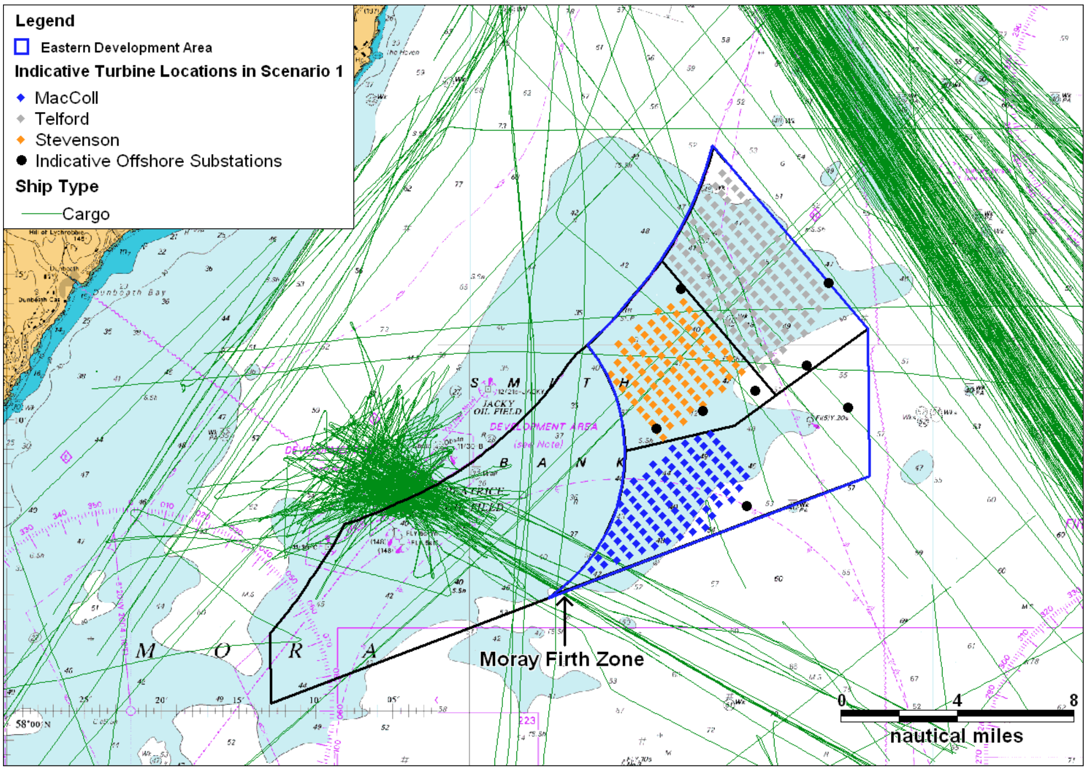


Figure 8.23 Plot of Cargo Tracks Passing Close to the Proposed Turbines

Sixteen cargo vessels intersected the proposed wind farm sites, with seven of these vessels involved in offshore operations.

The small to medium sized cargo vessels intersecting the proposed wind farm sites are listed below:

- *Cemi*
- *Deo Volente*
- *Ingelborg Pilot*
- *Grampian Talisker*
- *Grampian Talisman*
- *Konst. Paustovskiy*
- *Mekhanik Tyulenev*
- *Nordica*
- *Ocean Mainport*
- *Ocean Spirit*
- *Ocean West*
- *Scott Carrier*
- *SBS Torrent*
- *Thebe*
- *Tomke*
- *Sartor*

APPENDIX 5.2 D

8.4.3 Passenger/Cruise Vessels

A plot of close passing passenger/cruise vessels recorded within 10nm of the three proposed wind farm sites over 69 days is presented in Figure 8.24.

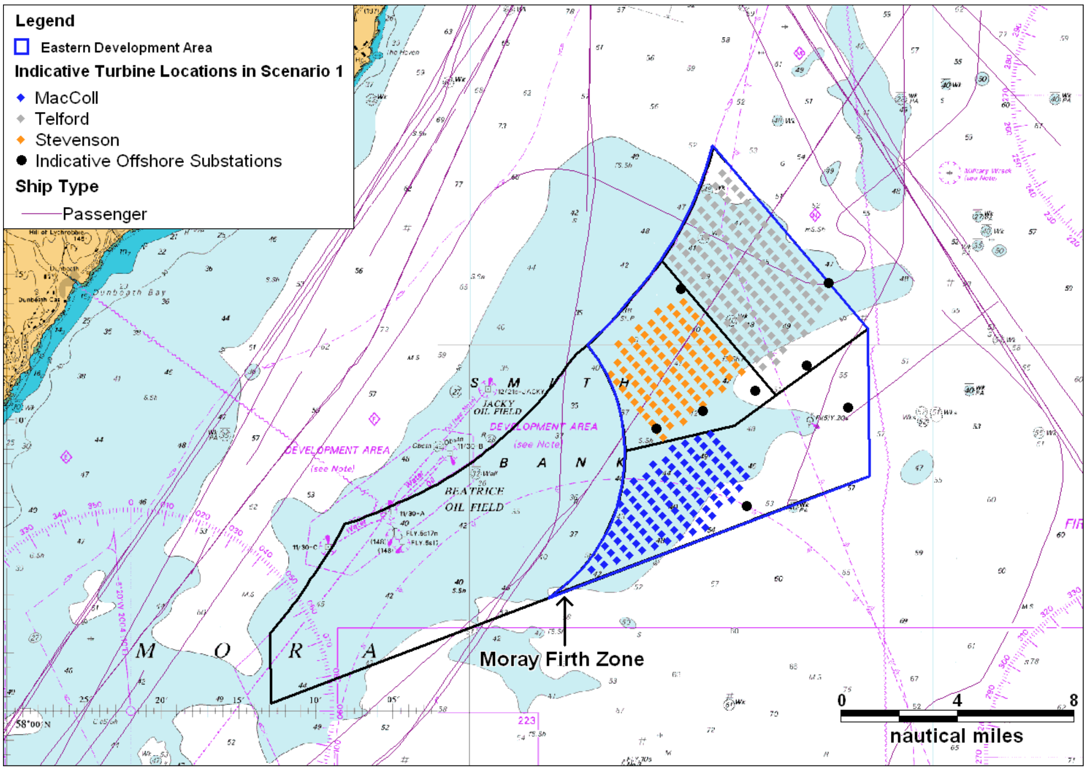


Figure 8.24 Plot of Passenger Ships Passing close to the Proposed Turbines

Four passenger/cruise vessels were recorded within the proposed wind farm sites headed between the Orkney/Shetland Isle (Northern Isles) and Invergordon in the Cromarty Firth. Vessels recorded intersecting the area are listed below

- *Aida Aura* (twice)
- *M/S Balmoral*
- *Regatta*
- *Oriana*

8.4.4 Other Vessels

A plot of close passing 'other' vessels recorded within 10nm of the three proposed wind over 69 days is presented in Figure 8.25.

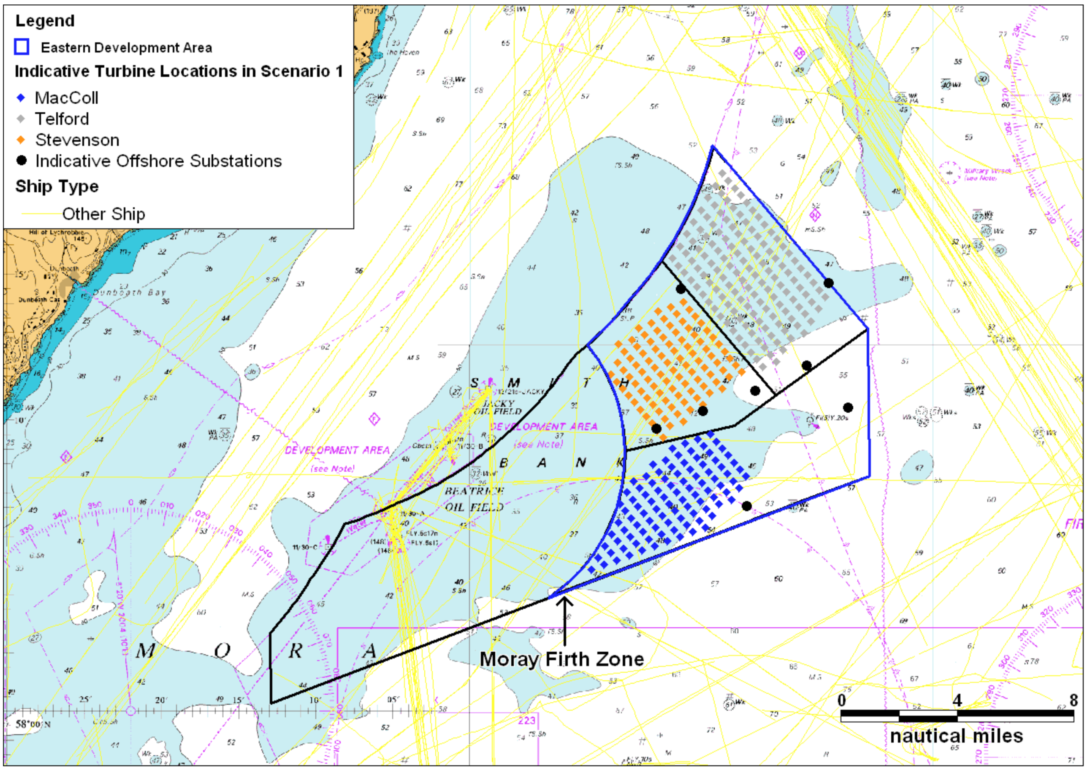


Figure 8.25 Plot of Other Vessels passing close to the Proposed Turbines

The large majority of other vessels in the area were offshore oil and gas support vessels and fisheries protection/research vessels.

Ten vessels passed through the proposed sites, as listed below:

- *Acergy Osprey*
- *Bibby Topaz*
- *Minna*
- *Pharos*
- *Kestrel BCK 81* (broadcasting as a 'other ship')
- *Seven Atlantic*
- *Subsea Viking*
- *Tridens*
- *VOS Premier*
- *RV Alba na Mara*

APPENDIX 5.2 D

8.4.5 Fishing Vessels

A plot of close passing fishing vessels recorded within 10nm of the three proposed wind farm sites over 69 days is presented in Figure 8.26.

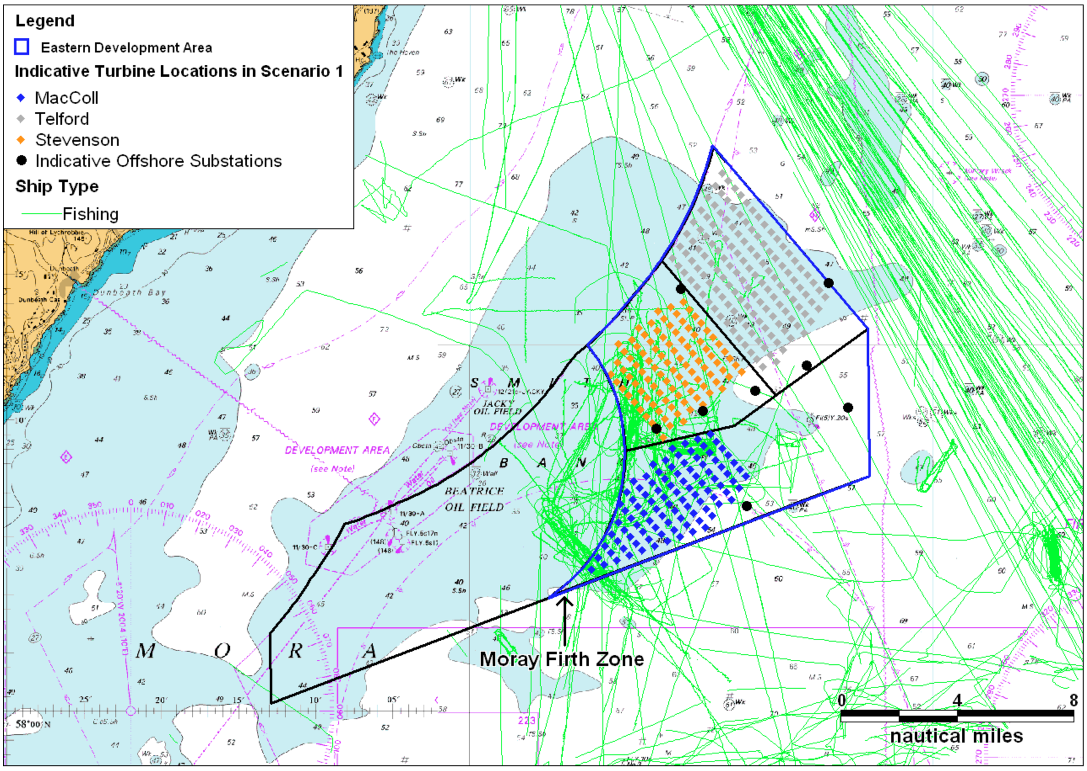


Figure 8.26 Plot of Fishing Vessels passing close to the Proposed Turbines

Approximately fifty of the fishing vessel tracks were recorded on radar (i.e. non-AIS), with five fishing vessels recorded on AIS:

- *Atlantis Belle*
- *Norlantean K508*
- *Our Pride*
- *Unity FR1656*

8.4.6 Recreation Vessels

A plot of close passing recreation vessels recorded within 10nm of the three proposed wind farm sites over 69 days is presented in Figure 8.27.

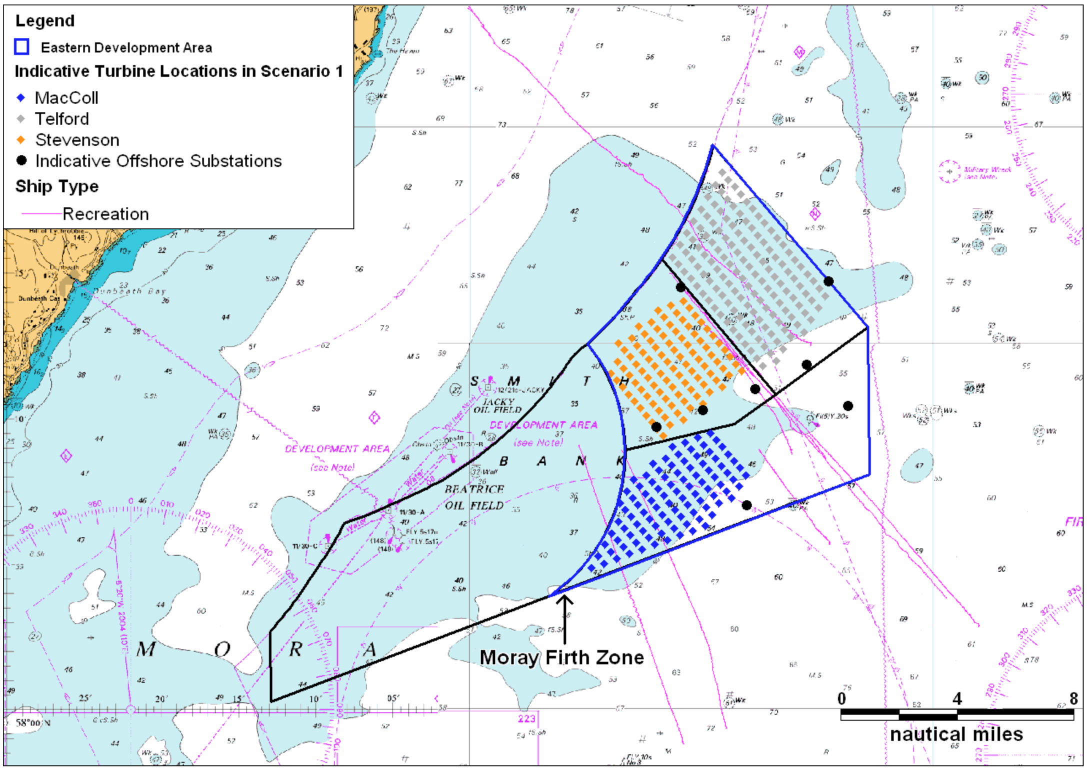


Figure 8.27 Plot of Recreation Vessels passing close to the Proposed Turbines

Approximately seven unique recreational vessels were recorded passing within the proposed wind farm sites, with all tracks recorded on radar (non-AIS).

Recreational vessel tracks were recorded passing through the EDA in a north by north west/south by south east direction and likely to be headed to/from Wick.

APPENDIX 5.2 D

8.4.7 Intersecting Vessels

Figure 8.28 presents the tracks of all vessels which were identified to pass within the proposed turbine perimeter during the combined 69-day survey period.

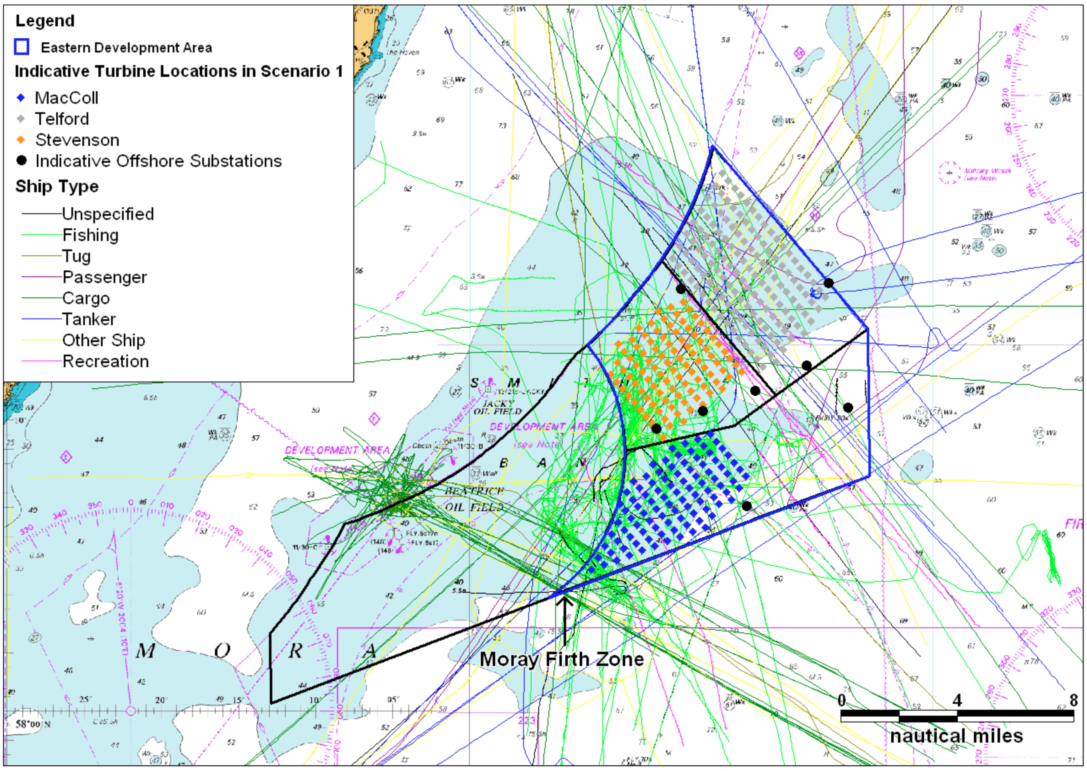


Figure 8.28 Tracks passing within the Proposed Sites (All Surveys)

A total of 49 AIS tracks and 128 non-AIS tracks were identified to pass within the proposed sites during the 69-day survey period, corresponding to an average of 2 to 3 vessels per day. Excluding unspecified vessels (mainly radar targets which were not identified visually), the most common types of ship passing through the area were fishing vessels and other/cargo ships, a large portion of which were offshore industry related.

In terms of AIS-equipped ships, vessels passing through the proposed sites on more than one occasion were offshore oil and gas industry vessels travelling to and from Beatrice and Jacky Fields.

A coastal tanker (*Vedrey Hallarna*) was also recorded transiting through the proposed sites on more than one occasion headed between Wick and Immingham.

The large majority of non-AIS vessels intersecting the area were fishing vessels with a small number of recreational vessels headed towards Wick.

8.5 Anchored Vessels

The positions of vessels at anchor recorded during the during the combined 69-day survey period (*Chartwell* July and *Gargano* winter) are presented in Figure 8.29.

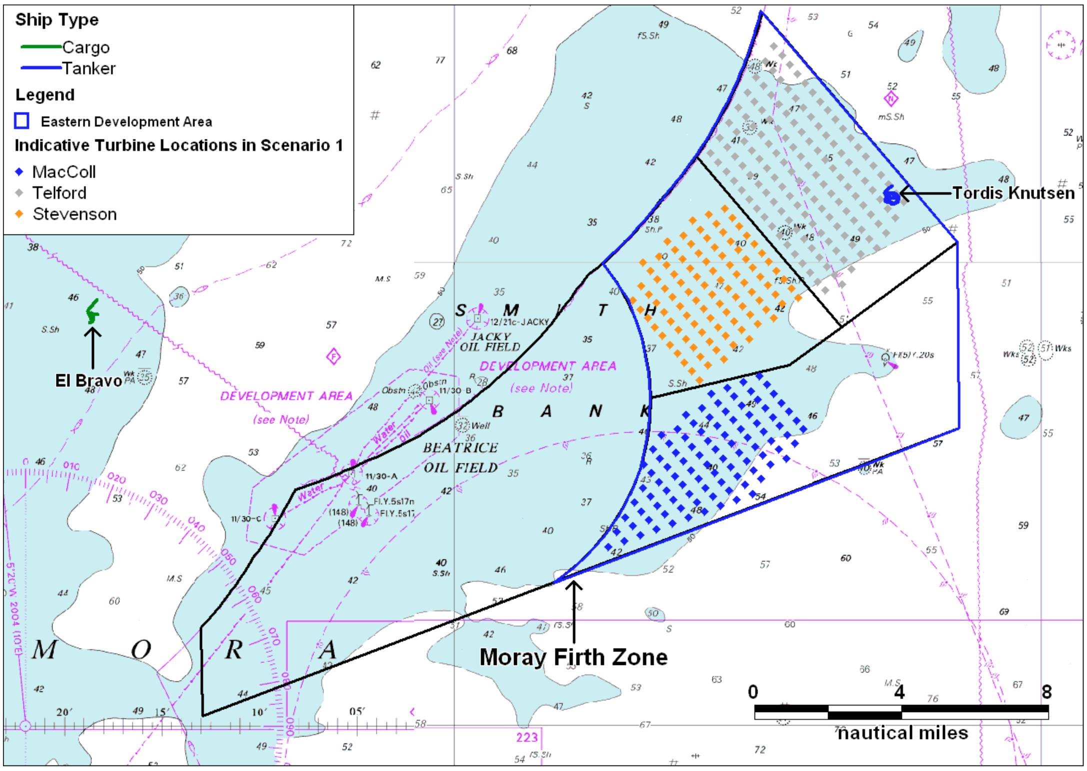


Figure 8.29 All Anchored Vessels during Surveys (69 days of surveying)

Two vessels were recorded an anchor within 14nm of the proposed wind farm sites over the combined survey period.

The crude oil tanker (*Tordis Knutsen*) was recorded anchored within the Telford Wind Farm site for three days during July 2010.

A cargo vessel (*El Bravo*) was recorded at anchor approximately 14nm west of the Stevenson site (off Dunbeath Bay) for two days in January 2011.

8.6 Detailed Analysis of Main Shipping Lanes

8.6.1 Wick Route

The main shipping lane passing the proposed wind farm is the north by north west-south by south east lane to/from Pentland Firth; however it is assumed that shipping on this route will not be significantly impacted by developments within the EDA and therefore will not require a deviation to current routingrouting.

The main route passing through the proposed wind farm sites consists of vessels headed to and from Wick. Vessels using this route during the combined surveys (*Chartwell* April to July 2010 and *Gargano* winter 2010/11) have been isolated for analysis, as presented in Figure 8.30.

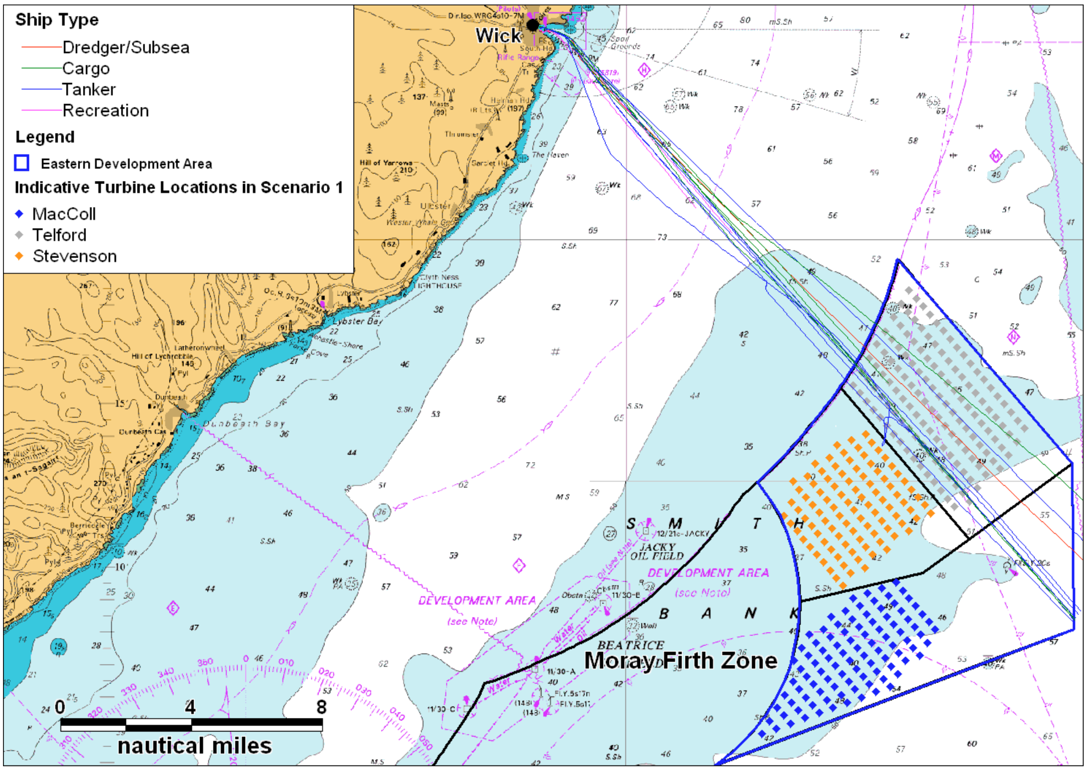


Figure 8.30 Tracks by Type on North East-South West Shipping Route

Figure 8.31 presents the percentage distribution of vessels on the Wick route, recorded during the combined surveys.

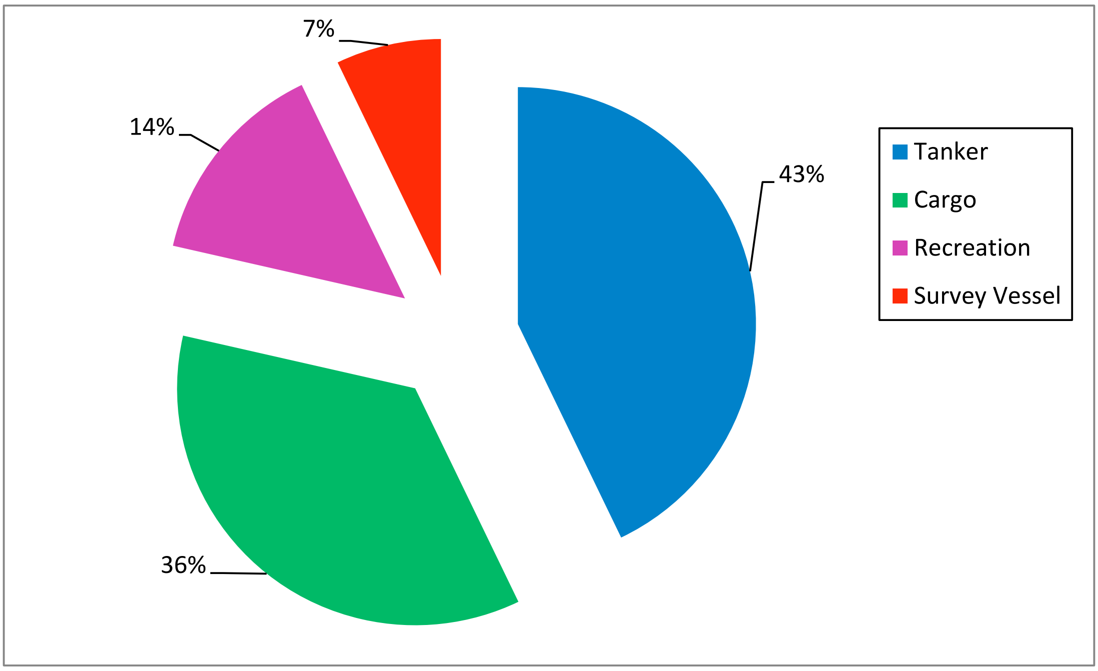


Figure 8.31 Distribution of Vessel Types recorded on the Wick Shipping Route

An average of 1 vessel every ten days during the survey used this route, with coastal tankers and cargo vessels the most frequent users.

It is noted that given the type and size of vessels on this route (i.e. smaller commercial vessels and recreational craft), the number of vessels using this route are likely to be influenced by weather and sea conditions. Thus sailing craft and/or smaller vessels may take more coastal/sheltered routes (south and west of the proposed wind farm sites) in strong tidal and/or poor sea conditions.

8.6.2 Offshore Supply Route

The second main route passing through and/or in close proximity to the proposed wind farm sites consists of offshore vessels headed to and from the Beatrice and Jacky Oil Fields.

Vessels using this route were extracted from a combined 69-day period of data (*Chartwell* July 2010 and *Gargano* winter 2010/11), as presented in Figure 8.32.

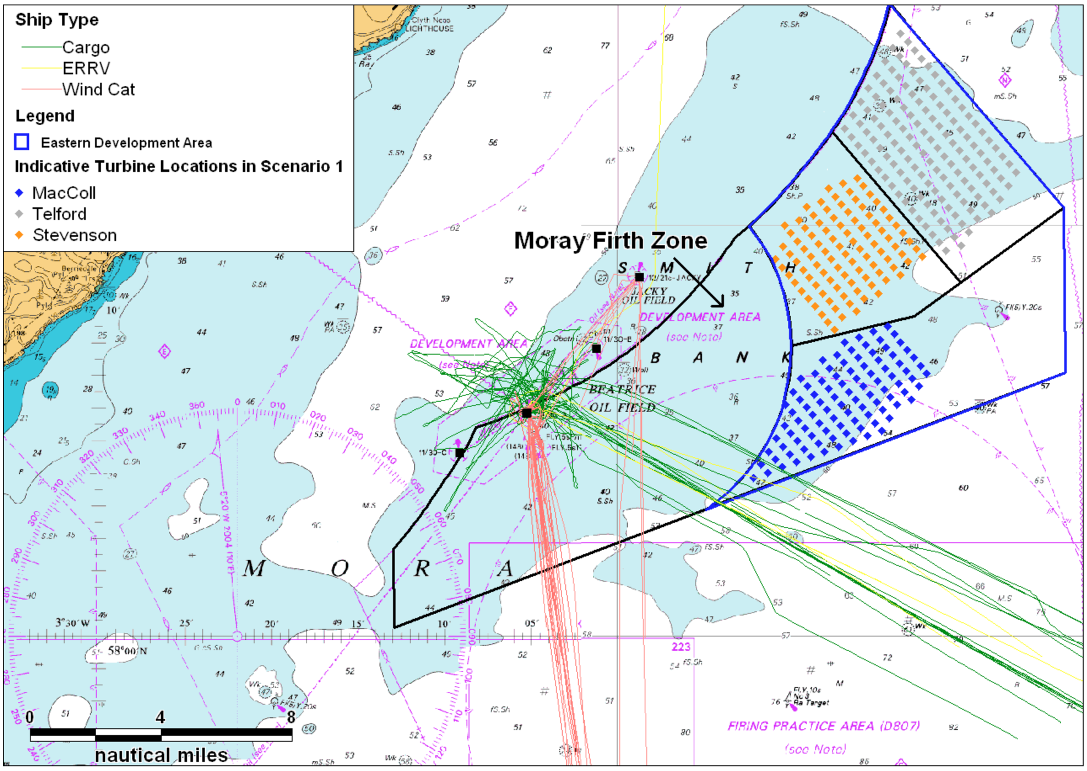


Figure 8.32 Tracks by Type on the Offshore Supply Route including Wind Cats

From the 69-day period of data analysed, there was an average of one transit every four days.

Tracks were made up of Emergency Response and Rescue Vessels (ERRVs) and supply vessels headed to/from the Beatrice Oil Field, mainly from Aberdeen (the main offshore support base in the North Sea).

It is noted that Wind Cat vessels also access the Beatrice and Jacky Oil Fields from Buckie.

9. IMPACT ON COMMERCIAL SHIPPING NAVIGATION

9.1 Passing Ships

Based on the analysis of the shipping survey data (see Section 8), it is considered that the proposed wind farms will not significantly impact passing ships on the Pentland Firth route as they pass well to the north east of the proposed wind farms (at least 3nm west).

In terms of nearby traffic, the majority of ships pass clear of the EDA (e.g. shipping using the coastal route 3-6nm west). The main route that will be impacted is the north east-south west shipping route to/from Wick. Approximately one vessel every ten days uses this route (on average), the majority of which are coastal tankers and/or small to medium cargo vessels. The current position of this traffic lane is analysed in Section 8.6.

In addition, a small number of vessels currently pass through the western part of the proposed sites when headed between the Moray Firth and Northern Norway/Russia. The vessels on this low use route are likely to pass west of the Beatrice offshore Development Area and proposed wind farm sites.

Offshore vessels headed to the Beatrice Oil Field will also route to the south of the EDA, however this is only a slight deviation from the current route.

To highlight that the majority of tracks pass outside the proposed sites, a Closest Point of Approach (CPA) analysis of the most recent survey data collected in winter 2010/11 was carried out.

The CPA distribution for these vessels (excluding vessels passing through the turbine perimeter) is presented in Figure 9.1.

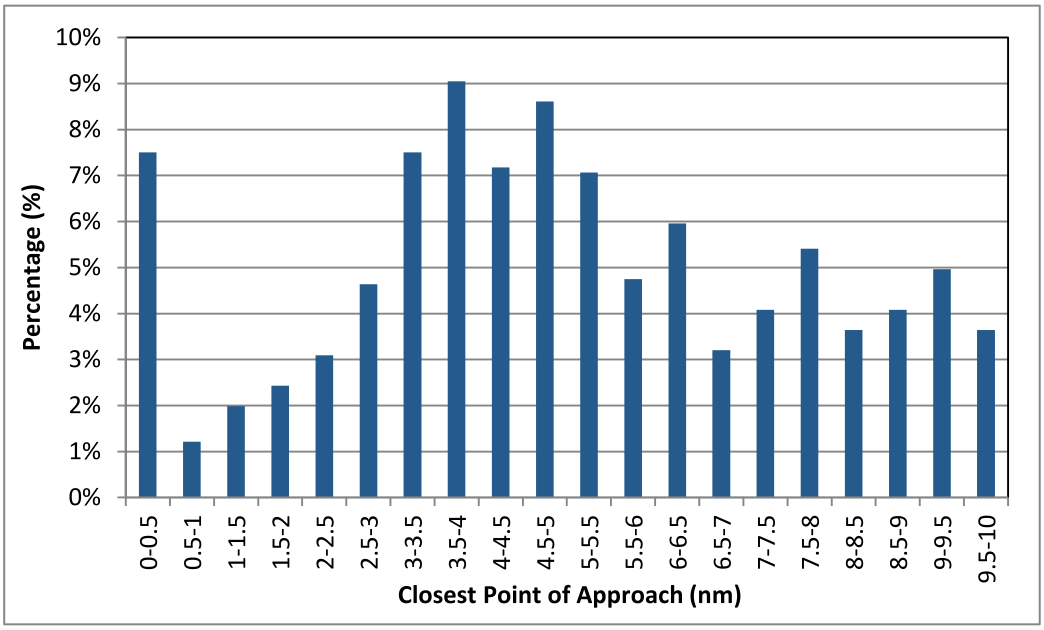


Figure 9.1 CPA Distribution for Vessels within 10nm (Winter Survey 38 Days)

APPENDIX 5.2 D

The MCA has published draft "Guidance to Mariners Operating in the Vicinity of UK Offshore Renewable Energy Installations (OREIs)". It does not provide guidance on a safe distance at which to pass, as this depends upon individual vessels and conditions, but states that:

> *"In planning a voyage mariners must assess all hazards and associated risks. The proximity of wind farms and turbines should be included in this assessment. "*

Based on experience at other sites, the proposed sites are not expected to affect the majority of the shipping in the area. However, the Wick route which currently passes through the northern section of the EDA will move north, and is expected to pass at a distance of approximately 1.4nm. There is sufficient sea room for vessels to make this change.

In addition, the lightly trafficked route from Moray Firth to Northern Norway/Russia is also predicted to increase passing distance west of the proposed sites, to the order of 1.5nm.

Offshore vessels headed to the Beatrice Oil Field are likely to increase passage distance from the southern tip of the EDA, with a deviation of approximately 0.5nm expected (from the current route).

An average track taken by a vessel heading to/from Wick, from Moray Firth to Northern Norway/Russia and to the Beatrice Oil Field, prior to and after construction of the wind farms within the EDA, is presented in Figure 9.2.

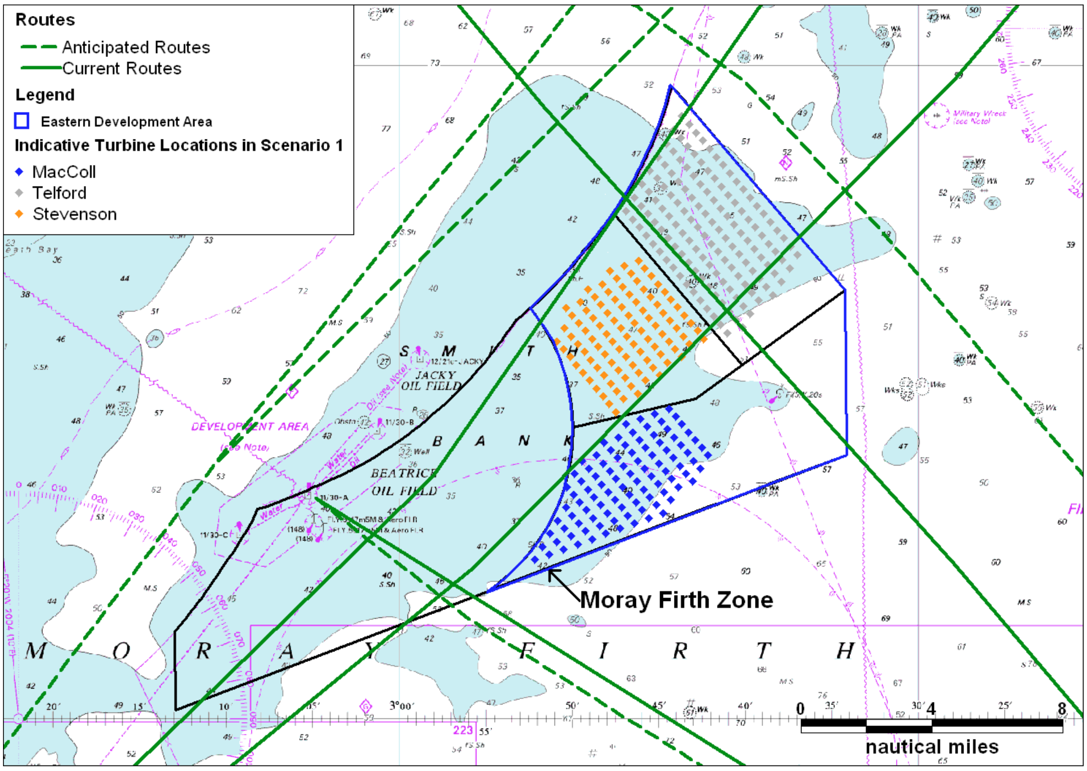


Figure 9.2 Current and Anticipated North East-South West Mean Route Position

The risks associated with the shipping changes anticipated due to the proposed wind farm have been quantified as part of the Formal Safety Assessment (see Sections 12 and 13). The proposed wind farm may also have an effect on marine radar. This potential impact is discussed in Section 16.

10. RECREATIONAL VESSEL ACTIVITY

10.1 Introduction

This section reviews recreational vessel activity at the proposed wind farm sites based on the two maritime traffic surveys (*Gargano* and *Chartwell*) and information published by the Royal Yachting Association (RYA).

10.2 RYA Data

10.2.1 Introduction

The RYA, supported by the CA, have identified recreational cruising routes, general sailing and racing areas around the UK in the Coastal Atlas (Ref. x). This work was based on extensive consultation and qualitative data collection from RYA and CA members, through the organisations' specialist and regional committees and through the RYA affiliated clubs. The consultation was also sent to berth holder associations and marinas.

The reports note that recreational boating, both under sail and power is highly seasonal and highly diurnal. The division of recreational craft routes into Heavy, Medium and Light Use is therefore based on the following classification:

- *Heavy Recreational Routes*: - Very popular routes on which a minimum of six or more recreational vessels will probably be seen at all times during summer daylight hours. These also include the entrances to harbours, anchorages and places of refuge.
- *Medium Recreational Routes*: - Popular routes on which some recreational craft will be seen at most times during summer daylight hours.
- *Light Recreational Routes*: - Routes known to be in common use but which do not qualify for medium or heavy classification.

10.2.2 Moray Firth Recreational Data

An overview and detailed plot of the recreational sailing activity and facilities in the Moray Firth and proposed sites is presented in Figure 10.1 and Figure 10.2.

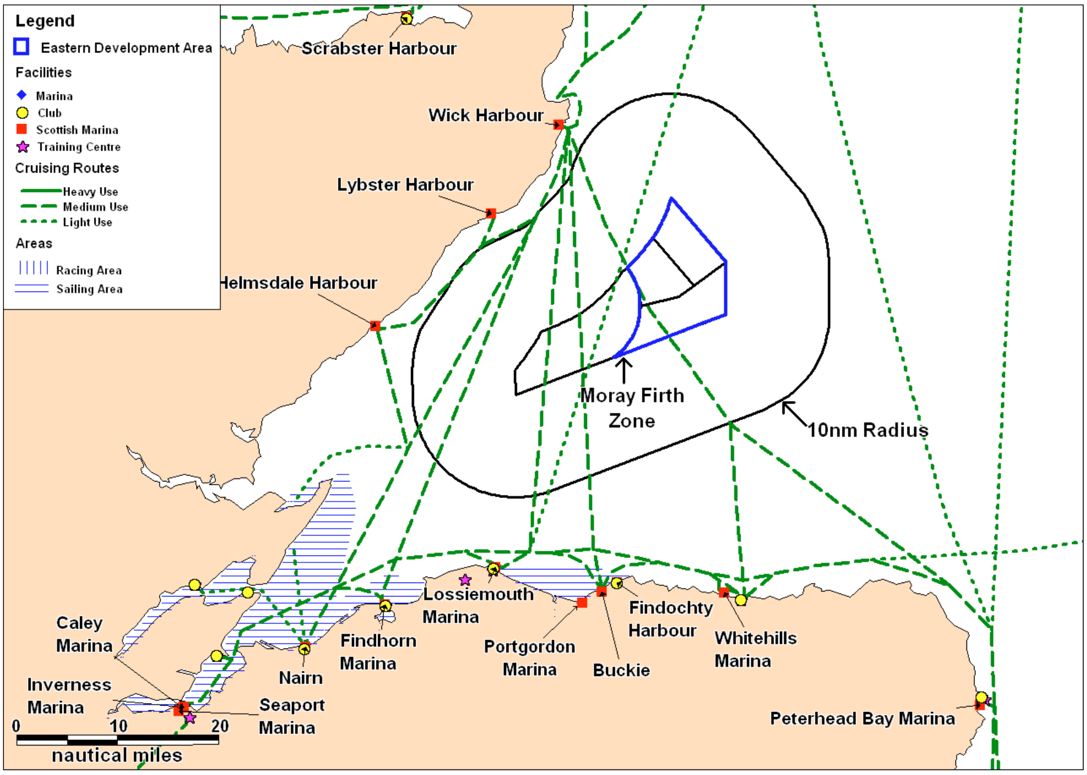


Figure 10.1 Overview Recreational Information for the Moray Firth

In terms of facilities, the nearest marina is located at Wick approximately 13nm north west of the proposed wind farm sites, with Lybster Harbour also having a marina 14nm west by north west. The nearest club is the Findochty Water Sports Club, 22nm south of the proposed wind farm sites.

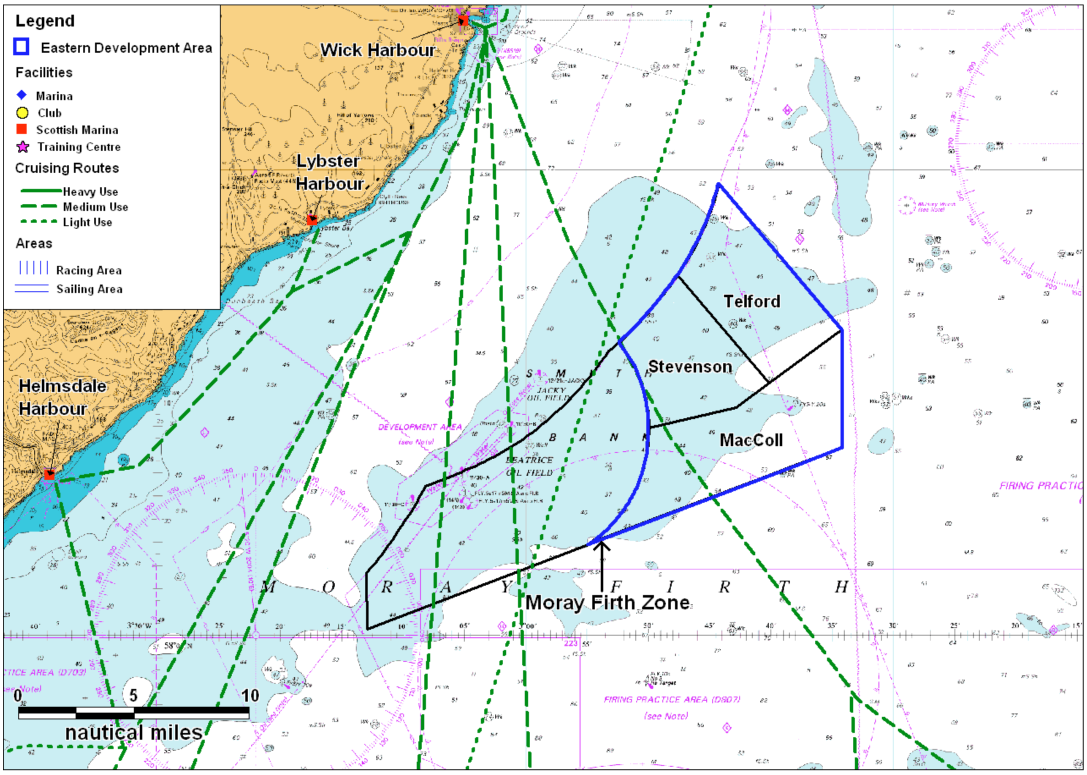


Figure 10.2 Detailed Recreational Information for the Proposed Wind Farm Sites

Based on the RYA published data, the proposed wind farm sites are intersected by a 'medium use' cruising route passing from Wick to north eastern Scottish marinas including Whitehills and Peterhead.

10.3 Survey Data

No recreational vessels were recorded during the *Gargano* winter 2010/11 survey; therefore the recreational tracks recorded during the *Chartwell* survey (May to July 2010) are presented. The effective survey period was approximately 90 days (AIS and radar).

Overall, 36 recreational vessel tracks were recorded during the period, an average of approximately one track every three days. It is noted that 53% of vessel tracks had AIS with 47% recorded on radar. A plot of the combined recreational tracks is presented in Figure 10.3.

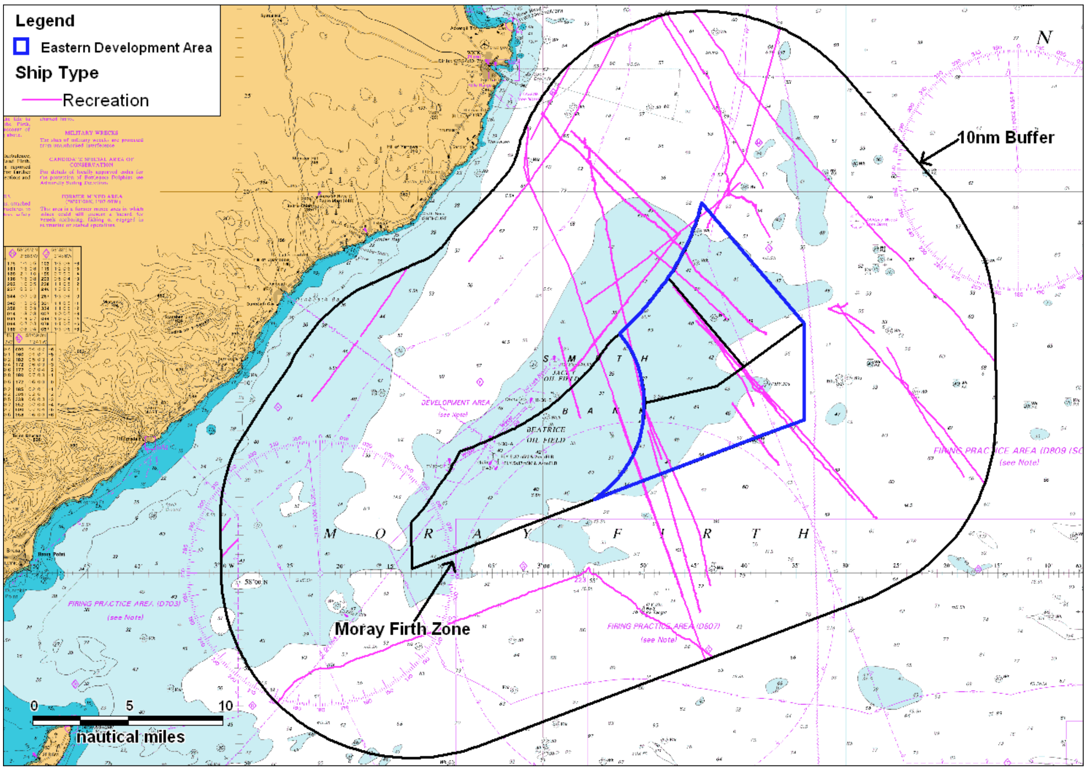


Figure 10.3 All Recreation Vessel Tracks May to July 2010 (90 days)

Fourteen recreation vessels were recorded passing through the proposed wind farm sites during the survey, headed north west / south east (generally to and from Wick).

Recreational vessels were mostly using cruising routes from Banff and Peterhead to Wick and Northern Isle marinas (i.e. Scrabster and Kirkwall).

Figure 10.4 Photograph of a Yacht *Shy Talk* observed Headed to Wick on 19th May 2010 (*Chartwell* Survey)

10.4 Impact Assessment

The air clearance between turbine rotors and sea level conditions at MHWS will not be less than 22m, as recommended by the MCA and RYA. This minimises the risk of interaction between rotor blades and yacht masts.

In terms of vessel routingrouting, recreational vessels should be able to pass between turbines in suitable conditions, as well as being able to pass inshore and offshore. Based on the activity review, this is not expected to be a frequent event and hence the impact on recreational vessels is considered to be minor.

11. FISHING VESSEL ACTIVITY

11.1 Introduction

This section reviews the fishing vessel activity at the proposed wind farm sites based on the maritime traffic survey.

11.2 Survey Tracks

The fishing vessels tracked during the July 2010 and winter 2010/11 surveys (69 days) are plotted in Figure 11.1.

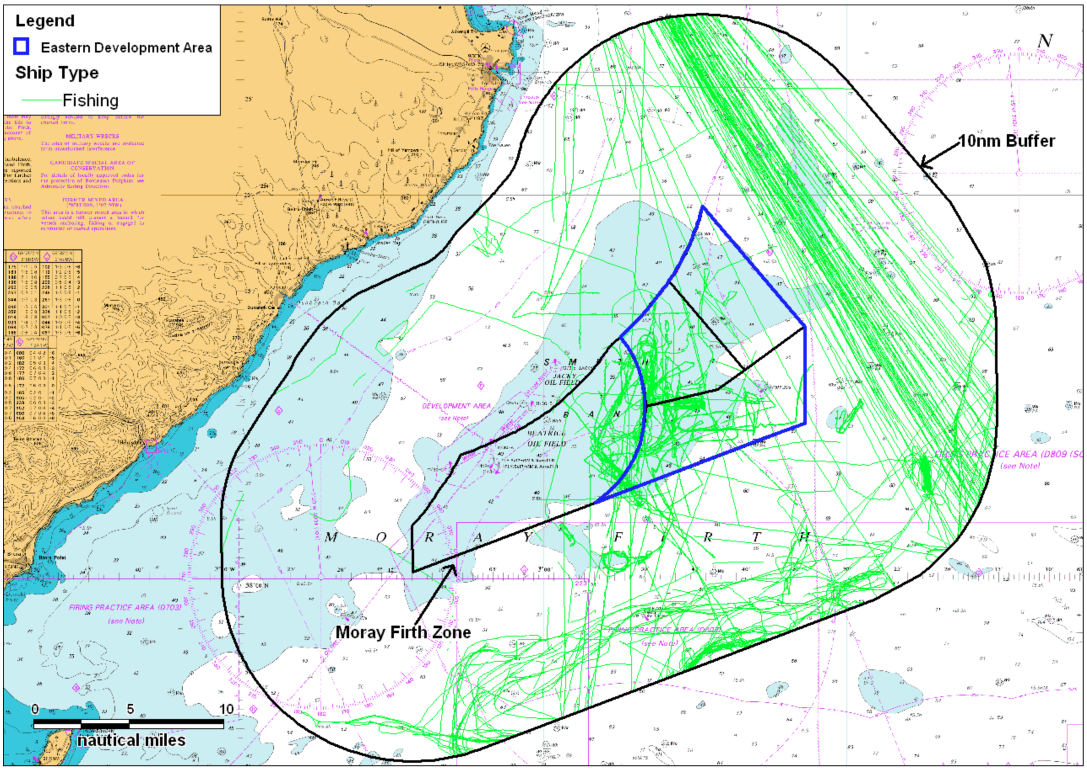


Figure 11.1 All Fishing Vessel Survey Tracks (69 Days)

A total of 74 fishing vessel tracks were logged passing through the site during the combined survey period, averaging 1 per day.

Examples of fishing vessels observed during the *Chartwell* survey (2010) are presented in the figures Figure 11.2 to Figure 11.5.

Figure 11.2 Photograph of *Deeside* BCK595 during the *Chartwell* Survey

Figure 11.3 Photograph of *Atlantis Belle* N80 during *Chartwell* Survey

Figure 11.4 Photograph of *Conquest* BCK265 during *Chartwell* Survey

Figure 11.5 Photograph of *Enterprise* INS11 during *Chartwell* Survey

11.3 Commercial Fisheries Assessment

A detailed study of the fishing activity in the vicinity of the proposed wind farm sites has been performed as part of the Environmental Impact Assessment (EIA) (Ref. xi).

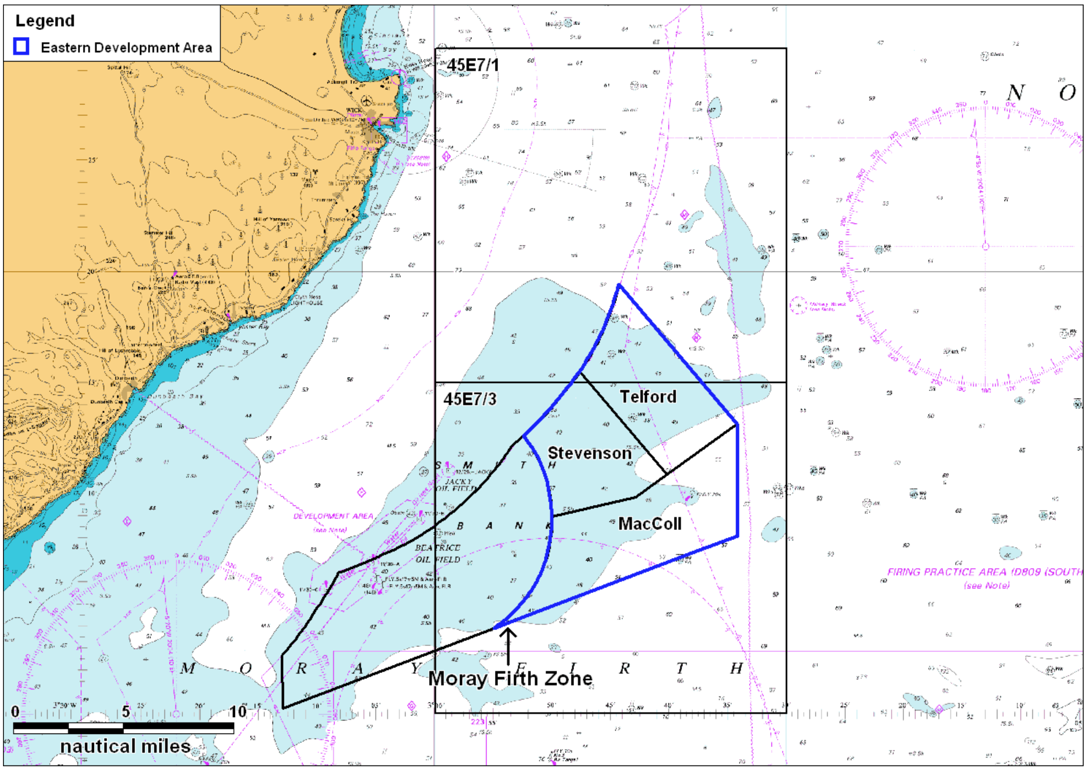


Figure 11.6 Overview of ICES Rectangles relative to the Proposed Sites

The proposed wind farm sites are situated within International Council for the Exploration of the Seas (ICES) Rectangle 45E7/1 and 45E7/3.

11.4 Impact Assessment

Based on the current fishing activity in the area, and the assumption that this will continue after the wind farm is built, there will be a limited risk of collision between fishing vessels and turbines. This risk is reviewed in the Hazard Review workshop (Section 12) and Risk Assessment (Section 13).

There is also potential to impact on the navigation of vessels to and from fishing grounds, for example, increased steaming distances and times. This is mainly an issue during the construction and decommissioning phases when there will be a safety zone and hence there may be some increased steaming distances. During operation there should be sufficient spacing between turbines for vessels to steam through the site if the conditions are considered suitable.

The risk of interaction between fishing gear and subsea cabling associated with the proposed wind farm sites is discussed in Section 13.4.

12. FORMAL SAFETY ASSESSMENT

12.1 Introduction

The IMO Formal Safety Assessment process (Ref. xii) as approved by the IMO in 2002 under SC/Circ.1023/MEPC/Circ392 has been applied within this study. This is a structured and systematic methodology based on risk analysis and cost benefit assessment (if applicable). There are five basic steps within this process:

1. Identification of hazards (a list of all relevant accident scenarios with potential causes and outcomes);
2. Assessment of risks (evaluation of risk factors);
3. Risk control options (devising regulatory measures to control and reduce the identified risks);
4. Cost benefit assessment (determining cost effectiveness of risk control measures); and
5. Recommendations for decision-making (information about the hazards, their associated risks and the cost effectiveness of alternative risk control measures).

Figure 12.1 is a flow diagram of the FSA methodology applied.

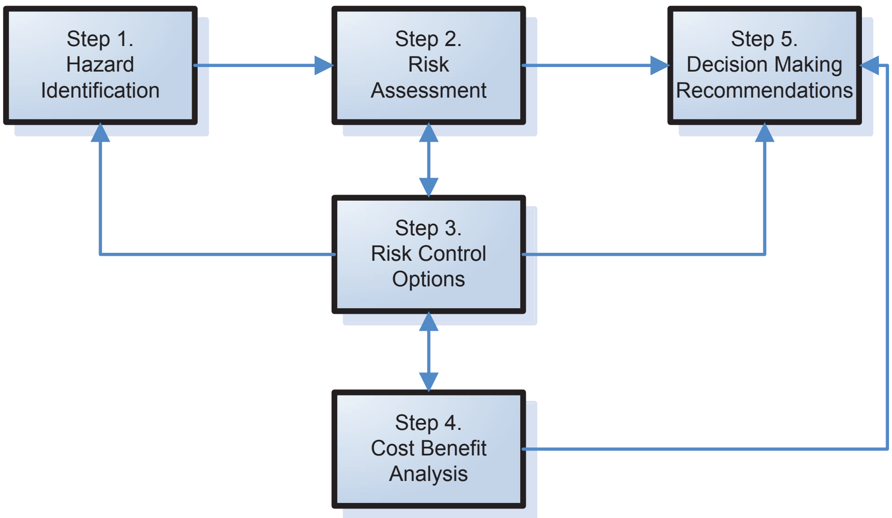


Figure 12.1 Overview of Formal Safety Assessment

As indicated within the IMO FSA guidelines and the DECC guidance on risk assessment methodology (Ref. i) for offshore renewable projects, the depth of the assessment should be commensurate with the nature and significance of the problem. Within the assessment of proportionality consideration was given to both the scale of the development and the magnitude of the risks/navigational impact.

From review it was concluded that the proposed wind farm sites are a large scale development with the potential to impact navigational safety. As a result, the content and methods of the risk assessment were responsive to this and included the following:

- Comprehensive Hazard Log

- Risk Ranking
- Detailed and quantified Navigational Risk Assessment for selected hazards
- Preliminary search and rescue overview
- Preliminary emergency response overview
- Comprehensive risk control/mitigation measures log

12.2 Hazard Identification

A Hazard Review workshop was held in Inverness on 6 July 2011 attended by local stakeholders representing nearby ports and shipping industry, as outlined in Table 12.1. Representatives from MCA, British Chamber of Shipping, RYA and CA were also invited but did not attend.

Table 12.1 Hazard Review Workshop Attendees

Name	Organisation
Ken Gray	Cromarty Firth Port Authority
Keith Stratton	Moray Council
Duncan Pockett	Elgin & Lossiemouth Harbour Company
Andrew Ironside	Fraserburgh Harbour
Archie Johnstone	Northern Lighthouse Board
Ken MacLean	Inverness Harbour
Clare Lavelle	EDP Renewables
Rosie Scurr	SSE Renewables
Ali MacDonald	Anatec Ltd
Peter Carey	Anatec Ltd

12.3 Key Findings

The focus of the meeting was on shipping navigational hazards and the key findings from the meeting are summarised below:

- A key issue identified for the area is the squid fisheries, which are located within the area. Vessels generally fish for squid for 2-3 months per year, from around July. Approximately 40 vessels fish for squid and these are generally between 12m and 22m in length and hence could be a risk of fishing vessel collision and gear interaction with cabling and substructures.

- Generally, it was considered that the sea room between the coast and the proposed wind farms was sufficient for ship-to-ship collision not to be a major issue for displaced traffic. It was also noted that yachts are more likely to use the inshore route.

- The main identified impact on shipping was for offshore support vessels accessing the Beatrice/Jacky platforms and potential collisions between traffic routingrouting around the wind farms and vessels exiting wind farms (such as a maintenance vessel).

- In addition, shuttle tankers associated with the Athena Field visiting the Cromarty Firth may pass in the vicinity of the development and also it was also pointed out that

Ithaca Energy is looking at the possibility of bringing in LNG regasification vessels to do transfer operations at the Nigg Terminal.

- The standard navigational control measures that have been applied to other sites were generally considered the most effective in reducing risks at the site, e.g., marking and lighting.

- Overall the workshop concluded that with the correct mitigation measures in place the navigational risks were likely to be Low.

12.4 Risk and Mitigation Measures

The risks involved with the development and the associated mitigation measures are summarised in the following table. In all cases, the competency of mariners has been assumed when assigning the risk of each hazard.

Hazard	**Key Points**	**Mitigation**
Commercial ship (powered) collision with turbine.	The vast majority of commercial vessels passing the site tend be on the Pentland Firth route and naturally avoid the wind farm. However, automated passage planning is used by some vessels and the wind farm could be used as a waypoint resulting in a potential collision The project are to hold discussions with the Northern Lighthouse Board and UKHO to ensure the farm is appropriately marked, lighted and depicted on charts, etc. Notices to Mariners to be used to circulate information on the project to stakeholders Competent mariners and the "rules of the road" will contribute to risk reduction. Overall the risks were identified as **LOW**.	Marking and Lighting Sound signal Chart Markings Safety Zones Development Area Notices to Mariners Consultation with Local Users
Man overboard during work activities at the site	A key issue is the access to the Jacky platform from helicopters, for both search and rescue as well as when a rig is working over the platform. The is great importance in working with the offshore operators and the MCA on Emergency Response Plans, and to note that helicopter SAR operations may not always be possible within the site	Site personnel suitably trained and equipped (Fire/First Aid, offshore survival and PPE) Procedures for all vessels working in the wind farm Emergency response action plans Control of work procedures Construction Design and

Hazard	Key Points	Mitigation
		Management Regulations (CDM) regulations Adverse weather working policy/procedures
Deliberate unauthorised boarding of turbine or mooring structure	It was highlighted that the development was considered to be too far offshore for this to be a major issue.	Promulgation of information to local users Inspection and maintenance Emergency Response Cooperation Plan Consultation with Local Users
Vessel anchoring / dragging anchor	Incident rates of vessels dragging anchor were difficult to quantify for the area. However, during severe weather in the North Sea, vessels anchor close to the Moray coast for shelter. Vessel types include shuttle tankers, supply vessels and cable laying vessels. There are two anchorages around Fraserburgh, with approximately one commercial vessel anchoring per month, generally 75-90m in length, with anchorages having a sandy sea bed. Overall risks were identified as **<u>LOW</u>** as it was considered unlikely that a vessel would drag anchor undetected and drift towards the turbines without starting engines.	AIS monitoring of the cable route Marking and Lighting Sound signal Chart Markings (cables) Notices to Mariners Consultation with Local Users Cable route away from shipping Appropriate cable protection/burial
Vessel-to vessel-collision due to	An increase in ship-to-ship encounters between vessels routingrouting around the wind farm and vessels exiting the wind farm.	Marking and Lighting Sound signal

Hazard	**Key Points**	**Mitigation**
avoidance of site (includes fishing, recreational and attendant/construction/ maintenance vessels)	However with competent crew/seamanship it was agreed that the risks of ship to ship collision were still likely to be **LOW**. Radar returns for larger vessels passing 0.7 to 1nm off the wind farm are unlikely to be impacted significantly. However smaller vessels exiting the wind farm have potential to go undetected which could pose difficulty to passing vessels. It is noted that fishing activity is greater during squid fishing; and this generally occurs in the south east of the development area. It was also noted yachts are more likely to take the inshore route.	Chart Markings Safety Zones Development Area Notices to Mariners Consultation with Local Users Website Effective Management of Vessels working in site Consultation with fishing and recreational stakeholders.
Fishing Gear interaction with interfield or export cabling	Scallop dredgers and nephrop trawlers operate in the area. In addition as noted squid fisheries are located south east of the area. It has not been confirmed if there will be guard vessels on site during construction of the wind farm.	AIS monitoring of the cable route Marking and Lighting Sound signal Chart Markings (cables) Cautionary Notices on charts Notices to fishermen and liaison Consultation with Local Users Cable route away from shipping Appropriate cable protection/burial Inspection and maintenance procedures
Recreational vessel	Lossiemouth to Wick is a popular route in the area.	Websites

Hazard	Key Points	Mitigation
collides with wind farm structure	Vessels would route to the east and west of the developments dependant on wind speed/direction. Likely that Port websites could be used to circulate wind farm construction progress and information	Promulgation of information to local users Notice to mariners Minimum blade clearance Marking and Lighting Sound signal Chart Markings (cables) Cautionary Notices on charts
Floating turbine anchor failure	There is potential for anchoring to fail causing the turbine to either collapse or with multiple mooring line failure the turbine to drift. Monitoring systems could be used to track the floating structure (i.e. GPS). Look at possibility of hydrostatic release if structure sinks and independent verification of mooring line design.	GPS tracking Hydrostatic releases Emergency Response Cooperation Plan Supervisory Control and Data Acquisition (SCADA) systems to monitor mooring systems Tension Monitoring Systems

12.5 Risk Analysis

Following identification of the key navigational hazards, risk analyses were carried out to investigate selected hazards in more detail. This allowed more attention to be focused upon the high risk areas to identify and evaluate the factors which influence the level of risk with a view to their effective management. Four risk assessments were carried out as per the DECC guidelines:

1. Base case without wind farm level of risk
2. Base case with wind farm level of risk
3. Future case without wind farm level of risk
4. Future case with wind farm level of risk

The following scenarios were investigated in detail, quantitatively or qualitatively.

Without Wind Farm:

- Vessel-to-vessel collisions

With Wind Farm

- Vessel-to-vessel collisions
- Vessel-to-wind farm collisions (powered and drifting)
- Cable interaction

All the quantified risk assessments were carried out using Anatec's COLLRISK software which conforms to the DECC methodology as outlined in Annex D3 in the Guidance (Ref. i). In line with this, Anatec makes the declaration that the models used within this work have been validated and are appropriate for the intended use. As required the following have been considered and justified:

- Tuning of parameters
- Consistency checks
- Behavioural reasonableness
- Sensitivity analysis
- Comparison with the real world

The results of the detailed risk analyses are presented in Section 13. Where considered appropriate in high risk scenarios, the change in individual and societal risk (based on Potential Loss of Life), as well as the risk of pollution, were calculated and compared to background risk levels in the UK.

12.6 Risk Control Measures

A summary of measures is presented in Section 21.

13. RISK ASSESSMENT

13.1 Introduction

This section assesses the risks identified from the hazard review to require more detailed assessment. This is divided into without wind farm (pre-installation) and with wind farm (post-installation) risks.

The base case assessment uses the present day vessel activity level identified from the maritime traffic surveys, consultation and other data sources. The future case assessment makes conservative assumptions on shipping traffic growth over the life of the wind farm.

The collision risk modelling is based on the Rochdale Envelope, three indicative offshore wind farm layouts, constructed at the proposed sites (refer to Section 3 for more details).

13.2 Without Wind Farm Risk

13.2.1 Encounters

An assessment of current ship-to-ship encounters has been carried out by replaying at high-speed 28 days of data (two fourteen day periods) from *Gargano* in November 2010 (7 days) and January 2011 (7 days) and *Chartwell* in June 2010 (14 days).

An encounter distance of 1nm has been considered. The tracks of vessels during encounters recorded during the 28 days of analyses, and heat maps based on the geographical distribution of encounters within a 1nm grid of cells, are presented in Figure 13.1 and Figure 13.4. This helps to illustrate where existing shipping congestion is highest and therefore where offshore developments, such as a wind farm, could potentially exacerbate congestion and hence increase the risk of encounters / collisions.

It can be seen that in all cases, the density of encounters in the vicinity of the proposed wind farm is minimal.

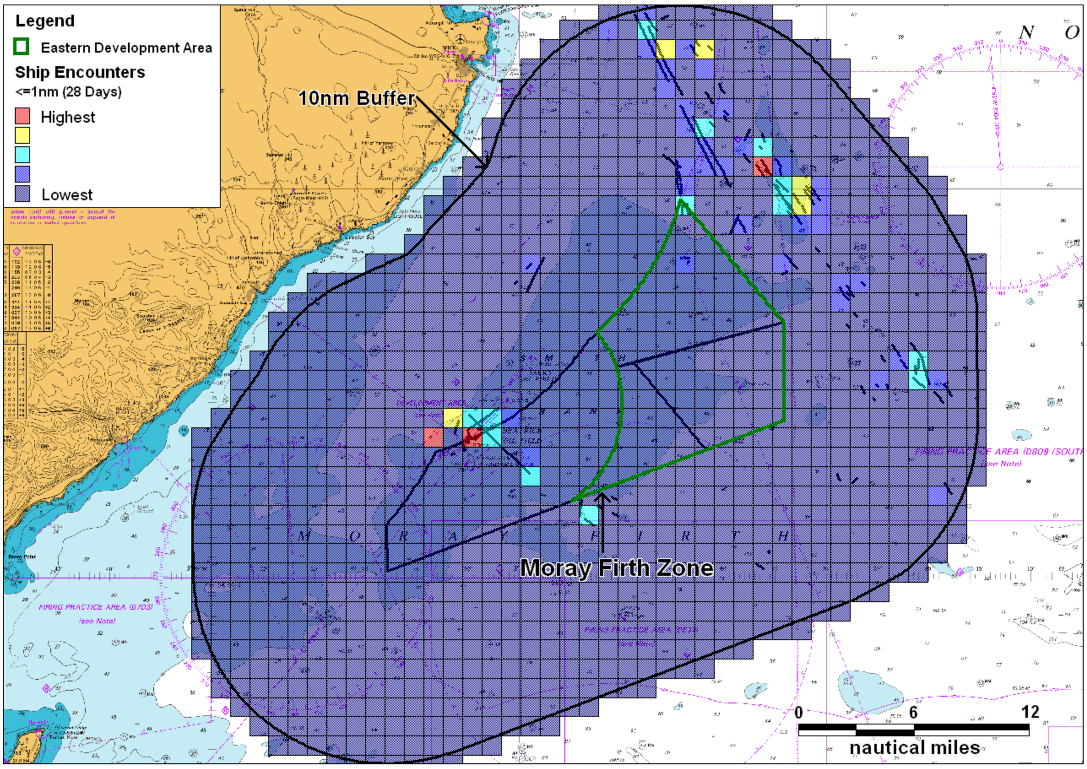
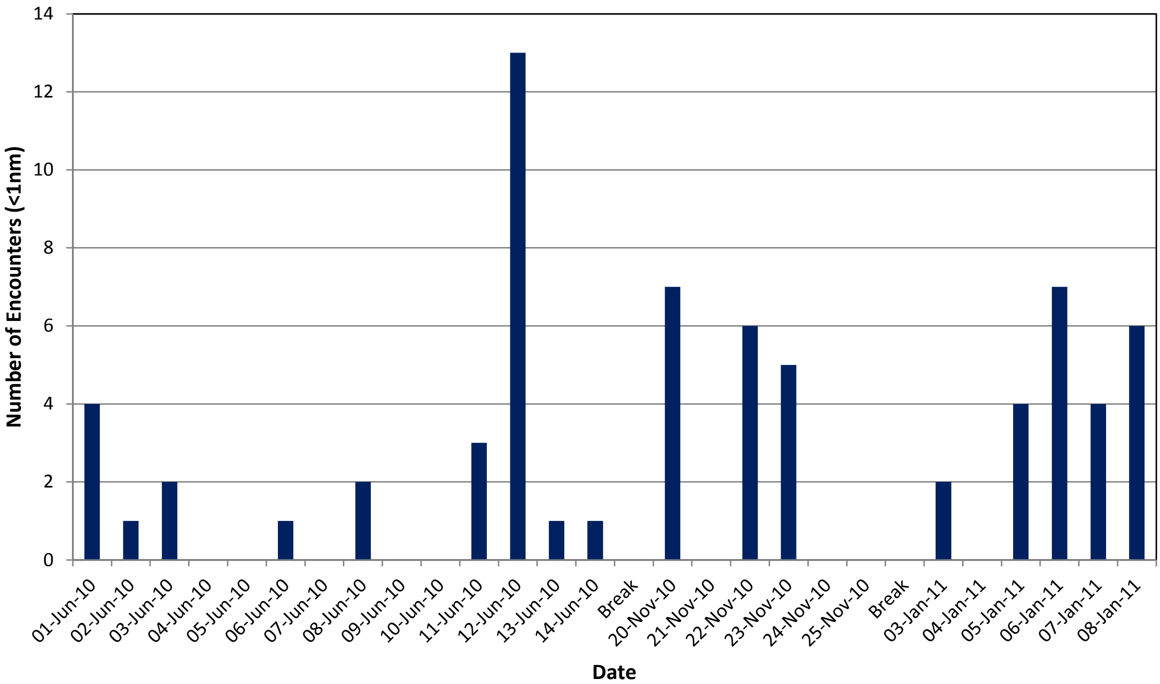


Figure 13.1 Ship Encounters within 1nm relative to a 1x1nm Grid

Due to the location of the proposed wind farm sites (i.e., in open sea), an encounter distance of 1nm has been used for further analysis of encounters.

There were 69 encounters during the 28-day period. Figure 13.2 presents the number of encounters per day, it is noted that breaks are used to separate the different survey periods.



APPENDIX 5.2 D

Figure 13.2 Number of Encounters per Day

The average number of encounters was 2 to 3 per day (2.5), with the highest number (13 encounters) observed on 12 June 2010 when two fishing vessels were operating in the area.

Figure 13.3 presents the distribution of vessel types involved in encounters (excluding unspecified).

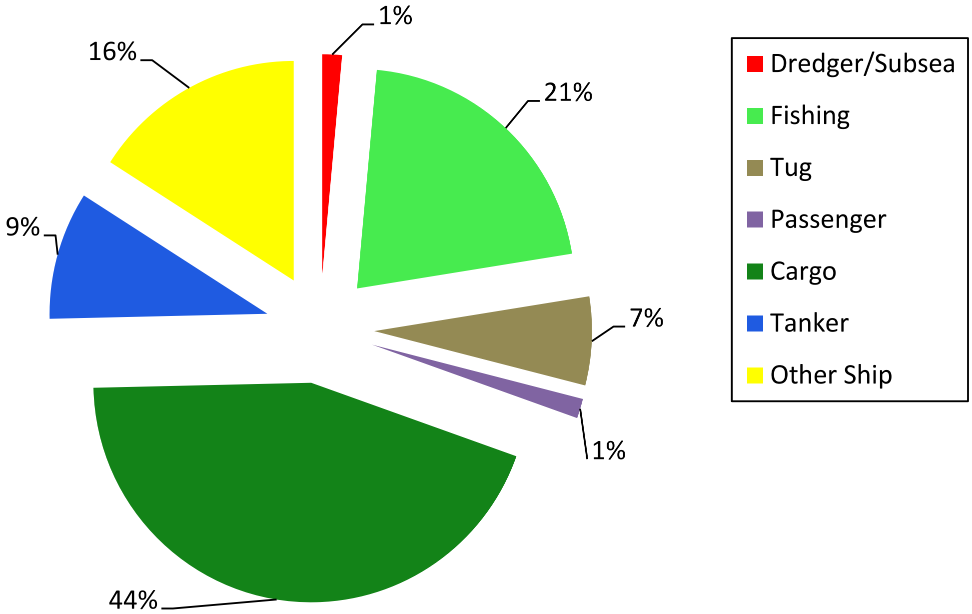


Figure 13.3 Vessel Types Involved in Encounters

It can be seen that the majority of encounters involved cargo ships (44%), fishing vessels (21%) and 'other ships' (16%). Excluding the fishing vessels, the majority of both are offshore industry support vessels working at Beatrice/Jacky or passing through the area.

The locations of encounters colour-coded by ship type during the 14 day period are presented in Figure 13.4.

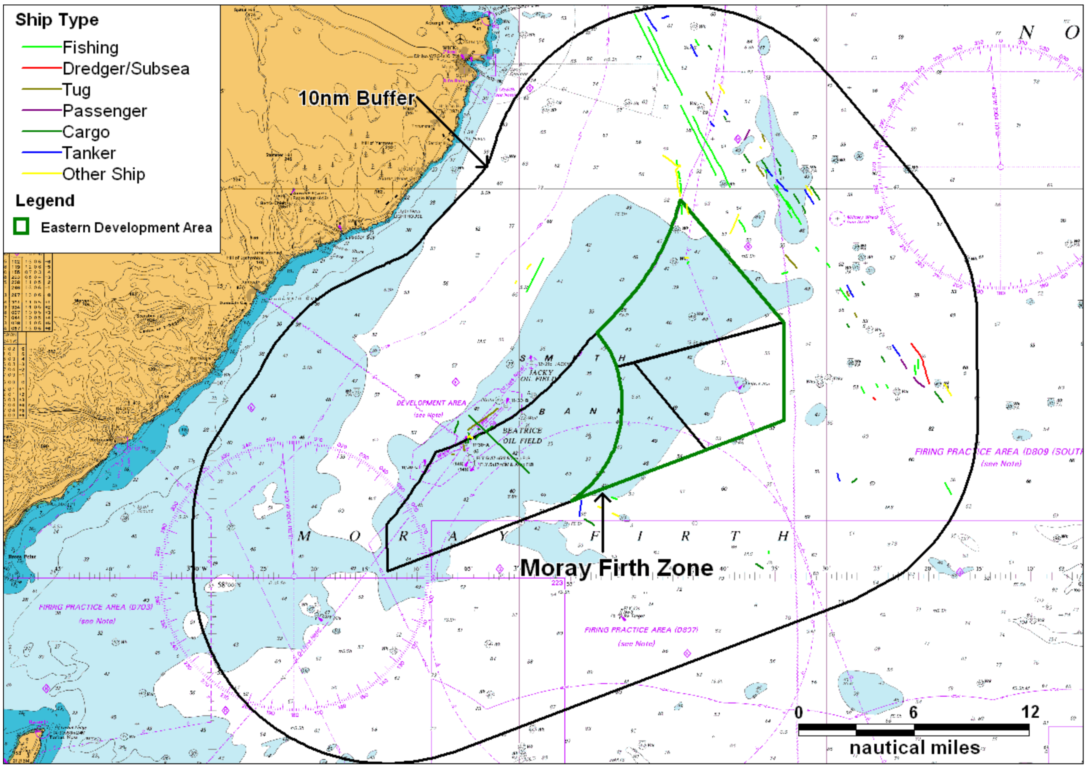


Figure 13.4 Overview of Encounters 1nm during 28 Days (AIS)

The vast majority of encounters occurred on the Pentland Firth route and within the Beatrice offshore Development Area where infield vessels are operating in close proximity.

There were two encounters recorded within the proposed sites, with the fisheries patrol vessels *Minna* and a Dutch flagged fishing vessel *Wron 5* passing within 1nm twice during the 12th June 2010 within the northern section of the proposed Telford wind farm boundary.

The closest point of approach between the two vessels was approximately 380m and it is assumed the fisheries patrol vessel was monitoring the fishing vessels compliance with EU Regulations/fishing quotas.

13.2.2 Vessel-to-Vessel Collisions

Based on the existing routingrouting and encounter levels in the area, Anatec's COLLRISK model has been run to estimate the existing vessel-to-vessel collision risks in the local area around the proposed wind farm sites. The route positions and widths are based on the survey analysis with the annual densities based on port logs and Anatec's ShipRoutes database, which take seasonal variations into consideration.

Based on the model run for the area, the baseline vessel-to-vessel collision risk level pre-wind farms is in the order of 1 major collision in just over 2,360 years.

It is emphasised the model is calibrated based on major incident data at sea which allows for benchmarking but does not cover all incidents, such as minor impacts, or incidents occurring within port. Other incident data from RNLI and MAIB is presented in Section 7. This includes other minor incidents including collisions in port (no collisions were reported by MAIB within 10nm of the proposed wind farm sites).

13.3 With Wind Farm Risk (Base Case)

13.3.1 Vessel-to-Vessel Collisions – Change in Risk

The revised routingrouting pattern following construction of the wind farm has been estimated based on the review of impact on navigation (see Section 9). The main change is displacement of ships passing close to the wind farm area on approach/departure from Wick and the inner Moray Firth. It is assumed that ships will be able to pre-plan their revised passage in advance of encountering the wind farm due to effective mitigation in the form of information distribution about the development to shipping through Notices to Mariners, updated charts, liaison with ports, etc. Fishing vessels may also be displaced from the site to other areas, which could increase the frequency of encounters.

Based on vessel-to-vessel collision risk modelling of the revised traffic pattern, the collision risk was estimated to increase to 1 major collision in 2,310 years. The change in collision frequency due to the proposed wind farms was estimated to be 4.3×10^{-4} per year.

As noted earlier, the model is calibrated based on major incidents at sea which allows for benchmarking but does not cover all incidents, such as minor impacts, or incidents occurring within port.

The following potential affects have not been quantified but may indirectly influence the vessel-to-vessel collision risk:

- Radar interference
- Visual obscuration when ships approach each other.

The radar interference issue is discussed in Section 16. It is noted that any potential impact is only likely to be a problem during bad visibility and this is mitigated to an extent by the widespread adoption of AIS which will assist vessels in discriminating genuine targets (although AIS is not currently mandatory for smaller vessels, e.g., fishing and recreational vessels).

The visual issue is reviewed in Section 20.2 and is not considered a significant factor for the proposed wind farm sites due to its position and orientation relative to the shipping lanes and the other navigational features in the area.

13.3.2 Ship Collision with Structure

There are two main scenarios for passing ships colliding with offshore structures such as wind farm turbines and substations:

- Powered Collision: Where the vessel is under power but errant
- Drifting Collision Where a ship on a passing route experiences propulsion failure and drifts under the influence of the prevailing conditions.

Each scenario is assessed below.

Powered Ship Collision

Based on the ship routingrouting identified for the area and the anticipated change in routingrouting due to the site, and assuming effective mitigation in terms of making mariners aware of the site through Notices to Mariners, charts, lights and markings, etc., the frequency of an errant ship under power deviating from its route to the extent that it comes into proximity with the proposed wind farm sites is not considered to be a likely event.

From consultation with the shipping industry it is assumed that merchant ships will not attempt to navigate between turbines due to the restricted sea room and will be directed by the navigational aids in the area.

The main risk of powered collision with a wind farm structure is from human error on the bridge of the ship, however, the proximity to the nearest shipping routes and Beatrice Oil Field developments should mean that mariners are already very attentive to their vessel's position and proximity to other vessels and obstructions in this area.

Based on modelling of the revised routingrouting (Figure 9.2), proposed layouts, local metocean data, the frequency of a passing powered vessel collision was estimated and the results are presented in Table 13.1.

Table 13.1 Powered Ship-to-Structure Collisions – Base Case with Wind Farms

Turbine Layout	Annual Collision Frequency	Collision Return Period
Scenario 1	7.2E-06	138,000 years
Scenario 2	7.5E-06	132,000 years
Scenario 3	4.3E-06	234,000 years

These collision frequencies are well below the historical average of 5.3×10^{-4} per installation-year for offshore installations on the UKCS (1 in 1,900 years). The risk to the proposed wind farms is estimated to highest for the indicative layout in scenario 2 which covers the largest area of sea room within the three wind farm sites. However the low ship-to-structure collision frequency is generally reflective of low level of traffic passing nearby.

The individual collision frequencies ranged from 3.8 x 10^{-6} for the substation on the northern boundary of scenario 2 and 3 layouts, to negligible for a turbine within the centre of the wind farms. Plots showing the passing powered collision frequency for each turbine in the three potential layouts, as well as the substations are presented in Figure 13.5 to Figure 13.7.

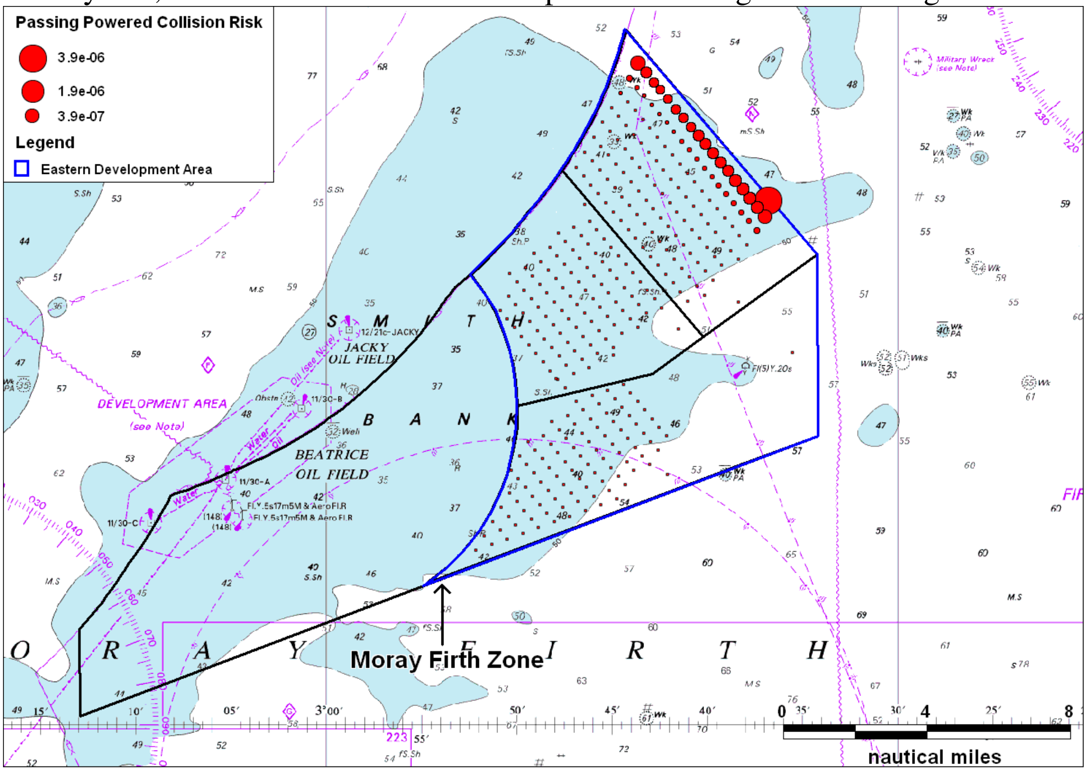


Figure 13.5 Annual passing powered collision frequency for Scenario 1

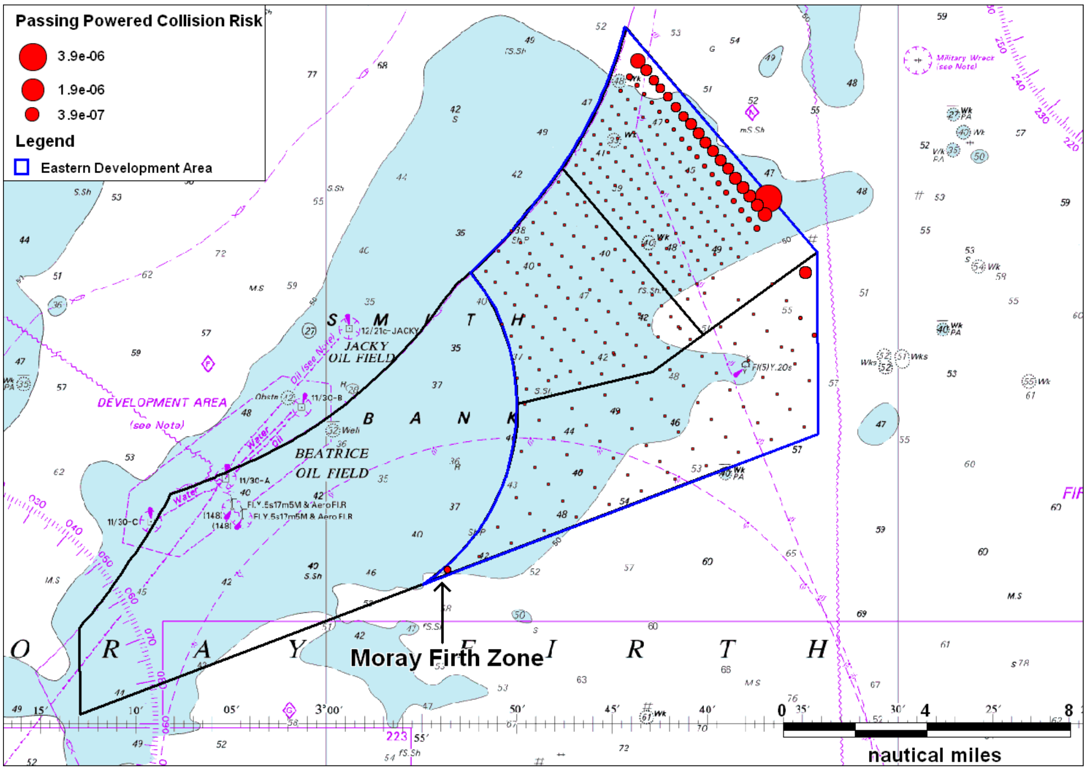


Figure 13.6 Annual passing powered collision frequency for Scenario 2

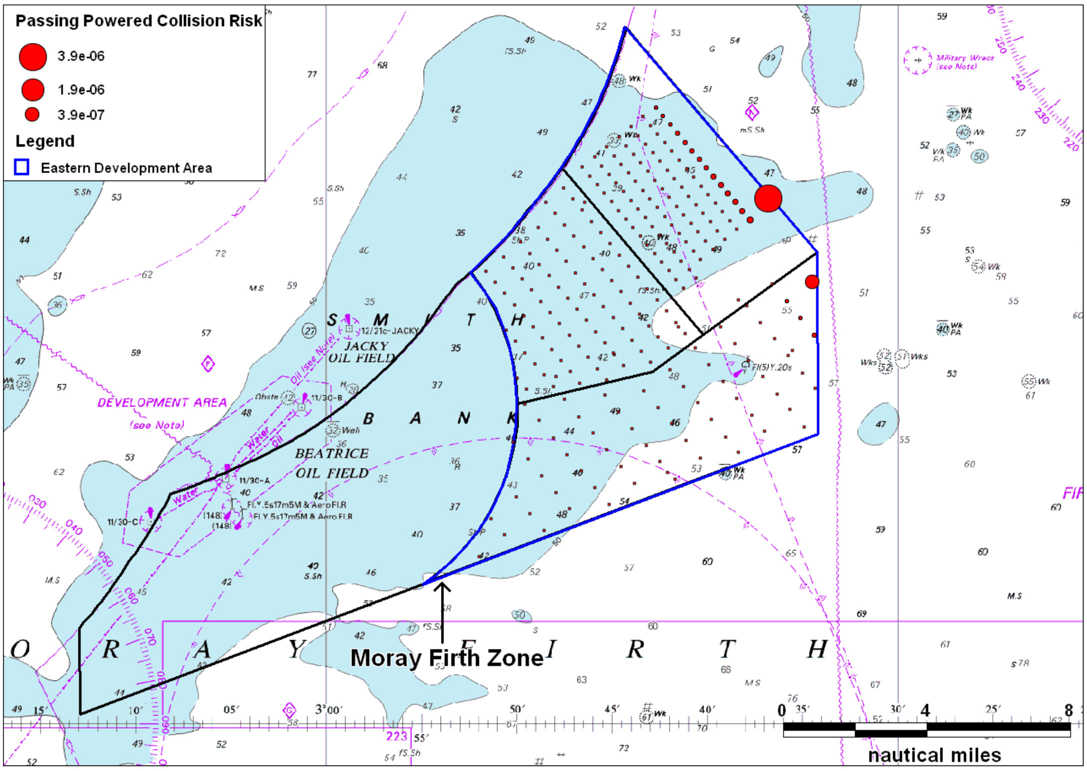


Figure 13.7 Annual passing powered collision frequency for Scenario 3

Drifting Ship Collision

The risk of a ship losing power and drifting into the proposed wind farm structures was assessed using Anatec's COLLRISK model. This model is based on the premise that propulsion on a vessel must fail before a vessel will drift. The model takes account of the type and size of the vessel, number of engines and average time to repair in different conditions.

The exposure times for a drifting scenario are based on the ship-hours spent in proximity to the proposed wind farms (up to 10nm from perimeter). These have been estimated based on the traffic levels, speeds and revised routing pattern. The exposure is divided by vessel type and size to ensure these factors, which based on analysis of historical accident data have been shown to influence accident rates, are taken into account within the modelling.

Using this information the overall rate of breakdown within the area surrounding the wind farm was estimated. The probability of a ship drifting towards a structure and the drift speed are dependent on the prevailing wind, wave and tide conditions at the time of the accident.

The following drift scenarios were modelled:

- Wind
- Peak Spring Flood Tide
- Peak Spring Ebb Tide

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

After modelling the three scenarios for the different layouts it was established that tide-dominated drift produced the worst case results for Scenarios 1 and 2 and the wind dominated drift was the worst case result fort Scenario 3. These results are presented in Table 13.2

Table 13.2 Drifting Ship-to-Structure Collisions – Base Case with Wind Farms

Turbine Layout	Annual Collision Frequency	Collision Return Period
Scenario 1	2.3E-06	430,000 years
Scenario 2	2.4E-06	418,000 years
Scenario 3	4.8E-07	Negligible

The worst case drifting collision risk has been identified as 1 every 418,000 years. Drifting collisions are assessed to be less frequent than powered collisions, which is reflective of historical data. There have been no reported 'passing' drifting ('Not under Command') ship collisions with offshore installations on the UKCS in over 6,000 operational-years. Whilst a large number of drifting ships have occurred each year in UK waters, most vessels have been recovered in time, e.g., anchored, restarted engines or taken in tow. There have also been a small number of 'near-misses'.

The majority of the drifting vessel collision frequency is associated with the more northerly structures, (e.g., structures on the northern edge of the proposed wind farm sites including those in MacColl and Telford) since the currents in the area set in a generally south by south east to north by north west direction on the ebb.

13.3.3 Fishing Vessel Collision

The fishing activity in the area was observed during the AIS and radar surveys. Based on the survey data, the average density of fishing vessels operating in the region at any one time was estimated to be approximately one vessel per 100nm^2.

Anatec's COLLRISK fishing vessel risk model has been calibrated using fishing vessel activity data along with offshore installation operating experience in the UK (oil and gas) and the experience of collisions between fishing vessels and UKCS offshore installations (published by HSE).

The two main inputs to the model are the fishing vessel density for the area and the structure details. The fishing vessel density in the area of the wind farm was based on the survey data as noted above. The worst case dimensions for the structures within Scenario 1 to 3 have been used.

Using the above site-specific data as input to the model, the worst case annual fishing vessel collision frequency for the proposed wind farm sites was estimated for the three scenarios.

Table 13.3 Fishing Vessel Collisions – Base Case with Wind Farms

Turbine Layout	Annual Collision Frequency	Collision Return Period
Layout 1	6.2E-02	16 years
Layout 2	5.3E-02	19 years
Layout 3	4.7E-02	21 years

The worst case fishing vessel collision risk has been identified as to be 6.2 x 10^{-2}, which corresponds to an average of 1 collision in 16 years for Scenario 1 which has the largest number of turbines and hence biggest target area. This collision frequency reflects the relatively high density of fishing vessels operating and passing through the area and also gives account to the fact fishing vessels are likely to operate within the project areas following construction of the wind farms.

13.3.4 Recreational Vessel Collision

There are two main collision hazards from recreational vessels interacting with wind farms:

1. Turbine Rotor Blade to Yacht Mast Collision
2. Vessel Collision with Main Structures

Blade/Mast Collision

A collision between a turbine blade and the mast of a yacht could result in structural failure of the yacht.

For a blade/mast collision to occur, the air draught of the yacht (from water-line to top of masthead) must be greater than the available clearance under the area swept by the rotating blade.

The planned minimum rotor blade clearance for the turbines is at least 22m above Mean High Water Springs (MHWS), which matches the MCA minimum requirement and recommendation of RYA. This is the clearance when the blade is in its lowest ('6 o'clock') position. The actual clearance at a given time will depend upon the prevailing tide and wave conditions, i.e., lower clearance at high water and rough seas, greater clearance at low water and calm seas.

To determine the extent to which yacht masts could interact with the rotor blades, details on the air draughts of the IRC fleet are provided in Figure 13.8 based on a fleet size of over 3,000 vessels. IRC is a rating (or 'handicapping' system) used Worldwide which allows boats of different sizes and designs to race on equal terms. The UK IRC fleet, although numerically only a small proportion of the total number of sailing yachts in the UK, is considered representative of the range of modern sailing boats in general use in UK waters.

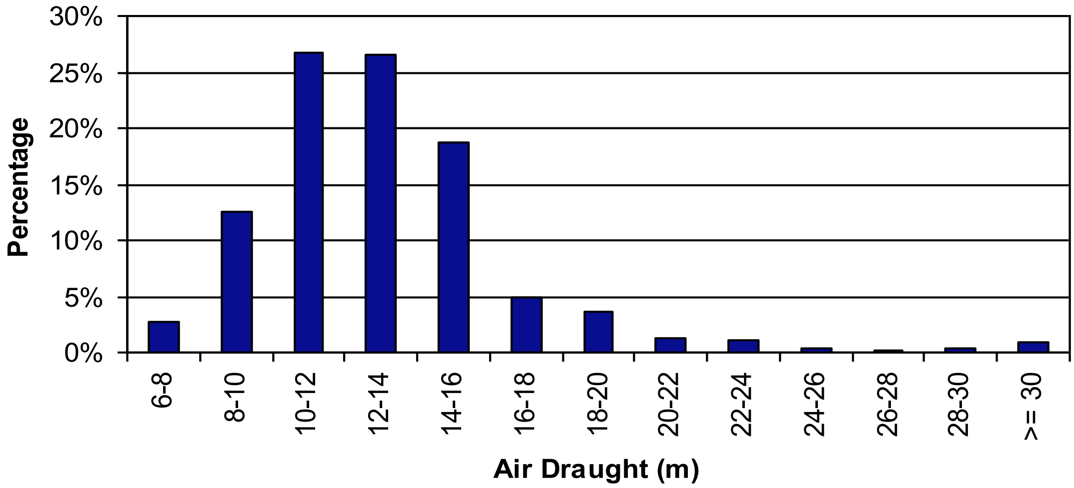


Figure 13.8 Air Draught Data – IRC Fleet (2002)

From this data, just under 3% of boats have air draughts exceeding 22m. Therefore, only a fraction of vessels could potentially be at risk of dismasting if they were directly under a rotating blade in the worst-case conditions.

It is further noted that the wind farm will be designed and constructed to satisfy the requirement of the Maritime & Coastguard Agency in respect of control functions and safety features, as specified in the MCA standards (Ref. ii).

The most likely reason for the Emergency Management System being ineffective is considered to be the mariner failing to alert the Coastguard either directly or indirectly using VHF, mobile phone, flares, etc. It is noted that very large yachts, which are the only boats that could potentially interact with the rotor blades, are also most likely to be equipped with VHF radio and other safety equipment.

Based on the information presented in this section, the risk of dismasting of a yacht by a rotating blade of an wind turbine is assessed to be minimal, and has not been further quantified.

Vessel/Structure Collision

In good conditions the wind farm should be visible, especially as most activity occurs during daylight hours. In this case, vessels, if competently skippered, will be able to navigate safely to avoid the structures. Even if a vessel were to get into difficulty, most should be able to keep clear of the structures or anchor or moor if necessary to avoid drifting closer to the wind farm whilst they fix the problem or call for assistance.

The main risk of collision is considered to be in bad weather, especially poor visibility, where a small craft could fail to see the wind farm and inadvertently end up closer than intended.

If there were poor visibility combined with adverse weather and/or strong tides, the vessel may not be able to anchor.

The risk of small craft being in the area during bad weather is reduced by the fact that most craft are fitted with radio receivers and VHF so will be able to listen to regular broadcasts of the weather forecast by the BBC and Coastguard. It is also standard practice for local clubs to post weather forecasts on notice boards.

Given the ready availability of weather forecasts and growing use of GPS, the risk of a vessel being in proximity to the wind farm in bad weather is considered to be low but not negligible. In this scenario, a vessel unable to make way from the wind farm and at risk of collision may alert Aberdeen VTS and the Coastguard using mobile phone, VHF or flares.

To minimise the risk of collision in this worst-case scenario, mitigation in line with regulator guidance will be put in place. It will be ensured, consistent with the requirements of NLB, that the structures are marked in such a way as to enhance the prospect of visual observation by passing recreational craft even in adverse conditions.

The Operator will also ensure notification of the development to the recreational craft community is widespread and effective throughout all phases.

These measures mean that whilst the collision risk cannot be completely eliminated it will be reduced to a level as low as reasonably practicable. In terms of consequences, most collisions with the turbines should be relatively low speed and hence low energy. If the seaworthiness of the recreational craft was threatened by the impact, the turbines will be equipped with access ladders for use in emergency, placed in the optimum position taking into account the prevailing wind, wave and tidal conditions, as required by the MCA. This should provide a place of safety/refuge until such time as the rescue services arrive.

13.4 Cable Interaction – Anchor and Trawl

All the subsea cables will be buried or trenched where sea bed conditions allow, in order to provide protection from all forms of hostile seabed interaction, such as fishing activity, dragging of anchors and dropped objects. There will be periodic inspections/surveys to ensure they do not become exposed. They will also be marked on Admiralty Charts, although whether all submarine cables are charted depends upon the scale of the chart; in some cases only the export cable may be shown.

The offshore export cable route to runs south east of the MORL Zone to land fall in Fraserburgh. This crosses the coastal route (east/west into the Moray Firth) and north/south vessels headed to Pentland Firth or the Northern Isle. In addition, there are relatively high numbers of fishing vessels associated with Fraserburgh and Peterhead routing through the area.

During severe weather in the North Sea, vessels may anchor for shelter off the Moray coast. This includes shuttle tankers, supply vessels, survey and cable laying vessels. Anchoring activity was limited within 10nm of the proposed wind farm sites during the surveys; however anchoring can occur within Aberdour Bay 7.3nm west of the route. Further offshore, larger vessels (including tankers) anchor in an area of shallower water, north of the Southern Trench, approximately 7nm south west off the main cable route.

There is a charted anchorage in Fraserburgh Beach and two vessels were recorded at anchor within the proposed cable survey extent during the cable survey (July to October 2011). As there is a charted anchorage in Fraserburgh Beach, to minimise the impact on current anchoring practices, cable protection and burial should be explored to decrease the likelihood of anchor dragging or snagging the export cables.

The predominant fishing activity in the area is demersal trawling and scallop dredging; with the largest number of fishing vessels recorded operating (fishing) in the cable corridor approximately 17nm south east of MacColl wind farm area and north of the Southern Trench. A high density of fishing vessels were also recorded steaming to local fishing ports, following the Aberdeenshire coast.

It is therefore assumed the cable will be suitably protected for the sea bed conditions and principally the fishing activity in the area through burial / trenching, information promulgation and periodic inspection.

13.5 Future Case Level of Risk

13.5.1 Shipping

The main factor that is likely to influence the future levels and composition of shipping in the vicinity of the proposed wind farm is the traffic using the Pentland Firth Route and shipping headed into the inner Moray Firth (i.e. Inverness and Cromarty Firth).

A summary of main ports and developments which have or are likely to influence future shipping levels within the area are provided below:

- Inverness Harbour has recently been expanded (Longman Quay) and part of the harbour regenerated. A new 150m quay has also been created with heavy lifting facilities – the quay is also capable of berthing small cruise ships (those that carry up to 300 passengers). In addition, work has been completed on the new 151 berth marina, with future plans to develop a 120-bedroom hotel and restaurant at the marina front.

- Scrabster Harbour has set out a Phase 1 development of the Old Fish market Pier and Tanker Berth, with target for completion in mid-2012. The developments will also ensure the oil depot can supply the entire northern North Sea area. The Phase 1 development shall enable the new generation of larger tankers to call at the port. In terms of fishing vessels, refrigeration of the fish market and full tidal access are a major part of the Phase 1 development. The development shall also provide sheltered, deep water facilities and infrastructure, including high speed fuel and water deliveries, essential in ensuring fast turnaround of vessels. Heavy lift facilities shall also be created for future development, i.e. for the renewables industry.

- Cromarty Firth Port Authority is an important deep water port able to handle vessels of all types and sizes. Invergordon is a major centre for the support of offshore operations as well as commercial traffic, Ro-Ro's and cruise vessels. Cruise ships are generally headed between the east coast of the UK, Northern Isle and Norway, with approximately 45 cruise liner visits expected during 2011.

- Nigg Yard/oil terminal facility has been under consideration for future developments including offshore support, renewables construction facilities and shuttle tanker offloading. It is noted that Talisman used the site during construction and deployment of the Beatrice Demonstration Turbines.

- The Moray Council and Highlands and Islands Enterprise (HIE) Moray evaluated re-development of Buckie harbour in 2006, with recommendations for funding to construct a marina and regenerate the harbour for commercial, fishing and renewable energy interests.

Data published by DfT (Ref.xiii) indicates the following changes in ship numbers and goods handled in recent years for the main ports in the area.

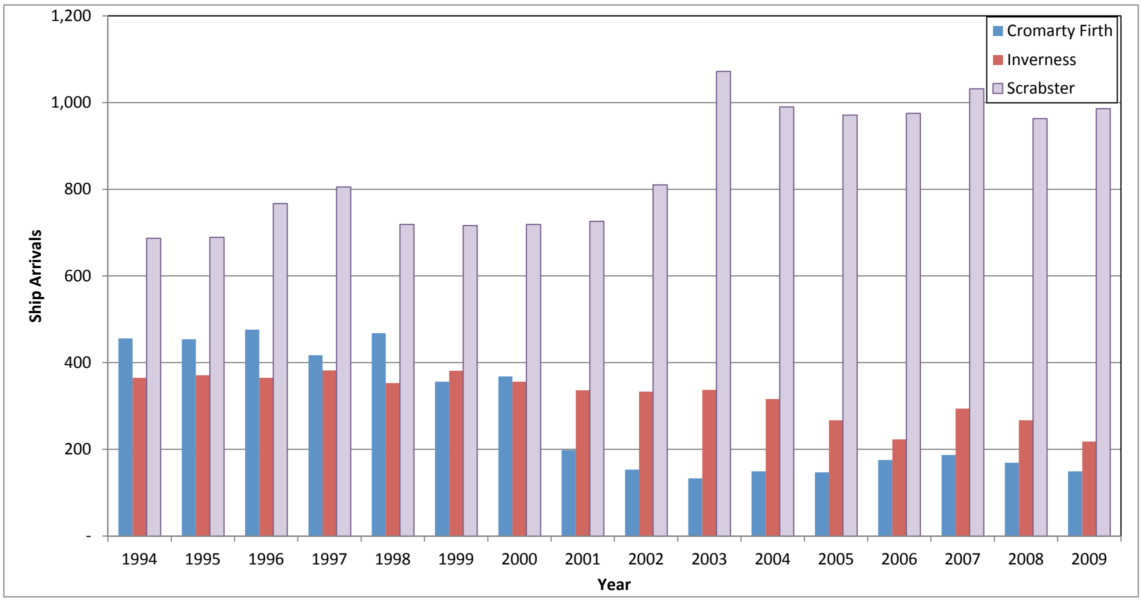


Figure 13.9 Ships through the Main Moray Firth Ports and Near to the Proposed Sites

APPENDIX 5.2 D

The number of ships calling in the main Moray Firth ports and Scrabster has varied during the 19 years analysed, with a slight drop in total ship arrivals up to 2009. This reflects a general trend in the shipping industry where increased trading tonnages are mainly being achieved through the use of larger vessels as opposed to increased ship movements.

Longer term tonnage data for the Cromarty Firth, Inverness and other Moray Firth harbours (Scrabster, Wick, Buckie, Burghead, Lossiemouth and Macduff) based on Department for Transport statistics are presented in Figure 13.10.

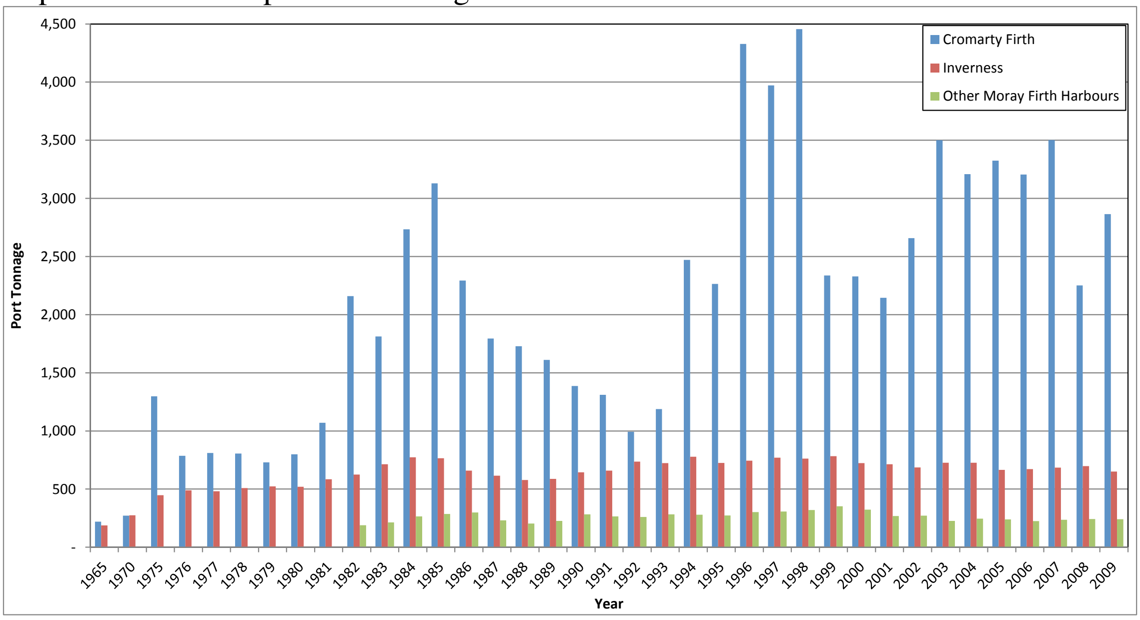


Figure 13.10 Total Tonnage through Moray Firth Ports and Harbours (DfT 1965-2009)

Between 1965 and 2009, total tonnage taken by the Moray Firth Ports increased ten-fold. However, in the last 20 years between 1990 and 2009, the overall increase has only been 35%.

The key north west-south east Pentland Firth route passing to the north east of the proposed wind farm is used by a number of ship types including merchant, fishing and oil/gas vessels. A range of factors are likely to influence vessel activity in the area including the global economy/trade of goods, oil prices and national/regional offshore developments (i.e. oil & gas and renewable energy projects). Therefore in the long-term, shipping in the area is expected to increase but the timescale for this is uncertain.

It has been conservatively assumed that over the life of the wind farm developments, there will be a 10% increase in shipping movements.

13.5.2 Fishing

The Commercial Fisheries Assessment (Ref. xi) considered the potential changes to the fishing baseline over the life of the development. It is recognised this is a speculative exercise due to numerous unpredictable, direct and indirect factors which can materially affect fisheries.

It stated that, at present, scallop fisheries are foreseen in the area surrounding the three wind farms within the EDA and in all probability there is unlikely to be an increase in either fishing effort or vessel numbers. It is also possible that increasing conservation concerns will lead to the implementation of designated protected marine conservation areas which will conceivably have the effect of enforcing further restrictions upon certain commercial fishing activities.

There exists the possibility that fishing practices within the wind farm could change during its operational life. An example is the appearance of large shoals of squid inshore during the summer in the Moray Firth, providing a valuable fishery which previously did not exist.

Based on the discussion presented, the future level of activity has been assumed to increase by 10% compared to current levels.

13.5.3 Recreational

In terms of recreational vessel activity, there are no major developments known of that will increase the activity of these vessels in the area (Buckie Marina plans have not been confirmed). There are a range of modern facilities located at Inverness which is popular for vessels passing through the Caledonian Canal.

Based on the discussion presented, the future level of activity has been assumed to increase by 10% compared to the current, low levels.

13.5.4 Collision Probabilities

The potential increase in vessel activity levels would increase the probability of ship-to-structure collisions (both powered and drifting). Whilst in reality the risk would vary by vessel type, size and route, it is roughly estimated this would lead to a linear 10% increase in the base case collision risks.

The increased activity would also increase the probability of vessel-to-vessel encounters and hence collisions. Whilst this is not a direct result of the proposed wind farm, the increased congestion caused by the site and potential displacement of traffic in the area may have an influence. Again a 10% overall increase is assumed.

13.6 Risk Results Summary

The base case and future case annual levels of risk without and with the proposed offshore wind farms are summarised in to Table 13.4 to Table 13.6. The change in risk is also shown, i.e., the estimated collision risk with the wind farm minus the baseline collision risk without the wind farm (which is zero except for vessel-to-vessel collisions).

Table 13.4 Summary of results – Scenario 1

Collision Scenario	Base Case			Future Case		
	Without	With	Change	Without	With	Change
Passing Powered	--	7.2E-06	7.2E-06	--	8.0E-06	8.0E-06
Passing Drifting	--	2.3E-06	2.3E-06	--	2.6E-06	2.6E-06
Vessel-to-Vessel	4.2E-04	4.3E-04	8.2E-06	4.7E-04	4.8E-04	9.0E-06
Fishing	--	6.2E-02	6.2E-02	--	6.8E-02	6.8E-02
Total	4.2E-04	6.3E-02	6.2E-02	4.7E-04	6.9E-02	6.8E-02

Table 13.5 Summary of results – Scenario 2

Collision Scenario	Base Case			Future Case		
	Without	With	Change	Without	With	Change
Passing Powered	--	7.6E-06	7.6E-06	--	8.3E-06	8.3E-06
Passing Drifting	--	1.5E-06	1.5E-06	--	1.7E-06	1.7E-06
Vessel-to-Vessel	4.2E-04	4.3E-04	8.2E-06	4.7E-04	4.8E-04	9.0E-06
Fishing	--	5.3E-02	5.3E-02	--	5.8E-02	5.8E-02
Total	4.2E-02	5.3E-02	5.3E-02	4.3E-04	5.9E-02	5.8E-02

Table 13.6 Summary of results – Scenario 3

Collision Scenario	Base Case			Future Case		
	Without	With	Change	Without	With	Change
Passing Powered	--	4.2E-06	4.2E-06	--	4.7E-06	4.7E-06
Passing Drifting	--	6.8E-07	6.8E-07	--	7.5E-07	7.5E-07
Vessel-to-Vessel	4.2E-04	4.3E-04	8.2E-06	4.7E-04	4.8E-04	9.0E-06
Fishing	--	4.7E-02	4.7E-02	--	1.6E-02	1.6E-02
Total	4.2E-02	4.8E-02	4.8E-02	4.3E-04	5.3E-02	5.2E-02

A summary of the annual collision risk for the three indicative scenarios is presented in Figure 13.11.

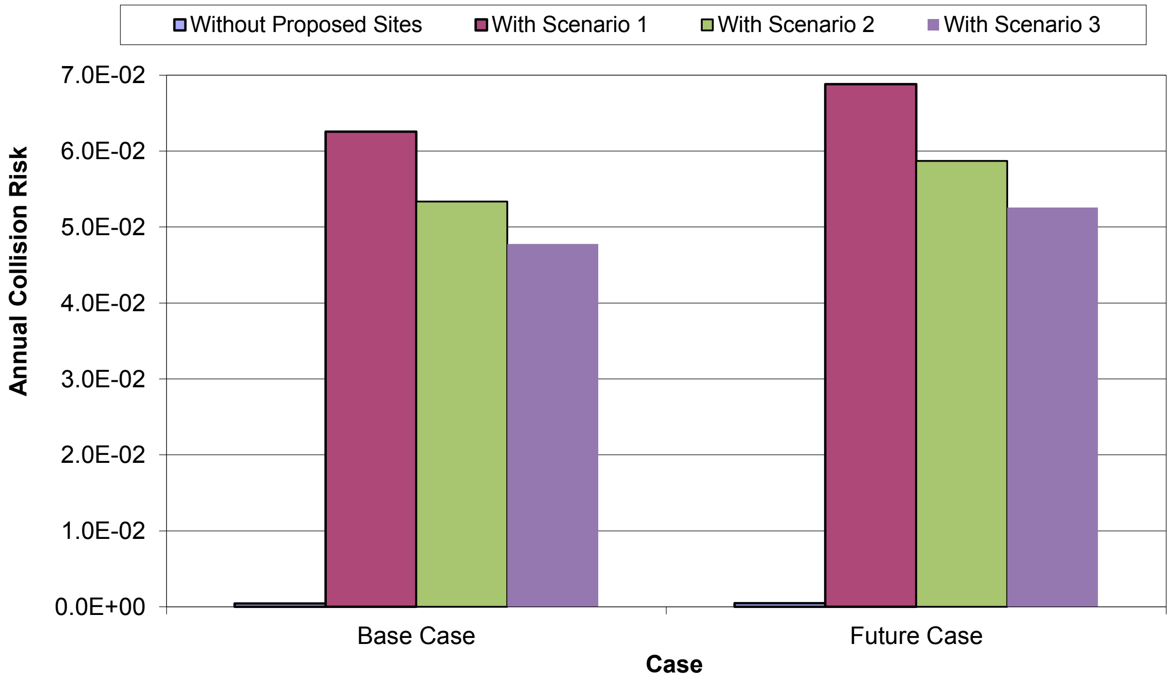


Figure 13.11 Summary of annual collision risk results

In the worst case (Scenario 1) the overall annual level of collision risk is estimated to increase due to the proposed wind farms by approximately 1 in 16 years (base case) and 1 in 15 years (future case). The vast majority of this risk is from fishing vessel collisions.

The increases are relatively low compared to the existing maritime risks in the area.

13.7 Consequences

The probable outcomes for the majority of hazards are expected to be minor. However, the worst case outcomes could be severe, including events with potentially multiple fatalities.

A collision involving a larger ship is likely to result in collapse of a turbine with limited damage to the ship. Breach of a ship's fuel tank is considered unlikely and in the case of vessels carrying hazardous cargoes, e.g., tanker or gas carrier, the additional safety features associated with these vessels would further mitigate the risk of pollution (for example double hulls). Similarly, in a drifting collision the proposed wind farm structures are likely to absorb the majority of the impact energy, with some energy also being retained by the vessel in terms of rotational movement (glancing blow).

In terms of smaller vessels such as fishing and recreational craft, the worst case scenario would be risk of vessel damage leading to foundering of the vessel and potential loss of life.

A quantitative assessment of the potential consequences of collision due to the proposed wind farms is presented in Appendix B. This applies the site-specific collision frequency results presented above with estimated outcomes in terms of fatalities on-board and oil pollution from the vessel based on research into historical collision incidents (MAIB, ITOPF, etc.).

The results are summarised in Table 13.7. It is noted that these are based on a conservative approach to give account to the uncertainty surrounding the jacket sub-structure foundation type.

Table 13.7 Annual predicted change in Potential Loss of life (PLL) due to proposed wind farms

	Scenario 1	Scenario 2	Scenario 3
Base Case PLL (fatalities per year)	1.1E-03	9.2E-04	8.2E-04
Future Case PLL (fatalities per year)	2.4E-03	2.0E-03	1.8E-03

For the worst case turbine layout (Scenario 1) the overall increase in PLL estimated due to the development is 1.1 x 10^{-3} fatalities per year (base case), which equates to one additional fatality in 927 years. This is a small change compared to the MAIB statistics which indicate an average of 29 fatalities per year in UK territorial waters.

In terms of individual risk to people, the incremental increase for commercial ships (in the region of 10^{-9}) is very low compared to the background risk level for the UK sea transport industry of 2.9 x 10^{-4} per year.

Similarly, for fishing vessels, whilst the change in individual risk attributed to the development is higher than for commercial vessels (in the region of 10^{-5}), it is low compared to the background risk level for the UK sea fishing industry of 1.2 x 10^{-3} per year.

Therefore, the incremental increase in risk to both people and the environment caused by the proposed wind farms is estimated to be low.

14. Secondary and Sensitivity Assessments

14.1 Introduction

The primary assessment within the NRA has focused on assessing the impact on shipping and navigation of the combined Telford, Stevenson and MacColl wind farm sites.

A secondary assessment has been carried out, focusing on the individual sites, with a sensitivity assessment carried out on different permutations of the wind farms within the EDA. The secondary and sensitivity assessments are presented in the following sections.

14.2 Secondary Assessment – Individual Wind Farms

A secondary assessment has been carried out on the individual wind farm sites, given the potential for different impacts and significance to arise for shipping and navigation.

It is noted that given the low historical accident levels in the vicinity of the individual sites and the operator requirements to meet MCA MGN 371, the operational phase of individual wind farms are unlikely to exacerbate maritime safety risks in the area or impact SAR operations and helicopters.

The impact on shipping and navigation is presented in the following subsections.

14.2.1 Telford Wind Farm

The Telford site is located in the northern section of the EDA. The indicative worst case layout assessed the largest number of turbines (139), which cover the largest area of the site. Turbine spacing between rows (NNW / SSE) is approximately 0.5nm (926m). Given the proximity of the site to shipping on the Pentland Firth route (approximately 4nm), Telford has the highest collision risk of the three sites. The highest turbine collision frequencies are on the outer edge of Telford, and the inner turbines are generally more shielded from ship-to-turbine collisions. In terms of collision risk, given the available sea room south of the Telford site and the relatively low density of close passing vessels (i.e. under 3nm), the change in ship-to-ship collision frequency is not considered to be significant.

The maritime shipping surveys recorded approximately one vessel every ten days on the Wick route, consisting of coastal tankers and a small number of fishing and recreation vessels. Commercial, fishing and recreation vessels using the low use route to Wick will deviate north or south of the Telford site to pass the turbines at a safe distance (i.e. 1 to 1.5nm from the nearest turbines). There is sufficient sea room to make this change and there will not be a significant increase in the vessel collision risk. Overall, the deviation on approach and departure from Wick is not considered to be significant in terms of routing distance and voyage time/fuel cost.

For fishing and recreation vessel routing and collision risk, the impact is considered to be negligible, given the available sea room in the area.

A number of sailing, fishing and other vessels bound for Wick pass inside the 1.5 nm range from turbines at which radar interference impacts could be experienced. However, upon development of Telford, vessels heading to/from Wick are likely to pass at approximately 1.5 nm north of turbines, thereby subject to a small level of interference. Therefore, no significant impact is predicted in terms of the impact on marine radar systems.

14.2.2 Stevenson Wind Farm

The Stevenson site is located in the centre (west) of the EDA. The worst case indicative layout assessed consisted of largest number of turbines (100), with approximately 0.5nm (926m) of spacing between rows (NNW / SSE). Turbines in the Stevenson site are generally located away from the main commercial shipping routes in the area; hence the site has the lowest collision frequency associated with it.

Given the low level of commercial shipping passing through the site and the available sea room in the area, the Stevenson site will not have a significant impact on commercial vessel collision risk and routing.

The maritime surveys recorded a number of fishing vessels in the south of the Stevenson site, and during construction / major maintenance phases, transiting vessels maybe required to deviate north or south of the area. There is available sea room in the area for fishing vessels to deviate around the site.

In a similar way for fishing activity, recreation vessels maybe required to deviate around construction / major maintenance works when heading to/from Wick. Given the available sea room and temporary nature of the works, no significant impact is predicted for recreation vessel collision risk, routing distance and voyage time.

Low traffic levels were recorded during the shipping surveys within the Stevenson site. Therefore, it was concluded that there will be a negligible impact on vessels marine radar systems.

14.2.3 MacColl Wind Farm

The MacColl site is located in the southern section of the EDA. The worst case indicative layout consists of the highest number of turbines, located in the south eastern area of the site and turbine spacing between rows (NNW / SSE) is approximately 0.5nm (926m).

Turbines in the southern area of the site are located in closer proximity to offshore support traffic supporting the Beatrice and Jacky Fields, hence there is a higher collision frequency (relatively as the collision frequency for the entire site is low) for turbines on southern tip. Offshore vessels will deviate approximately 1 to 1.5nm south of MacColl, where there is available sea room. Overall, the increase in collision risk and routing distance is not considered to be significant.

In addition, one vessel every ten days was recorded on the Wick route which passes through the MacColl site. Commercial, fishing and recreation vessels using the low use route to Wick will deviate north or south of the MacColl site to pass the turbines at a safe distance (i.e. 1 to 1.5nm from the nearest turbines). There is sufficient sea room to make this change and there will not be a significant increase in the vessel collision risk. Overall, the deviation on approach and departure from Wick is not considered to be significant in terms of routing distance and voyage time/fuel cost.

The maritime shipping survey recorded fishing vessel activity within the southern part of the MacColl site. Fishing vessel collision risk will increase for vessels operating within the

MacColl site. However, the impact on these vessels (whilst fishing and during transit between fishing grounds and port) is considered to be minor given the available sea room in the area.

For recreation vessel routing and collision risk, the impact is considered not to be significant, as low recreational vessel activity recorded during the shipping surveys and the available sea room in the area for vessel deviations.

Radar interference could also be experienced by offshore vessels heading to the Beatrice and Jacky platforms as the 500m turbine buffer from MacColl intersects offshore vessels tracks recorded during the surveys. It is considered that given the sea room to the south of the site, navigation will not be significantly impacted in terms of marine radar interference.

14.3 Sensitivity Assessment

A sensitivity assessment has been carried out on different permutations of the wind farms within the EDA, given the potential for different impacts and significance to arise on shipping and navigation. The permutations of the sensitivity assessments are as follows:

- Telford plus Stevenson
- Telford plus MacColl
- Stevenson plus MacColl

As noted in the secondary assessment, given the low historical accident levels in the vicinity of the sites (and wind farm permutations in the sensitivity assessment), the operational phase is unlikely to exacerbate maritime safety risks in the area or impact SAR operations and helicopters. Therefore, the impact on SAR and helicopter operations/access is considered not to be significant for each wind farm combination.

The sensitivity assessment for the three permutations of wind farms are presented in the following subsections.

14.3.1 Telford plus Stevenson Wind Farms

The Telford site is located approximately 4nm from the Pentland Firth shipping route and therefore has relatively higher collision frequency than Stevenson. Turbines within the Stevenson site are located in an area of low shipping density and cumulatively the Telford turbines will present a small level of shielding from both powered and drifting ship-to-turbine collisions. Overall, the increase in collision risk from both sites is not considered to be significant, as the sites are out-with the main shipping lanes.

Commercial, fishing and recreation vessels using the low use route to Wick will deviate north or south of the Telford and Stevenson sites, passing the turbines at a safe distance (i.e. 1 to 1.5nm). Overall, both commercial and non-commercial vessels bound for Wick are likely to deviate around the two sites resulting in a minor change to vessel routing and voyage time.

A number of commercial, fishing and recreation vessels bound for Wick could be exposed to a small level of radar interference as ships deviate around the two sites. There are low traffic volumes on the Wick route and available sea room to the north (out-with the Pentland Firth route); therefore the impact on marine radar systems will not be significant.

14.3.2 Telford plus MacColl Wind Farms

The northern boundary of the Telford site is located approximately 4nm from the Pentland Firth shipping route and has a relatively higher collision frequency than MacColl. A small number of turbines within the north eastern edge of the MacColl site are relatively more exposed to both a powered and drifting ship-to-turbine collision. However, the increase in shipping collision risk from both sites will not be significant as the sites are out-with the main shipping lanes.

Commercial, fishing and recreation vessels using the low use route to Wick will deviate north or south of the Telford and MacColl sites, passing the turbines at a safe distance (i.e. 1 to 1.5nm). No significant impact on vessel routing and voyage time is predicted on commercial and non-commercial vessels.

Commercial, fishing and recreation vessels associated with the Wick route could be exposed to a small level of radar interference as ships deviate around the two sites. Given, the low traffic volume on the Wick route and available sea room to the north (out-with the Pentland Firth route); the impact on marine radar systems will not be significant.

14.3.3 Stevenson plus MacColl Wind Farms

A number of turbines within the north eastern edge of the MacColl site are relatively more exposed to both powered and drifting ship-to-turbine collision as turbines are located approximately 4nm from the Pentland Firth shipping route. Therefore, turbines in MacColl have a relatively higher collision frequency than Stevenson. However, the increase in shipping collision risk from both sites will not be significant as the sites are out-with the main shipping lanes (i.e. Pentland Firth route).

Commercial, fishing and recreation vessels using the low use route to Wick will deviate north of the MacColl site, passing the turbines at a safe distance (i.e. 1 to 1.5nm). No significant impact on vessel routing and voyage time is predicted on commercial and non-commercial vessels.

Vessels associated with the Wick route and offshore vessels supporting the Beatrice and Jacky Fields could be exposed to a small level of radar interference as ships deviate around the two sites. Given the available sea room to the north and south of the sites; the impact on marine radar systems will not be significant.

15. CONSTRUCTION AND DECOMMISIONING IMPACTS

15.1 Introduction

This study has primarily focused on the operational and maintenance phase of the proposed wind farms, however, it is recognised that there will be additional potential impacts during the construction and decommissioning phases of the project.

In general, whilst the same hazards apply as during operational and maintenance, there are additional hazards which are distinctly associated with these phases of the project and require different risk control measures.

15.2 Hazards during Construction/Decommissioning

During the construction/decommissioning phase there will be an increased level of vessel activity within the proposed sites and along the offshore export cable route.

The presence of construction vessels within the area is likely to pose an additional navigational risk, although such vessels can also provide on-site response and mitigation. The main hazards associated with construction/decommissioning which have been identified over and above those associated with all phases (i.e., where the same risk control measures and emergency response will apply during all phases) are listed below.

- Construction vessel collision with another vessel on-site
- Construction vessel collision with structure
- Construction vessel collision with passing vessel en route to or from site
- Construction vessel encounters (jack-ups or anchors on) underwater obstruction (e.g., cable, pipeline etc.).
- Construction vessel jacks-up or anchors onto unexploded ordnance
- Man overboard during personnel transfer operations
- Dropped object during major lifting operations

It is noted that to a large extent the hazards will depend on the vessels and procedures which are to be used for these operations. This will not be known in detail until the structures, construction methods and vessels/contractors have been selected. It is therefore planned that hazard/risk assessment workshops be carried out as part of the project-planning process. The objective of the workshops will be to identify all of the different activities which will be taking place and identify any potential hazards as well as appropriate mitigation measures and operating procedures relevant to the selected vessels and construction methods.

An example measure might be that, wherever possible, construction vessels would follow prescribed transit corridors. These corridors would be defined in consultation with local maritime stakeholders, such as Aberdeen Harbour.

The suggested compositions for the workshops are as follows:

- Project Team
- Contractor Representatives (e.g., barges, cable-laying)
- Harbour Representatives

- HM Coastguard (MCA)
- Fishing Representative
- Recreational Vessel Representative
- RNLI Representative

This process will build mutual understanding of the activities and operating constraints of the different parties involved and allow effective procedures to be developed. Separate workshops should be held for each phase of the project as well as for distinct activities.

It is noted that the construction company appointed will have their own internal health and safety procedures that they will adhere to during the work, providing additional security. Experience and lessons learned from the construction of other offshore wind farm projects will be considered prior to the proposed wind farms being constructed. The same process will apply during the decommissioning phase of the project

15.3 Risk Control/Mitigation during Construction/Decommissioning

Details of risk control/mitigation measures which will apply during these phases of the work are summarised in Section 21.

16. IMPACT ON MARINE RADAR SYSTEMS

16.1 Introduction

In 2004 the MCA conducted trials at the North Hoyle wind farm off North Wales to determine any impact of wind turbines on marine communications and navigations systems (Ref. iii).

The trials indicated that there is minimal impact on VHF radio, Global Positioning Systems (GPS) receivers, cellular telephones and AIS. UHF and other microwave systems suffered from the normal masking effect when turbines were in the line of the transmissions.

This trial identified areas of concern with regard to the potential impact on ship borne and shore based radar systems. This is due to the large vertical extent of the wind turbine generators returning radar responses strong enough to produce interfering side lobe, multiple and reflected echoes (ghosts). This has also been raised as a major concern by the maritime industry with further evidence of the problems being identified by the Port of London Authority around the Kentish Flats offshore wind farm in the Thames Estuary. Based on the results of the North Hoyle trial, the MCA produced a wind farm/shipping route template (see Section 2.2) to give guidance on the distances which should be established between shipping routes and offshore wind farms.

A second trial was conducted at Kentish Flats on behalf of BWEA (Ref. iv). The project steering group had members from BERR, the MCA and the Port of London Authority (PLA). The trial took place between 30 April and 27 June 2006. This trial was conducted in Pilotage waters and in an area covered by the PLA VTS. It therefore had the benefit of Pilot advice and experience but was also able to assess the impact of the generated effects on VTS radars.

The trial concluded that:

- The phenomena referred to above detected on marine radar displays in the vicinity of wind farms can be produced by other strong echoes close to the observing ship although not necessarily to the same extent.
- Reflections and distortions by ships structures and fittings created many of the effects and that the effects vary from ship to ship and radar to radar.
- VTS scanners static radars can be subject to similar phenomena as above if passing vessels provide a suitable reflecting surface but the effect did not seem to present a significant problem for the PLA VTS.
- Small vessels operating in or near the wind farm were detectable by radar on ships operating near the array but were less detectable when the ship was operating within the array.

16.2 Beatrice Demonstrator Turbine Project Radar Impacts Study

As well as the documented radar trials carried out at North Hoyle and Kentish Flats, a study was carried out on the impacts of the two 5MW Demonstrator turbines located in the Moray Firth east of the Beatrice Oil Field (Ref. xiv).

The main findings of this study are summarised below:

- Regarding the Beatrice platform radar - any fluctuations of the wind turbine plots, (caused by the motion of the wind turbines) could lead to occasional false alarms in the collision avoidance systems.
- Ship based radar plots showed that the proposed turbines do not make a significant detrimental impact on the overall radar picture. The returns from the turbines are large enough to cause plots on a radars display (which can be used for navigation in the normal way).
- Obstruction issues - in the case of Beatrice, the turbine platform is based on a jacket structure, which allows the radar energy through the base of the turbine. In addition, the phenomenon of diffraction means that any shadow cast behind a turbine quickly fills back in.
- Furthermore, AIS is unlikely to be affected and the study indicated that shadowing by the turbines will not cause any loss of AIS transponder signals.
- Final conclusions were that there were no radar effect caused by the turbines that are not already caused by other large structures such as the oil platforms and large ships.

16.3 Impact on Collision Risk

The potential radar interference is mainly a problem during periods of bad visibility when mariners may not be able to visually confirm the presence of other vessels in the vicinity (i.e. those without AIS installed which are usually fishing and recreational craft).

However, given recreational vessel activity is influenced by weather conditions, most yachts are likely to take more sheltered coastal routes; therefore fishing vessels are considered to be the most likely to be impacted by possible radar interference.

Based on the trials carried out to date the onset range from the turbines of false returns is about 1.5nm, with progressive deterioration in the radar display as the range closes.

Figure 16.1 to Figure 16.3 presents the combined 69 days of survey tracks relative to the proposed sited, based on the three indicative layouts in Scenario 1 to 3. 500m, 1.5nm and 2nm buffers have been applied around each turbine location to illustrate current passing distances.

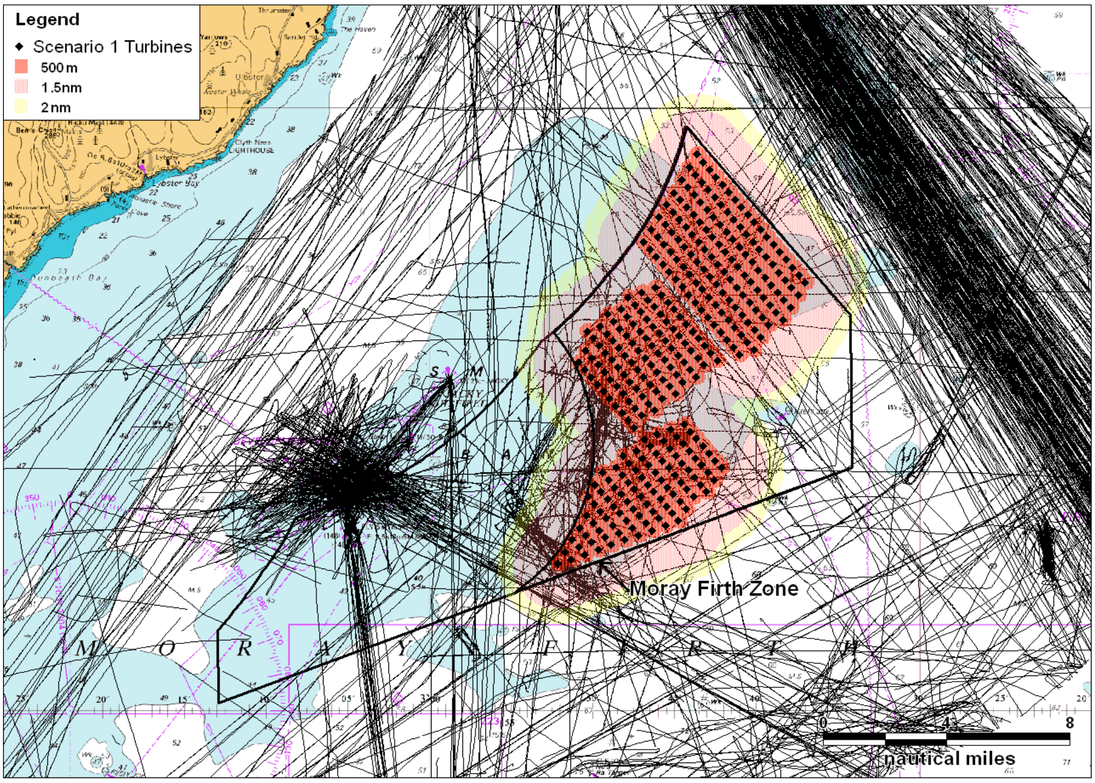


Figure 16.1 Scenario 1 Buffer Zones versus Current Shipping Tracks (69 days)

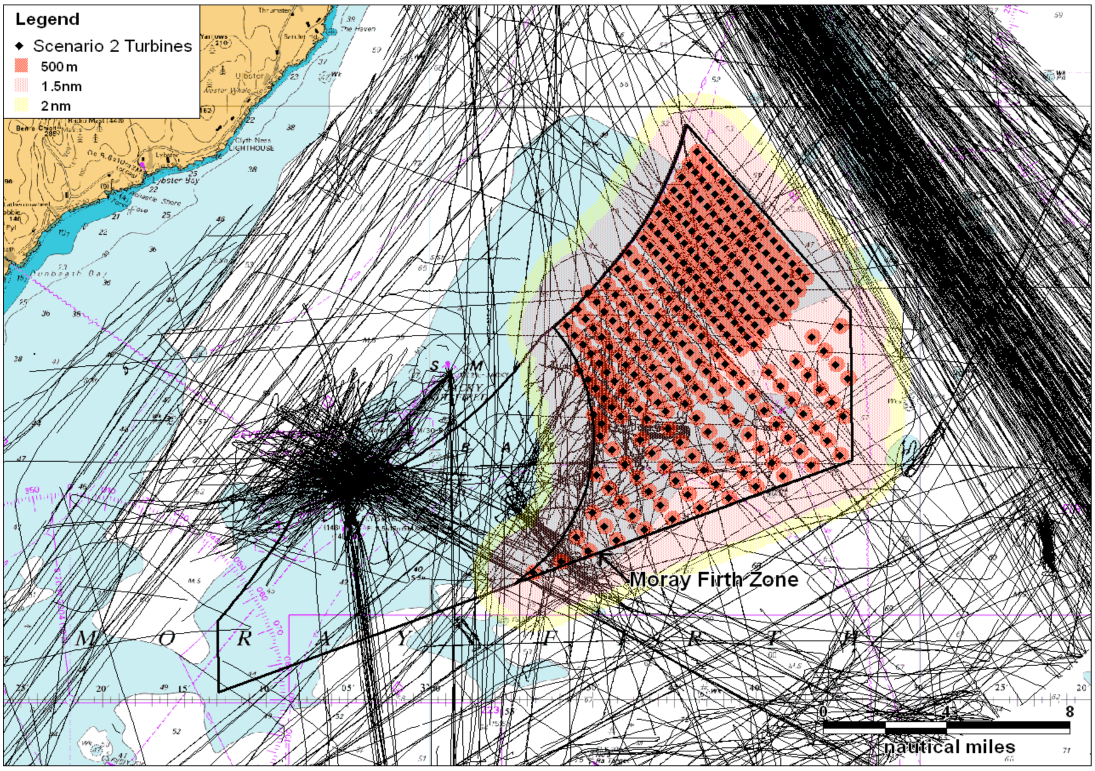


Figure 16.2 Scenario 2 Buffer Zones versus Current Shipping Tracks (69 days)

APPENDIX 5.2 D

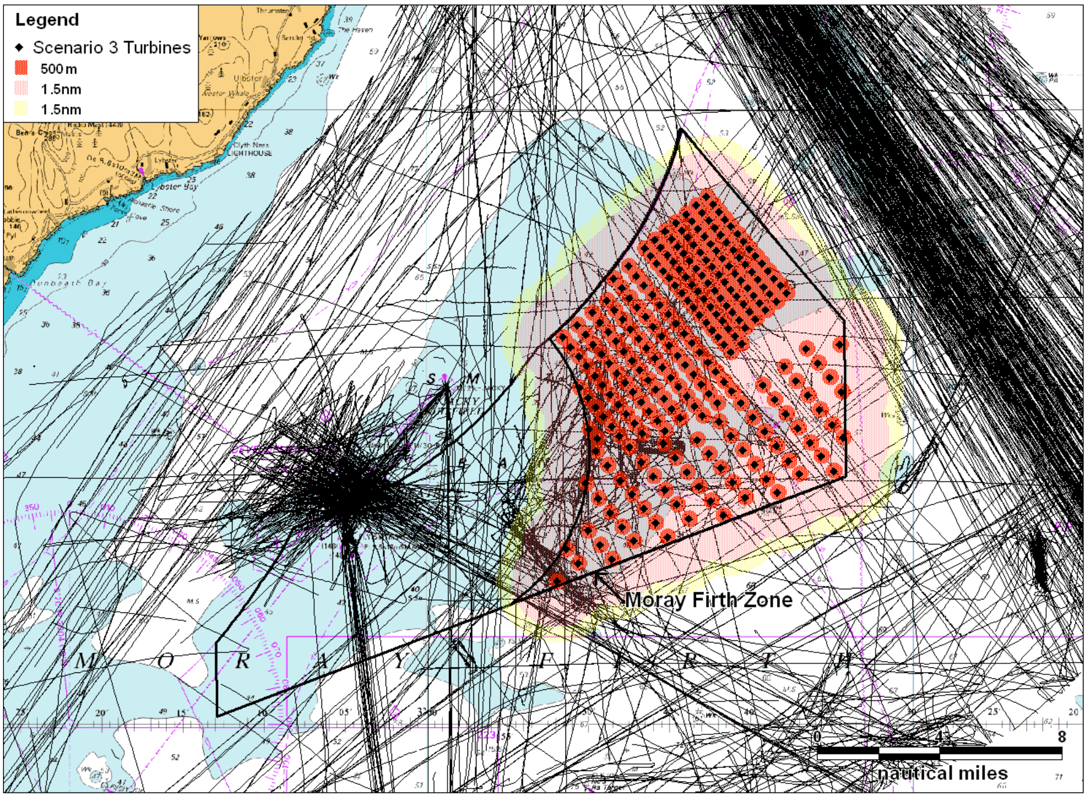


Figure 16.3 Scenario 3 Buffer Zones versus Current Shipping Tracks (69 days)

The potential radar interference from the indicative turbine layouts in Scenario 1 and Scenario 3 will potentially be less than Scenario 2, given the different spacing and that vessels are inside the 1.5nm range of radar interferences for less time.

A number of sailing, fishing and vessels bound for Wick pass inside the 1.5nm range from turbines at which radar interference could be experienced. It is noted that upon development of the proposed wind farm sites vessels heading to/from Wick are likely to pass at approximately 1.5nm north of the wind farm boundary, thereby subject to a small level of radar interference. However the radar impacts will be dependent on foundation type as jacket structures allow radar energy to pass through the structure aiding identification of any targets within a wind farm.

In addition, radar interference could be experienced by offshore vessels heading to the Beatrice and Jacky platforms as the 500m turbine buffer intersects offshore vessels tracks. Consultation with the Oil & Gas operators indicated that Wind Cats approach Beatrice and Jacky platforms from Buckie. Access and navigation from the south will be minimally impacted due to the development and turbines within the proposed sites could be used to aid navigation.

Experienced mariners should be able to suppress the observed problems to an extent and for short periods (a few sweeps) by careful adjustment of the receiver amplification (gain), sea clutter and range settings of the radar. However, there is a consequent risk of losing targets with a small radar cross section, which may include buoys or small craft, particularly yachts or Glass Reinforced Plastic (GRP) constructed craft, therefore due care is needed in making such adjustments. The Kentish Flats study observed that the use of an easily identifiable reference target (a small buoy) can help the operator select the optimum radar settings.

The performance of a vessel's automatic radar plotting aid (ARPA) could also be affected when tracking targets in or near the wind farm. However, although greater vigilance is required, it appears that during the Kentish Flats trials, false targets were quickly identified as such by the mariners and then the equipment itself. This was also observed during work carried out for the Beatrice Demonstration turbines whereby the structures were plotted and could be used as an aid to navigation.

The evidence from mariners operating in the vicinity of existing wind farms is that they quickly learn to work with and around the effects. The MCA have produced guidance to mariners operating in the vicinity of UK OREIs which highlights radar issue amongst others to be taken into account when planning and undertaking voyages in the vicinity of offshore renewable energy installations (OREIs) off the UK coast (Ref. xv).

AIS information can also be used to verify the targets of larger vessels, generally ships above 300 tonnes, however small fishing and recreational craft are increasingly utilising the cheaper Class B AIS units.

Indeed, Directive 2009/17/EC of the European Parliament and of the council of April 23 2009 amended Directive 2002/59/EC. One of the main amendments made related to the use of AIS on fishing vessels, which is addressed through the insertion of Article 6a:

Use of automatic identification systems (AIS) by fishing vessels.

Any fishing vessel with an overall length of more than 15 metres and flying the flag of a Member State and registered in the Community, or operating in the internal waters or territorial sea of a Member State, or landing its catch in the port of a Member State shall, in accordance with the timetable set out in Annex II, part I (3), be fitted with an AIS (Class A) which meets the performance standards drawn up by the IMO.

Fishing vessels equipped with AIS shall maintain it in operation at all times. In exceptional circumstances, AIS may be switched off where the master considers this necessary in the interest of the safety or security of his vessel.

The timetable set out in Annex II, part 1(3) is as follows:

Fishing vessels with a length of more than 15 metres overall are subject to the carrying requirement laid down in Article 6a according to the following timetable:

- fishing vessels of overall length 24 metres and upwards but less than 45 metres: not later than 31 May 2012,
- fishing vessels of overall length 18 metres and upwards but less than 24 metres: not later than 31 May 2013,
- fishing vessels of overall length exceeding 15 metres but less than 18 metres: not later than 31 May 2014.

New built fishing vessels of overall length exceeding 15 metres are subject to the carrying requirement laid down in Article 6a as from 30 November 2010.'

Beyond this it is noted from a number of surveys Anatec has been carrying out on the United Kingdom Continental Shelf (UKCS) that the number of fishing vessels using AIS has increased significantly over the last two years.

17. CUMULATIVE EFFECTS

17.1 Introduction

Cumulative impacts with maritime activities (shipping, fishing, recreation and associated facilities) are assessed in the main part of this report. The following sections present details on possible cumulative effects with the Beatrice Offshore Wind Farm and other offshore projects.

In-combination effects with other future developments in the area are assessed, including offshore developments relative to the proposed offshore wind farms.

17.2 Developments Considered in the Cumulative Assessment

The following list presents the developments which were considered for the cumulative and in-combination assessment based on the Moray Firth Offshore Wind Developers Group (MFOWDG), Cumulative Impact Assessment Discussion Document (CIADD):

Marine Renewable Projects:

- Beatrice Offshore Wind Farm (BOWL);
- Individual sites within MORL EDA;
- MORL Western Development Area;
- Marine Energy Developments in Pentland Firth and Orkney;
- Proposed SHETL hub;
- Forth and Tay offshore wind developments (Neart na Gaoithe, Inch Cape, Seagreen Phases 1-3;
- Aberdeen Offshore Wind Farm; and
- Beatrice Demonstrator Turbines.

Cable:

- MORL offshore export cable and onshore infrastructure;
- BOWL offshore export cable and onshore infrastructure;
- Proposed SHETL hub;
- Proposed Viking SHETL cable and onshore infrastructure; and
- SHEFA telecoms cable.

Oil and Gas industry infrastructure:

- Beatrice and Jacky platforms and associated infrastructure; and
- The proposed Caithness and PA Resources infrastructure for existing leases.

Other marine stakeholders in the Moray Firth:

- Shipping and Navigation;
- Military activities;
- Commercial Fisheries[1];
- Marine and Port Developments in the Moray Firth:

[1] The cumulative impact on commercial fisheries is assessed the Commercial Fisheries Assessment. The NRA assesses the cumulative impact on shipping and navigation, i.e. the routing of fishing vessels.

- Nigg Oil Terminal, Platform Yard and Site;
- Invergordon;
- Highland Deephaven;
- Inverness Harbour; and
- Ardersier Fabrication Yard.

- Coastal dredging and sea disposal within the Moray Firth.

Consultation also identified that Ithaca Energy is looking at the possibility of bringing in Liquid Nitrogen Gas (LNG) regasification vessels to do transfer operations at the Nigg Terminal. In addition, there is also a potential future option of tankers offloading in the area.

17.3 Predicted Impacts

A high level review of the offshore developments was undertaken to screen out those that would not result in a cumulative impact. Details of the developments that were screened out are provided below:

- The offshore wind farms in the Outer and Firth of Forth (Neart na Gaoithe, Inch Cape, Firth of Forth Round 3 sites and Methil) and the turbines planned at the Aberdeen European Offshore Wind Deployment Centre are of a scale and at a sufficient distance that there will not be a cumulative impact on shipping and navigation;
- The cumulative impact of the proposed wind farms within the EDA on the two Beatrice Demonstrator Turbines are not considered to be significant, given the low levels of shipping in the area and the fact the turbines are operational and located inside 500m safety zones. In addition, it is unlikely that any turbines within the WDA will be constructed in close proximity to the Demonstrator turbines (i.e. under 1nm);
- The Pentland Firth and Orkney Marine Energy developments have been screened out, given that the majority of construction and operation/maintenance vessels will be routing from local support bases (e.g. Scrabster, Stromness, Kirkwall and Lybster) and as a result vessel will navigate well clear from the EDA offshore wind farms;
- There are a small number of charted spoil grounds located within close proximity to the coast (approximately 4nm). There is available sea room in the Moray Firth for transiting vessels and given the size of ships working from local ports/harbours, vessels are likely to use more coastal routes. Therefore the cumulative impact is concluded to be negligible;
- Given the relatively low commercial shipping density in the Moray Firth and the availability of sea room east and west of the EDA offshore wind farms (i.e. for LNG tankers headed into the Moray Firth) it is considered that any future in-combination impact of developing wind farms within the EDA will be negligible;
- A small number of military vessel tracks were recorded during the maritime surveys within 10nm of the proposed wind farms. The large majority of vessels were recorded on the Pentland Firth route, therefore the no significant cumulative impact on marine based military activities are predicted; and
- Marine and port developments in the Moray Firth include those at Nigg, Invergordon, Evanton, Inverness and Ardesier. Given the distance of the offshore wind farms to these marine/port developments and the available sea room in the Moray Firth (out with the proposed wind farms), shipping associated with the developments will not be impacted in terms of routing and collision risk. Overall a negligible cumulative impact is predicted on the Moray Firth marine and port developments.

The potential cumulative impacts on shipping and navigation in the Moray Firth that are considered in this impact assessment on are:

- Changes to vessel routing:
  - Commercial vessels;
  - Fishing vessels;
  - Recreation vessels; and

- Increase in collision risk for all vessels:
  - Vessel-to-structure ; and
  - Vessel-to-vessel.

17.4 Wind Farm Developments

An overview of nearby wind farms, including Round 3 Zones and Scottish Territorial Water (STW) sites is presented in Figure 17.1.

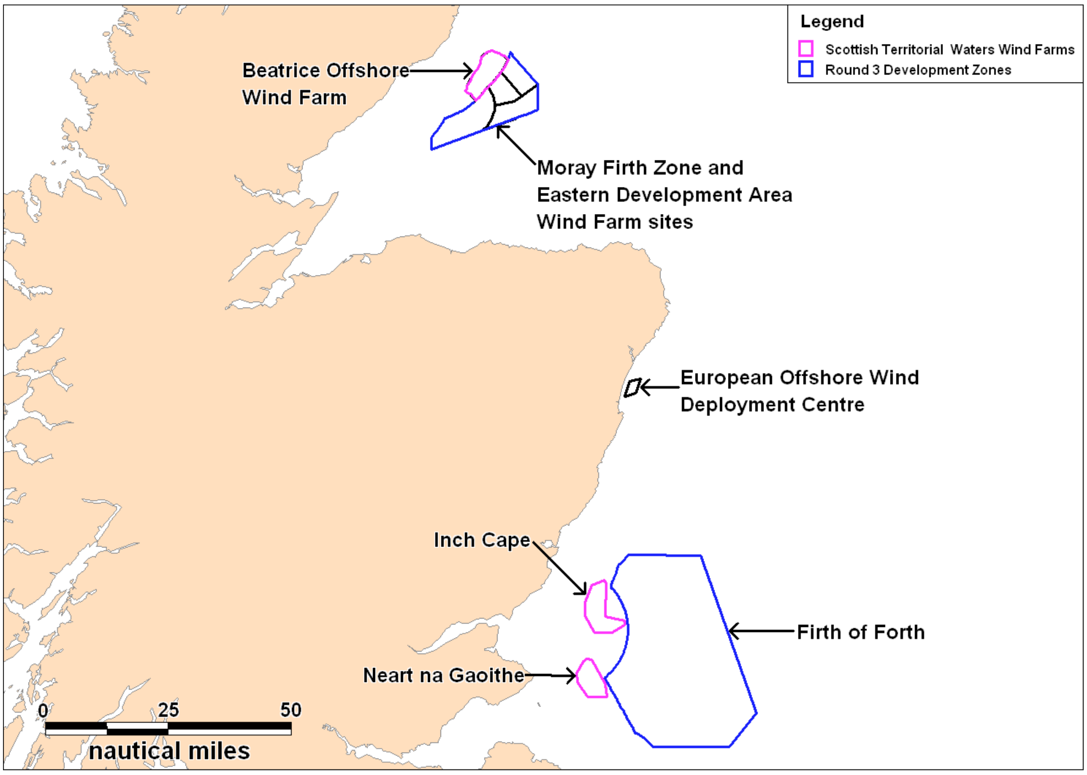


Figure 17.1 Overview of Nearby Wind Farm Areas (including 12nm Limit)

17.4.1 Regional Wind Farm Development

In a regional context, the nearest potential wind farm development area is located at the Beatrice Offshore Wind Farm, on the western boundary of the Stevenson and Telford sites (see Section 6.8).

Given the proximity of the Beatrice Offshore Wind Farm to the MORL Zone developments, MFOWDG was formed by MORL and BOWL in partnership with The Crown Estate to work collaboratively on potential regional cumulative impacts arising from their proposed offshore wind development.

As part of this collaborative approach, a joint navigational Hazard Review workshop and a number of consultation meetings were carried out (MCA, CoS, RYA/CA, NLB and Oil & Gas operators). This approach allowed marine stakeholders to be consulted on both developments.

In terms of proposed wind farm sites and the Beatrice Offshore Wind Farm, cumulatively there will be an increased impact on shipping and navigation routing, given vessels will deviate around the developments. In addition, there will be a potential increase in the collision risk, where vessels deviate around the wind farm sites into busier shipping channels, (i.e. the Pentland Firth route).

However, given the low density of shipping passing through the proposed wind farms and the available sea room out-with major shipping routes (i.e. Pentland Firth route); the cumulative impact is considered to be minor.

The impact on smaller vessel routing is considered to be similar to that of commercial vessels. There is available sea room for vessels to deviate around the developments. However, in terms of vessels routing through the sites, it will be up to individual masters to assess the risk of navigating between turbines based on vessel size, sea conditions and weather. It is considered that this is likely to be an infrequent event and overall the cumulative impact is predicted to be minor.

In terms of the export cable works from the Beatrice Offshore Wind Farm, it is considered that there will not be a significant cumulative impact on shipping and navigation given the expected cable corridors are likely to run well clear of the MORL Zone developments and associated export cables.

17.5 Subsea Cables

SHETL has made proposals for an offshore High Voltage Direct Current (HVDC) cable and hub, which is planned approximately 1nm to the north east of the proposed Telford wind farm.

In general commercial shipping density is relatively low within the area of the proposed wind farm sites, however vessels associated with the Wick route could be cumulatively impacted in terms of routing and collision risk. It is predicted that vessels on the Wick route will be able to safely pass the proposed wind farms and Hub platform, as there is available sea room north of the developments. Overall, the cumulative impact on vessel routing and/or collision risk will not be significant.

The cumulative impact from the SHEFA telecommunications cable is considered to be similar to that of the SHETL cable and hub. However, it is noted that additional traffic from cable laying works will be not represent a significant risk to passing vessels, as the area adjacent to the proposed sites has a low density of passing traffic. Cable laying is generally temporary in nature, and given the available sea room and low density of shipping, the cumulative impact on shipping and navigation for both commercial and non-commercial is not considered to be significant.

17.6 Oil and Gas Industry Infrastructure

Consultation with Oil and Gas Operators identified the potential decommissioning of Jacky to be a possible issue; however this is largely dependent on other offshore developments in the area. During decommissioning or future drilling campaigns, a possible cumulative impact will be on access to the platforms in the Jacky and Beatrice Fields and other development locations including the Caithness and PA Resources blocks west of the proposed wind farm sites.

In general, vessels and rigs tend to route to the Beatrice and Jacky Fields from the south and south east, which are clear of the proposed wind farm sites within the EDA. Overall, the impact on access and towing drilling rigs to locations west of the proposed wind farms will be largely dependent on any turbines planned for the WDA; however there is available sea room to the south (and north/west) and therefore the cumulative impact is not considered to be significant.

18. Safety Zones

18.1 Guidance on Applications for Safety Zones

Guidance for safety zone applications can be found in the DECC guidance notes (authored whilst under the name of BERR [Department for Business, Enterprise and Regulatory Reform]) (Ref. xvi). The safety zone scheme, as set out in the Energy Act 2004 applies to territorial waters in or adjacent to England, Scotland and Wales. A safety zone can be established either by the successful application by an applicant or, if no such application is made and the view of the Secretary of State for DECC, following consultation with the MCA Navigation Safety Branch, is that a safety zone is necessary, by the Secretary of State.

Where a consent for an OREI is required from the Secretary of State under Section 36 of the Electricity Act 1989 (for generating stations above 1MW in internal and territorial waters and above 50MW in the UK Renewable Energy Zone (REZ)) the Secretary of State must consider whether a safety zone will be needed at the same time that consideration is given to the consent for the OREI development. The safety zone application process is summarised below:

- The applicant makes an application to the Secretary of State and serves notice of application on the MCA and, as appropriate, the Scottish Government or National Assembly for Wales, providing information as necessary to support the case for the safety zone;
- In parallel the applicant publicises the fact that an application is being made to give an opportunity to anyone who wishes to comment on the application to make their views known to the Secretary of State; and
- The Secretary of State then takes a decision on the application, taking into account any comments they have received and all other material considerations.

18.2 Construction/Decommissioning & Major Maintenance Phases

The NRA assessment was primarily focused on the operational phase of the proposed wind farm sites. However, it is identified that during the construction/decommissioning phases of the development there will be large construction vessels, working personnel and support craft in operation within and around the proposed wind farms and export cable. Further, heavy lifting, piling and cable laying operations will be carried out which have inherent dangers.

In addition the cost of operating construction vessels, the cost of delay can be significant. A means of controlling 3rd party navigation during these periods of high activity is required. Without this, it will not be possible to exclude vessels and carry out their offshore operations in a controlled manner.

Navigational risks are generally managed in line with similar offshore construction projects to ensure the safety of navigational stakeholder in the area. A detailed review of the requirement will be undertaken as part of the construction/decommissioning planning. It is expected that this could involve the use of 500m safety zones which will provide a means of regulating the rights of navigation so as to preserve the safety of those working in the wind farms and those on-board other vessels that may be navigating in this area.

The safety zones are likely to apply to all vessel types not involved in the wind farm operations. These would be applied for in line with DECC guidance (Ref. xvi) and the required level of consultation would be held.

Safety zones of 500m may be imposed around construction works, from which all vessels are excluded. The area of the sites considered to be a construction zone may vary throughout the project if a phased construction approach is adopted, which is most likely situation.

In addition, during the construction and decommissioning phases, marine procedures will be implemented for radar and AIS monitoring of vessel activities within the working area, to detect safety zone infringements. Procedures will also be established to ensure that any infringements are formally reported in line with the regulatory requirements.

Occasionally larger support vessels may be required for planned and unplanned maintenance activities. It is likely that several pre-determined areas would be identified and marked as temporary anchorage areas. In these cases semi-permanent structure markings would also comply with the NLB requirements and IALA O-0138 and 500m safety zones would apply.

18.3 Operational Phase

During the operation of the proposed wind farm sites there are plans to have 50m operational safety zones during the normal operational phase, unless experience during the construction phase presents evidence that such zones may not be required.

In addition, large maintenance vessels could be present at the proposed wind farm sites during the operational phase. The need for 500m safety zones will be assessed based on experience during construction. Safety zones will be based on the length of time and type of maintenance activities at the sites.

It is noted that in terms of third-party vessels, it is considered highly unlikely that merchant ships would elect to pass between turbines due to the limited sea room and the fact that the closest routes tend to naturally avoid the proposed wind farms. Therefore, it is expected that fishing and recreational vessels are the main vessel types navigating within the sites.

It will be up to individual Masters, taking into account the prevailing weather and sea conditions, to decide whether it is safe to navigate, or fish, within the turbine arrays.

18.4 Summary

The safety zones planned for the project are as follows:

- Construction/Decommissioning:
  - 500m rolling safety zones to prevent vessels not associated with the development work from interfering with the active construction site.
- Operation:
  - 50m safety zones to prevent vessels not associated with the wind farms interfering with operations.

The existence of safety zones will be published electronically and via Notices to Mariners.

19. Search and Rescue (SAR)

19.1 Introduction

This section summarises the existing Search & Rescue resources in the region and the issues being considered in relation to the design of proposed wind farms. (A detailed review of the historical incidents in the area, including RNLI launches, has been presented in Section 7.)

It is noted that coastguard SAR resources are considered as a secondary response to an incident arising within or related to the offshore wind farm development. The current emphasis is on 'self-help', i.e. for the first response to be from the developer/operator, for both emergency tug provision and initial evacuation/SAR activity. Emergency procedures should be detailed within the Emergency Response Co-operation Plan (ERCoP) (see Section 19.3).

19.2 SAR Resources

19.2.1 SAR Helicopters

A review of the assets in the area of the proposed wind farm sites indicated that the closest SAR helicopter base is located at Lossiemouth, operated by the RAF, approximately 25.5nm to the south by south west of the proposed wind farm sites. This base has Sea King helicopters with a maximum endurance of 6 hours and speed of 110 mph giving a radius of action of approximately 250nm which is well within the range the wind farm sites within the EDA. One helicopter is available at 15 minutes readiness between 0800 and 2200 hours, with another available at 60 minutes readiness between 0800 hours and evening civil twilight (ECT). Between 2200 and 0800 hours, one helicopter is held at 45 minutes readiness.

All RAF SAR helicopters are equipped for full day/night all weather operations over land and sea (some limitations exist with regard to freezing conditions, but in general terms the helicopters are all weather capable) and have a full night vision goggle (NVG) capability. Crews are well practised in NVG operations which is a major enhancement to search capability. In addition, all RAF SAR helicopter rear crew are medically trained, with the winchman trained up to paramedic standard.

Up to 18 persons can be carried, however this is dependent on weather conditions and the distance of the incident from the helicopter's operating base. All RAF SAR helicopters are equipped with VHF (Marine and Air Band), UHF and HF radios. They are also capable of homing to all international distress frequencies.

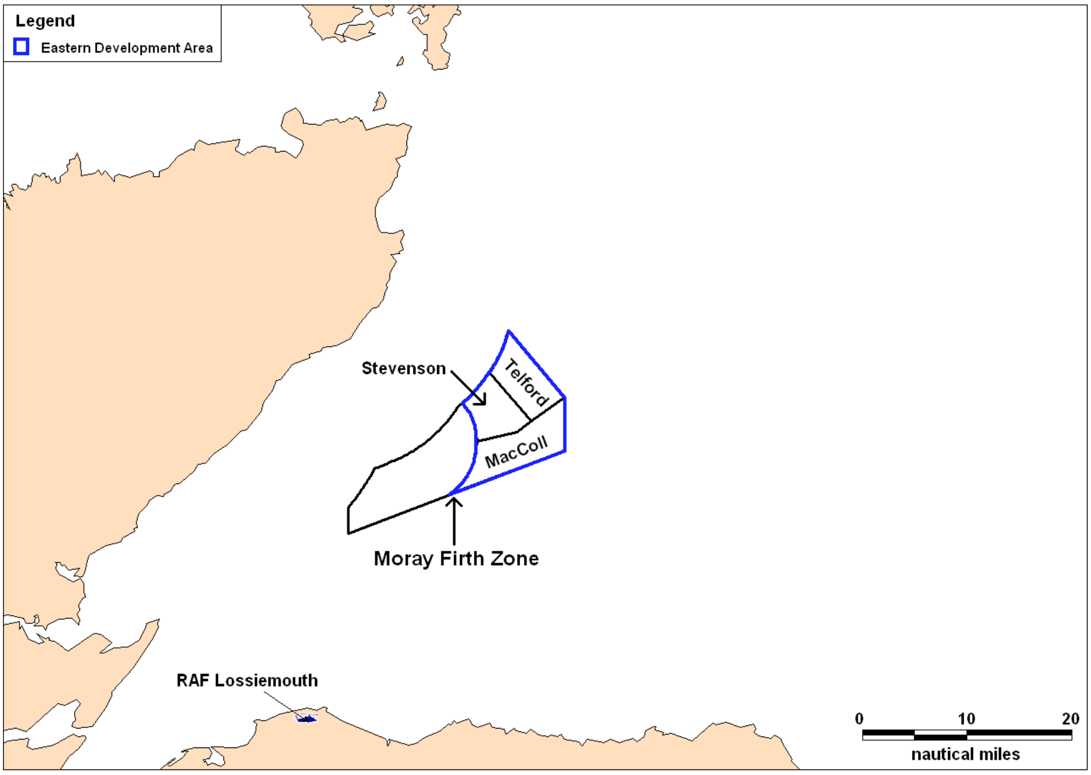


Figure 19.1 SAR Helicopter Bases relative to the Proposed Wind Farm Sites

Based on the above information, the day-time response to the wind farm sites will be approximately 30 minutes. At night time this will increase by 30 minutes to approximately 1 hour due to the additional response time at the base. It is noted that these calculation are based on still air and will vary depending on the prevailing conditions.

19.2.2 RNLI Lifeboats

The Royal National Lifeboat Institution maintains a fleet of over 400 lifeboats of various types at 235 stations round the coast of the UK and Ireland.

The RNLI stations in the vicinity of the proposed wind farms are presented in Figure 19.2.

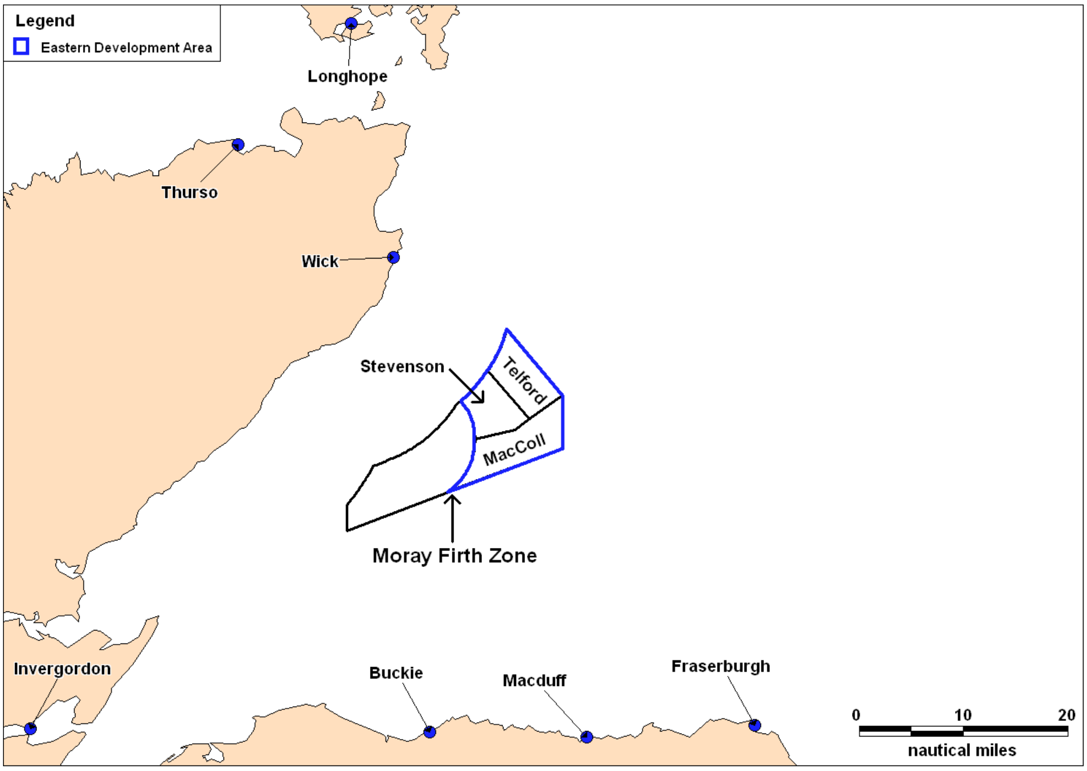


Figure 19.2 RNLI Bases near the Proposed Wind Farm Sites

At each of these stations crew and lifeboats are available on a 24-hour basis throughout the year. Table 19.1 provides a summary of the facilities at the stations closest to the EDA.

Table 19.1 Lifeboats Held at nearby RNLI Stations

Station	Lifeboats	ALB Spec	ILB Spec	Distance to Proposed Sites
Wick	ALB	Trent	-	12nm
Buckie	ALB	Severn	-	23nm
Macduff	ILB	-	B Class	26nm
Fraserburgh	ALB	Trent	-	32nm

Based on the offshore position of the proposed wind farms it is likely that ALBs would respond to an incident within the proposed sites from Wick and Buckie. This is confirmed when reviewing the historical incident data (see Section 7.2).

The Trent class lifeboat has a maximum speed of 25 knots and a 250nm range all-weather lifeboats are fitted with the latest in navigation, location and communication equipment, including electronic chart plotter, VHF radio with direction finder, radar and global positioning systems (GPS).
The Severn class lifeboat is similar to the Trent class, but is 3m longer in length. This vessel has a maximum speed of 25 knots and a 250nm range.

The B class lifeboat is small and highly manoeuvrable, making it ideal for rescues close to shore in fair to moderate conditions. It has a speed of 35 knots, range of 2.5 hours at maximum speed and is equipped with VHF radio and GPS.

Response times vary but an average declared by RNLI is 14 minutes for all-weather lifeboats and 7 minutes for inshore lifeboats. This is the time from callout, i.e., first contact from the Coastguard to the lifeboat station to launch.

The time for an all-weather lifeboat to reach the proposed wind farm sites (taking into account a 14 minute call out time) from the nearest station at Wick would be approximately 42minutes.

19.2.3 Changes to Coastguard Stations

MCA published a consultation document in December 2010 (Ref. xvii) in order to modernise HM Coastguard. The main part of the document proposes the reduction in the number of Maritime Rescue Co-ordination (MRCC) stations around the UK coastline.

Revised plans were released by the UK Government mid-way through 2011 (Ref. xviii) with a second consultation period from 14th July 2011 to 6th October 2011. Under the revised proposals the MCA intends to:

- Establish a single 24 hour Maritime Operations Centre (MOC) based in the Southampton/Portsmouth area with 96 operational coastguards. The MOC will act as a national strategic centre to manage Coastguard operations across the entire UK network as well as co-ordinating incidents on a day to day basis. The MOC will also generate a maritime picture using information from a variety of sources;

- Dover will be configured to act as a stand-by MOC for contingency purposes. Dover would have 28 staff and would retain its responsibilities for the Channel Navigation Information Service (CNIS);

- In addition to the MOC and Dover, there will be eight further put in centres, Maritime Rescue Sub-Centres (MRCS), all of which would be connected to the national network and the MOC. All would be open 24 hours a day with a total staffing of 23 in each. These would be based at the following stations:

    - MRSC Aberdeen
    - MRSC Shetland
    - MRSC Stornoway
    - MRSC Belfast
    - MRSC Holyhead
    - MRSC Milford Haven
    - MRSC Falmouth
    - MRSC Humber

*The station at London will be retained unchanged.

19.2.4 Effect of Changes to Coastguard Stations on the Proposed Wind Farm Sites

The proposed wind farm development currently lies in the former Scotland and Northern Ireland region with the nearest Maritime Rescue Sub-Centres being (MRCS) Aberdeen. MRCS Aberdeen's area of responsibility provides search and rescue coverage from Cape

Wrath (most northerly tip of mainland UK) to the East coast of Scotland at Doonie Point (just south of Aberdeen).

The proposed changes to the UK MRCS structure will result in the Aberdeen MRCS covering a much wider area of northern UK; however it will continue to respond to any incidents within the Moray Firth including the proposed wind farms.

19.2.5 Salvage

Coastguard SAR resources are considered as a secondary response to an incident arising within or related to the offshore wind farm development. In the first instance, both emergency tug provision and initial evacuation/SAR activity should be provided by the developer/operator of the offshore development.

At the time of writing (March 2012), Emergency Towing Vessels (ETVs) have been removed from duty in the UK, and two vessels previously covered the north of Scotland providing emergency towing cover for the Western Isle/north west Scotland and Shetland. The UK and Scottish Governments are currently engaged in discussions with the oil and gas industry about how future cover for the Northern Isles might be provided and funded.

In addition each MRCC/MRSC also holds comprehensive databases of harbour tugs available locally. Procedures are also in place with Brokers and Lloyd's Casualty Reporting Service to quickly obtain information on towing vessels that may be able to respond to an incident.

Emergency tug provision will generally be a contracted agreement between the vessel owners and tug operators. Coastguard Agreement on Salvage and Towage (CAST) will be invoked when owners are either unable or unwilling to engage in a commercial tow contract. MCA will pursue costs through arbitrators on a cost recovery basis.

JP Knight (Caledonian) operates four tugs that work out of Cromarty Firth (approximately 48nm south west of the proposed wind farm site, along with offshore support vessels which may have with towing capabilities that pass or work in the area (i.e. Beatrice and Jacky Oil Fields).

Lastly, tugs are available within Aberdeen Harbour through a licensed Tug Operator. An agreement exists which retains one tug permanently in Aberdeen, however in practice there are two tugs most of the time. The tugs *Cultra* and *Carrickfergus* have a bollard pull of 30 tonnes each. A third tug is available with notice.

19.3 Wind Farm SAR Matters

The wind farm will meet the MCA's requirements in terms of standards and procedures for generator shutdown and other operational requirements in the event of a search and rescue, counter pollution or salvage incident in or around the site. These are laid out in Annex 5 of MGN 371 (Ref. ii).

This includes the development of an ERCoP for the wind farm, which will in place pre-construction.

Examples of features to be incorporated are as follows:

Design:

- All wind turbine generators (WTGs) and other OREI individual structures will each be marked with clearly visible unique identification characters which can be seen by both vessels at sea level and aircraft (helicopters and fixed wing) from above.

- The identification characters shall each be illuminated by a low-intensity light visible from a vessel thus enabling the structure to be detected at a suitable distance to avoid a collision with it. The size of the identification characters in combination with the lighting will be such that, under normal conditions of visibility and all known tidal conditions, they are clearly readable by an observer, stationed 3 metres above sea levels, and at a distance of at least 150 metres from the turbine.

Operation:

- The Marine Control Centre, or mutually agreed single contact point, will be manned 24 hours a day.

- All MRCCs (MOC and/or MRCS) will be advised of the contact telephone number of the Central Control Room, or single contact point (and vice versa)

- The control room operator, or single contact point, will immediately initiate the shut-down procedure for WTGs as requested by the MRCC (MOC and/or MRCS), and maintain the WTG in the appropriate shut-down position, as requested by the MRCC (MOC and/or MRCS), until receiving notification from the MRCC that it is safe to restart the WTG.

19.3.1 Impact on SAR Helicopter Operations

There is the potential for the operational phase of the proposed wind farms to impact SAR helicopters, including access for SAR within the turbine arrays.

The wind farm sites will be designed to satisfy the following requirements for emergency response in the event of a SAR, operation in or around the wind farms, as per MGN 371 (Ref. ii):

- The turbine shall have high contrast markings (dots or stripes) placed at 10m intervals on both sides of the blades to provide helicopter pilots with a hover-reference point.

- All SAR helicopter bases will be supplied with an accurate chart of all the offshore wind farm structures and their GPS positions.

It is noted that there could be the possibility that SAR response may only be possible from surface units (lifeboats) given restrictions on helicopter access in a wind farm. However, to aid helicopter SAR, there are specific requirements to allow safe helicopter operations within wind farms and close to, or over, wind turbine generators:

- Emergency evacuation of persons directly from a turbine nacelle by SAR helicopter is a last resort. It will normally be considered where risk to life is such that the speed of reaction and transfer of survivors to a place of safety or of injured persons directly to shore medical facilities can most effectively be achieved by SAR helicopter.

- If winching is to take place to/from a turbine, the blades will have to be feathered and the rotor brakes applied (where feasible blades should be pinned). The nacelle should be rotated so that the blades are at 90 degrees off the wind with the wind blowing on to the left side of the nacelle e.g., if wind is blowing from 270 degrees, the nacelle will need to be rotated to right so that the hub is facing 360 degrees.

- If winching is to take place to/from a nacelle, wherever possible wind farm personnel should be in the nacelle to assist the winch man.

- In poor visibility or at night, any lighting on turbines may be required to be switched on or off - at the discretion of the helicopter pilot.

- For SAR helicopter operations, radar is a prime flight safety tool - especially at night and in bad weather/poor visibility. For safe operation of SAR helicopters within and around wind farms, it is crucial that the turbines are detectable to airborne radars (at a safe range) and that the aircraft crew, using radar, can discriminate between individual turbines.

It is noted that there is the possibility for wind farm structure(s) and the onshore Moray Firth operations and maintenance base to have a helipad.

In terms of the impact on SAR helicopters, based on the MGN 371 guidance and industry best-practice, including the development of an ERCoP, any impact on SAR helicopter operations can be well managed.

20. ADDITIONAL NAVIGATION ISSUES

20.1 Introduction

There are a number of additional navigational issues identified within MGN 371 (Ref. ii) which require to be addressed by the developer. The following subsections cover additional navigation related issues which have not been covered elsewhere within this report.

20.2 Visual Navigation and Collision Avoidance

20.2.1 Introduction

MGN 371 identifies the potential for visual navigation to be impaired by the location of offshore wind farm structures, based on vessels not being visible to each other (hidden behind structures) and navigational aids and/or landmarks not being visible to shipping.

20.2.2 Visual Impact (Other Vessels)

Based on the position, orientation, number of turbines and spacing between turbines it is not considered there will be any significant issue of visual impact between vessels on the main commercial shipping routes in the area, i.e. the Pentland Firth route which passes over 3nm to the north east.

During the shipping surveys, recreational activity was recorded during the summer survey (2010), with fishing identified all year round in the general area. However, given the low commercial vessel activity in the immediate vicinity of proposed offshore wind farms (< 2nm) the likelihood of a small vessel emerging from the wind farm towards shipping traffic is low. Even if that were the case, the vessel should be visible for the vast majority of the time due to the size of the turbines relative to the large spacing between them.

20.2.3 Visual Impact (Navigational Aids and/or Landmarks)

It is likely that the proposed wind farm sites within the EDA will form a significant aid to navigation, which will be highly visible to shipping with lights on significant peripheral structures (SPSs), as well as selected intermediate structures (IPSs), in accordance with NLB requirements (see Section 4).

It is therefore not considered that the EDA wind farm sites will degrade the ability of ships to navigate in the area through visual impairment of navigation aids or landmarks.

20.3 Potential Effects on Waves and Tidal Currents

Based on a specialist study, it was concluded that there will be no significant or measurable far field impact from the development on local tidal currents. Any impact on the waves will be very localised (in close proximity to the turbines).

20.4 Impacts of Structures on Wind Masking/Turbulence or Sheer

The offshore turbines have the potential to affect vessels under sail when passing through the site from effects such as wind shear, masking and turbulence.

From previous studies of offshore wind farms it was concluded that turbines do reduce wind velocity by the order of 10% downwind of a turbine. The temporary effect is not considered as being significant and similar to that experienced passing a large ship or close to other large structures (e.g. bridges) or the coastline. In addition, practical experience to date from RYA members taking vessels into other sites indicates that this is not likely to be an issue.

20.5 Sedimentation/Scouring Impacting Navigable Water Depths in Area

There is the potential for structures positioned in the tidal stream to produce siltation, deposition of sediment or scouring which could affect the navigable water depths in the wind farm areas or adjacent to the area.

The specialist work carried out as part of the ES has shown that no significant impact on navigation will result from the potential effects of the proposed wind farm sites on the physical environment.

20.6 Structures and Generators affecting Sonar Systems in Area

No evidence has been found to date with regard to existing wind farms to suggest that they produce any kind of sonar interference which is detrimental to the fishing industry, or to military systems. No impact is anticipated for the proposed wind farms.

20.7 Electromagnetic Interference on Navigation Equipment

Based on the findings of the trials at the North Hoyle Offshore Wind Farm (Ref. iii), the wind farm generators and their cabling, inter-turbine and onshore, did not cause any compass deviation during the trials. However, it is stated that as with any ferrous metal structure, caution should be exercised when using magnetic compasses close to turbine towers.

It is noted that all equipment and cables will be rated and in compliance with design codes. In addition the inter-array cables associated with the wind farm will be buried and any generated fields will be very weak and will have no impact on navigation or electronic equipment. No significant impact is anticipated for the proposed offshore wind farms and associated cable works.

20.8 Impacts on Communications and Position Fixing

The following summarises the potential impacts of the different communications and position fixing devices used in and around offshore wind farms. The basis for the assessment is the trials carried out by the MCA at North Hoyle and experience of personnel/vessels operating in and around other offshore wind farm sites.

20.8.1 VHF Communications (including Digital Selective Calling)

Vessels operating in and around offshore wind farms have not noted any noticeable effects on VHF (including voice and DSC communications). No significant impact is anticipated at the site.

20.8.2 Navtex

The Navtex system is used for the automatic broadcast of localised Maritime Safety Information (MSI). The system mainly operates in the Medium Frequency radio band just above and below the old 500 kHz Morse Distress frequency. No significant impact has been noted at other sites and none are expected at the proposed wind farms.

20.8.3 VHF Direction Finding

During the North Hoyle trials, the VHF direction equipment carried in the lifeboats did not function correctly when very close to turbines (within about 50m). This is deemed to be a relatively small scale impact and provided the effect is recognised, it should not be a problem in practical search and rescue.

20.8.4 Automatic Identification System (AIS)

In theory there could be interference when there is a structure located between the transmitting and receiving antennas (i.e., blocking line of sight). This was not evident in the trials carried out at the North Hoyle site and no significant impact is anticipated for AIS signals being transmitted and received at the proposed wind farms

20.8.5 Global Positioning System (GPS)

No problems with basic GPS reception or positional accuracy were reported during the trials at North Hoyle and this has been confirmed from other vessels which have been inside offshore wind farms. Consideration will require to be given to any potential degradation of DGPS signals being used to position construction equipment when close to a tower.

20.8.6 LORAN-C

LORAN-C is a low frequency electronic position-fixing system using pulsed transmissions at 100 kHz. The absolute accuracy of Loran-C varies from 0.1 to 0.25 nautical miles. Its use is in steep decline, with GPS being the primary replacement. It is mostly used in ships on and near the US coast, although some GPS receivers have built-in Loran C software.

Attempts were made to test a system during the North Hoyle trial, but there were difficulties which were probably attributable to operational errors or lack of a nearby transmitter.

Although a position could not be obtained using LORAN-C in the wind farm area, the available signals were received without apparent degradation. The proposed wind farms are not expected to have a significant impact on LORAN-C. It is noted that the Department for Transport are funding an enhanced LORAN (eLORAN) service in the UK.

20.9 Noise Impact

20.9.1 Acoustic Noise Masking Sound Signals

The concern which must be addressed under MGN 371 is whether acoustic noise from the wind farm could mask prescribed sound signals. The sound level from a wind farm at a distance of 350m has been estimated to be 35-45 dB and it should therefore be well below a background sound level which is typically 63-68 dB.

The 1972 International Regulations for Preventing Collisions at Sea (1972 COLREGS), ANNEX III, entered into force by the IMO, specifies the technical requirements for sound signal appliances on marine vessels. Frequency range and minimum decibel level output is specified for each class of ship (based on length).

A ship’s whistle for a vessel of 75m should generate in the order of 138 dB and be audible at a range of 1.5nm, so this should be heard above the background noise of the proposed wind farms. Foghorns will also be audible over the background noise of the wind farm.

Therefore, there is no indication that the sound level of the proposed wind farms will have any significant influence on marine safety.

20.9.2 Noise Impacting Sonar

Once in operation it is not believed that the subsea acoustic noise generated by the wind farm sites will have any significant impact on sonar systems.

21. RISK MITIGATION MEASURES & MONITORING

21.1 Mitigation

This section summarises the main industry standard and best practice risk mitigation measures adopted by MORL for the proposed wind farm sites within the EDA to reduce the navigational impact of the development.

Table 21.1 Mitigation Measures

Type of Mitigation	Mitigation	Description
Industry Standard	Marked on Admiralty Charts	Wind farm will be charted by the UK Hydrographic Office using the magenta turbine tower chart symbol found in publication ‘NP 5011 - Symbols and Abbreviations used in Admiralty Charts’. Submarine cables associated with wind farms will also be charted on the appropriate scale charts.
Industry Standard	Information circulation	Appropriate liaison to ensure information on the wind farm sites and special activities is circulated in Notices to Mariners, Navigation Information Broadcasts and other appropriate media.
Industry Standard	Marking and lighting	Structures to be marked and lit in-line with NLB and IALA guidance. (See Section 4.)
Industry Standard	Turbine air draught	Lowest point of rotor sweep at least 22m above Mean High Water Springs as per MCA recommendations.
Industry Standard	Cable burial and protection	Cables will be protected appropriately taking into account fishing and anchoring practices. Positions of the cable routes notified to Kingfisher Information Services-Cable Awareness (KIS-CA) for inclusion in cable awareness charts and plotters for the fishing industry.
Industry Standard	Compliance with MCA’s Marine Guidance Notice (MGN) 371 including Annex 5	Annex 5 specifies ‘Standards and procedures for generator shutdown and other operational requirements in the event of a search and rescue, counter pollution or salvage incident in or around an OREI.’
Industry Standard	Formulation of an Emergency Response Cooperation Plan (ERCoP) as per MCA template	MORL will use the draft template created by the MCA to formulate an emergency response plan and site Safety Management Systems, in consultation with the MCA.
Best Practice	Marine Control Centre	A Marine Control Centre will monitor AIS and non-AIS vessels by CCTV and record the movements of ships around the wind farm sites as well as company vessels working at the site. Vessels identified in construction areas or safety zones will be identified and contacted.

Discussions on best practice and other measures including safety zones (see Section 18) will continue both pre- and post-construction and during the life of the project with the MCA and other stakeholders including offshore operators at the Beatrice and Jacky Oil Fields.

21.2 Future Monitoring

21.2.1 Safety Management Systems

From a navigation risk perspective, monitoring will take place through the project's Safety Management System (SMS). The Safety Management System will include an incident/accident reporting system which will allow incidents and near misses to be recorded and reviewed to monitor the effectiveness of the risk control measures in place at the site. In addition to this any information gleaned from near misses/accidents at other offshore wind farm site will be considered with respect to the control measures applied at the proposed wind farms.

During maintenance, there will regularly be vessels operating in the site which can monitor any third party vessel activity, both visually and on radar, although this will not be their primary function.

21.2.2 CCTV

CCTV may be installed to enable coverage of the proposed wind farms from key locations either on the wind turbine structures or the substations. CCTV technology can be adjustable for day / night conditions, which will allow operators in a central control room to identify vessel names from a distance to facilitate radio communications.

21.2.3 Marine Control Centre

Whilst no radar monitoring of vessel movements has been proposed for the site (it was noted during the Hazard Workshop that Beatrice Alpha has radar fitted, a Marine Control Centre monitoring AIS monitoring is being considered which can be used to monitor and record the movements of vessels around the wind farm sites and associated offshore export cables to shore, as well as company vessels working at the wind farms.

Any vessel with AIS installed, observed to stray into the operational safety zones will be identified by all available monitoring methods and contacted by a designated member of the crew of the wind farm or from the Marine Control Centre via multi-channel VHF radio, including DSC, and warned that they have encroached the safety zone. Vessels which ignore this warning and are considered to be causing a potential danger will be further requested to move from the area of concern and the then the details of the vessel will be reported to the MCA enforcement unit.

21.2.4 Subsea Cables

The subsea cable routes will be subject to periodic inspection to monitor cable burial depths.

22. CONCLUSIONS

Following a review of the baseline shipping and navigation, a Navigational Risk Assessment for the proposed wind farms located in the EDA has been undertaken.

The assessment has included collision risk modelling and a formal safety assessment for all phases of the project as well as an assessment of cumulative and impacts. A summary of the main conclusions of the NRA are presented below:

- Consultation has been undertaken with regulators and operators, key points include:
    - In general consultation with navigational stakeholders was positive with no objections to the site, however close coordination is needed between MORL and the nearby Oil & Gas operators and also BOWL who are proposing to develop the nearby STW site. This collaborative approach is on-going at the time of writing this report.
    - Squid fisheries are located within the area, with approximately 40 vessels fishing between 12m and 22m in length and hence could be a risk of fishing vessel collision and gear interaction with cabling and substructures.
    - Generally, it was considered that the sea room between the coast and the proposed wind farms was sufficient for ship-to-ship collision not to be a major issue for displaced traffic. It was also noted that yachts are more likely to use the inshore route.
    - Offshore support vessels accessing the Beatrice/Jacky platforms could be impacted if the Western Development Area is developed.
    - It was stated that the given the distance between the sites and the coastline they would not be concerned regarding the amount of sea room between the sites and the coast.
    - RYA/CA noted that recreation activity is very weather dependent and the busiest routes are mainly coastal - along the Moray and Caithness coastlines.
    - The proposed wind farm sites have been located in area of low commercial ship density with the main ship route passing over 3nm north east of the Telford wind farm on the Pentland Firth route.

- In the hazard review workshop involving local navigational stakeholders, all hazards were identified to be low.

- Following identification of the key navigational hazards, risk analyses were carried out to investigate selected hazards in more detail. The worst case (Rochdale Envelope) overall annual level of risk was estimated to be for the Scenario 1 layout leading to increase due to wind farms by approximately 1 in 16 years (base case) and 1 in 15 years (future case based on traffic growth estimates over the life of the development). The vast majority of this risk is from fishing vessel collisions given the modelling assuming current levels of fishing will continue in the area.

- The risks associated with recreational craft interaction with the proposed wind farm structures (blade/mast and vessel/structure collisions) were qualitatively assessed and concluded to be as low as reasonably practicable given the mitigation measures planned.

- A quantitative assessment estimated that, compared to the background marine accident risk levels in the UK, the increase in risk to both people and the environment caused by the proposed wind farms is low.

- In terms of cumulative and issues from nearby developments including the Beatrice Offshore Wind Farm, given the low density of shipping passing through the area and the available sea room the impact on ship routing and collision risk is considered to be low. Dependant on the future plans for Western Development Area, offshore vessels should be able to pass south and west of the proposed wind farm sites.

- Mitigation and safety measures will be applied to proposed wind farms appropriate to the level and type of risk determined during the EIA. The specific measures to be employed will be selected in consultation with the MCA Navigation Safety Branch and other relevant statutory stakeholders where required.

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