Navigational Risk Assessment Addendum

(Appendix 12A)

Prepared by	Anatec Limited
Presented to	Seagreen Wind Energy Limited
Date	20 06 2018
Revision Number	03
Document Reference	A4078-SWEL-NRA-3 App-12A

	Aberdeen Office	Cambridge Office
Address	10 Exchange Street, Aberdeen, AB11 6PH, UK	Braemoor, No. 4 The Warren, Witchford Ely, Cambs, CB6 2HN, UK
Tel	01224 253700	01353 661200
Fax	0709 2367306	0709 2367306
Email	aberdeen@anatec.com	cambs@anatec.com

Revision Number	Date	Summary of Change
00	11 July 2012	Initial Submission
00	04 May 2018	Addendum
01	29 May 2018	Review of Comments
02	13 June 2018	Further Review of Comments
03	20 June 2018	Final Submission

Table of Contents

Table of Figures

Table of Tables

Abbreviations Table

Abbreviation	Definition
AIS	Automatic Identification System
ALB	All Weather Lifeboat
CAA	Civil Aviation Authority
CIA	Cumulative Impact Assessment
CGOC	Coastguard Operations Centre
CoS	Chamber of Shipping
CRO	Coastguard Rescue Officer
CRT	Coastguard Rescue Team
DfT	Department for Transport
DSLP	Development and Specification Layout Plan
EIA	Environmental Impact Assessment
ERCoP	Emergency Response and Co-operation Plan
EU	European Union
FSA	Formal Safety Assessment
HSE	Health and Safety Executive
IALA	International Association of Marine Aids to Navigation and Lighthouse Authorities
ICOL	Inch Cape Offshore Limited
ILB	Inshore Lifeboat
IMO	International Maritime Organization
km	Kilometre
LAT	Lowest Astronomical Tide
LMP	Lighting and Marking Plan
MAIB	Marine Accident Investigation Branch
MCA	Maritime and Coastguard Agency
MEHRA	Marine Environmental High Risk Area
MGN	Marine Guidance Note
MHWS	Mean High Water Springs
MS-LOT	Marine Scotland Licensing Operations Team

Abbreviation	Definition
N	North
NLB	Northern Lighthouse Board
nm	Nautical Mile
NMOC	National Maritime Operations Centre
NnGOWL	Neart na Gaoithe Offshore Wind Limited
NRA	Navigational Risk Assessment
OREI	Offshore Renewable Energy Installations
OSP	Offshore Substation Platform
PLL	Potential Loss of Life
RNLI	Royal National Lifeboat Institution
RSPB	Royal Society for the Protection of Birds
RYA	Royal Yachting Association
SAR	Search and Rescue
SFF	Scottish Fishermen's Federation
SOLAS	International Convention for the Safety of Life at Sea
UK	United Kingdom
UKCS	United Kingdom Continental Shelf
UKHO	United Kingdom Hydrographic Office
W	West
WTG	Wind Turbine Generator

1 Introduction

1.1 Background

Following gap analysis of work undertaken to date (prior to the Environmental Impact Assessment (EIA) for the optimised Seagreen Project) and based on the requirements of Marine Guidance Note (MGN) 543 (Maritime and Coastguard Agency (MCA), 2016), Anatec was commissioned by Seagreen Wind Energy Limited (Seagreen), in 2017, to undertake a Navigational Risk Assessment (NRA) addendum for the optimised Seagreen Project. The original Seagreen Project (herein referred to as the originally consented project) received development consents from Scottish Ministers in 2014. This was confirmed in November 2017, following legal challenge by the Royal Society for the Protection of Birds (RSPB) to the consents award decision. Seagreen is now applying for additional consents for an optimised design (herein referred to as the optimised Seagreen project), based on fewer, larger, higher capacity Wind Turbine Generators (WTG)s that have become available, since the 2014 consents decision, and inclusion of monopiles as a foundation option.

This Appendix forms an addendum to the original 2012 NRA (Appendix 12C (Project Alpha and Project Bravo 2012 NRA) of the EIA Report) which was submitted as part of the originally consented project application. This addendum considers and presents information on optimised Seagreen Project impacts which may have changed due to the proposed design optimisation, or due to changes in relevant guidance and legislation, changes in the baseline environment, or changes in assessment methodologies. It should be noted some assessment elements have been omitted due to minimal changes since the 2014 consents. These include the impacts of the optimised Seagreen Project on:

- Communication, Radar and Position fixing including Electromagnetic interference; and
- Other Navigational features (such as marine aggregate extraction areas) not relevant to the optimised Seagreen Project or having been previously covered within the original NRA (Appendix 12C (Project Alpha and Project Bravo 2012 NRA)) and remain unchanged.

1.2 Navigational Risk Assessment Process

An EIA is a process which identifies and assesses the potential environmental impacts of a project, both negative and positive, in accordance with European Union (EU) Directives. Impacts on shipping and navigation are informed by an NRA. In line with the MCA methodology (MCA, 2015) and MGN 543 (MCA, 2016), this NRA includes:

- Implications of offshore wind farms including position of wind turbines;
- Assessment of navigational risk pre and post development of the optimised Seagreen Project;
- Identification of mitigation measures;
- Assessment of maritime incidents; and

- Emergency response.

Following a gap analysis of the work undertaken to date (prior to the EIA for the optimised Seagreen Project), the following areas (as per MGN 543 (MCA, 2016)) have been identified as requiring additional or updated assessment to meet 2018 guidelines or updated baseline data sources. These include:

- Updated consultation, to inform stakeholders of the changes and to re confirm the baseline (Chapter 12 (Shipping and Navigation);
- Emergency Response, due to changes to the baseline;
- Maritime Accidents, due to updated baseline data sources:
- Vessel Routeing (pre and post windfarm), given changes to vessel routeing in the area;
- Collision and allision risk modelling, given changes to the project design envelope; and
- Cumulative routeing assessment, given the changes to other developments within the area (as well as changes to vessel routeing).

2 Project Description

This section presents details of the optimised Seagreen Project design which has been assessed within this NRA addendum and the subsequent EIA Report (Chapter 12 (Shipping and Navigation)).

The proposed development site is located within the North Sea, in the outer Firth of Forth and Firth of Tay Region, approximately 15 nautical miles (nm) east of the Angus coastline of the UK. The optimised Seagreen Project consists of two areas: Project Alpha and Project Bravo, which together cover an area of approximately 114nm^2 (391 kilometres (km)^2). The Project optimisation does not include the Offshore Transmission Asset, as the existing 2014 licence remain valid however, risk assessment of offshore substation platforms (OSPs) is considered within this Appendix of the EIA Report as they form an integral part of the array therefore were required to be included within the collision and allision modelling in Section 10 and 11.

A full description of the optimised Seagreen Project is provided in Chapter 5 (Project Description) of the EIA Report.

2.1 Optimised Seagreen Project Boundaries

The corner coordinates of the optimised Seagreen Project (optimised Project Alpha and Project Bravo) are presented in Table 2.1. The Project Alpha and Project Bravo sites are shown in Figure 2.1.

Table 2.1 Corner Co-ordinates of the optimised Seagreen Project

Corner	Latitude (Transverse Mercator WGS84)	Longitude (Transverse Mercator WGS84)
C1	56° 40' 39.19" North (N)	001° 56' 13.56" West (W)
C2	56° 40' 36.37" N	001° 36' 09.04" W
C3	56° 39' 43.71" N	001° 36' 38.98" W
C4	56° 30' 55.39" N	001° 53' 32.48" W
C5	56° 30' 48.19" N	001° 56' 22.68" W
C6	56° 39' 18.99" N	001° 36' 53.02" W
C7	56° 39' 55.40" N	001° 34' 37.62" W
C8	56° 31' 54.06" N	001° 29' 22.12" W

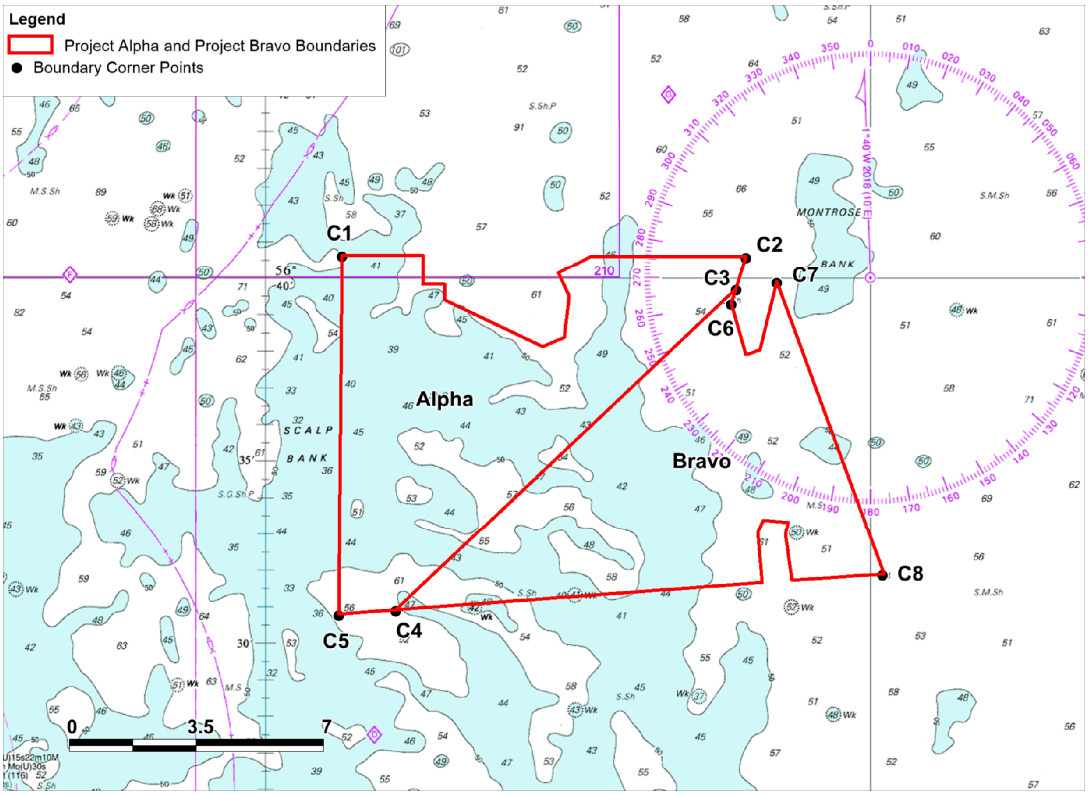


Figure 2.1 Corner Coordinates of the Optimised Seagreen Project

For shipping and navigation receptors, the worst case has been identified as 120 WTGs on jacket foundations and four OSPs. It should be noted that the OSPs are part of the Transmission Asset which was licenced separately in 2014. This asset remains as licensed, and is therefore not part of the current EIA, however OSPs have been quantitatively and qualitatively considered as they form an integral part of the array and are required to be considered within the allision and collision modelling (Section 10 and 11).

A layout is shown in Figure 2.2, which shows indicative structure positions (including WTGs and OSPs).

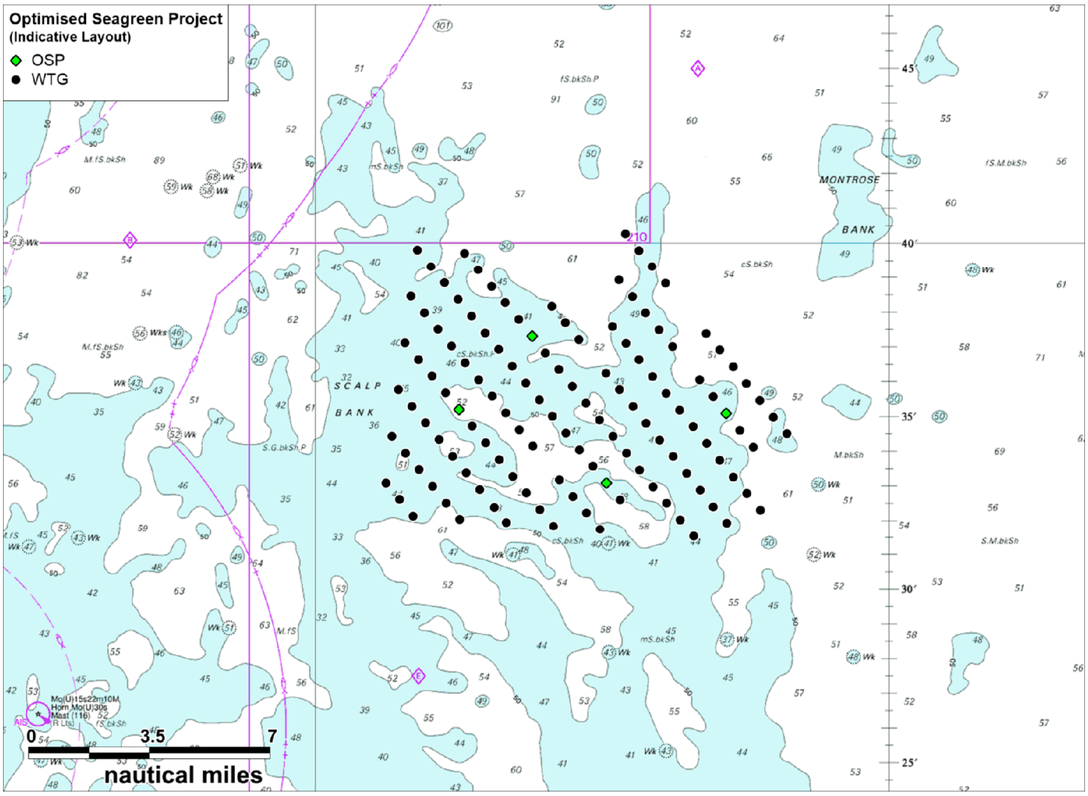


Figure 2.2 Overview of Indicative Layout (120 WTGs and Four OSPs)

The combined indicative layout of Project Alpha and Project Bravo is considered to be the worst case from a shipping and navigation perspective, when compared to Project Alpha or Project Bravo in isolation. Therefore, the combined indicative layout (the optimised Seagreen Project) has been used within the allision and collision risk modelling (see Section 9 for further information). This is considered an indicative worst case, based on the parameters defined within the design envelope, including the maximum number of structures.

2.2 Wave Buoys

In addition to the structures described above, a maximum of six wave buoys deployed around the optimised Seagreen Project have been included (up to three in Project Alpha and up to three in Project Bravo).

2.3 Array Cables

The total length of each array cable within both Project Alpha and Project Bravo will be up to 355m with the majority of cables (at least 299.5m) anticipated to be trenched. Rock or mattress protection would be used where cable burial is not possible.

2.4 Transmission Asset

As previously noted, the Transmission Asset was licenced separately in 2014 and includes up to five OSPs and up to six export cables. This asset remains as consented, and is therefore not part of the current EIA, however OSPs have been quantitatively and qualitatively considered as they form an integral part of the array.

3 Consultation

As part of the EIA process, key marine and navigational stakeholders were consulted by Seagreen and Anatec, on the optimised Seagreen Project. Table 12.1 of the EIA Report (Chapter 12 (Shipping and Navigation)), summarises the issues raised relevant to shipping and navigation. These have been identified following the submission of the 2017 Scoping Report (Seagreen, 2017a) which was an update to the original 2010 Scoping Report (Seagreen, 2010) as well as through post scoping consultation.

The following stakeholders were consulted:

- Marine Scotland Licensing Operations Team (MS-LOT);
- MCA;
- Mainstream Renewable Power on behalf of Neart na Gaoithe Offshore Wind Limited (NnGOWL);
- Red Rock Power Limited on behalf of Inch Cape Offshore Limited (ICOL);
- Northern Lighthouse Board (NLB);
- Royal Yachting Association (RYA) Scotland;
- Scottish Fishermen's Federation (SFF);
- Transport Scotland (Ports and Harbours);
- Forth Ports;
- Chamber of Shipping (CoS);
- Cruising Association; and
- Regular operators identified from the marine traffic survey.

All stakeholders with the exception of Red Rock Power Limited responded.

3.1 Regular Operator

Regular commercial operators were identified from the marine traffic survey data (see Appendix 12B (AIS Marine Traffic Validation) of the EIA Report), and each were subsequently sent information regarding the optimised Seagreen Project, and a request for a consultation response.

A summary of the operators contacted, and the responses received are provided in Appendix 12E (Regular Operator Consultation) of the EIA Report.

4 Guidance and Data Sources

4.1 Guidance

This section summarises the main guidance and data sources used in assessing the existing environment and shipping activities relative to the optimised Seagreen Project.

- MCA Methodology for Assessing the Marine Navigational Safety of Offshore Wind Farms (MCA, 2015)
- International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) Recommendations O-139 on the Marking of Man-Made Structures (IALA, 2013)
- MGN 543 Offshore Renewable Energy Installations (OREIs) – Guidance of United Kingdom (UK) Navigational Practice, Safety and Emergency Response (MCA, 2016);
- MGN 372 (M+F) Guidance to Mariners Operating in the Vicinity of UK OREIs (MCA, 2008).and
- The RYA's Position on Offshore Renewable Energy Developments: Paper 1 – Wind Energy (RYA, 2015)

4.2 Data

The main data sources used in this 2017 NRA addendum assessment are as follows:

- Automatic Identification System (AIS) marine traffic survey data collected from onshore receivers (14 days February to March 2017 and 14 days July to August 2017);
- Maritime incident data from the Marine Accident Investigation Branch (MAIB) (1995-2014)
- Maritime incident data from the Royal National Lifeboat Institution (RNLI) (2005-2014);
- Admiralty Sailing Directions – North Sea (West) Pilot – NP 54 (United Kingdom Hydrographic Office (UKHO)), 2016);
- UKHO Admiralty Charts 2, 115, 245, 273, 278, 1407, 1409 and 2182B; and
- Metocean Data – Health and Safety Executive (HSE) Weather Database.

5 Emergency Response

This section summarises the existing Search and Rescue (SAR) resources in proximity to the optimised Seagreen Project. It is noted that the optimised Seagreen Project will be required to consider self-help capabilities for its own personnel and vessels.

5.1 SAR Helicopters

In March 2013, the Bristow Group were awarded the contract by the MCA (as an executive agency of Department for Transport (DfT)), to provide helicopter SAR operations in the UK over a ten year period. Bristow have now been operating the service since April 2015. There are ten base locations for the SAR helicopter service. The nearest SAR helicopter base is the Inverness base which is approximately 87nm from the closest point of the optimised Seagreen Project as presented in Figure 5.1, and has been in operation since April 2015. This base operates two Agusta Westland AW189 aircraft.

5.2 RNLI

The RNLI is organised into six divisions, with the relevant region for the optimised Seagreen Project being the Scotland Division. Based out of more than 230 stations, there are more than 350 lifeboats across the RNLI fleet, including both all-weather lifeboats (ALBs) and inshore lifeboats (ILBs). Based on the offshore position of the optimised Seagreen Project it is likely that ALBs from Montrose or Arbroath would respond to an incident in proximity to the Project, given they generally operate within a 100nm limit (due to endurance and transit time). Locations of RNLI lifeboat stations along the east coast of Scotland are presented in Figure 5.1 and details of the types of the lifeboats operating out of these stations are given in Table 5.1. At each station, crew, ALBs and ILBs are available on a 24-hour basis throughout the year.

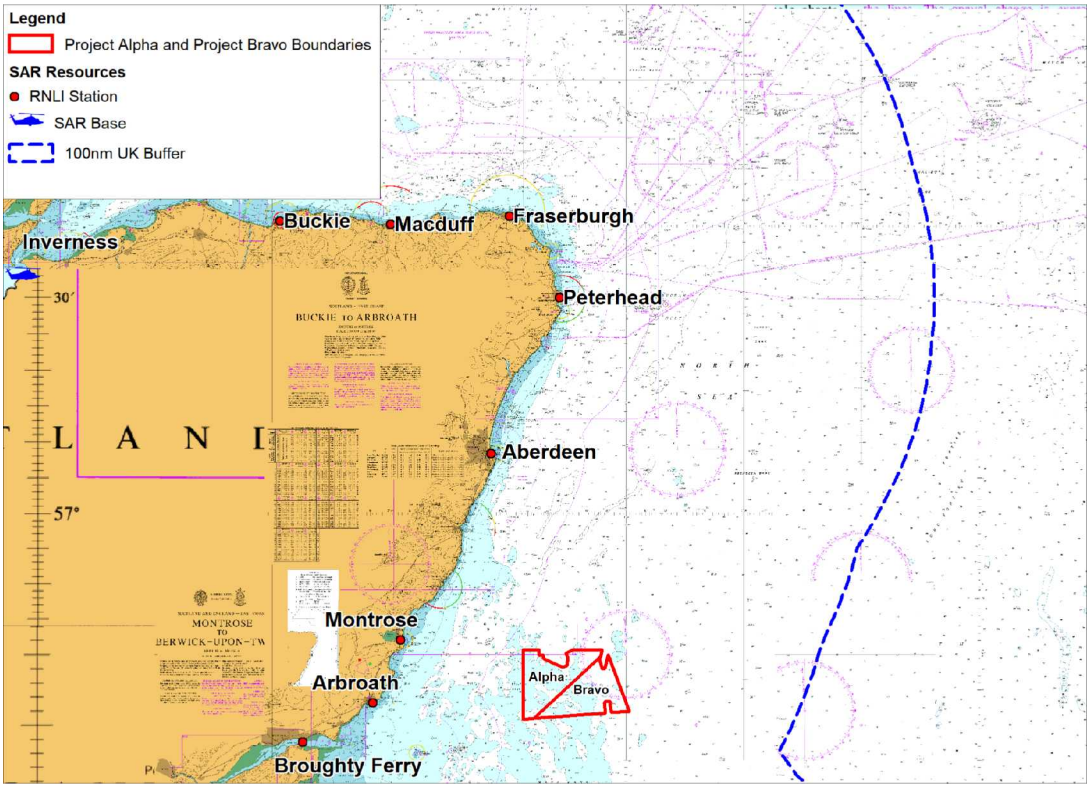


Figure 5.1 SAR Resources in Proximity to the Optimised Seagreen Project

Table 5.1 UK Lifeboats Operated from North Sea RNLI Stations

Station	Lifeboat(s)	ALB Class	ILB Class	Approximate Distance to Closest Point Optimised Seagreen Project (nm)
Montrose	ALB & ILB	Shannon	D Class	17
Arbroath	ALB & ILB	Mersey	D Class	21
Aberdeen	ALB & ILB	Severn	D Class	28
Broughty Ferry	ALB & ILB	Trent	D Class	31
Peterhead	ALB	Tamar	-	50
Fraserburgh	ALB	Trent	-	61
Macduff	ILB	-	B Class	63
Buckie	ALB	Severn	-	69

5.3 Coastguard Operations Centre

The UK coordinates SAR through a network of 11 Coastguard Operations Centres (CGOC), including a National Maritime Operations Centre (NMOC) based in Hampshire. A corps of over 3,500 volunteer Coastguard Rescue Officers (CROs) around the UK form over 352 local Coastguard Rescue Teams (CRT) involved in coastal rescue, searches and surveillance.

The nearest rescue coordination centre to the optimised Seagreen Project is based in Aberdeen, located approximately 28nm (52km) from the closest point of the Project.

5.4 Third Party Assistance

Companies operating offshore typically have resources of vessels, helicopters and other equipment available for normal operations that can assist with emergencies offshore. Alongside this, all vessels under International Maritime Organization (IMO) obligations set out in the International Convention for the Safety of Life at Sea (SOLAS) (IMO, 1974) as amended, are required to render assistance to any person or vessel in distress if safely able to do so.

6 Maritime Incidents

This section provides details of marine incidents that have occurred within the vicinity of the optimised Seagreen Project. The analysis is intended to provide an indication as to the baseline level of incidents within the general area, and show the common causes and vessel types involved.

Incident data has been collected and reviewed from two sources:

- MAIB; and
- RNLI.

It is noted that the same incidents may be recorded by both sources.

6.1 MAIB

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

The locations of accidents, injuries and hazardous incidents reported to the MAIB within the study area, between 1994 and 2014 are presented in Figure 6.1 and are colour-coded by incident type.

A total of 21 incidents were reported within the study area; however four of these involved two vessels, therefore a total of 17 unique incidents were reported. None of the incidents occurred within the optimised Seagreen Project.

The most frequently recorded incident types were “Hazardous Incident” representing seven of the 17 incidents.

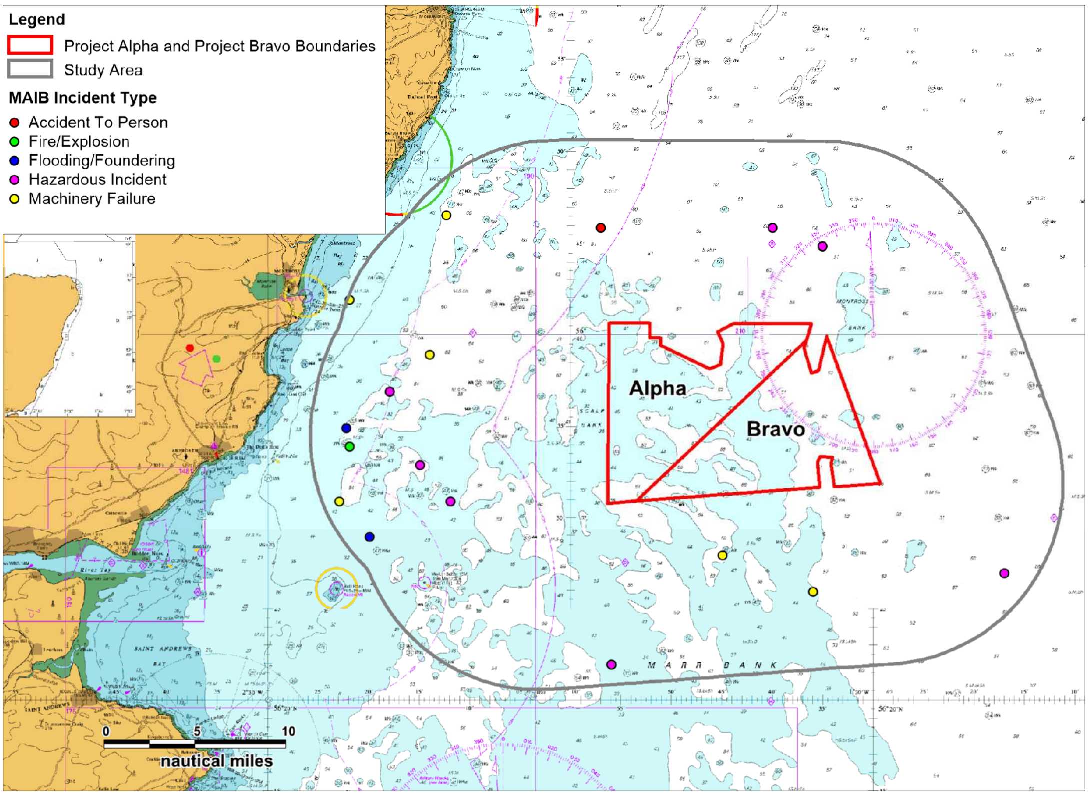


Figure 6.1 MAIB Incident Locations by Incident Type (1994-2014)

Figure 6.2 presents the same set of incidents, colour-coded by vessel type. The most frequently recorded vessel type was fishing vessels, accounting for nine of the 17 incidents throughout the period analysed.

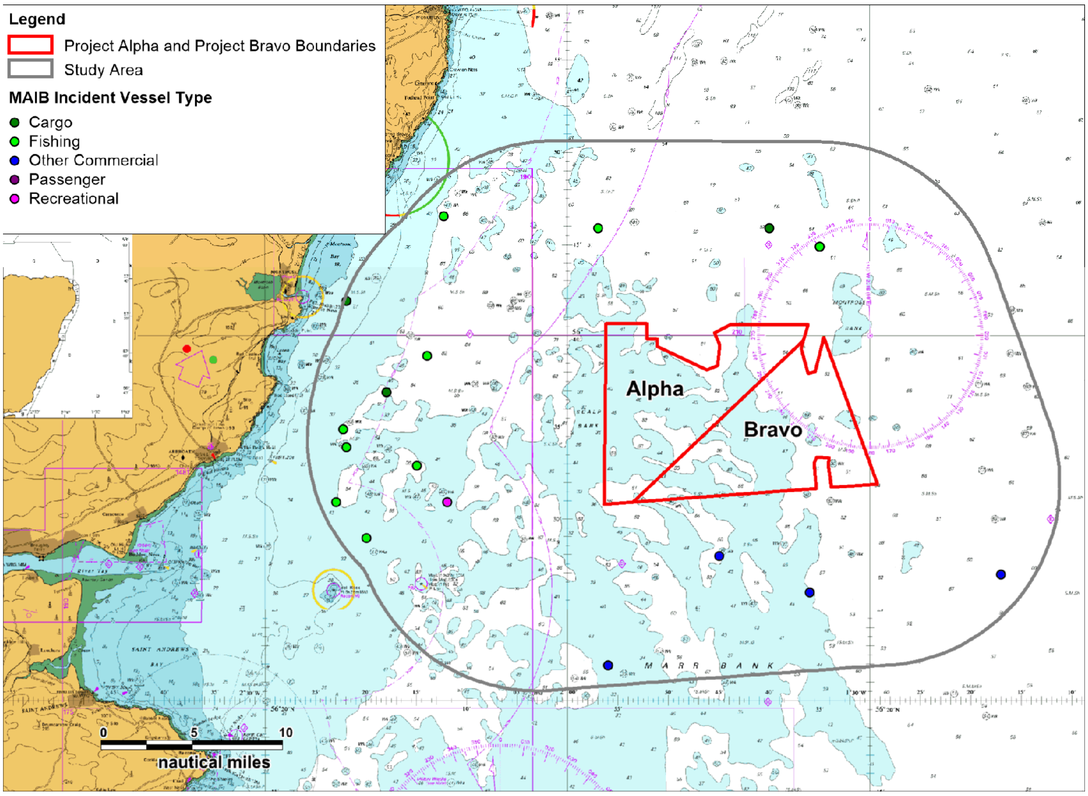


Figure 6.2 MAIB Incident Locations by Vessel Type (1994-2014)

6.2 RNLI

Data on RNLI lifeboat responses within the study area for the ten year period between 2005 and 2014 were analysed, with cases of a hoax or false alarm excluded. The locations of incidents responded to by the RNLI between 2005 and 2014 are presented in Figure 6.3 and are colour-coded by incident type. It should be noted that this analysis only includes incidents to which the RNLI responded.

A total of 15 unique incident launches were reported within the study area; however, none of these occurred within the optimised Seagreen Project.

The most frequently recorded incident type was “Machinery Failure”, representing five of the 15 incidents.

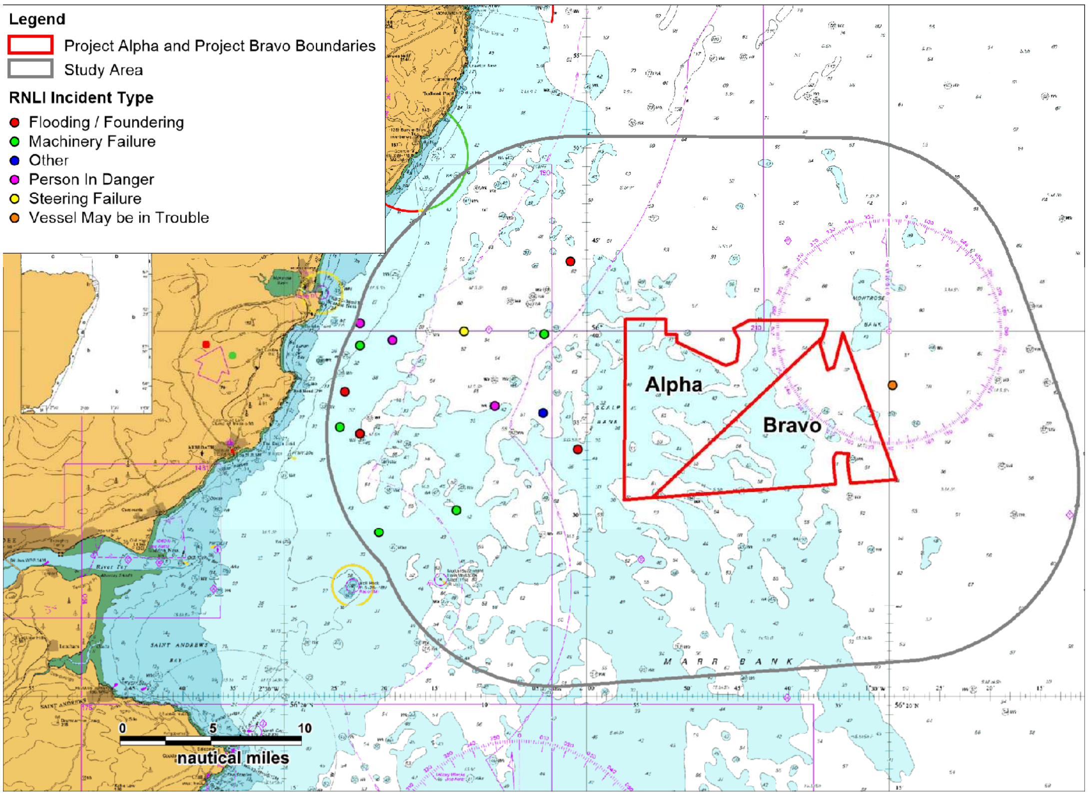


Figure 6.3 RNLI Incident Locations by Incident Type (2005-2014)

Figure 6.4 presents the same set of incidents colour-coded by casualty type. The most frequently recorded vessel type was recreational vessels, accounting for eight of the 15 incidents throughout the period analysed.

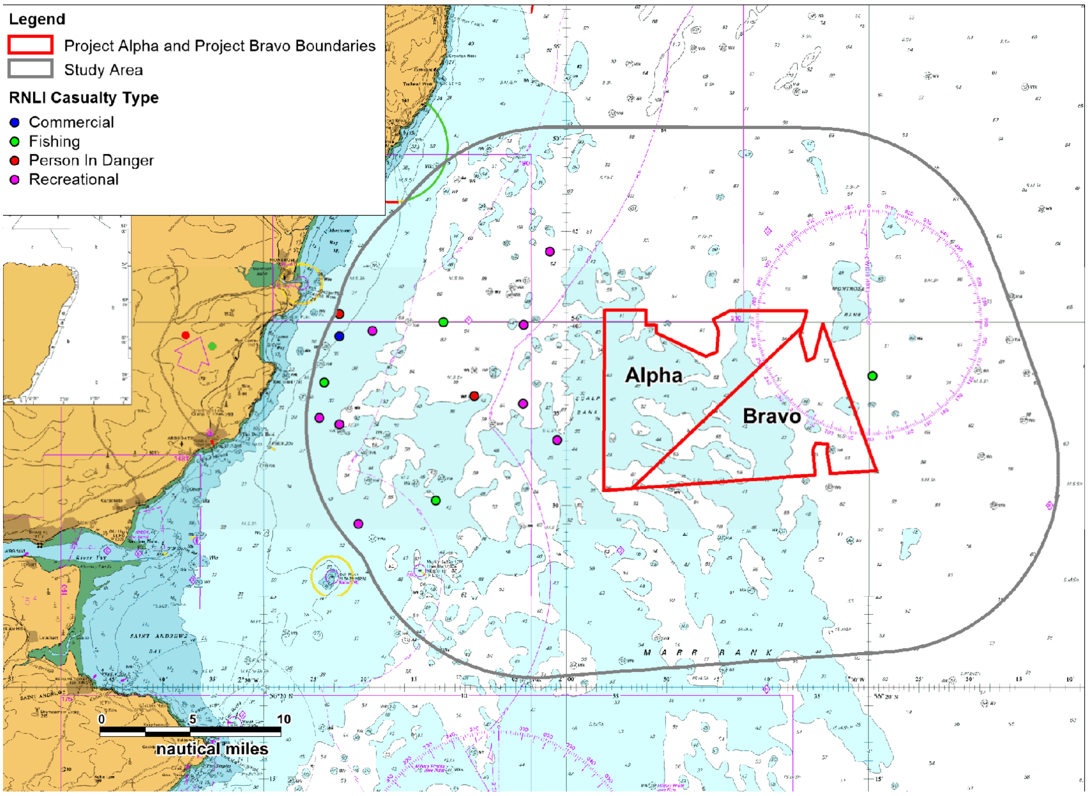


Figure 6.4 RNLI Incident Locations by Casualty Type (2005-2014)

7 Base Case Routeing Analysis (Pre-Wind Farm)

7.1 Methodology

7.1.1 Marine Traffic

This section provides an assessment of the base case regular vessel routeing within the vicinity of the optimised Seagreen Project. The "base case" is as per the terminology of the Formal Safety Assessment (FSA) (IMO, 2007) and describes the scenario whereby marine traffic levels remain at the current baseline level. This assessment has been primarily based on marine traffic survey data collected via AIS from onshore receivers (see Appendix 12B (AIS Marine Traffic Validation) of the EIA Report), however Anatec's internal UK route database has been used for validation purposes.

7.2 Routes

The marine traffic data presented in Appendix 12B (AIS Marine Traffic Validation) of the EIA Report was used to identify the main vessel routes within the vicinity of the optimised Seagreen Project. The routes identified are presented in Figure 7.1, with details per route then provided in Table 7.1.

The destinations provided per route represent the most common destinations identified from vessels using that route (based on the marine traffic survey data), and a vessel on a given route will therefore not necessarily be associated with either destination listed.

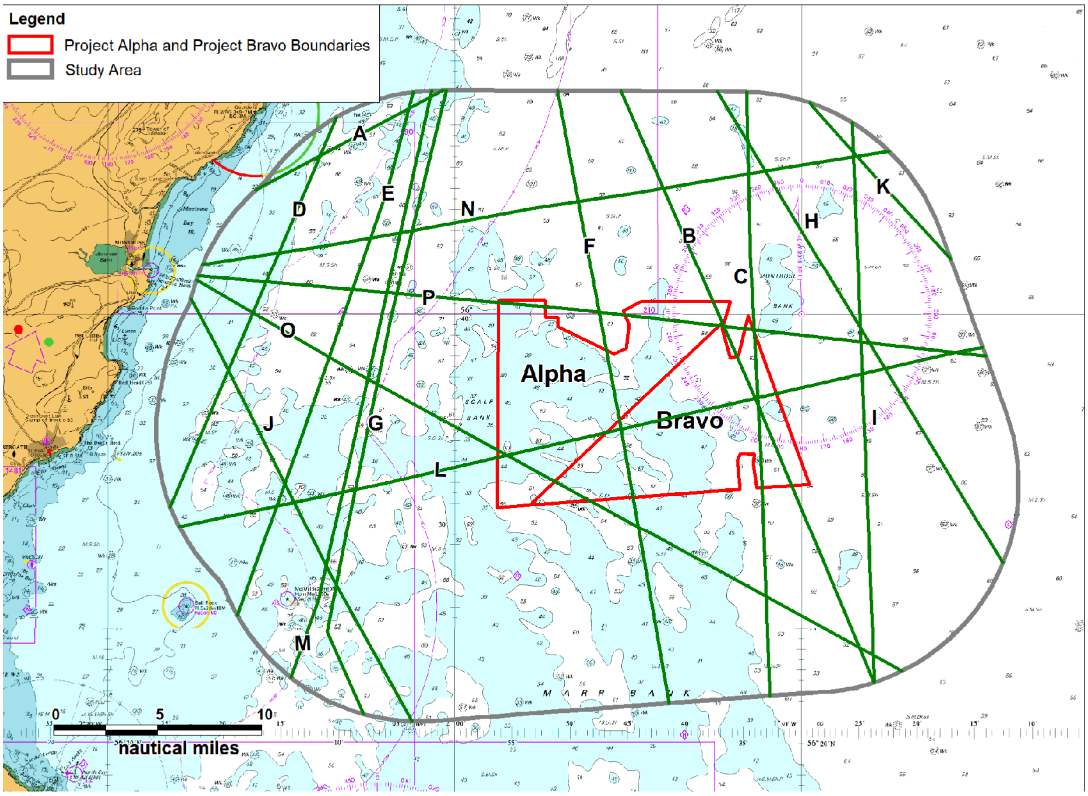


Figure 7.1 Base Case Vessel Routeing

Table 7.1 Main Routes

Route Number	Main Destination/Origin Ports	Average Vessels per Day	Main Vessel Types	Description
A	Montrose/North Sea Fields	1	Oil and Gas	Route used mainly by oil and gas support vessels associated with various North Sea fields.
B	Aberdeen/Rotterdam	1	Cargo	Cargo vessels mainly associated with Aberdeen. Route includes some tanker activity.
C	Peterhead/Immingham	1	Cargo/Tanker	Mainly cargo vessels and tankers running between northeast Scottish ports and the Humber.
D	Aberdeen/Immingham	1	Cargo/Tanker	Mainly cargo vessels and tankers running inshore

Route Number	Main Destination/Origin Ports	Average Vessels per Day	Main Vessel Types	Description
				between Aberdeen and Immingham or Dundee.
E	Aberdeen/Immingham	1	Cargo/Tanker	Mainly cargo vessels and tankers running inshore between Scottish ports and Immingham/Grangemouth.
F	Aberdeen/Immingham	1	Tanker	Tankers mainly running between Aberdeen and Immingham.
G	Aberdeen/Immingham	1	Tanker	Tankers mainly running between Aberdeen/Peterhead and Immingham.
H	Aberdeen/Rotterdam	1	Cargo/Tanker	Cargo vessels and tankers mainly associated with Aberdeen.
I	Belfast/Tees	1	Cargo/Tanker	Mainly cargo vessels and tankers associated with Tees.
J	Montrose/Tees	1	Cargo	Mainly cargo vessels associated with Montrose.
K	Aberdeen/Cygnus Field	0.5	Oil and Gas	Oil and gas traffic between Aberdeen and Cygnus Field.
L	Dundee/Køge	0.5	Cargo	Mainly cargo vessels running between Dundee and continental Europe.
M	Scottish Ports/Immingham	0.5	Cargo/Tanker	Mainly cargo and tanker vessels transiting between Scottish ports and Immingham.

Route Number	Main Destination/Origin Ports	Average Vessels per Day	Main Vessel Types	Description
N	Montrose/Rostok	0.5	Cargo	Mainly cargo vessels running between Montrose and continental Europe.
O	Montrose/Eemshaven	0.5	Cargo	Mainly cargo vessels running between Montrose and continental Europe.
P	Montrose/Alma Field	0.5	Oil and Gas	Oil and gas traffic associated with Montrose.

7.3 Percentiles

The 90th percentile lanes (as per the requirements of MGN 543 (MCA, 2016)), which have been estimated from the mean route positions and marine traffic survey data, are presented in Figure 7.2.

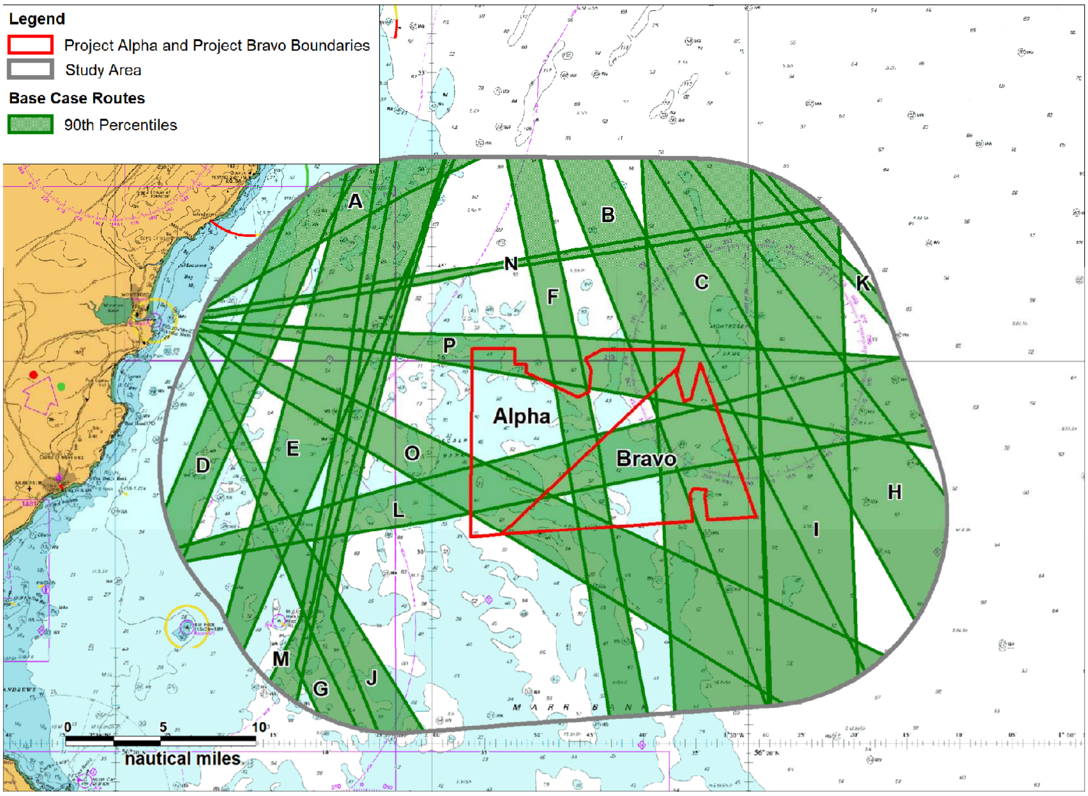


Figure 7.2 Base Case 90th Percentiles

7.4 Adverse Weather Routeing

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

The probability of occurrence in a particular sea state may differ for each vessel. Adverse weather is considered most significant for passenger vessels, due to the potential health and safety risks (as well as the impact on passenger comfort) to people on board (such as sea sickness and difficulty moving around the vessel). This can also have implications for regular timetabled vessels, due to increases in journey time and potential cancellations. Mitigation for vessels include adjusting their heading to position themselves at 45° to the wind, altering or delaying sailing times, reducing speed and potentially cancelling journeys.

No clear adverse weather routeing was observed within the marine traffic survey data (Appendix 12B (AIS Marine Traffic Validation) of the EIA Report) for the study area.

8 Post Wind Farm Routeing Analysis

This section provides likely route deviations that will arise during the operational phase of the optimised Seagreen Project. Five of the 16 identified routes intersect the Project, and will therefore require deviation (routes C, F, L, O and P in Figure 7.1 and Table 7.1).

It has been assumed that deviated vessels will keep a distance of at least one nautical mile from the optimised Seagreen Project structures. The anticipated future case routes are presented in Figure 8.1 on that basis. It is noted that the deviated routes are worst case, and assume that a vessel will seek to return to its normal route as quickly as possible, rather than re routeing on a different course or making earlier course adjusts as part of their passage plan.

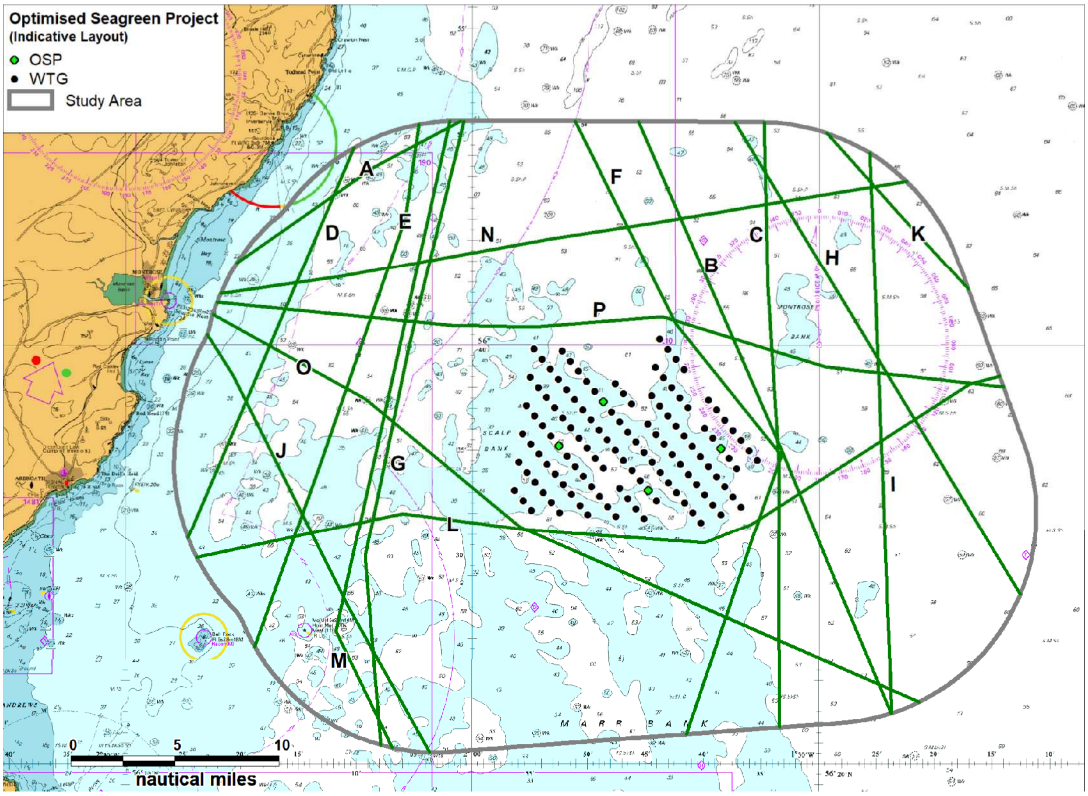


Figure 8.1 Future Case Vessel Routeing

8.1 Individual Route Deviations

Detailed views of each of the deviated routes are presented in Figure 8.2 to Figure 8.6.

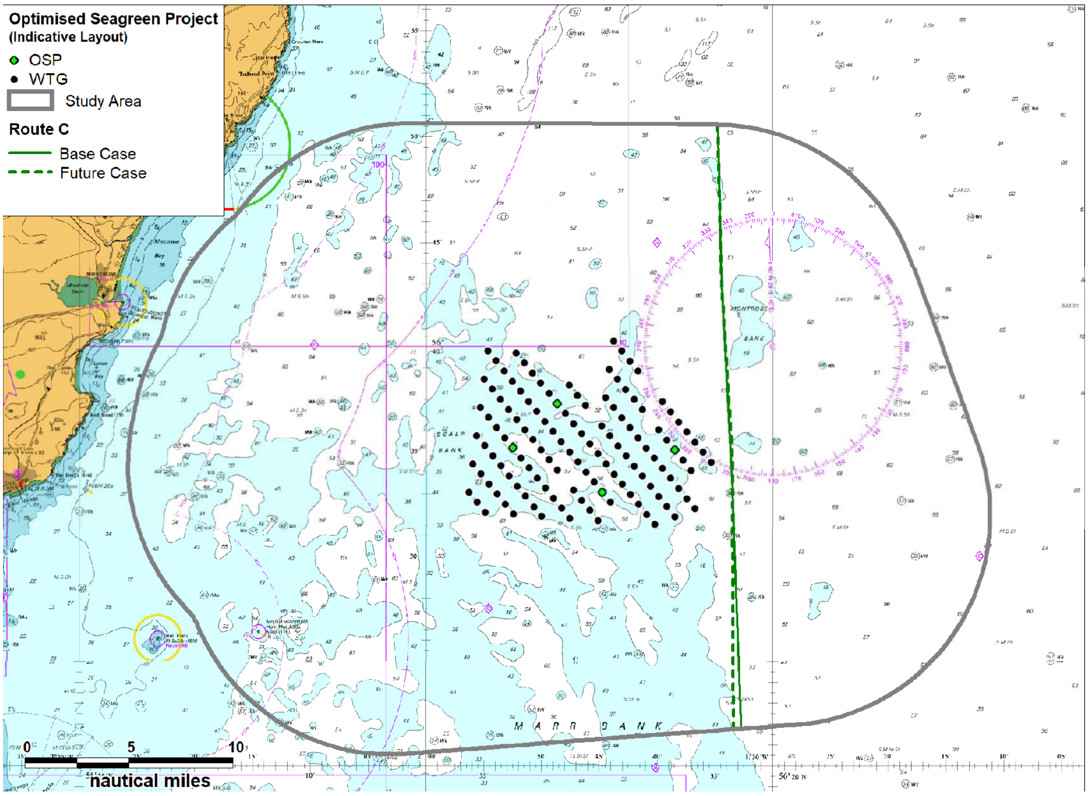


Figure 8.2 Route C Deviation

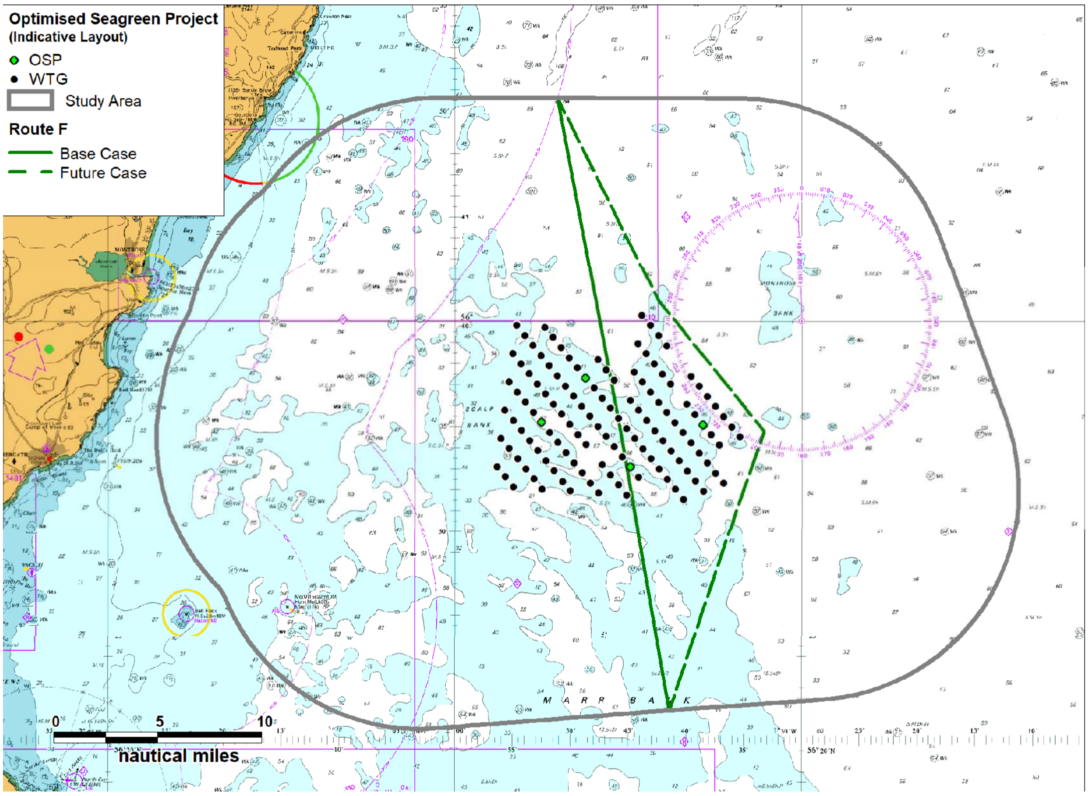


Figure 8.3 Route F Deviation

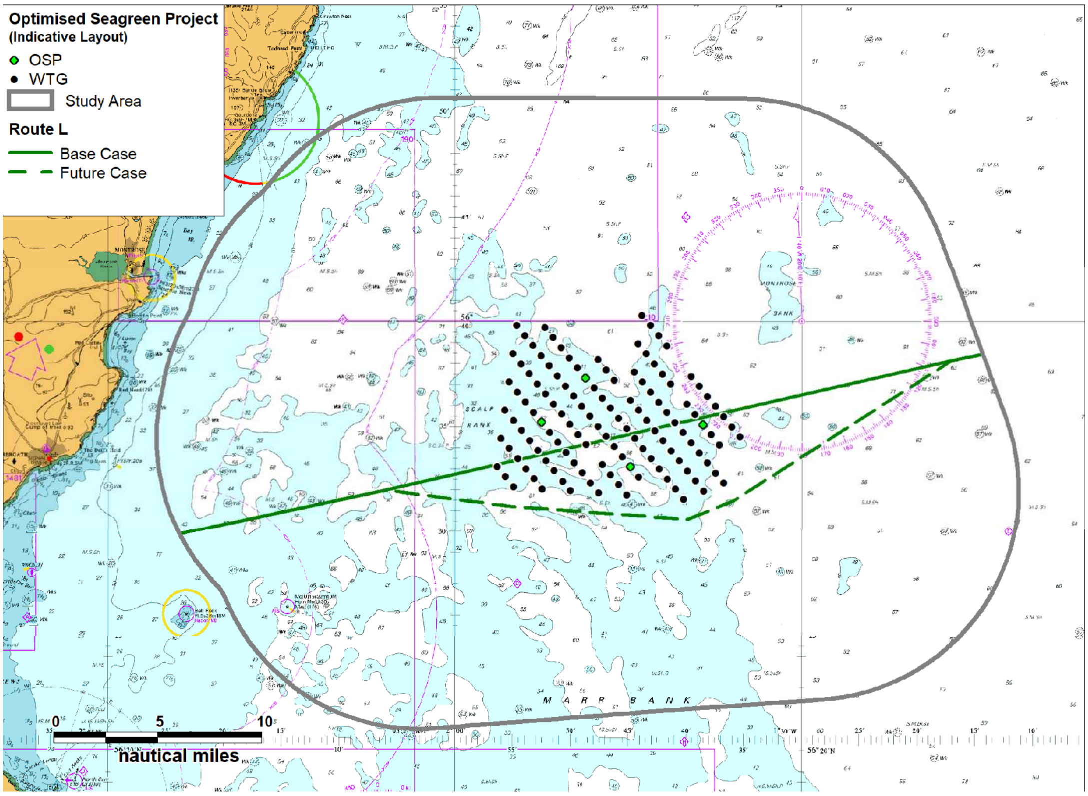


Figure 8.4 Route L Deviation

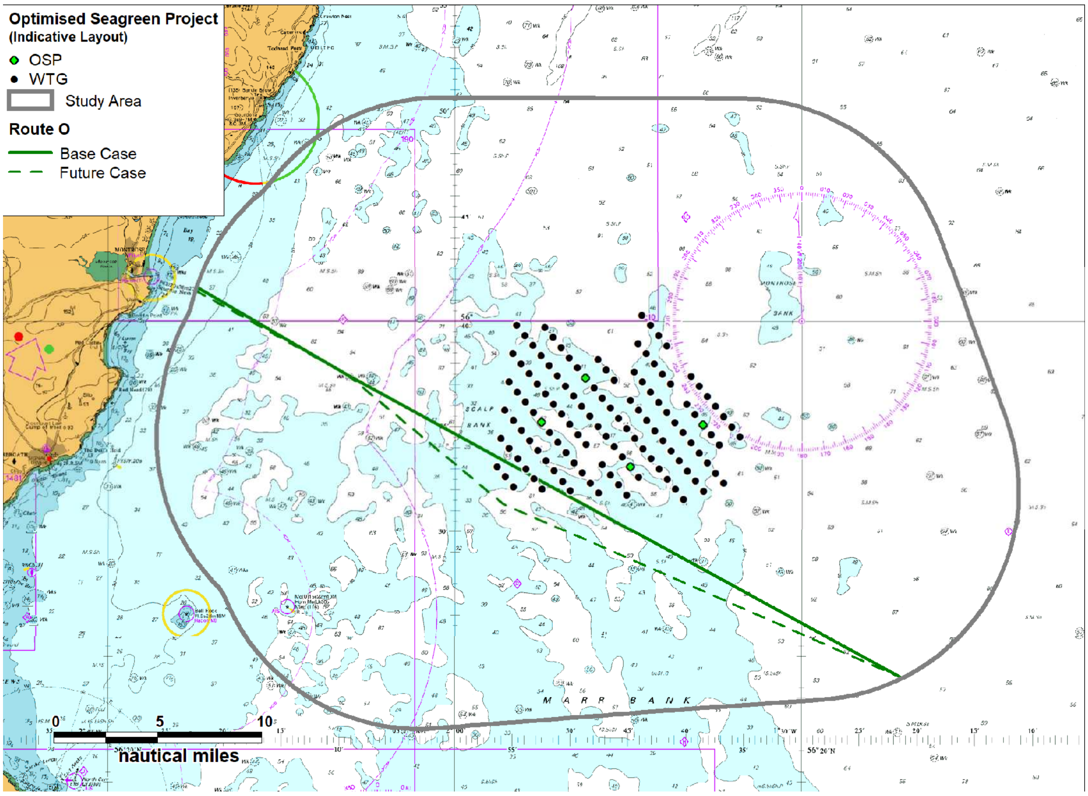


Figure 8.5 Route O Deviation

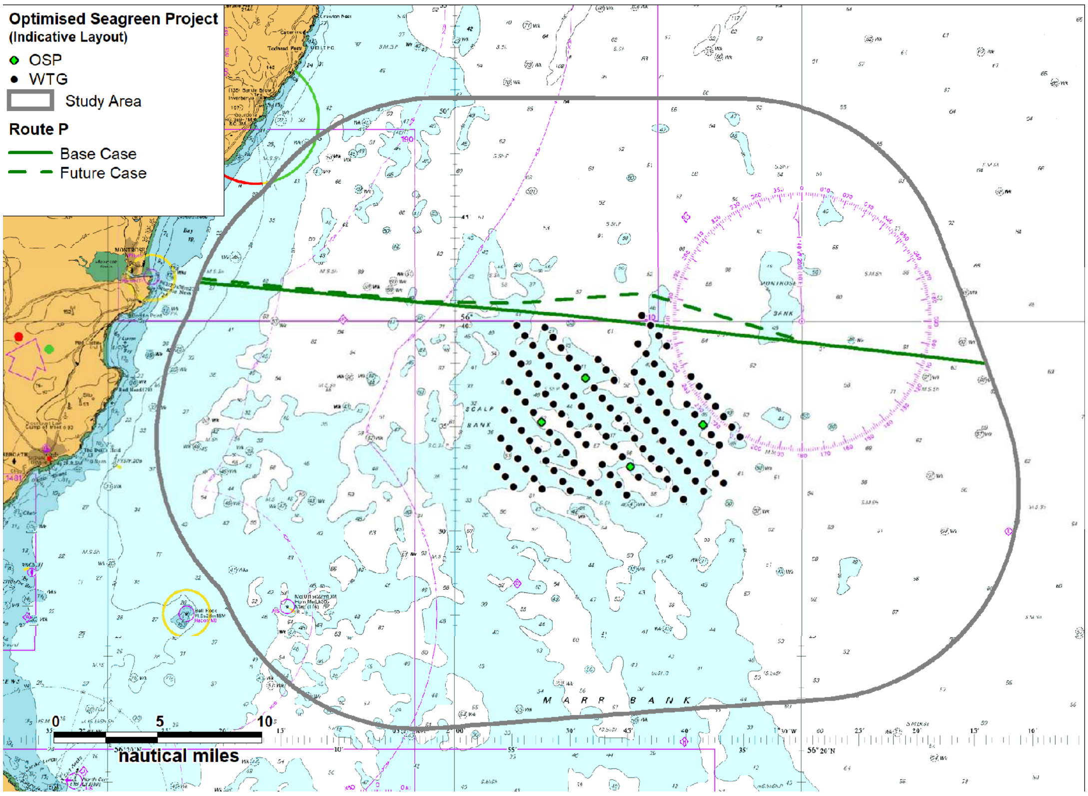


Figure 8.6 Route P Deviation

8.2 Simulated AIS – Future Case

To illustrate the anticipated vessel activity from regular routed traffic, the deviated routes presented in Figure 8.1 were used as input to Anatec's AIS simulator. This program creates randomised AIS tracks on each input route, based on the mean route positions, standard deviations, and vessel numbers. The results for a 28 day period are presented in Figure 8.7. It is noted that deviations are presented as realistic worst case and in reality vessels would distance themselves appropriately from the optimised Seagreen Project, in line with MGN 372 (MCA, 2008), depending on weather (notable visibility) and sea state.

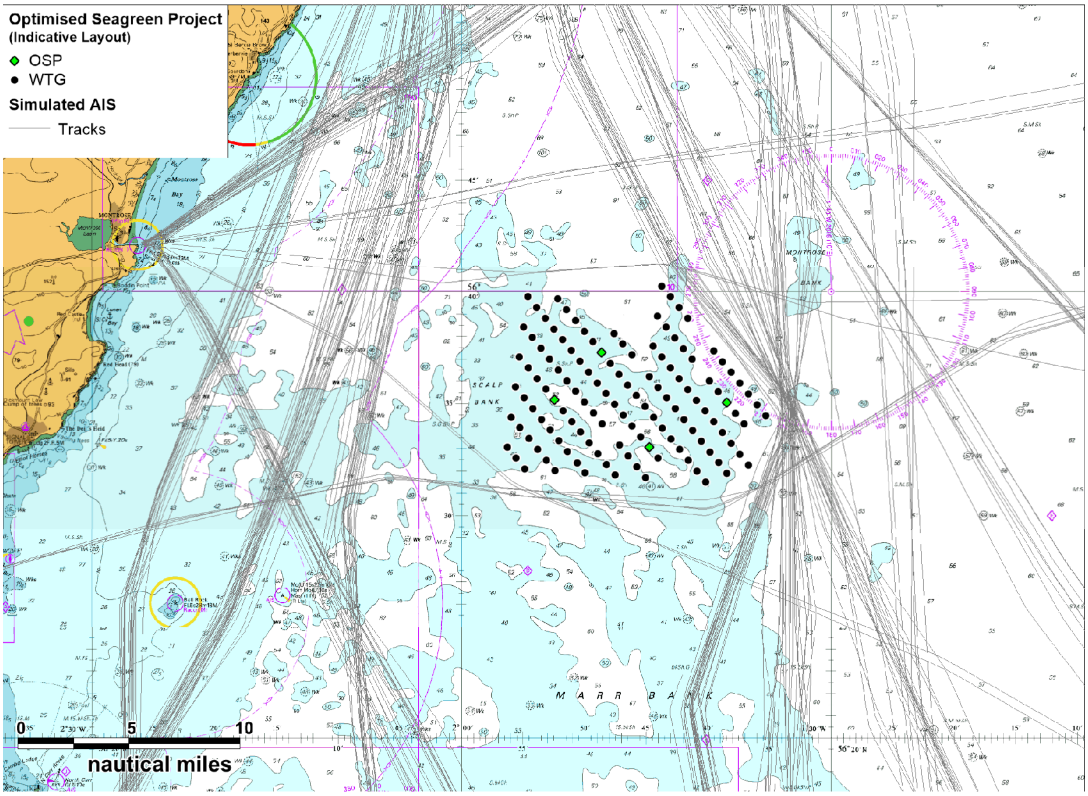


Figure 8.7 Simulated AIS Relative to Indicative Layout (28 Day Period)

9 Collision and Allision Risk Modelling Overview

This section provides an overview of the allision and collision risk modelling process which has been undertaken for the optimised Seagreen Project. The following allision and collision risks have been assessed:

- Vessel to vessel collision;
- Vessel to structure allision from a vessel under power;
- Vessel to structure allision from a drifting vessel; and
- Vessel to structure allision (fishing vessels).

A pre wind farm assessment is provided in Section 10, with the post wind farm scenario then assessed in Section 11. Following this, cumulative routeing assessment is presented in Section 12.

9.1 Potential Traffic Increases (Future Case)

There is the potential for traffic levels to increase during the lifespan of the optimised Seagreen Project, which may lead to increases in allision and collision risk within the area. Accurate forecasts of traffic increases are difficult, as a large number of variables require consideration. For this reason, an indicative increase of 10% for all vessel types has been assessed within this NRA, in addition to an assessment of risk, should traffic levels remain constant. This increase is in line with the assessments undertaken for other UK offshore wind farms, including Inch Cape Offshore Wind Farm and Neart na Gaoithe Offshore Wind Farm and therefore ensures a consistent approach with existing assessments. It is noted that this value relates to the number of vessels, rather than increases in overall tonnage.

The increase was implemented by increasing the total vessel numbers per route shown in Table 7.1 by 10%, whilst maintaining the breakdowns by vessel type and size. The updated vessel numbers were then rounded to the nearest whole number. To summarise, the base case presents the scenario whereby traffic levels do not increase from the current baseline. The future case presents the scenario whereby current baseline traffic is increased by 10%.

On this basis, the following scenarios have been assessed:

- Base case allision and collision risk should traffic levels remain at the current baseline level, pre wind farm;
- Base case allision and collision risk should traffic levels remain at the current baseline level, post wind farm;
- Future case allision and collision risk should traffic levels increase by 10% of the current baseline level, pre wind farm; and
- Future case allision and collision risk should traffic levels increase by 10% of the current baseline level, post wind farm.

It should be noted that allision risk is zero in pre-wind farm scenarios since there are no structures present.

9.2 Modelled Layout and Structure Dimensions

The worst case indicative layout which has been used as input to the modelling process is presented in Figure 2.2 (within Section 2.1). The WTG and OSP dimensions which have been modelled are presented in Table 9.1.

Table 9.1 Modelled Dimensions

Structure	Shape	Dimensions
WTG	Rectangle	30 x 30m
OSP	Rectangle	40 x 40m

9.3 Metocean Data

According to the Admiralty Sailing Directions (UKHO, 2016), the west North Sea region has a generally mild climate with winds mostly from between the south and northwest. Strong winds and gales are more common in the winter months.

Rainfall is not considerable and there is little variation throughout the year. Fog occasionally affects the east coast, particularly within the north.

Metocean data from the HSE weather database was used as input to the collision risk modelling process. This provided information on the following:

- Wind direction;
- Sea state; and
- Visibility.

9.3.1 Wind Direction

Wind direction probabilities for the area are presented in Table 9.2. The prevalent wind direction was from the southwest.

Table 9.2 Wind Direction Probabilities

Wind Direction Range (30° Segments)	Probability
0	0.060
30	0.047
60	0.041
90	0.043
120	0.059
150	0.081
180	0.108

Wind Direction Range (30° Segments)	Probability
210	0.137
240	0.141
270	0.116
300	0.093
330	0.075

9.3.2 Sea State

Sea state probabilities for the area are presented in Table 9.3. The prevalent sea state was moderate.

Table 9.3 Sea State Probabilities

Sea State	Probability
Calm	0.354
Moderate	0.646
Severe	0

9.3.3 Visibility

The HSE Weather Database assumes the probability of poor visibility to be 0.03.

9.3.4 Tidal Streams

Information on tidal streams was provided from UKHO Admiralty Chart 1407, which covers the sea area between Montrose and Berwick-upon-Tweed.

10 Optimised Seagreen Project Assessment – Base Case

This section provides an assessment of the base case collision risk within the vicinity of the optimised Seagreen Project. Data from the 2017 validation report (Appendix 12B (AIS Marine Traffic Validation) of the EIA Report) has been used as the input to the base case modelling. The results of this assessment have then been compared to the base case collision risk results of the 2012 NRA risk assessment (Appendix 12C (Project Alpha and Project Bravo 2012 NRA) of the EIA Report). Details of the data sets are presented in Table 10.1.

Table 10.1 Summary of Survey Data

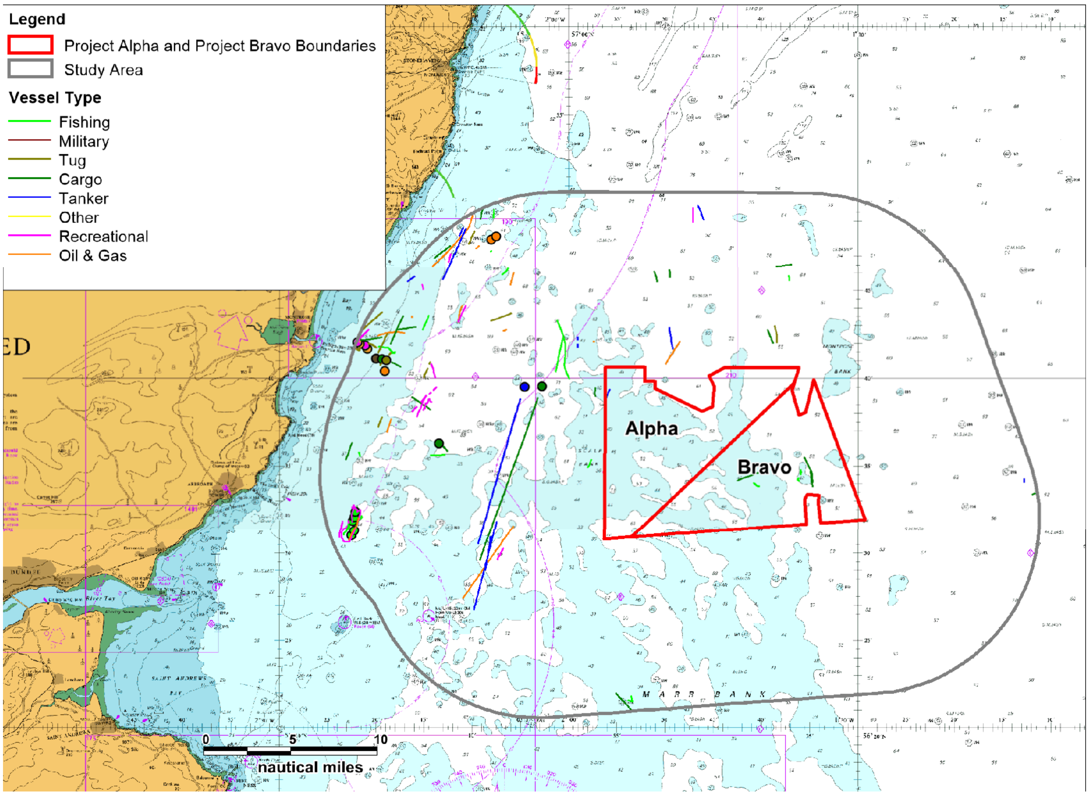
Survey	Season	Survey Period	Data Type	Data Capture
NRA Survey (2011)	Summer	20th June – 21st July 2011	AIS and Radar	26 Days
	Winter	12th March – 26th March 2011	AIS and Radar	14 Days
Validation Survey (2017)	Summer	21st July – 3rd August 2017	AIS	14 Days
	Winter	16th February – 1st March 2017	AIS	14 Days

10.1 Encounters

The marine traffic survey data (Appendix 12B (AIS Marine Traffic Validation) of the EIA Report) has been used to run an encounters assessment, which provides an indication of how often vessels pass in close proximity to the optimised Seagreen Project within the study area. The results of this assessment have then been compared to the results of the 2012 NRA collision risk assessment (Appendix 12C (Project Alpha and Project Bravo 2012 NRA) of the EIA Report). The base case collision rates of regular routed traffic have then been estimated, using the routes presented in Section 7.

The marine traffic survey data was used to identify all cases of vessel "encounters" recorded during the winter (14 days February and March 2017) and summer (14 days July and August 2017) survey periods. For the purposes of this assessment, an encounter is defined as two (or more) vessels passing within one nautical mile of each other, within the same minute. This helps to illustrate where existing shipping congestion is highest and therefore where offshore developments, such as wind farms, could potentially increase congestion and therefore increase the risk of encounters/collisions.

It should be considered when viewing the encounters analysis, that the marine traffic validation survey was AIS only. Therefore a negligible number of vessels which do not carry AIS are not accounted for during the survey periods.



10.1.1 Overview

An overview plot of the tracks identified as being involved in an encounter is presented in Figure 10.1, colour-coded by vessel type. Where only one transmitted data point from a vessel was recorded within an encounter zone, only that single point has been shown. Otherwise, the track created by joining the points transmitted within the zone has been shown.

Figure 10.1 Encounters Overview

Cargo vessels, fishing vessels and oil & gas vessels were the most common vessel types involved in an encounter within the study area. Within the optimised Seagreen Project, tanker, cargo vessel and fishing vessel encounters were recorded. Encounters were recorded along two Aberdeen to Immingham routes (routes A and G in Figure 7.1 and Table 7.1), as well as the Scottish Ports to Immingham route (route M). A number of encounters were also recorded near the port of Montrose.

10.1.2 Daily Counts

The number of encounters recorded during the winter and summer survey periods are presented in Figure 10.2 and Figure 10.3 respectively. As discussed previously, it should be noted when viewing these figures that encounters involving a non-AIS vessel are not accounted for.

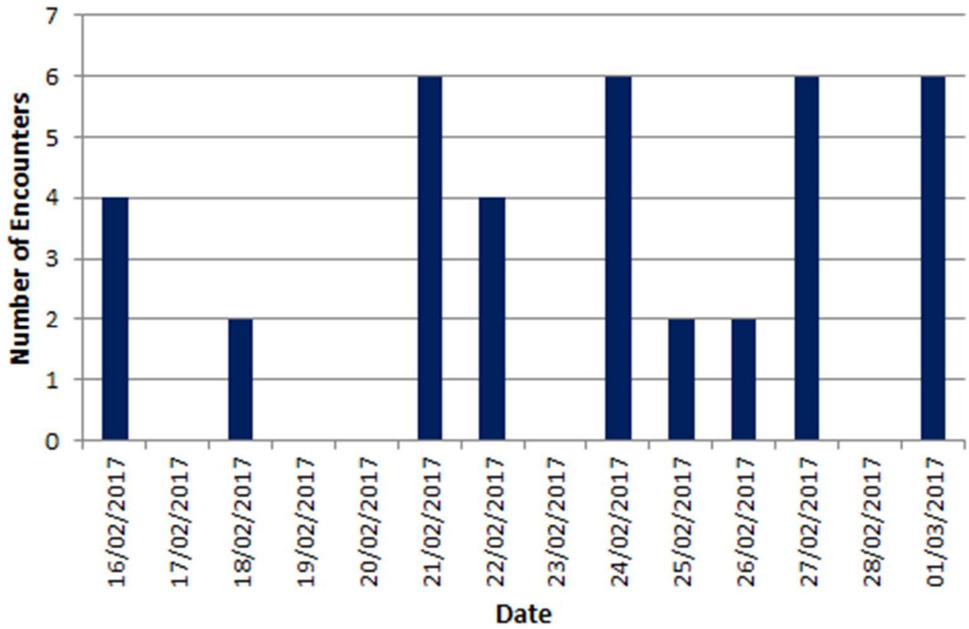


Figure 10.2 Number of Encounters – Winter Period (AIS)

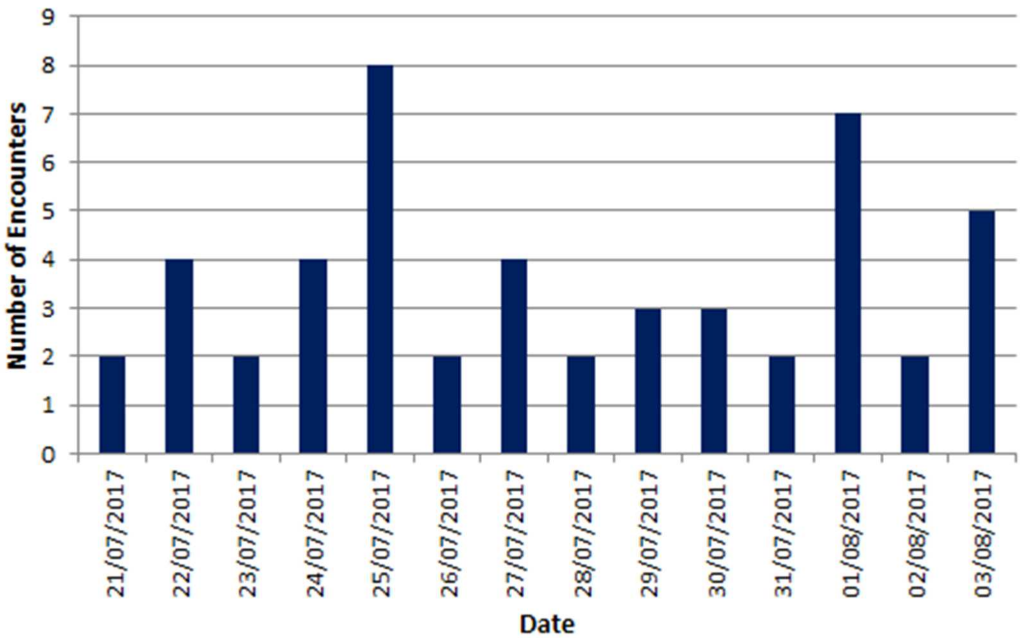


Figure 10.3 Number of Encounters – Summer Period (AIS)

The busiest day in terms of encounters was the 25th July 2017, when eight encounters were identified within the marine traffic survey data, four of which involved recreational vessels.

Two cargo vessels, one tanker and one fishing vessel encounter were also recorded on this day.

It is noted that encounter levels were slightly lower in winter than in summer (an average of three per day during winter, compared to four during summer).

10.1.3 Vessel Type Distribution

Figure 10.4 presents the distribution of vessel types involved in encounters.

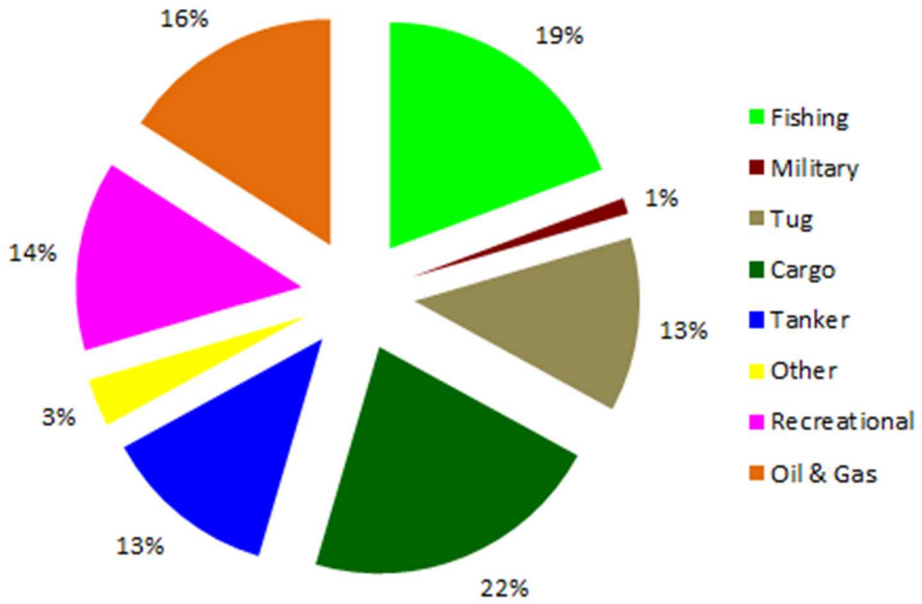


Figure 10.4 Vessel Types Involved in Encounters

Cargo vessels were the most common vessel type involved in identified encounters however there was no significant difference in the number of encounters for the majority of the vessel types recorded. As previously noted, the validation survey was AIS only therefore there is potential for a negligible number of encounters involving a non-AIS vessel (fishing, recreational) to be underrepresented.

10.2 Vessel to Vessel Collisions

The base case routes presented in Section 7 were used as input to the vessel to vessel collision model included in Anatec's CollRisk model suite, to estimate the vessel to vessel collision rates in the vicinity of the optimised Seagreen Project pre wind farm.

It was estimated that a vessel would be involved in a collision once every 2,679 years pre wind farm. The results of the model are summarised in Figure 10.5, which shows the results as a density grid, with each cell colour-coded according to collision frequency.

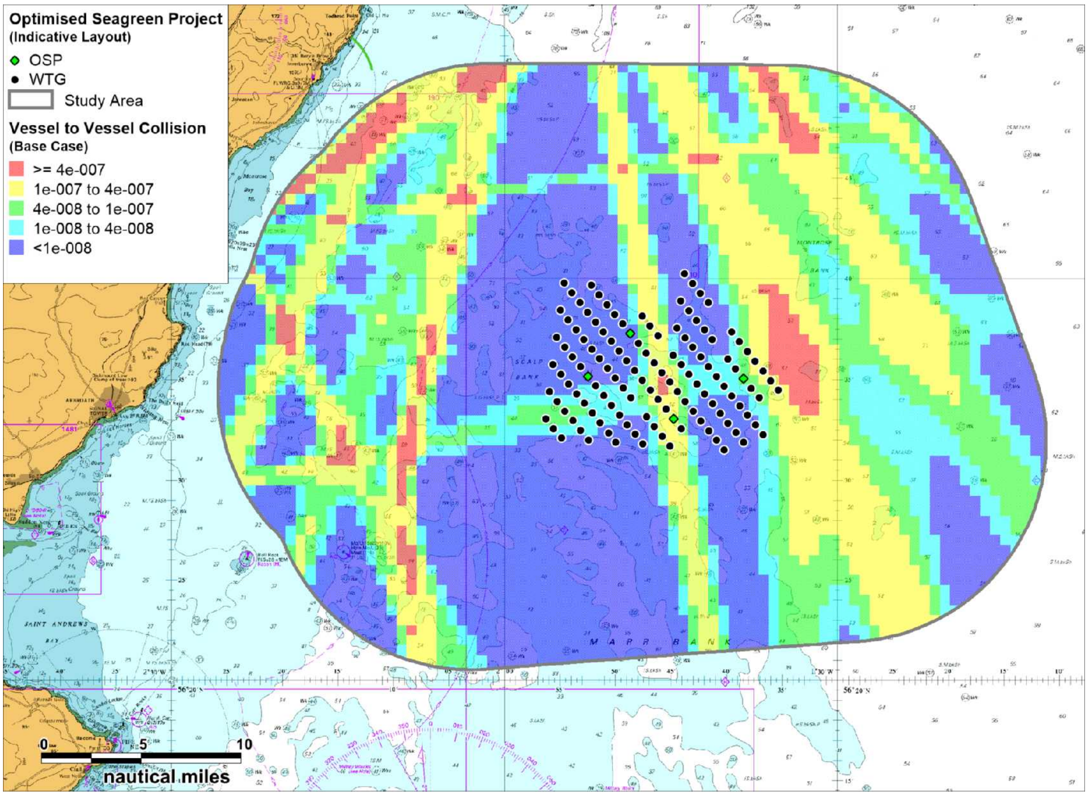


Figure 10.5 Vessel to Vessel Collision Frequency – Base Case

The areas of highest risk were observed to be the eastern boundary of the optimised Seagreen Project, where two cargo vessel routes and one cargo vessel/tanker route intersect and within the centre of the Project, where a cargo vessel route and a tanker route intersect. Collision rates inshore (west) of the optimised Seagreen Project were also significant at points where routes crossed each other.

The above analysis reports the collision frequency, based on the base case routes and therefore commercial traffic only, as per Anatec's modelling methodology. In 2012 (Appendix 12C (Project Alpha and Project Bravo 2012 NRA) of the EIA Report), the collision frequency of commercial vessel traffic, recreational vessels and fishing vessels was modelled. The base case result for Project Alpha in isolation was one collision every 1,899 years and for Project Bravo, one collision every 3,094 years. The optimised Seagreen Project (Project Alpha and Project Bravo in combination) collision frequency is estimated to increase to one collision every 1,117 years when recreational and fishing vessel traffic is included alongside the commercial vessel traffic. Comparing these results to Project Alpha and Project Bravo in isolation, the optimised Seagreen Project is the worst case scenario for collision frequency, as the projects combined provide the greatest potential for displacement and therefore the highest risk of collision.

It is emphasised that 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. Other incident data, which includes minor incidents, is presented in Section 6.

10.3 Vessel to Structure Allisions

There is no vessel to structure allision risk pre wind farm (as there are no structures present). Section 11.2 provides an assessment of vessel to structure allision post wind farm.

11 Optimised Seagreen Project Assessment – Future Case

This section provides an assessment of estimated collision and allision rates post wind farm, based on the future case routes presented in Section 8. Data from the 2017 validation report (Appendix 12B (AIS Marine Traffic Validation) of the EIA Report) has been used as the input to the future case modelling. The results of this assessment have then been compared to the future case collision and allision risk results of the 2012 NRA risk assessment (Appendix 12C (Project Alpha and Project Bravo 2012 NRA) of the EIA Report). Details of the data sets are presented in Table 10.1.

11.1 Vessel to Vessel Collisions

11.1.1 Results Summary

A plot of the results of the future case vessel to vessel collision assessments are presented in Figure 11.1. The results are then summarised in Table 11.1, with base case results included for comparison.

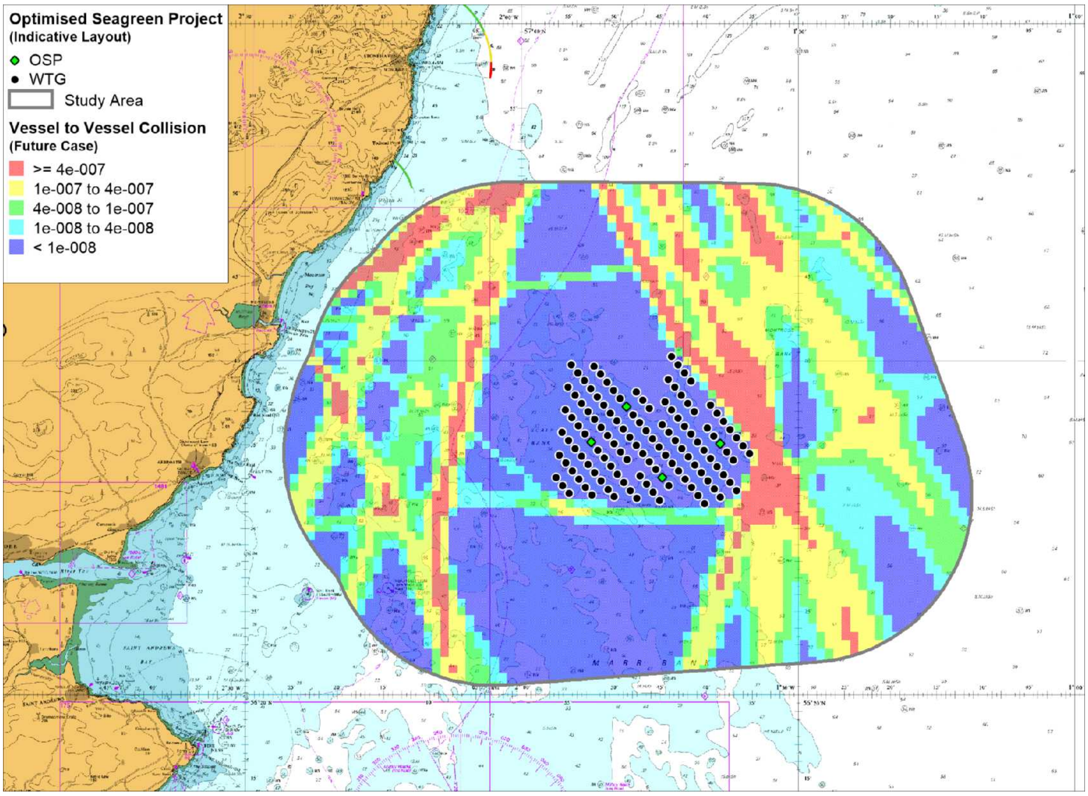


Figure 11.1 Vessel to Vessel Collision Frequency – Future Case

Table 11.1 Vessel to Vessel Collision Rates

Scenario	Annual Collision Frequency	Return Period (Years)	Increase from Base Case – Pre Wind Farm
Base Case – Pre Wind Farm	3.73×10^{-4}	2,679	n/a
Base Case – Post Wind Farm	4.90×10^{-4}	2,042	31%
Future Case – Pre Wind Farm	4.37×10^{-4}	2,289	17%
Future Case – Post Wind Farm	5.72×10^{-4}	1,748	53%

Assuming no growth in traffic (base case), it was estimated that post wind farm a vessel will be involved in a collision once every 2,042 years. This represents an increase of 31% from the base case pre wind farm. If traffic levels were to increase by 10% (future case post wind farm), it was estimated that collision rates would increase by approximately 53% from the base case pre wind farm results.

The above analysis reports the collision frequency based on the future case deviated routes and therefore commercial traffic only, as per Anatec's modelling methodology. In 2012 (Appendix 12C (Project Alpha and Project Bravo 2012 NRA) of the EIA Report) the collision frequency when recreational and fishing vessel traffic is included alongside the commercial vessel traffic was modelled. The future case result for Project Alpha in isolation was one collision every 982 years and for Project Bravo, one collision every 1,561 years. For comparison, the optimised Seagreen Project (Project Alpha and Project Bravo in combination) collision frequency is estimated to increase to one collision every 851 years when recreational and fishing vessel traffic is included alongside the commercial vessel traffic. Comparing these results to Project Alpha and Project Bravo in isolation, the optimised Seagreen Project is the worst case scenario for collision frequency, as the projects combined provide the greatest potential for displacement and therefore the highest risk of collision.

11.2 Vessel to Structure Allisions

11.2.1 Powered

A powered allision is defined as a vessel making contact with a structure whilst under power.

The deviated routes presented in Section 8 were used as input to the powered allision function of Anatec's CollRisk modelling suite. This model estimates the likelihood that vessels will allide with one of the wind farm structures whilst under power. It is noted that the model was run with a shielding range of 1.1nm based on the maximum distance between structure positions.

The results for the post wind farm scenarios are summarised in Table 11.2. These include the scenario in which traffic levels remain at the current baseline level (base case, 0% increase) or increase beyond the current baseline level (future case, 10% increase).

Table 11.2 Vessel to Structure Allision Results - Powered

Scenario	Annual Allision Frequency	Return Period (Years)
Base Case – Post Wind Farm	7.02×10^{-4}	1,425
Future Case – Post Wind Farm	7.67×10^{-4}	1,304

It was estimated that a vessel may allide under power with a structure within the optimised Seagreen Project once every 1,425 years, assuming no growth in traffic (base case), and once every 1,304 years should traffic increase by 10% (future case).

For comparison, Project Alpha in isolation was assessed (Appendix 12C (Project Alpha and Project Bravo 2012 NRA) of the EIA Report) to have a passing powered vessel allision once every 3,947 years assuming no growth in traffic, and once every 3,588 years should traffic increase by 10%. Project Bravo in isolation was assessed to have an allision once every 2,272 years assuming no growth in traffic, and once every 2,066 years following a 10% increase in traffic. When comparing the optimised Seagreen Project results to Project Alpha and Project Bravo in isolation, the optimised Seagreen Project is the worst case scenario for allision frequency, as the projects combined provide the greatest number of structures, thus the largest surface area and therefore the highest risk of allision.

The structures most at risk were observed to be the periphery WTGs on the east and southeast of the optimised Seagreen Project, as a result of multiple routes passing the eastern boundary. Traffic passing to the west of the optimised Seagreen Project passed at a large enough distance to avoid significant risk to WTGs on the western boundaries. One route passing in close proximity to the northwestern boundary has low traffic levels (average of 22 vessels per year future case) therefore the northwestern boundary WTGs also avoid significant risk. This is illustrated in Figure 11.2, which shows a graduated plot of risk to the WTGs and OSPs.

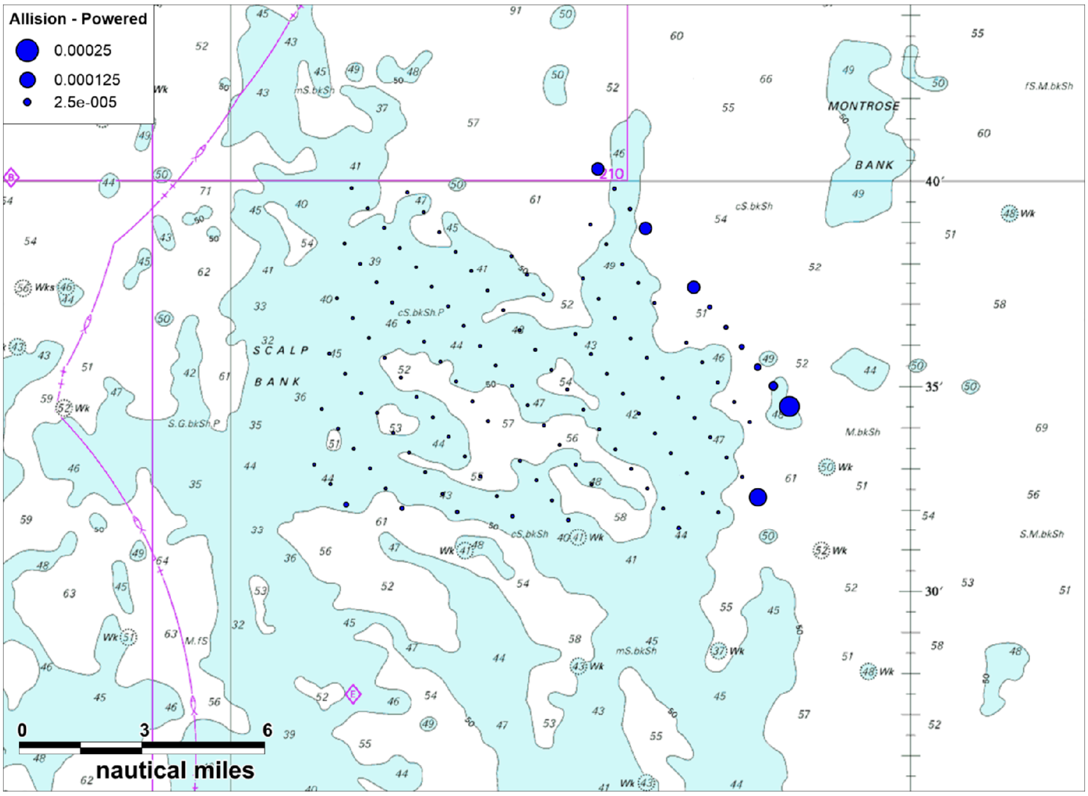


Figure 11.2 Powered Allision – 10% Traffic Growth (Future Case)

11.2.2 Drifting

The deviated routes presented in Section 8 were used as input to the drifting allision function of Anatec's CollRisk modelling suite. This model is based on the premise that propulsion on a vessel must fail before a vessel would drift, and takes account of the type and size of the vessel, number of engines, average time to repair, and differing weather conditions. It should be noted that since the original drifting allision modelling undertaken in 2012 (Appendix 12C (Project Alpha and Project Bravo 2012 NRA) of the EIA Report), there have been refinements in the methodology for determining the vessel routes used as an input to the model and updates to the modelling methodology and software. These changes have been made in response to ongoing developments within NRA process including consultation feedback which continually improve the outputs of any models used. This may have attributed to notable differences in the drifting allision results between 2012 and 2017.

The exposure times for a drifting scenario are based on the vessel hours spent in proximity to the optimised Seagreen Project. These were estimated based on the traffic levels, speeds and revised routeing pattern. The exposure was 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, were taken into account within the modelling.

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

The following drift scenarios were modelled:

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

The peak spring flood tide based scenario was observed to produce the worst case results, and this scenario was therefore chosen for presentation. The results for the 0% (base case) and 10% (future case) traffic increase cases are presented in Table 11.3.

Table 11.3 Vessel to Structure Allision Results - Drifting

Scenario	Annual Allision Frequency	Return Period (Years)
Base Case – Post Wind Farm	1.73×10^{-4}	5,773
Future Case – Post Wind Farm	1.91×10^{-4}	5,247

It was estimated that, assuming no growth in traffic, that a vessel will drift into an optimised Seagreen Project structure once every 5,773 years, with this rate rising to once every 5,247 years if traffic were to grow by 10%.

The peak spring flood tide based scenario was also observed to produce the worst case results for Project Alpha and Project Bravo in isolation. For comparison, Project Alpha in isolation was assessed (Appendix 12C (Project Alpha and Project Bravo 2012 NRA) of the EIA Report)to have a drifting vessel allision once every 27,981 years assuming no growth in traffic, and once every 25,465 years should traffic increase by 10%. Project Bravo in isolation was assessed to have an allision once every 23,498 years assuming no growth in traffic, and once every 21,322 years following a 10% increase in traffic. Therefore Project Alpha and Project Bravo in combination (the optimised Seagreen Project) is the worst case scenario for a passing powered allision.

As previously noted, the large change in drifting collision risk between modelling undertaken for in 2012 (Appendix 12C (Project Alpha and Project Bravo 2012 NRA) of the EIA Report) and the 2017 optimised Seagreen Project, can be attributed to refinements in the methodology for determining the vessel routes used as an input into the model as well as the way it processes these results. These changes have been made in response to ongoing developments within NRA process including consultation feedback which continually improve the outputs of any models used. It is noted that both values are considered within acceptable limits.

Risk distribution across the structures was observed to be similar to that observed in the powered allision assessment (Section 11.2.1), with the eastern and southeastern periphery structures most at risk. This is illustrated in Figure 11.3, which shows drifting allision risk per structure. It should be noted that the risk bands differ from those used to illustrate the powered allision results shown in Figure 11.2 and therefore direct comparison of allision frequency should not be made between the figures. However, comparison between the "hot spot" allision frequency locations can be made.

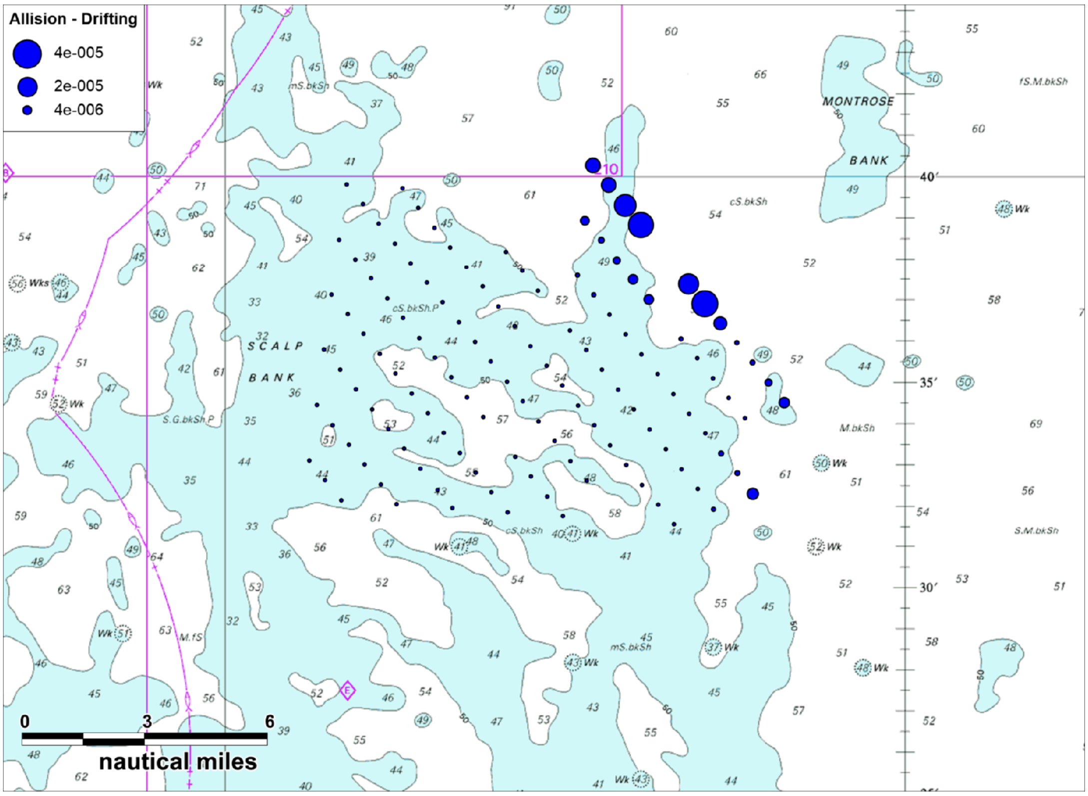


Figure 11.3 Drifting Allision – 10% Traffic Growth (Future Case)

11.3 Fishing Vessel Allision

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 allisions between fishing vessels and United Kingdom Continental Shelf (UKCS) offshore installations (published by the HSE).

The two main inputs to the model are the fishing vessel density for the area and the structure details including the number and dimensions of the structures. The fishing vessel density in the optimised Seagreen Project was based upon the marine traffic validation survey (Appendix 12B (AIS Marine Traffic Validation) of the EIA Report). It should be noted that non-AIS activity was not available.

The results are summarised in Table 11.4.

Table 11.4 Vessel to Structure Allision Results - Fishing

Scenario	Annual Allision Frequency	Return Period (Years)
Base Case – Post Wind Farm	5.76×10^{-2}	17
Future Case – Post Wind Farm	6.34×10^{-2}	16

The fishing allision results are high when compared to the results of the allision assessment of regular routed vessels provided in Section 11.2. This reflects the assumption that the presence of the structures within the optimised Seagreen Project will have no impact on current fishing levels (i.e. takes no account of vessels deviating around the structures, whereas it has been assumed that regular routed commercial traffic will deviate to avoid the optimised Seagreen Project). It is also noted that any allision from a fishing vessel within the optimised Seagreen Project site is expected to be low speed (the estimated average speed of fishing vessels within the optimised Seagreen Project was approximately five knots), and therefore lower risk to the crew, vessel, and structure.

For comparison, Project Alpha in isolation was assessed (Appendix 12C (Project Alpha and Project Bravo 2012 NRA) of the EIA Report) to have a fishing vessel allision once every 49 years assuming no growth in traffic, and once every 44 years should traffic increase by 10%. Project Bravo in isolation was assessed to have an allision once every 96 years assuming no growth in traffic, and once every 87 years following a 10% increase in traffic. Therefore the Project Alpha and Project Bravo in combination (the optimised Seagreen Project) is the worst case scenario for a passing powered allision.

11.4 Modelling Results Summary

A summary of the collision and allision risk frequency modelling results for the optimised Seagreen Project is provided in Table 11.5.

Table 11.5 Allision and Collision Risk Results Summary

Scenario	Base Case		Future Case	
	Pre Wind Farm	Post Wind Farm	Pre Wind Farm	Post Wind Farm
Vessel to Vessel	3.73×10^{-4} (2,679 years)	4.90×10^{-4} (2,042 years)	4.37×10^{-4} (2,289 years)	5.72×10^{-4} (1,748 years)
Allision – Powered	n/a	7.02×10^{-4} (1,425 years)	n/a	7.67×10^{-4} (1,304 years)
Allision – Drifting	n/a	1.73×10^{-4} (5,773 years)	n/a	1.91×10^{-4} (5,247 years)

Scenario	Base Case		Future Case	
Allision – Fishing	n/a	5.76×10^{-2} (17 years)	n/a	6.34×10^{-2} (16 years)
Total	3.73×10^{-4} (2,679 years)	5.90×10^{-2} (17 years)	4.37×10^{-4} (2,289 years)	6.49×10^{-2} (15 years)

The overall annual level of collision risk is calculated based on the combined risk results from the four scenarios above. This gives an estimate that the annual level of collision risk will increase due to the optimised Seagreen Project to approximately one in 17 years (base case) and one in 15 years (future case). The vast majority of this increase is attributed to the higher fishing vessel allision risk in both cases (17 years and 16 years respectively). Despite this weighting, both values within the total summary for collision risks are within acceptable levels for consented wind farms.

11.5 Consequences

The consequences associated with the probable outcomes of a collision or allision is expected to be minor. However, the worst case outcomes could have severe consequences, including events with the potential for multiple fatalities. This section presents a summary of the consequences assessment; the full assessment is presented in Appendix 12G (Consequences Assessment) of the EIA Report. The consequences assessment is primarily based on the results of the allision and collision modelling undertaken in this NRA addendum.

An allision involving a larger vessel may result in the collapse of a wind turbine with limited damage to the vessel. Breach of a vessel'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 allision, 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 (PLL).

The overall increase in PLL estimated due to the optimised Seagreen Project is 2.47×10^{-4} fatalities per year (base case), which equates to approximately one fatality per 4,042 years. The annual increase in PLL due to the impact of the optimised Seagreen Project for the future case is estimated to be 2.72×10^{-4}, which equates to one additional fatality in 3,674 years (see Appendix 12G (Consequences Assessment) of the EIA Report for the full assessment).

In terms of individual risk to people, the incremental increase for commercial vessels (approximately 1.20×10^{-8} for the base case) is negligible compared to the background risk level for the UK sea transport industry of 2.9×10^{-4} per year.

For fishing vessels, the change in individual risk attributed to the optimised Seagreen Project is higher than commercial vessels (approximately 8.16×10^{-6} for the base case), which is minor compared to the background risk level for the UK sea fishing industry of 1.2×10^{-3} per year.

The overall total increase in oil spilled due to the optimised Seagreen Project is 0.002% per year (see Appendix 12G (Consequences Assessment) of the EIA Report for the full assessment). From research undertaken as part of the DfT Marine Environmental High Risk Area (MEHRA) project (DfT, 2005) the average annual tonnes of oil spilled in the waters around the British Isles, due to marine accidents in the 10-year period from 1989 to 1998 was 16,111. Therefore, the overall increase in pollution estimated for the optimised Seagreen Project is very low compared to the historical average pollution quantities from marine accidents in the UK waters.

The impact of the optimised Seagreen Project on people and the environment is relatively low compared to the existing background risk levels in UK waters. However, it should be noted that this is the localised impact of the optimised Seagreen Project. There may be additional maritime risks associated with other offshore wind farm developments in and around the Firth of Forth and the UK as a whole, however, the purpose of the EIA is to consider the optimised Seagreen Project in isolation; with cumulative impacts where interaction is identified – this is not the case with additional maritime risks.

Impacts associated with the allision and collision modelling are considered within the EIA Report (Chapter 12 (Shipping and Navigation)).

Further detail on the consequences assessment is presented in Appendix 12G (Consequences Assessment) of the EIA Report.

12 Cumulative Assessment

This section provides an assessment of likely cumulative vessel routeing in the vicinity of the optimised Seagreen Project, if other potential nearby developments are taken into consideration. Data from the 2017 validation report (Appendix 12B (AIS Marine Traffic Validation) of the EIA Report) has been used as the input to the cumulative routeing assessment. This assessment feeds into the cumulative impact assessment undertaken in the EIA Report (Chapter 12 (Shipping and Navigation)), Cumulative Assessment section.

12.1 Methodology of Assessing Cumulative Impacts

Cumulative impacts have been considered for shipping and navigation within this NRA addendum; this includes the cumulative impact of the optimised Seagreen Project and the impacts of other offshore developments and activities associated with other marine operations. Fishing and recreational transits have been considered as part of the baseline assessment.

Cumulative assessment has taken into account the Cumulative Impact Assessment (CIA) list presented in Chapter 6 (EIA Process) of the EIA Report, as well as those identified through shipping and navigation consultation and scoping report responses.

Neart na Gaoithe Offshore Wind Farm and Inch Cape Offshore Wind Farm are considered as part of the cumulative scenario, due to their proximity to the optimised Seagreen Project. Following consultation with key marine and navigational stakeholders (see Section 3), it was also agreed that Kincardine Offshore Wind Farm and the European Offshore Wind Deployment Centre, also known as Aberdeen Offshore Wind Farm, would be included within the cumulative scenario.

Other projects identified in the CIA list and screened into the cumulative assessment on the basis of vessel routeing include Forthwind Offshore Wind Farm, the NorthConnect interconnector cable and the Aberdeen Harbour Expansion Project.

Cumulative impacts are considered in the EIA Report (Chapter 12 (Shipping and Navigation)), Cumulative Assessment section.

12.2 Cumulative Screening

The projects that have been considered (given a potential for cumulative routeing impacts) within the cumulative assessment are listed below:

- Neart na Gaoithe Offshore Wind Farm;
- Inch Cape Offshore Wind Farm;
- Kincardine Offshore Wind Farm;
- Forth Wind Offshore Wind Farm;
- European Offshore Wind Deployment Centre;
- Aberdeen Harbour Expansion Project; and
- NorthConnect.

Other plans and projects have been screened out of assessment due to distance from the optimised Seagreen Project.

12.3 Cumulative Deviations

An overview of the anticipated cumulative vessel routes (obtained by deviating the base case routes from Section 7 using the same methodology as outlined in Section 8, to account for the developments considered) are presented in Figure 12.1. Following this, Figure 12.2 presents the cumulative routeing within the vicinity of the optimised Seagreen Project. The route ID numbering shown in the figure corresponds to that presented in Sections 7 and 8.

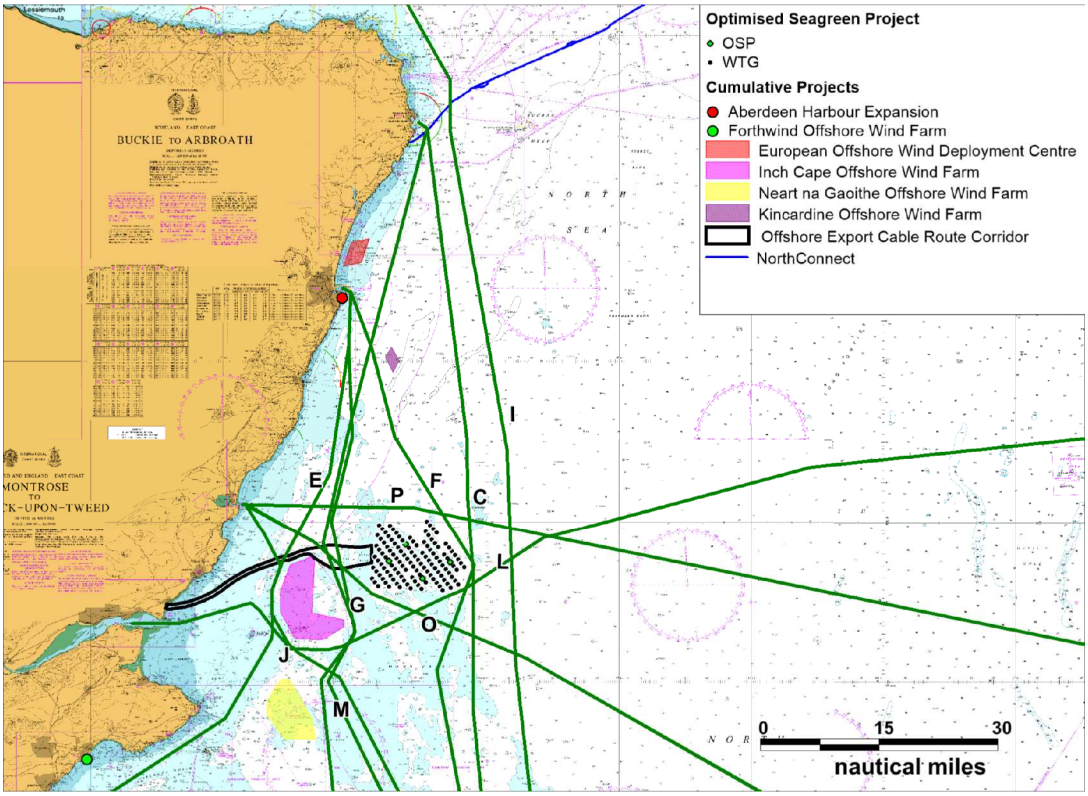


Figure 12.1 Overview Cumulative Routeing in Vicinity of the Optimised Seagreen Project

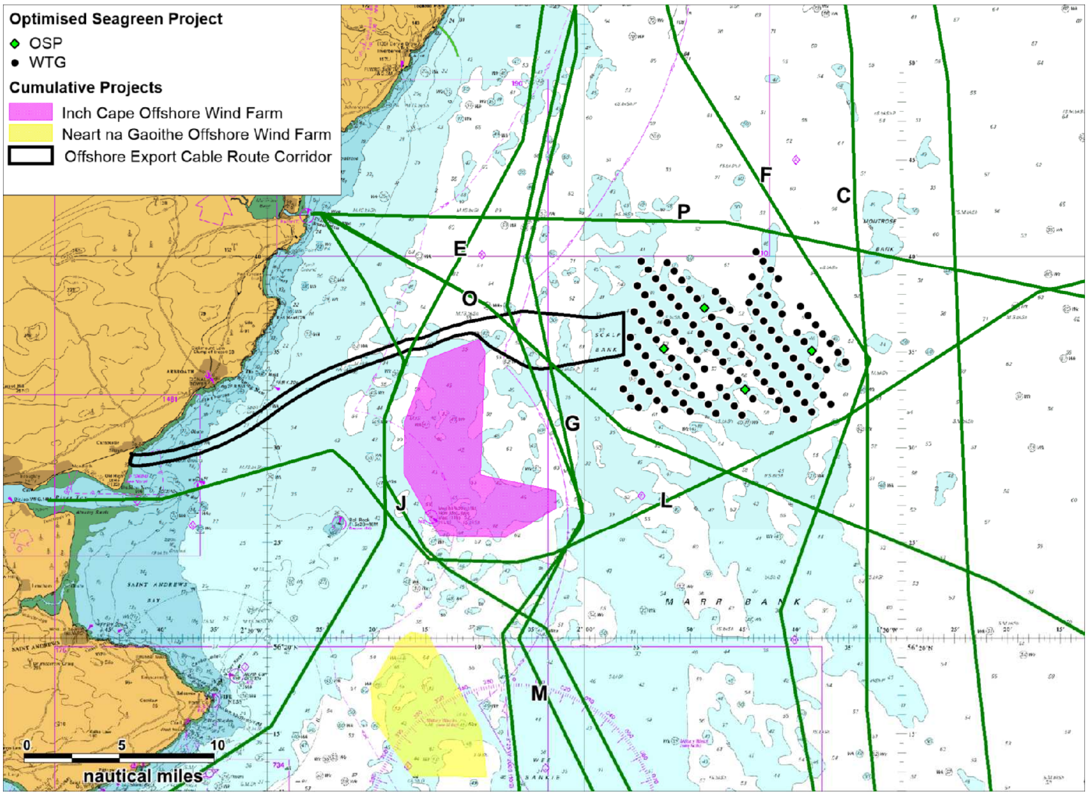


Figure 12.2 Cumulative Routeing in Vicinity of the Optimised Seagreen Project, Inch Cape and Neart na Gaoithe

Of the 16 vessel routes identified in the study area, nine will be cumulatively affected by the presence of the optimised Seagreen Project, Neart na Gaoithe and Inch Cape. The largest deviation required in terms of an increase in distance will be route L which consists mainly of cargo vessels transiting between Dundee and Køge.

Table 12.1 presents the projects which affect each individual route.

Table 12.1 Cumulative Projects Affecting Individual Routes

Route ID	Optimised Seagreen Project	Inch Cape	Neart na Gaoithe
C	✓	X	x
E	x	✓	x
F	✓	X	x
G	x	✓	x
J	x	✓	x
L	✓	✓	x

Route ID	Optimised Seagreen Project	Inch Cape	Neart na Gaoithe
M	x	✓	x
O	✓	X	x
P	✓	X	x

Although routes E, G, J and M are not directly impacted by the optimised Seagreen Project, indirect impacts shall also be assessed given the combined presence of the Project and Inch Cape Offshore Wind Farm will contribute to the overall routeing and encounters within the area. For example, routes G and M may want to displace themselves further from Inch Cape Offshore Wind Farm or the optimised Seagreen Project but are unable to do so because of the presence of the other Project.

In terms of the cumulative impact of the projects scoped in through consultation and the CIA list, Kincardine Offshore Wind Farm and NorthConnect are the only projects which may cause direct cumulative displacement on commercial vessels, due to minor baseline routeing deviations. One commercial vessel route was identified as intersecting the proposed Kincardine Offshore Wind Farm. However, it should be noted that the boundary for Kincardine Offshore Wind Farm is determined by the current WTG layout and therefore is subject to change and finalisation before the cumulative assessment can be accurately determined. Three commercial vessel routes were recorded as crossing the proposed NorthConnect project route, however, it is noted that this impact should only be present during construction of the project, when rolling 500m safety zones will be in place which are subject to change as the cable is laid. Once operational, the NorthConnect cable will be buried or suitably protected in seabed conditions unsuitable for burial therefore should not impact these routes.

It is not considered likely that the development of the Aberdeen Harbour Expansion Project or the Forthwind Offshore Wind Farm would impact routeing options (given the distance from the optimised Seagreen Project) or impact numbers of vessels so as to increase the level of risk.

12.4 Cumulative Impact Assessment within the EIA

Cumulative impacts have been assessed in the EIA Report (Chapter 12 (Shipping and Navigation) and take the projects listed in Section 12.2 into account.

13 Mitigation Measures

This section summarises the measures assumed to be embedded within the optimised Seagreen Project. The EIA has been undertaken on the understanding that these measures will be in place.

Table 13.1 Embedded Mitigation Measures

Mitigation	Description
Blade clearance	Blade clearance will be at least 32.5m above Lowest Astronomical Tide (LAT) which is above 22m Mean High Water Springs (MHWS) as required by MGN 543 (MCA, 2016) and RYA (RYA, 2015) requirements).
Buoyed construction and decommissioning areas	During construction and decommissioning, the extents of the optimised Seagreen Project will be marked with temporary buoyage, to indicate the area within which construction is being undertaken (noting navigation will only be restricted within active safety zones). This will be undertaken following NLB consultation and approval.
Compliance with international maritime regulations as adopted by the flag state	It will be ensured that all vessels associated with the optimised Seagreen Project are familiar with, and will comply with, international maritime regulations as adopted by the flag state. This includes COLREGS (IMO, 1972) and SOLAS (IMO, 1974).
Development and Specification Layout Plan (DSLP)	Post consent, Seagreen will create a DSLP, which will include the final layout of the optimised Seagreen Project. This layout will be agreed with MS-LOT, who will consult with the MCA, NLB and CoS.
Emergency Response and Co-operation Plan (ERCoP)	Post consent, Seagreen will provide an ERCoP to the MCA for approval. The ERCoP will provide details of emergency response plans in place for the optimised Seagreen Project.
Guard vessels	Guard vessels will be used during construction and decommissioning where appropriate (as determined through risk assessment).

Mitigation	Description
Marine coordination	Vessel movements on site during construction and operation will be managed via a Marine Coordination Centre.
Marking on Admiralty Charts and Admiralty Sailing Directions	The positions of WTGs, OSPs, and cables will be provided to the UKHO, who will add the information to Admiralty Charts as appropriate. The optimised Seagreen Project will also be noted within the Admiralty Sailing Directions as per the RYA's requirements.
MGN 543	The optimised Seagreen Project will be designed giving consideration to the recommendations set out in MGN 543 (MCA, 2016), including the SAR annex.
Permanent AtoNs	Permanent AtoNs will be established in line with IALA, NLB, Civil Aviation Authority (CAA) and MCA SAR requirements (as per the Lighting and Marking Plan (LMP)).
Promulgation of information	Information regarding the optimised Seagreen Project information will be promulgated to relevant stakeholders, including through the means of Notice to Mariners, Kingfisher bulletins, fisheries liaison and further appropriate media. As per RYA Scotland's request, information will be promulgated to allow insertion into Pilot Books as required.
Safety zones	Seagreen will apply for rolling safety zones during construction, for periods of major maintenance during operation, and for during decommissioning.

14 References

IMO. 1972. *Convention on the International regulations for Preventing Collisions at Sea – Annex 3.* IMO, London.

IMO. 1974. *Convention on the Safety of Life at Sea (SOLAS)*. London: IMO.

IMO, 2007. Consolidated Text of the Guidelines for FSA for use in the IMO rule-making Process. (MSC/ Circ. 2013-MEPC/ Circ.392). IMO, London.

MCA. 2008. *Marine Guidance Note 372 (M+F) Guidance to Mariners Operating in the Vicinity of UK OREIs*. MCA, Southampton.

MCA. 2015. *Methodology for Assessing the Marine Navigational Safety Risks of Offshore Wind Farms*. MCA, Southampton

MCA. 2016. *MGN 543 (M+F) Safety of Navigation OREIs – Guidance on UK Navigational Practice, Safety and Emergency Response.* MCA, Southampton

RYA. 2015. *The RYA's Position on Offshore Renewable Energy Developments Paper 1 – Wind Energy.* RYA, Southampton.

Seagreen. 2010. *Seagreen Phase 1 Scoping Report.* Seagreen, Glasgow

Seagreen. 2017a. *Seagreen Phase 1 Offshore Project Scoping Report: Round 3: Firth of Forth.* Seagreen, Glasgow.