East Anglia ONE North Offshore Windfarm

Appendix 14.2

Navigational Risk Assessment

Environmental Statement
Volume 3

Applicant: East Anglia ONE North Limited
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East Anglia ONE North Navigation Risk Assessment (Appendix 14.2)

Prepared by	Anatec Limited
Presented to	ScottishPower Renewables
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	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

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00	18th October 2018	Initial Draft
01	14th January 2019	Updates following changes to layout
02	1st May 2019	Update with Section 42 responses

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Abbreviations Table

Abbreviation	Definition
AIS	Automatic Identification System
ALARP	As Low as Reasonably Practicable
ALB	All-Weather Lifeboat
AtoN	Aids to Navigation
BEIS	Department for Business, Energy and Industrial Strategy
BMAPA	British Marine Aggregate Producers Association
CA	Cruising Association
CGOC	Coastguard Operations Centre
CIA	Cumulative Impact Assessment
COLREGs	International Regulations for Preventing Collisions at Sea
CoS	Chamber of Shipping
CRO	Coastguard Rescue Officer
CRT	Coastguard Rescue Team
DCO	Development Consent Order
DfT	Department for Transport
DMT	Deemed Marine Licence
DWR	Deep Water Route
EIA	Environmental Impact Assessment
ERCoP	Emergency Response Co-operation Plan
ES	Environmental Statement
EU	European Union
FSA	Formal Safety Assessment
GT	Gross Tonnage
HSE	Health and Safety Executive
IALA	International Association of Marine Aids to Navigation and Lighthouse Authorities
IHO	International Hydrographic Organisation
ILB	Inshore Lifeboat
IMO	International Maritime Organization

Abbreviation	Definition
km	kilometre
LAT	Lowest Astronomical Tide
LOA	Length Overall
LPG	Liquid Petroleum Gas
m	metre
MAIB	Marine Accident Investigation Branch
MCA	Maritime and Coastguard Agency
MEHRA	Marine Environmental High Risk Area
Met Mast	Meteorological Mast
MGN	Marine Guidance Note
MHWS	Mean High Water Springs
MMO	Marine Management Organisation
MoD	Ministry of Defence
MSC	Maritime Safety Council
MW	Megawatt
nm	Nautical mile
NMOC	National Maritime Operations Centre
NOREL	Nautical Offshore Renewable Energy Liaison
NRA	Navigation Risk Assessment
NUC	Not Under Command
OREI	Offshore Renewable Energy Installations
PEIR	Preliminary Environmental Information Report
PEXA	Practice and Exercise Area
PLL	Potential Loss of Life
REZ	Renewable Energy Zone
RIV	Rapid Intervention Vessel
RNLI	Royal National Lifeboat Institution
Ro Ro	Roll on Roll off
RYA	Royal Yachting Association
SAR	Search and Rescue

Abbreviation	Definition
SMS	Safety Management System
SNSOWF	Southern North Sea Offshore Wind Forum
SOLAS	International Convention for the Safety of Life at Sea
SPR	ScottishPower Renewables
STS	Ship-to-Ship
TH	Trinity House
TSS	Traffic Separation Scheme
UK	United Kingdom
UKHO	United Kingdom Hydrographic Office
VHF	Very High Frequency

Glossary

Term	Definition
As Low As Reasonably Practicable (ALARP)	The principle that the residual risk shall be reduced as far as reasonably practicable.
Allision	Contact between a moving and stationary object.
Automatic Identification System (AIS)	Automatic Identification System. A system by which vessels automatically broadcast their identity, key statistics e.g. length, brief navigation details e.g. location, destination, speed and current status e.g. survey. Most commercial vessels and European Union (EU) fishing vessels over 15 m are required to have AIS.
Baseline	The assessment of risk based on current shipping densities and traffic types as well as the marine environment.
Collision	The act or process of colliding (crashing) between two moving objects.
Environmental Statement (ES)	A document reporting the findings of the Environmental Impact Assessment (EIA) and produced in accordance with the EIA Directive as transposed into United Kingdom

Term	Definition
	(UK) law by the EIA Regulations.
Formal Safety Assessment (FSA)	A structured and systematic process for assessing the risks and costs (if applicable) associated with shipping activity.
Future Case	The assessment of risk based on the predicted growth in future shipping densities and traffic types as well as foreseeable changes in the marine environment.
Marine Environmental High Risk Area (MEHRA)	Areas in UK coastal waters where ships' masters are advised of the need to exercise more caution than usual i.e. crossing areas of high environmental sensitivity where there is a risk of pollution from commercial shipping.
Marine Guidance Note (MGN)	A system of guidance notes issued by the Maritime and Coastguard Agency (MCA) which provide significant advice relating to the improvement of the safety of shipping and of life at sea, and to prevent or minimise pollution from shipping.
Navigational Risk Assessment (NRA)	A document which assesses the overall impact to shipping and navigation of a proposed Offshore Renewable Energy Installation (OREI) based upon formal risk assessment.
Not Under Command (NUC)	Under Part A of the International Regulations for Preventing Collisions at Sea (COLREGs), the term “vessel not under command” means a vessel which through some exceptional circumstance is unable to manoeuvre as required by these Rules and is therefore unable to keep out of the way of another vessel.
Offshore Renewable Energy Installation (OREI)	OREIs as defined by Guidance on UK Navigational Practice, Safety and Emergency Response Issues, MGN 543. For the purpose of this report and in keeping with the consistency of the EIA, OREI can mean offshore turbines and the associated electrical infrastructures such as offshore

Term	Definition
	High Voltage Alternating Current (HVAC) transformer substations, offshore High Voltage Direct Current (HVDC) converter substations, construction, operation and maintenance (accommodation) platforms and offshore HVAC booster stations.
Radar	Radio Detection And Ranging – an object-detection system which uses radio waves to determine the range, altitude, direction, or speed of objects.
Regular Operator	A commercial vessel operator whose vessel(s) are observed to transit through a particular region on a regular basis.
Safety Zone	A marine area declared for the purposes of safety around a renewable energy installation or works / construction area under the Energy Act 2004.

1 Introduction

1.1 Background

1. Anatec were commissioned by ScottishPower Renewables (SPR) to undertake a Navigation Risk Assessment (NRA) for the proposed East Anglia ONE North project. The report presents information on the East Anglia ONE North offshore development area relative to the existing and future case navigational activity.

1.2 Environmental Impact Assessment (EIA)

2. Assessments of impacts on shipping and navigation receptors during the construction, operation and decommissioning phase of a project are informed by an NRA. Following the Maritime and Coastguard Agency (MCA) methodology for assessing marine navigational risk of offshore windfarms (MCA 2015) and Marine Guidance Note (MGN) 543 (MCA 2016), the NRA includes:

- Overview of base case environment;
- Marine traffic survey data and analysis;
- Assessment of navigational risk pre and post development of the offshore development area;
- Emergency response;
- Technical assessment for the Formal Safety Assessment (FSA) being undertaken as part of the Environmental Impact Assessment (EIA);
- Identification of mitigation measures; and
- Through life safety management.

3. Results from the NRA are then used to inform the EIA, a process which identifies the environmental effects of the offshore development area, both negative and positive, in accordance with European Union (EU) Directives.

2 Regulations and Guidance

2.1 Primary Guidance

4. The primary guidance documents used to inform this NRA are as follows:

- MCA MGN 543 (Merchant and Fishing) Safety of Navigation Offshore Renewable Energy Installations (OREIs) – Guidance on United Kingdom (UK) Navigational Practice, Safety and Emergency Response (MCA 2016);
- MCA Methodology for Assessing Marine Navigational Safety Risks of Offshore Wind Farms (2015); and
- Guidelines for FSA – Maritime Safety Council (MSC)/Circular 1023/MEPC/Circular 392 (International Maritime Organization (IMO) 2002).

5. MGN 543 highlights issues that shall be taken into consideration when assessing the effect on navigational safety from offshore renewable energy developments, proposed in UK internal waters, territorial sea or Renewable Energy Zone (REZ).

6. The MCA require that their methodology is used as a template for preparing NRAs, including the completion of an FSA. The methodology is centred on risk management and requires a submission that shows that sufficient controls are, or will be, in place for the assessed risk (base case and future case) to be judged as broadly acceptable or tolerable with mitigation. An MGN 543 checklist referencing the sections in this report which address all MCA requirements is presented in *Appendix 14.6 MGN 543 Checklist*.

2.2 East Marine Plan

7. During consultation (see section 5), the Chamber of Shipping (CoS) requested that the East Inshore and East Offshore Marine Plans (Marine Management Organisation (MMO) 2014) be taken into consideration therefore the ports and shipping policies have been presented in *Table 2.1* along with where the policies have been addressed or where they have been addressed.

Table 2.1 East Marine Plan Ports and Shipping Policies

Policy Number	Description	Where they have been Addressed
PS1	Proposals that require static sea surface infrastructure or that significantly reduce under-keel clearance should not be authorised in IMO designated routes.	The offshore development area is not situated within IMO designated routes as presented in section 8.3.

Policy Number	Description	Where they have been Addressed
PS2	Proposals that require static sea surface infrastructure that encroaches upon important navigation routes should not be authorised unless there are external circumstances. Proposals should: ▪ Be compatible with the need to maintain space for safe navigation, avoiding economic impact; ▪ Anticipate and provide for future safe navigational requirements where evidence and / or stakeholder input allows; and ▪ Account for impacts upon navigation in-combination with other existing and proposed activities.	Pre and post windfarm vessel routeing around the proposed offshore development area has been assessed in section 14 and section 15, respectively.
PS3	Proposals should demonstrate, in order of preference: ▪ That they will not interfere with current activity and future opportunity for expansion of ports and harbours; ▪ How, if the proposal may interfere with current activity and future opportunities for expansion, they will minimise this; ▪ How, if the interference cannot be minimised, it will be mitigated; and ▪ The case for proceeding if it is not possible to minimise or mitigate the interference.	Given that the East Anglia ONE North windfarm site is out with the operational area or harbour limits of any ports, harbours or marinas there are not considered to be any cumulative impacts associated with the construction, operation and maintenance or decommissioning phases. Routeing to and from ports is considered in section 14 and 15 (offshore development area in isolation) and section 19.4 (cumulatively).

2.3 Other Guidance

8. Other (secondary) guidance documents used during the NRA are listed below:

- MCA MGN 372 (Merchant and Fishing) OREIs Guidance to Mariners Operating in the Vicinity of UK OREIs (MCA 2008);
- International Association of Marine Aids to Navigation (AtoN) and International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) Recommendation O-139 on The Marking of Man-Made Offshore Structures, Edition Two (IALA 2013);

- Royal Yachting Association (RYA) – the RYA's Position on Offshore Renewable Energy Developments Paper One – Wind Energy (RYA 2015); and
- Department for Business, Energy and Industrial Strategy (BEIS) Standard Marking Schedule for Offshore Installations (BEIS 2011).

3 NRA Methodology

3.1 Methodology for Assessing the East Anglia ONE North Windfarm Site in Isolation

9. As per the primary guidance described in section 2.1, shipping and navigation impacts are assessed within the EIA based on an FSA approach. The NRA forms the technical workings of, and primary input to, the FSA.

10. The NRA has evaluated all required effects as detailed within MGN 543 (see *Appendix 14.6*) and as required by the MCA. Those effects associated with shipping and navigation receptors have then been carried forward to *Chapter 14 Shipping and Navigation* as impacts requiring further assessment.

11. Where an impact has been identified the overall severity of consequence to the receptor and likely frequency of occurrence of the impact have been determined. As this process incorporates a degree of subjectivity both screening of significant impacts from the NRA process and the consequent assessment within the EIA have used the following sources:

- Scoping responses;
- Baseline data and assessment (including marine traffic survey data);
- Expert opinion;
- Outputs of the Hazard Workshop (*Appendix 14.3*);
- Level of stakeholder concern;
- Significance of any deviation;
- Number of transits of specific vessel and / or vessel type;
- Outputs of modelling where undertaken; and
- Lessons learnt from existing offshore projects.

12. The definitions used within the FSA for severity of consequence and frequency of occurrence are presented in *Table 3.1* and *Table 3.2*, respectively. These rankings assume the embedded mitigation measures listed in section 21 will be in place. It should be noted that the primary concern of the NRA and subsequent FSA is navigational safety (risk to the safety of vessels and / or crew) however financial and reputation consequences have also been considered from a cost benefit approach as per the methodology (MCA 2015).

Table 3.1 Severity of Consequence Definitions

Rank	Severity	Definition
1	Negligible	▪ No injury to persons. ▪ No significant damage to infrastructure or vessel. ▪ No significant environmental impacts.

Rank	Severity	Definition
		▪ No significant business (safety), operation or reputation impacts.
2	Minor	▪ Slight injury(s) to person. ▪ Minor damage to infrastructure or vessel. ▪ Tier 1 pollution assistance (marine pollution). ▪ Minor business (safety), operation or reputation impacts.
3	Moderate	▪ Multiple moderate or single serious injury to persons. ▪ Moderate damage to infrastructure or vessel. ▪ Tier 2 pollution assistance (marine pollution). ▪ Considerable business (safety), operation or reputation impacts.
4	Serious	▪ Serious injury or single fatality. ▪ Major damage to infrastructure or vessel. ▪ Tier 2 pollution assistance (marine pollution). ▪ Major national business (safety), operation or reputation impacts.
5	Major	▪ More than one fatality. ▪ Extensive damage to infrastructure or vessel (> £10M). ▪ Tier 3 pollution assistance (marine pollution). ▪ Major international business (safety), operation or reputation impacts (> £10M).

Table 3.2 Frequency of Occurrence Definitions

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

13. The significance of each impact is then assessed as either "**Broadly Acceptable**", "**Tolerable**", or "**Unacceptable**" based on the tolerability risk matrix presented in *Table 3.3*. Definitions of these significance rankings are presented in *Table 3.4*. Where an impact is assessed as being of Unacceptable significance, additional mitigation is required to reduce the significance of the impact to within the "Broadly Acceptable" or "Tolerable" ranges. The impact is then considered to be As Low as is Reasonably Practicable (ALARP).

Table 3.3 Significance Matrix

Frequency						
Frequency	**Frequent**	Tolerable	Tolerable	Unacceptable	Unacceptable	Unacceptable
Frequency	**Reasonably Probable**	Broadly Acceptable	Tolerable	Tolerable	Unacceptable	Unacceptable
Frequency	**Remote**	Broadly Acceptable	Broadly Acceptable	Tolerable	Tolerable	Unacceptable
Frequency	**Extremely Unlikely**	Broadly Acceptable	Broadly Acceptable	Broadly Acceptable	Tolerable	Tolerable
Frequency	**Negligible**	Broadly Acceptable	Broadly Acceptable	Broadly Acceptable	Broadly Acceptable	Tolerable
		Negligible	**Minor**	**Moderate**	**Serious**	**Major**
		Severity				

Table 3.4 Significance Ranking Definitions

Ranking	Definition
No Impact	No impact on shipping and navigation receptors.
Broadly Acceptable	Risk ALARP with no additional mitigations or monitoring required above embedded mitigations. Includes impacts that have no perceptible effect (effect would not be noticeable to receptors).
Tolerable	Risk acceptable but may require additional mitigation measures and monitoring in place to control and reduce to ALARP.
Unacceptable	Significant risk mitigation or design modification required to reduce to ALARP.

3.2 Scope

14. Following the Scoping Report (SPR 2017), the following receptors were identified for impact assessment during the construction, operation and decommissioning phases of the offshore development area:

- Commercial vessels;
- Commercial fishing vessels;
- Recreational craft; and
- Emergency response.

15. Impacts on these receptors have been assessed in *Chapter 14 Shipping and Navigation.*

16. It should be noted that impacts on communications, navigation and marine radar interference have been scoped out of the assessment following consultation with the MCA (see *Table 5.1*). Impacts to marine aggregate dredgers have also been scoped out as part of this NRA process. Further details and justification are provided in section 21.1.

3.3 Methodology for Assessing Cumulative Impacts

17. Cumulative effects have been considered for shipping and navigation within this NRA; this includes impacts of other offshore developments, as well as activities associated with other marine operations. Fishing, recreation and marine aggregate dredging transits have been considered as part of the baseline assessment. Other developments and relevant marine activities have been identified within section 8 and section 12, and summarised in the baseline assessment in *Chapter 14 Shipping and Navigation*.

18. A list of screened in cumulative developments and activities is presented in section 19. Associated cumulative effects are then assessed within the Cumulative Impact Assessment (CIA) within *Chapter 14 Shipping and Navigation.*

3.4 Methodology for Assessing Transboundary Impacts

19. *Chapter 6 EIA Methodology* presents the methodology associated with transboundary impact assessment. Similar to the cumulative impacts this section will consider transboundary offshore wind projects with regards to vessel routeing and international ports. It should be noted that fishing, recreation and marine aggregate dredging impacts, although they have the potential to be internationally owned or located, have been considered as part of the baseline assessment.

3.5 Assumptions

20. The shipping and navigation baseline and impact assessment has been carried out based on the information available, and consultation responses received (including the Scoping Report (SPR 2017)) at the time of preparation. This includes design parameters of the offshore development area (as set out in the Design Envelope), and the anticipated schedule.

21. Assessment has considered a worst case scenario (from a shipping and navigation perspective) from the proposed design envelope noting the final locations of structures will not be finalised until post consent.

3.6 Study Areas

22. The analysis within this NRA has largely been undertaken within a ten nautical mile (nm) buffer of the East Anglia ONE North windfarm site (hereafter referred to as the shipping and navigation study area). The 10nm radius is a standard value for shipping and navigation assessments given that it will generally capture all relevant passing traffic, while ensuring the ensuing analysis remains site specific to the area. Most notably, the 10nm buffer captures traffic utilising the nearby Deep Water Route (DWR). All assessment for East Anglia ONE North to date (in terms of shipping and navigation) has been undertaken based on a 10nm buffer, including the assessment undertaken as part of the Scoping Process (SPR, 2017).

23. In addition, analysis of marine traffic data and relevant navigational features has been undertaken within a 2nm buffer of the offshore cable corridor (hereafter referred to as the export cable corridor study area). Both study areas are presented in *Figure 3.1*.

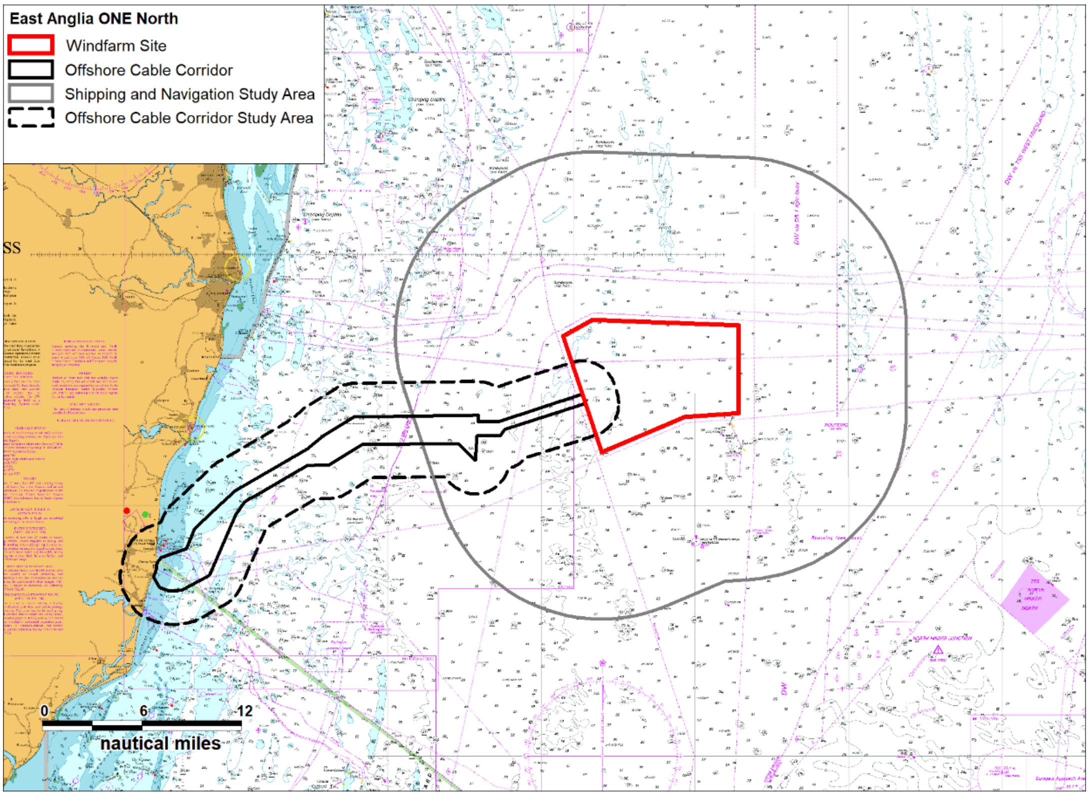

Figure 3.1 Study Area Overview

24. Cumulative impacts have been considered within a 10nm buffer around the East Anglia ONE North windfarm site (as per the shipping and navigation study area) but

where applicable vessel routes which transit through this area have been considered beyond this threshold where they intersect another cumulative site.

4 East Anglia ONE North Offshore Development Area Description

4.1 Boundaries and Layouts

25. The East Anglia ONE North windfarm site covers an area of approximately 208km^2, and is located approximately 20nm from the coast (at its closest), as shown in *Figure 4.1*. The coordinates of the corner points are given in *Table 4.1*, with the positions of the corresponding point illustrated in *Figure 4.1*.

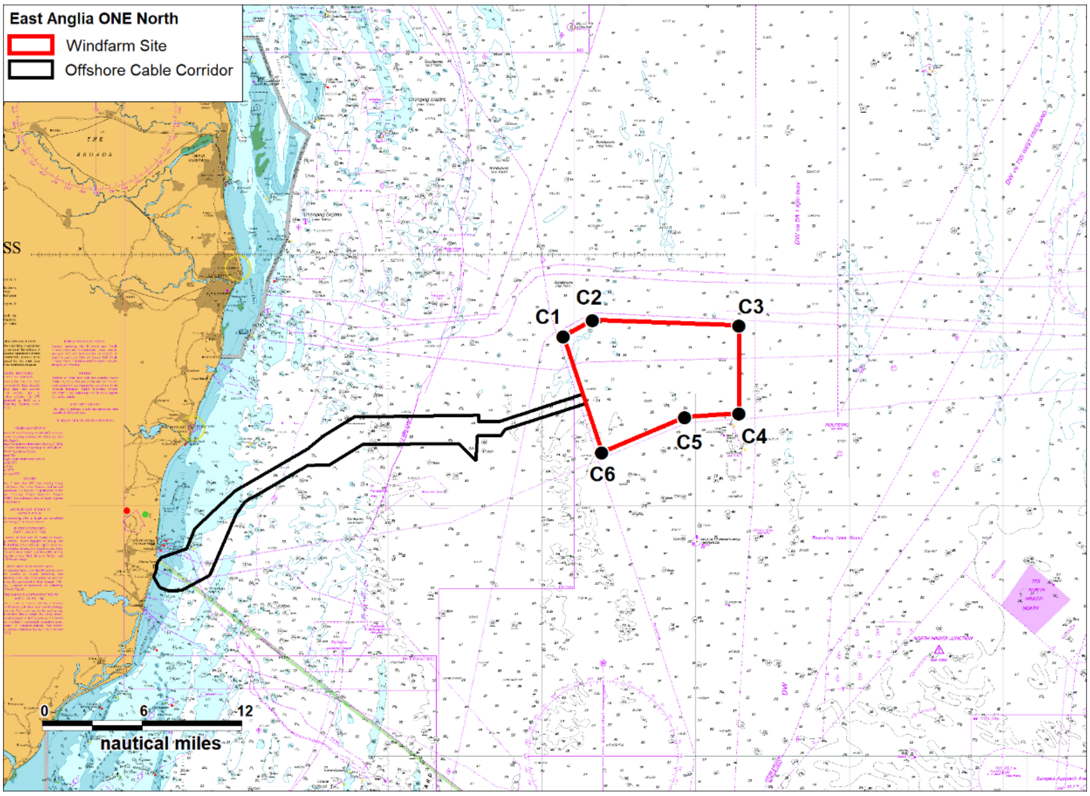

Figure 4.1 East Anglia ONE North Windfarm Site

Table 4.1 East Anglia ONE North Windfarm Site Coordinates

Corner	Latitude	Longitude
C1	52° 25' 09.84" N	002° 17' 03.92" E
C2	52° 26' 07.82" N	002° 19' 55.69" E
C3	52° 25' 47.95" N	002° 34' 14.12" E
C4	52° 20' 33.28" N	002° 34' 13.79" E
C5	52° 20' 19.05" N	002° 28' 56.31" E
C6	52° 18' 11.92" N	002° 20' 49.77" E

4.2 Project Details

26. A maximum of 67 wind turbines will be installed within the East Anglia ONE North windfarm site.

27. Offshore export cables will connect the offshore electrical platforms (up to four) within the East Anglia ONE windfarm site to shore, making landfall between Sizewell and Thorpeness in Suffolk.

28. Key characteristics and parameters of the East Anglia ONE North project are detailed in *Table 4.2*.

Table 4.2 Key East Anglia ONE North Project Characteristics

Parameter	Value
Maximum Wind Turbine Blade Tip Height (above Lowest Astronomical Tide (LAT))	300m
Maximum Wind Turbine Rotor Diameter	250m
Minimum Clearance above MHWS	22m
Minimum Turbine Spacing	800m
Maximum Number of Offshore Electrical Platforms	4
Number of Operational Meteorological Masts (Met Masts)	1
Maximum Number of Export Cables	2
Maximum Length of Inter-Array Cables	200km
Maximum Number of Platform Link Cables	7 (up to 15km in length each with a maximum total length of 75km)

29. Several foundations types are currently under consideration for use, these are:

- Monopiles;
- Suction caissons;
- Gravity base structures;
- 4-leg jackets on piles; and
- 4-leg jackets on suction caissons.

30. As site conditions, in particular water depths, vary across the East Anglia ONE North windfarm site, it is possible that more than one foundation type may be used for wind turbines, offshore platforms and the Met Mast.

31. The wind turbines will maintain at least one line of orientation.

4.3 Worst Case Layout

32. For the purpose of this NRA, the worst case layout (from a shipping and navigation perspective) has been chosen from layouts currently under consideration for use as input to the modelling process, as is described further in section 16. The worst case is considered to be the maximum number of structures over the largest area. Following a review of the potential layouts, the worst case is presented in *Figure 4.2* (the maximum 67 wind turbines, four offshore electrical platforms, one construction, operation and maintenance platform).

33. The worst case parameters considered for the assessment are detailed in Table 4.3 Table 4.3. It should be noted that the minimum inter-row and in-row spacing have only been qualitatively assessed rather than modelled, given that the worst case from a shipping and navigation perspective is maximum number of structures over the greatest area. Therefore, 1060m inter-row spacing and 2400m in-row spacing within the 67 wind turbine indicative layout has been modelled, rather than the actual minimum spacing being considered.

Table 4.3 Worst Case Structure Dimensions

Parameter	Dimensions
Number of turbines	67
Wind Turbine Surface Dimensions	55.5 x 55.5m
Offshore Substation Surface Dimensions	50 x 70m
Wind Turbine Rotor Diameter	250m
Minimum Spacing (Modelled)	1060m (inter-row) and 2400m (in row)
Minimum Spacing (Qualitatively Assessed)	1200m (inter-row) and 800m (in row)

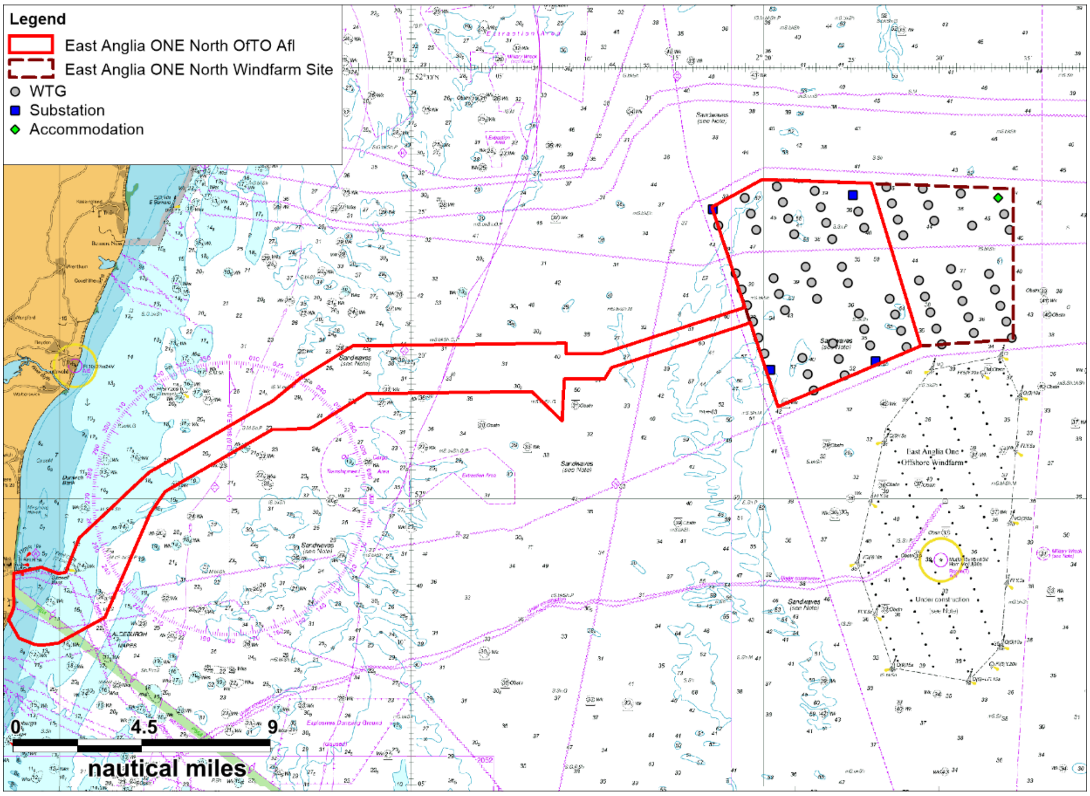

Figure 4.2 East Anglia ONE North 250m wind turbine Layout (67 Wind Turbines)

5 Consultation

5.1 Introduction

34. A key input to the NRA and subsequent FSA were responses received from key statutory and non-statutory stakeholders relevant to shipping and navigation. This included consideration of responses received within the Scoping Opinion in response to the Scoping Report issued for the windfarm (East Anglia ONE North Offshore Windfarm Scoping Report November 2017), regular operator responses, and consultation undertaken via a Hazard Workshop and responses received under Section 42 of the Planning Act 2008 in response to the Preliminary Environmental Information Report (PEIR).

35. The marine traffic survey data presented in section 12 was used to identify any regular operators utilising the area. Regular operator responses received are included in *Table 5.3* and key consultation output from the Hazard Workshop (see section 20.2) is summarised in *Table 5.4*.

5.2 Scoping and Statutory Stakeholder Responses

36. Key consultation responses arising from the scoping process and from subsequent meetings held with statutory stakeholders are provided in *Table 5.1*, with an explanation of how the points raised have been addressed, or a reference to where they have been addressed, included.

Table 5.1 Consultation Responses

Consultee	Comment	East Anglia ONE North Approach
The Planning Inspectorate	In the absence of justification for the proposed approach the Inspectorate does not agree that the matter of impacts to communications, navigations and radar of commercial vessels can be scoped out.	Justification on this was provided to the MCA on the 25th April 2017. Agreement from the MCA was received on the 11th May 2017.
	The Applicant should include a clear and concise justification for the chosen study area.	Section 3.6 details the study area chosen and *Figure 3.1* presents the study area.

Consultee	Comment	East Anglia ONE North Approach
	Highlights to the Applicant the risk of invalidating the NRA if the hydrographic surveys do not fulfil the requirements according to Marine Guidance Note 543 and advises that this guidance should be taken into account. The Applicant is referred to the comments of the MCA in this regard.	Noted. Any hydrographic surveys will be undertaken in compliance with MGN 543 Annex 2 and IHO Order 1a and details will be provided to the MCA Hydrographic Manager.
	Recommends that the Applicant seeks agreement with the MCA on the approach of the assessment, particularly in respect to commercial traffic.	The approach to cumulative assessment has been considered as part of the NRA and PEI consultation process; as well as within the Scoping Opinion.
Maritime and Coastguard Agency	MCA relatively comfortable with summer only vessel survey.	Noted. Summer survey carried out by a dedicated vessel during July 2018.
	MCA currently looking at best orientations for windfarms. It may be preferable for helicopters to have turbines facing downwind rather than with prevailing winds.	Noted; will be considered post consent during layout discussions which will be secured under the Deemed Marine Licence (DML).
	The PEI should supply detail on the possible impact on navigational issue for both commercial and recreational craft.	Section 14.6 of *Chapter 14 Shipping and Navigation* assesses the impacts on both commercial vessels and recreational craft.

Consultee	Comment	East Anglia ONE North Approach
	A NRA will need to be submitted in accordance with MGN 543 (and MGN 372) and the MCA Methodology for Assessing the Marine Navigation Safety & Emergency Response Risks of OREIs. The NRA should be accompanied by an MGN 543 Checklist.	This NRA includes the completed MGN 543 Checklist as *Appendix 14.6*.
	Attention needs to be paid to routeing; particularly in heavy weather ensuring shipping can continue safe passage without significant large scale deviations. The possible cumulative effects on shipping routes should also be considered.	Analysis of post windfarm routeing is provided within section 15 of this NRA. The cumulative routeing assessment is provided in section 19. Adverse weather routeing for DFDS Seaways is discussed in section 12.9.
	The turbine layout design will require MCA approval prior to construction. As such, MCA would seek to ensure all structures are aligned in straight rows and columns. Any additional navigation safety and / or Search and Rescue (SAR) requirements will be agreed at the approval stage.	The final layout will be agreed with the MCA post consent; this process will be secured through the DML.
	Particular attention should be paid to cabling routes. A Burial Protection Index study and an anchor penetration study should be undertaken if necessary. The MCA would accept a 5% reduction in depth referenced to Chart Datum.	A Cable Burial Risk Assessment will be undertaken post consent as per embedded mitigations (section 21). This will include an assessment of expected cable burial depths and a plan for other forms of protection where necessary.

Consultee	Comment	East Anglia ONE North Approach
	Information on potential mooring arrangements of floating wind turbines should be included in the ES.	Floating wind turbines are not being considered for the offshore development area.
	Any application for safety zones would need to be carefully assessed and additionally supported by experience from the development and construction stages.	As discussed in section 21, an application for safety zones will be submitted post consent.
	Consideration should be given to the implications of the site size and location of SAR resources and Emergency Response Co-operation Plans (ERCoP).	The East Anglia ONE North windfarm site will comply with MGN 543 as per embedded mitigations (section 21).
	MGN 543 Annex 2 details the requirements of hydrographic surveys. Failure to report the survey or conduct it may invalidate the NRA.	Noted. Any hydrographic surveys will be undertaken in compliance with MGN 543 Annex 2 and IHO Order 1a and details will be provided to the MCA Hydrographic Manager.

Consultee	Comment	East Anglia ONE North Approach
	The radar effects of a windfarm on ships' radars are an important issue and the effects, particularly with respect to adjacent windfarms on either side of a route, will need to be assessed on a site specific basis taking into consideration previous reports on the subject available on the MCA website.	A request to scope out the consideration of impacts of turbines on Very High Frequency, Automatic Identification System (AIS) and Radar equipment was submitted at a meeting with MCA in April 2017. A subsequent letter was submitted to MCA on the 25th April, 2017. A formal agreement to this request was received on the 11th May, 2017 which approved the scoping out of impacts of Very High Frequency (VHF), AIS and Radar equipment.
	Suggested consultation with MCA once bathymetry data is available for the offshore cable corridor. The MCA request that SPR provide water depths at all cable crossing locations to enable consultation on appropriate conditions to be input to Development Consent Order (DCO). Assessment of under keel clearance and vessel activity may be required.	Noted. Hydrographic data and water depths will be provided to the MCA.

Consultee	Comment	East Anglia ONE North Approach
	An NRA without a current Radar traffic survey cannot be relied upon as AIS has obvious limitations. Although the Radar data may only be just outside the 24 month window, the MCA cannot be sure this will not slip further therefore we would appreciate reconsideration of the traffic surveys in line with MGN 543.	The marine traffic data assessed for this NRA includes Radar data collected during 2018.
Trinity House	Expect the NRA to include: ▪ vessel traffic analysis in accordance with MGN 543; ▪ cumulative and in-combination effects on shipping routes and patterns; ▪ layouts that conform with MGN 543; and ▪ additional risk assessment of offshore platforms or Met Masts that lie out with the wind turbine layout.	An MGN 543 checklist has been completed as part of this NRA (*Appendix 14.6*). Up to date marine traffic survey data has been used to assess current shipping levels and patterns within the vicinity of the East Anglia ONE North windfarm site. The results of the analysis are available in section 12. Vessel routeing has been considered on a cumulative basis in section 19. Associated impacts have been assessed in *Chapter 14 Shipping and Navigation.* The final layout will be agreed with the MCA post consent; this process will be secured through the DML. This process will include consideration of any offshore platforms and Met Masts.

Consultee	Comment	East Anglia ONE North Approach
	The development will require marking in accordance with IALA 0-139 Recommendations (IALA 2013). Additional aids to navigation may also be required. All marine navigational marking will need to be agreed with TH.	The East Anglia ONE North windfarm will comply with the requirements of IALA O-139 as per embedded mitigations (section 21). All lighting and marking will be agreed with TH prior to implementation.
	Monitoring equipment must also be marked as required by TH.	Monitoring equipment will be marked as agreed with TH prior to implementation.
	An appropriate buffer zone relating to the IMO DWR to the east of the project should be considered.	A one nautical mile separation distance will be maintained between the East Anglia ONE North windfarm site and the DWR. This will ensure alignment with other projects bordering the DWR, most notably East Anglia ONE.
	A decommissioning plan which includes a scenario where an obstruction is left on site therefore a danger to navigation should be considered.	A decommissioning plan will be created post consent. Impacts associated with the decommissioning of the East Anglia ONE North windfarm site are considered in *Chapter 14 Shipping and Navigation*.
	The impact on navigation and requirements for appropriate mitigation should be assessed for the possible requirement of marking export cables and vessels laying them.	The impacts associated with the offshore cable corridor are presented in section 14.6 of *Chapter 14 Shipping and Navigation*.

Consultee	Comment	East Anglia ONE North Approach
	Highlighted that ferries sometimes transit closer to shore during adverse weather therefore having inshore access reduced during adverse weather may be a concern to operators.	Noted. Adverse weather routeing for DFDS Seaways is discussed in section 12.9.
Norfolk Country Council	The PEI should indicate that suitable navigation and shipping mitigation measures can be agreed with the appropriate regulatory bodies to ensure that Norfolk's Ports (King's Lynn and Wells) are not adversely affected by this proposal. The PEI will need to consider the wider cumulative impacts taking into account existing operational windfarm; those under constructions; those consented and those in planning.	As described in section 21, embedded mitigation measures will be in place. Vessel routeing has been considered on a cumulative basis in section 19 of the NRA. Associated impacts have been assessed in section 14.6 of *Chapter 14 Shipping and Navigation.*
Royal Yachting Association	Any reduction in water depth is required to be marked and notified where necessary, particularly within the landfall.	Noted.
	Content with application for statutory safety zones during construction and major operation and maintenance activities.	Noted. No action required.
Chamber of Shipping	Primary concern to avoid choke points in traffic particularly entering and leaving Harwich and Felixstowe.	Vessel routeing has been considered on a cumulative basis in section 19 of this NRA.

Consultee	Comment	East Anglia ONE North Approach
	Agree with safety zone approach for construction and operation and maintenance however disagree with permanent safety zones around fixed assets.	As noted in section 21, an application for safety zones will be submitted post consent.
	There should be consideration of shipping policies within the East Marine Plan.	Ports and shipping policies from the East Marine Plan are considered in section 2.2.
	It would be useful to have a breakdown of cargo vessel types recorded.	Breakdown of cargo vessels by type is provided in section 12.5 of this NRA.
	Queried methodology for CIA.	The CIA methodology is detailed in section 14.4 of *Chapter 14 Shipping and Navigation*. Cumulative impacts are then assessed in section 14.7.
Cruising Association (CA)	Concern over AIS only winter survey as it is possible that not all yachts and recreational craft have AIS systems or will turn their AIS on.	Section 12.1 highlights that only 4% of tracks recorded during summer were via Radar. Base line data also considers the RYA United Kingdom (UK) Coastal Atlas of Recreational Boating. Additional AIS and Radar marine traffic survey data is also being collated in 2018.

5.3 Section 42 Responses

37. Responses received under Section 42 of the Planning Act 2008 in response to the PEIR are detailed in Table 5.2.

Table 5.2 Section 42 Responses

Consultee	Comment	Response / Where

		Addressed
CA	Almost all yachts in the area will be on long-distance passages with very little local or day-sailing. A high proportion will be strangers to the area, many foreign-flagged and unlikely to have on board local charts with full details of wind farm turbine positions. While the distance between the site and the shore is generally adequate for traffic north-south it should be noted that tidal streams in the area can be strong and yachts will cross the cable corridor either close to the shore or close to the wind farms. Coast is not hospitable and in inclement weather yachts will transit closer to the wind farms, possibly increasing encounter risk with commercial vessels also sailing north-south and forced to do so by the project.	Noted. The impact on recreational vessels has been assessed in section 14.6.4 of *Chapter 14 Shipping and Navigation*. Assessment of encounter risk is presented in section 17.1 and includes recreational vessels.
	Yachts on passage east-west may choose to pass between the turbines. Cumulative effects are becoming an issue. Many yacht harbours are tidal so additional time or distance can have important impacts on safety in poor weather	Minimum spacing and turbine alignments mean that small craft, such as recreational vessels, will be able to navigate through the array during the operational phase.
	The minimum air-draught clearance adopted of 22m above MHWS meets our present standard. This was determined many years ago to enable 97% of all sailing craft in Europe to clear safely and is now under review with indications that it should be increased to perhaps 24m.	East Anglia ONE North complies with the existing guidance on minimum blade clearance.
	We advocate minimum spacing of turbine towers to be 900m x 1000m and the pattern to be square or rectangular in regular straight lines. While the proposal of 800m x 1200m is acceptable we would confirm the need for a straight-line layout to have platforms and met-masts to be in line with the turbines. The wind farm field should have straight edges avoiding outlying structures. Fewer, larger, turbine towers with increased spacing are of course safer for passage between than	East Anglia ONE North will comply with requirements on layout design contained within MGN 543 as per section 21 (embedded mitigation).

	more, smaller ones, closer together but it is important visually that designs are not mixed.	
	Concern with export cable landfalls is any impact to anchoring of recreational craft. Ask that recognised yacht anchorages are avoided and have no concerns about cables in water depths of > 10m. In lesser depths ask that cables are buried 1.5m including any cable protection and leave a smooth seabed with no humps over. This depth is currently under review but unlikely to be altered. The Thorpeness area is not a recognised anchorage but emergency anchoring in strong weather could take place. The charted anchorage off Southwold is rarely used if at all by yachts and not a problem to recreational craft.	East Anglia ONE North will undertake an assessment of export cable routes, cable burial and protection post consent as per section 21 (embedded mitigation).
	No concerns regarding tower or foundation type but request that there is a 3m clear depth of water around visible parts of the structure and suggest identical structures are used throughout each field.	East Anglia ONE North will comply with existing guidance on under keel clearance including that contained within MGN 543 as per section 21 (embedded mitigation).
	Appreciate the embedded mitigations but add the following comments: ▪ Marking of the gaps by buoyage at corners between neighbouring wind farms could be very helpful. ▪ It has been requested by some of our members to suggest that in addition a horizontal black band round corner towers at HAT level would be useful. ▪ Agree with the use of 500m safety zones around active Restricted in Ability to Manoeuvre construction vessels and with 50m zones around each completed tower including whether pre-commissioned or operational. ▪ Note that up to 74 or so construction and other vessels may be on site.	- Buoyage will be deployed at the request of TH as per section 21 (embedded mitigation). Lighting and marking with be as per the requirements of TH and MCA as per section 21 (embedded mitigation). -As per embedded mitigations in section 21 an application for safety zones post consent around structures where construction or major maintenance is being

	We ask that the Coastguard be warned and a regular 'all ships' warning is promulgated by marine VHF. ▪ Request that construction and other vessels regularly visiting the site follow regular publicised routes between base and site.	undertaken. - As per embedded mitigations in section 21 a dedicated Marine Coordination Centre to manage on site vessels
	The baseline estimates for recreational traffic may be somewhat low, but do not have alternative data to offer. Confirm that recreational traffic is gradually increasing but have no figures to offer and accept your estimate of 10%.	Noted, baseline estimates are based on AIS, radar and visual surveys as per the requirements of MGN 543.
Hanson Aggregate Marine Ltd. (HAML)	Concerned that there is potential for some existing activities, e.g. navigation and fishing, being displaced to areas where marine aggregate operations have traditionally taken place, increasing the operational risks to ourselves and other aggregates operators / licensees (including H&S issues arising from navigational risk). Associated with displacement are the increased issues that will arise from the 'squeeze' and condensing of activities. The nature of these impacts are likely to be disproportionately harder to overcome for dredging operators concerned because of the differences in comparative size/value of the projects.	Marine aggregate dredgers are considered within the baseline assessment and assessment on impact on commercial vessels contained within section 14.6.1 of *Chapter 14 Shipping and Navigation***.** Impacts are assessed to be within acceptable parameters.
	Traditional routes that HAML/others use to transit from licensed areas to discharge ports could be impacted. Normally, these are very different to established navigation routes, (short term AIS analysis will not necessarily recognise these) and HAML consider that it may be helpful to examine this issue so the information is available to feed into both Crown Estate Conflict checks (through their MARS system / GIS).	BMAPA transit routes are considered within section 8 (existing environment).

TH	Sent through draft DCO / DML conditions.	Noted. Consultation on the DCO/DML will be undertaken as part of the Statement of Common Ground post submission.
MCA	An approved ERCOP will need to be in place prior to construction. A SAR checklist will be discussed as the project progresses to track all requirements detailed in MGN 543. The checklist will be adapted to suit East Anglia ONE North.	Noted, an ERCOP will be produced post consent and agreed with the MCA as per section 21. The SAR checklist will be discussed and agreed with the MCA post consent.
	MCA would like to see continuous construction which is progressive across the wind farm with no opportunity for two separate areas to be constructed with a gap in the middle.	East Anglia ONE North considers that the effects of disparate construction sites are mitigated, notably through the use of aids to navigation during the entire construction phase. Embedded mitigation is listed in section 21.
	Note the levels of vessel activity observed within and in close proximity of the site. As the development areas carries a significant amount of through traffic, attention needs to be paid to routing, particularly in heavy weather ensuring shipping can continue to make safe passage without significant large-scale deviations. We see this has been considered in section 15 of the NRA.	Noted.
	Appreciate the early opportunity to comment on the draft MGN 543 checklist, and we can discuss the elements further as the project progresses.	Noted.
	We are content at this stage with regards to the process you have undertaken in order to comply with MGN 543, and its annexes, and we welcome the work undertaken in order to achieve our requirements.	Noted.
	Note section 4.3 of the NRA "…the worst case layout (from a shipping and navigation perspective) has been chosen from layouts	Noted.

	currently under consideration for use as input to the modelling process (as described in section 16). The worst case layout from a shipping and navigation perspective is represented by the maximum number of structures covering the maximum area". Figure 4.2 appears to demonstrate an indicative worse case layout in a grid formation with a minimum of two lines of orientation, and other structured all in alignment, which the MCA would welcome.	
	The NRA has assessed worst case which includes just one line of orientation. At this stage, MCA can only agree to a single line of orientation where a detailed safety justification is provided (as per MGN 543) for both surface navigation and SAR capability. The NRA itself would not provide that justification but would be used to inform the safety case as well as any results from surveys and other constraints leading to just one line of orientation in the layout design, and the consideration of the impact on SAR with just one line of orientation.	Noted. The final layout and any required justifications will be discussed post consent as per the DCO/DML conditions
	The turbine layout design will require MCA approval prior to construction to minimise the risks to surface vessels, including rescue boats, and SAR aircraft operating within the site. As such, MCA will seek to ensure all structures are aligned in straight rows and columns, including any platforms. Any additional navigation safety and/or SAR requirements, as per MGN 543 Annex 5, will be agreed at the approval stage.	The layout and any additional navigational safety and / or SAR requirements will be agreed with the MCA post consent as per the DCO/DML conditions.
	Note that the marine traffic data assessed for this NRA includes Radar data collected during 2018. The MCA would like to ensure that the traffic surveys are undertaken as per MGN 543, so we welcome this update.	Noted.
	The NRA addresses those gaps between projects, and the MCA's requirement for sufficient room within the corridor between	Noted.

	wind farms for a vessel to deviate up to 20°, as per MGN 543. The East Anglia TWO, East Anglia ONE North and East Anglia ONE development areas create a gap, and the MCA welcomes the assessment of the gap against the guidance to ensure compliance. This will also influence the lighting and marking requirements going forward to be discussed further as the project progresses.	
	MGN 543 requires that hydrographic surveys should fulfil the requirements of the International Hydrographic Organisation (IHO) Order 1a standard, with the final data supplied as a digital full density data set, and survey report to the MCA Hydrography Manager. This information will need to be submitted, ideally at the ES stage.	Hydrographic surveys are compliant with IHO Order 1a and MCA requirements as per MGN 543.
	Export cable routes, cable burial protection index and cable protections are issues that are yet to be fully developed. However due cognisance needs to address cable burial and protection, particularly close to shore where impacts on navigable water depth may become significant. Any consented cable protection works must ensure existing and future safe navigation is not compromised. The MCA would accept a maximum of 5% reduction in surrounding depth referenced to Chart Datum. Where burial depths are not achieved consultation will need to take place with MCA regarding the locations, impact and potential risk mitigation measures.	An assessment of export cable routes, cable burial and protection post consent as per section 21 (embedded mitigation).
	Safety zones during the construction, maintenance and decommissioning phases are supported, however it should be noted that operational safety zones may have a maximum 50m radius from the individual turbines. A detailed justification would be required for a 50m operational safety zone,	A safety zone application would be produced and agreed with the MCA post consent, noting that the application for safety zones is assumed as embedded mitigation in section 21. This

	with significant evidence from the construction phase in addition to the baseline NRA required supporting the case.	may include provision for operational safety zones around manned platforms.

5.4 Regular Operator

38. Regular commercial operators were identified from the marine traffic survey data (see section 12), and each were subsequently sent information regarding the offshore development area, and a request for a consultation response.

39. A summary of the operators contacted, and the responses received are provided in *Table 5.3*. Further details (including a template of the communication sent to each operator) are provided in *Appendix 14.7 Regular Operator Consultation*.

Table 5.3 Regular Operator Consultation

Date Sent	Consultee	Comment	East Anglia ONE North Approach
13/04/2018	AdMare Ship Management	No Response	n/a
	Amasus Shipping	No Response	n/a
	Arklow Shipping	No Response	n/a
	Carl F. Peters	No Response	n/a
	Carnival	Responded on 23/04/2018. East Anglia TWO will have some impact on Carnival UK routeing when transiting from Norwegian Ports to Southampton. Consider this impact manageable therefore not significant concern. In order to avoid the development area, vessels would be required to use deep water route which is not normally part of their passage.	Noted. This response was considered most applicable to East Anglia TWO however it has been included for completeness. Cumulative routeing is considered in section 19.4.
	Cobelfret Ferries	No response but accepted Hazard Workshop invite on 25/04/2018	n/a

Date Sent	Consultee	Comment	East Anglia ONE North Approach
	British Marine Aggregate Producers Association (BMAPA)	Forwarded email on to BMAPA representatives. Cemex responded on 17/04/2018 with request for GIS layer of offshore development area.	n/a
	DFDS Seaways	Response on 26/04/2018. Sent through figure with routeing of DFDS vessels within vicinity of East Anglia ONE North and accepted Hazard Workshop invite.	Noted the DFDS vessel routes. These are presented in section 12.9.
	Döhle Group	No Response	n/a
	German Tanker Shipping	No Response	n/a
	Hanson Aggregate Marine	No Response	n/a
	Hav Ship Management	No Response	n/a
	Herning Shipping	No Response	n/a
	HJH Shipmanagement	No Response	n/a
	James Fisher Everard	No response but accepted Hazard Workshop invite on 26/04/2018	n/a
	JT Essberger	No Response	n/a
	Nordic Tankers	No Response	n/a
	Scotline	No Response	n/a
	Seatrans Ship Management	No Response	n/a
	Stena Line	No Response	n/a
	Stolt Tankers	No Response	n/a
	UECC	No Response	n/a
	Unibaltic	No Response	n/a

Date Sent	Consultee	Comment	East Anglia ONE North Approach
	Shipping		
	W&R Shipping	No Response	n/a
	Wagenborg Shipping	No Response	n/a
	Warnecke Schiffahrt	No Response	n/a
	Wilson	No Response	n/a

5.5 Hazard Log Consultation

Table 5.4 Hazard Log Consultation

Consultee	Comment	East Anglia ONE North Approach
CoS	Queried whether lines of orientation for the East Anglia TWO offshore development area and East Anglia ONE North offshore development area would be parallel.	Due to the distance between the sites, this is unlikely.
	Questioned why accommodation platforms have been included within the envelope.	Construction, operation and maintenance (accommodation) platforms have been included as they are part of the worst case scenario.
Cobelfret Ferries	Queried capability of wind turbines to be shut down	MGN 543 requires wind turbines to have the possibility to be shut down and locked in position. Such measures will be detailed post consent in the ERCoP.
	Concern regarding the increased use of fuel resulting from deviations which may be required due to East Anglia TWO. The loss of a turbine(s) may theoretically	Noted. This response was considered most applicable to East Anglia TWO however it has been included for completeness.

Consultee	Comment	East Anglia ONE North Approach
	be balanced by the reduction in fuel used.	
CA	Stated that individual safety zones do not provide any concern to recreational craft.	Noted.
	Concern regarding the length of internal turbine rows and that low visibility can be an issue for recreational craft.	East Anglia ONE North will have large spacing between turbines (see *Table 4.2*) and markings to allow recreational craft to safely navigate the windfarm.
	The level of AIS usage by recreational craft further inshore will be low and contribute to the variation in recreational traffic between seasons.	Additional data sources have been utilised to assess the level of recreational activity such as the RYA Coastal Atlas (RYA 2016).
	Queried the risk to recreational craft involved in sailing races.	Embedded mitigation measures such as marine coordination and compliance with International Regulations for Preventing Collisions at Sea (COLREGS) will reduce the risk to recreational craft. Multiple windfarms are operational in key recreational areas with no reported effects on sailing vessels to date.
	Queried which ports will be used for operations and the level of marine traffic which could be expected.	This will be determined post consent. Windfarm vessels will be managed by marine coordination to ensure they avoid third party vessels (with consideration of COLREGS).
Brown & May Marine	Potting and whelking activity is more likely to occur at East Anglia TWO than East Anglia	Noted.

Consultee	Comment	East Anglia ONE North Approach
	ONE North due to the presence of wrecks. Pots can be left for two to three days and should be clearly marked but this is not always the case. Angling charter vessels are also common out of Lowestoft and Southwold.	

6 Data Sources

40. This section lists the data sources that have been used as input to this NRA, and hence the subsequent FSA. The primary input was the marine traffic surveys, undertaken to assess the baseline traffic patterns within the vicinity of the East Anglia ONE North windfarm site. Further details of the marine traffic surveys are presented in section 12 (which establishes the marine traffic baseline), with other relevant data sources considered listed below (used to supplement the marine traffic baseline, and to establish the navigational feature baseline in section 8 of this NRA):

- Marine incident data from Marine Accident Investigation Branch (MAIB) (2005 to 2014) and maritime incident data from the Royal National Lifeboat Institution (RNLI) (2005 to 2014). Although all UK commercial vessels are required to report accidents to the MAIB, non-UK vessels do not have to report unless they are in a UK port or within 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;
- AIS marine traffic data for DFDS vessels recorded from local Met Mast (1st January to 31st December 2017);
- Admiralty Sailing Directions – Dover Strait Pilot, NP28 United Kingdom Hydrographic Office (UKHO), 2017
- Admiralty Sailing Directions – North Sea West Pilot, NP54 United Kingdom Hydrographic Office (UKHO), 2016;
- UKHO Admiralty Charts (notably charts 1408, 1504, 1610, and 1630)
- Department for Transport (DfT) Port Vessel Arrivals (2018);
- DFDS Seaways Vessel Routeing (2018);
- RYA UK Coastal Atlas of Recreational Boating (2016); and
- Metocean data – Health and Safety Executive (HSE) Weather Database (see section 9 for more details).

7 Lessons Learned

41. There is considerable benefit to developers in the sharing of lessons learned within the offshore industry. The NRA, and in particular the hazard assessment, includes general consideration for lessons learned and expert opinion from previous offshore windfarm projects and other sea users.

42. These include:

- Anatec. (2012) NRA: East Anglia ONE Offshore Windfarm, Anatec: Aberdeen;
- Anatec. (2015) NRA: East Anglia THREE Offshore Windfarm, Anatec: Aberdeen;
- Anatec. (2017) Norfolk Vanguard NRA, Anatec: Aberdeen;
- MCA. (2005) Offshore Wind Farm Helicopter SAR – Trials Undertaken at the North Hoyle Wind Farm Report of helicopter SAR Trials undertaken with Royal Air Force Valley 'C' Flight 22 Squadron on March 22nd 2005, Southampton: MCA;
- Nautical Offshore Renewable Energy Liaison (NOREL Group). (2005) A Report compiled by the Port of London Authority based on experience of the Kentish Flats Wind Farm Development, NOREL Work Paper, WP4 (2nd NOREL);
- Renewables UK. (2014 issue 2) Guidelines for Health and Safety in the Wind Energy Industry, Renewables UK: London;
- RYA and CA. (2004) Sharing the Wind – Identification of recreational boating interests in the Thames Estuary, Greater Wash and North West (Liverpool Bay), Southampton: RYA;
- The Crown Estate. (2012) Strategic Assessment of Impacts on Navigation of Shipping and Related Effects on Other Marine Activities Arising from the Development of Offshore Wind Farms in the UK REZ, The Crown Estate: London;
- SPR and Vattenfall. (2012) East Anglia ONE Offshore Windfarm ES Volume 2 Offshore, Chapter 15 – Shipping and Navigation, SPR: Glasgow; and
- SPR and Vattenfall. (2015) East Anglia THREE ES Volume 1 Chapter 15 Shipping and Navigation, SPR: Glasgow.

8 Existing Environment

8.1 Introduction

43. This section presents the navigational baseline assumed within this NRA which has been established based on the data sources outlined in section 6. The assessment is primarily based on the contents of the Admiralty Sailing Directions (UKHO 2016) and Admiralty Charts covering the East Anglia sea area.

44. Each of the navigational features within the vicinity of the East Anglia ONE North windfarm site and offshore cable corridor is discussed in the following subsections.

8.2 Other Windfarm Projects

45. Other UK windfarms within and in the vicinity of the shipping and navigation study area are shown in *Figure 8.1*. A summary of the status of the projects shown is then given in *Table 8.1*. For the purpose of this NRA, windfarms under construction or operational are considered baseline. All other projects have only been considered cumulatively. This is discussed further in section 19, which also provides a full list of the projects considered cumulatively, including transboundary projects.

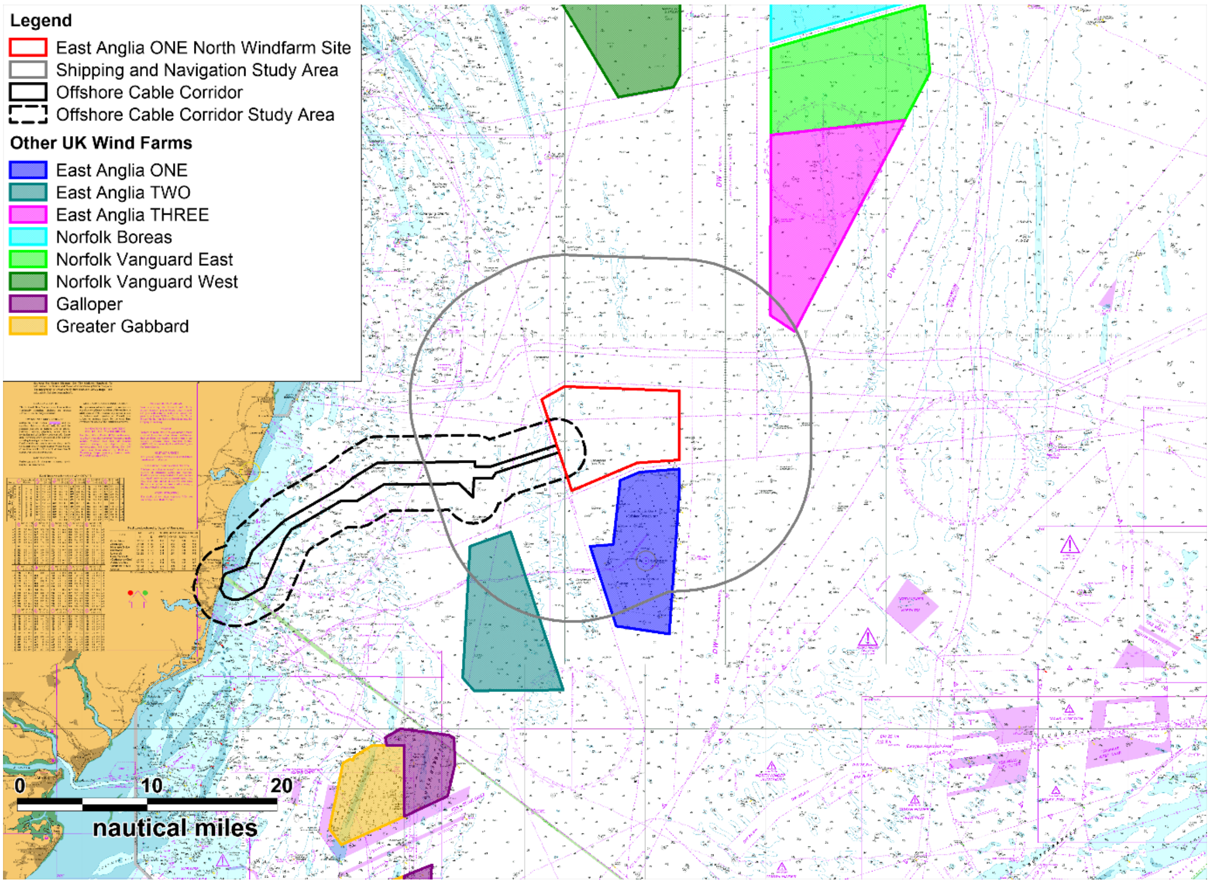

Figure 8.1 Other UK Windfarms

Table 8.1 Windfarm Status Summary

Windfarm	Status
East Anglia ONE	Under Construction
East Anglia TWO	Concept/Early Planning
East Anglia THREE	Consented
Norfolk Boreas	Pre Consent
Norfolk Vanguard	Application Submitted
Galloper	Operational
Greater Gabbard	Operational

8.3 IMO Routeing Measures

46. The IMO designated routeing measures within the vicinity of the East Anglia ONE North windfarm site are shown in *Figure 8.2*. The key measure (in terms of the project) is the DWR which intersects the shipping and navigation study area, and passes the East Anglia ONE North windfarm site maintaining a one nautical mile separation distance.

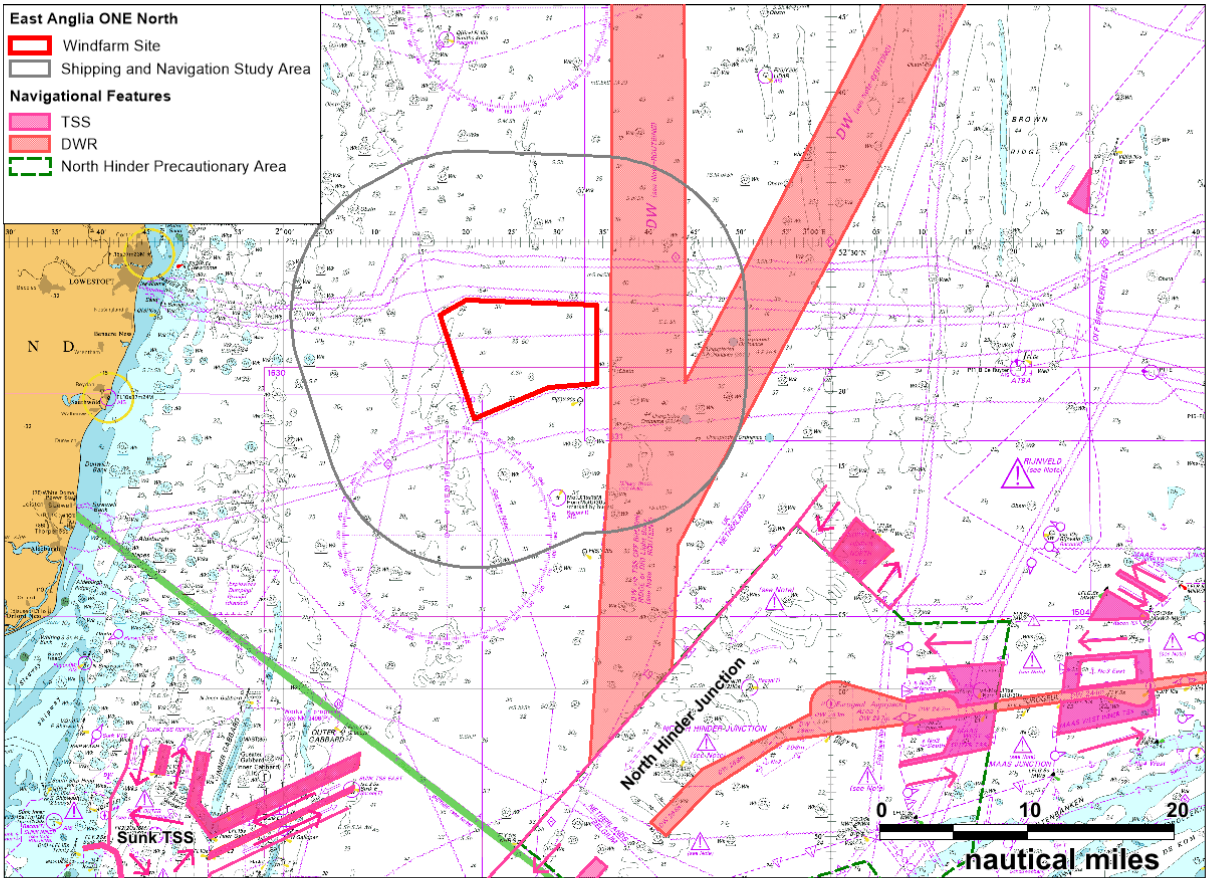

Figure 8.2 IMO Routeing Measures

8.4 Aids to Navigation

47. The Aids to Navigation (AtoN) within the shipping and navigation study area and the offshore cable corridor study area are shown in *Figure 8.3*. The buoys marking the East Anglia ONE construction site have been included for reference given that at the time of writing they are charted, however it should be noted that these are temporary measures which will be removed once operational lighting and marking is commissioned.

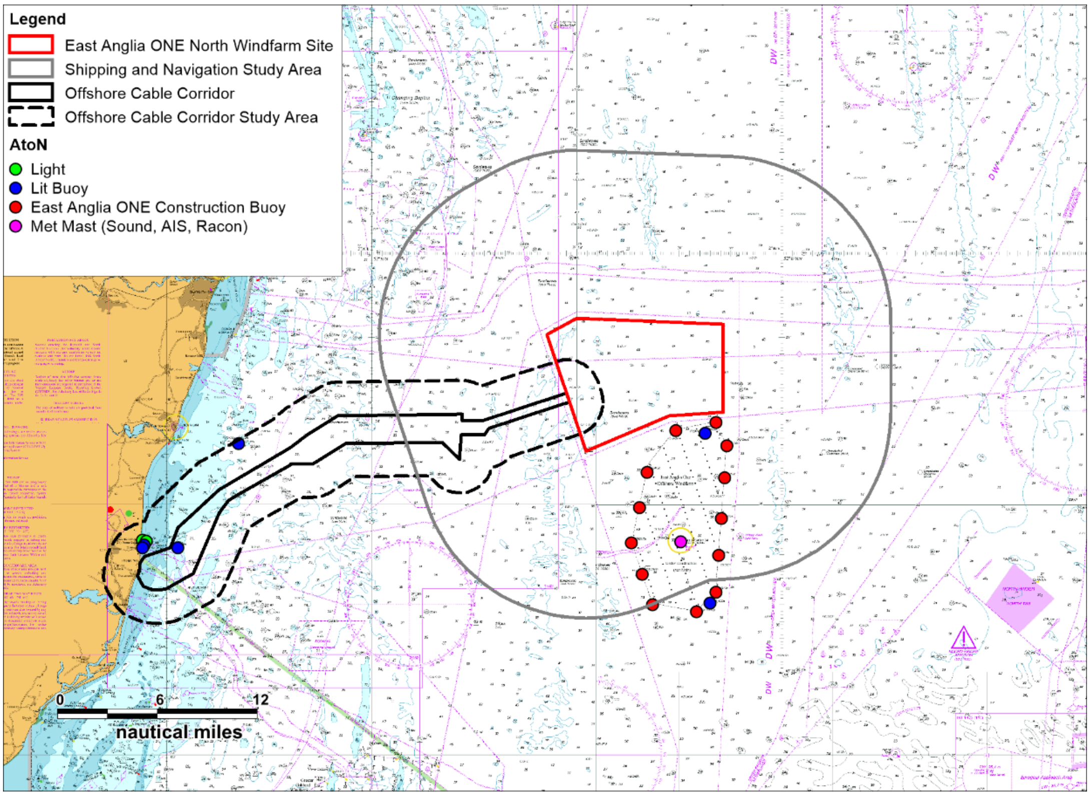

Figure 8.3 AtoN Overview

8.5 Anchorage Areas

48. There are no charted anchorages within the study areas, nor does the Admiralty Sailing Directions (UKHO 2016) specifically indicate any areas within the study areas which are suitable for anchoring. It should be considered that vessels are free to anchor where they choose, assuming there are no charted restrictions.

49. An oil transhipment area was identified within the offshore cable corridor study area, located within 2km of the offshore cable corridor itself as shown in *Figure 8.4*. Whilst not an anchorage in of itself, tankers considered likely to be associated with this area were observed to anchor nearby within the marine traffic assessment (see section 12.13 for further details).

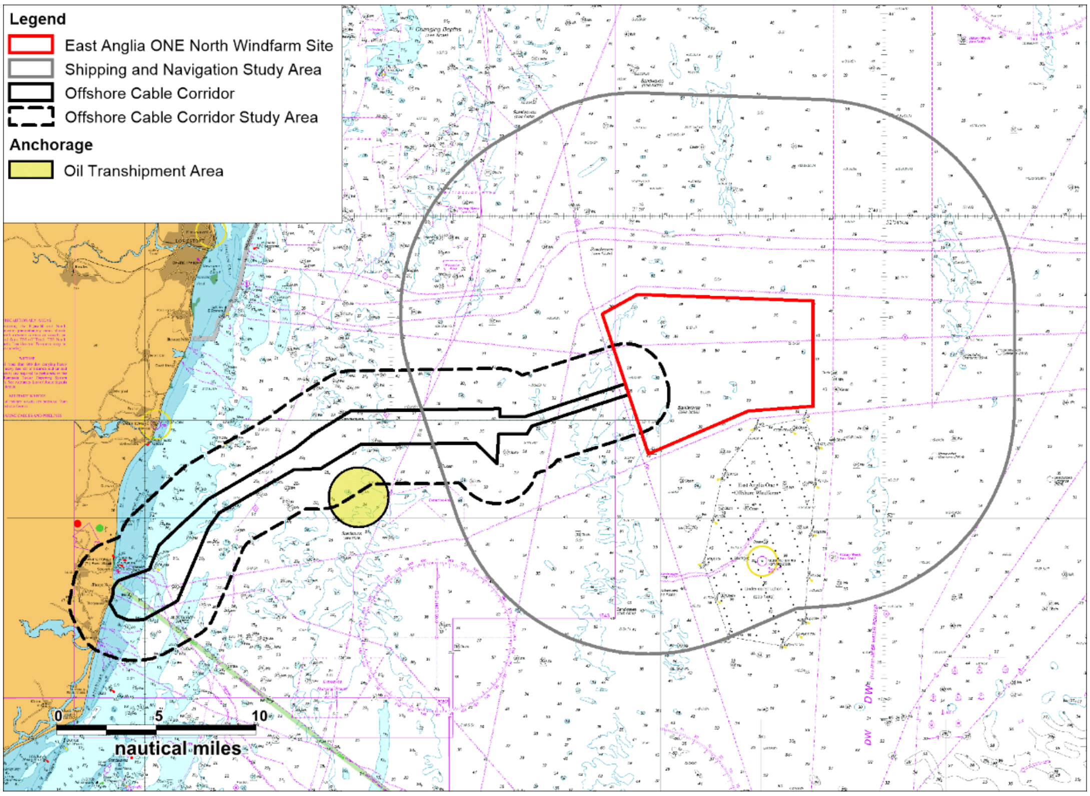

Figure 8.4 Southwold Oil Transhipment Area

8.6 Ports

50. Major ports and harbours in the vicinity of the East Anglia ONE North windfarm site are Southwold, Lowestoft and Great Yarmouth. The numbers of vessel arrivals to the principal ports in the coastal area (DfT, 2018) are presented in *Figure 8.5*. It should be noted that there was no data available for the port of Southwold. These statistics exclude some movements which occur within the port or harbour limits, however they are considered to provide a good indication of the relative traffic levels and trends.

51. Lowestoft is the closest harbour to the East Anglia ONE North windfarm site, located approximately 19.7nm west of the East Anglia ONE North windfarm site. Southwold is the closest port to the offshore cable corridor, approximately 4nm north-west.

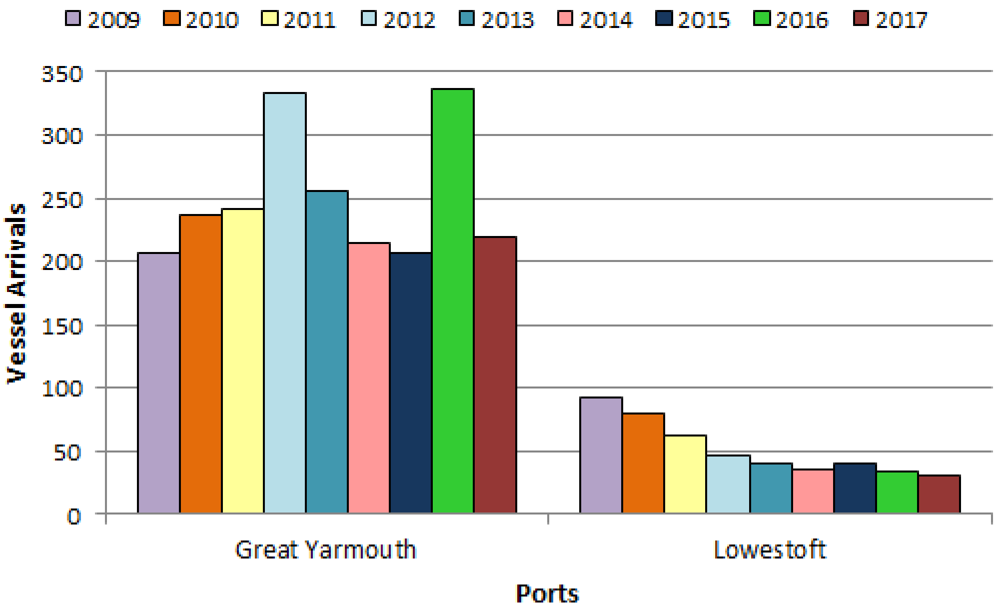

Figure 8.5 Vessel Arrivals to Principal Ports (2009 to 2017) (DfT, 2018)

8.7 Ministry of Defence Practise and Exercise Areas

52. There are no Ministry of Defence (MoD) Practice and Exercise Areas (PEXAs) within or in the immediate vicinity of either study area. The closest is located in excess of 14nm from the offshore cable corridor, and is utilised by the Royal Navy for marine counter measures.

8.8 Oil and Gas Infrastructure

51. The Bacton to Zeebrugge natural gas pipeline intersects the shipping and navigation study area and passes close to the western boundary of the East Anglia ONE North windfarm site (approximately 0.3nm). This is presented in Figure 8.6.

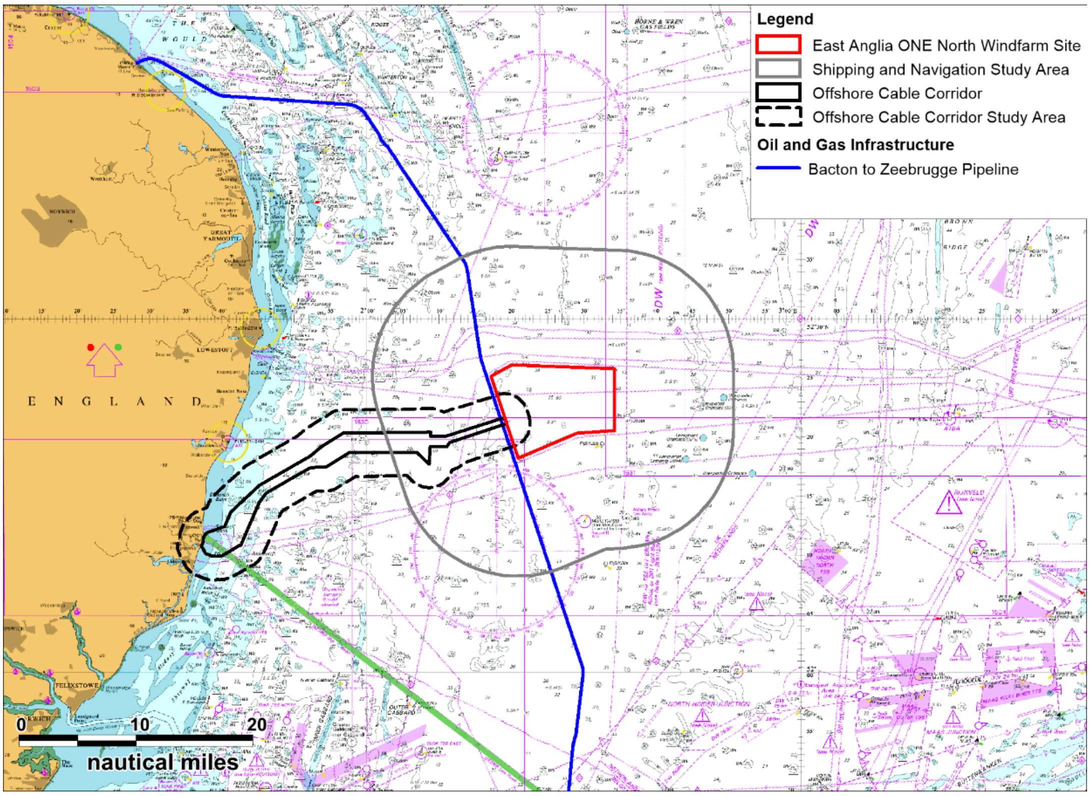

Figure 8.6 Oil and Gas Infrastructure

8.9 Marine Aggregate Dredging Areas

53. The marine aggregate dredging area within the vicinity of the East Anglia ONE North windfarm site are shown in *Figure 8.7*. Included are BMAPA dredger transit routes, which provide an indication of dredger routeing between the marine aggregate dredging areas and home ports.

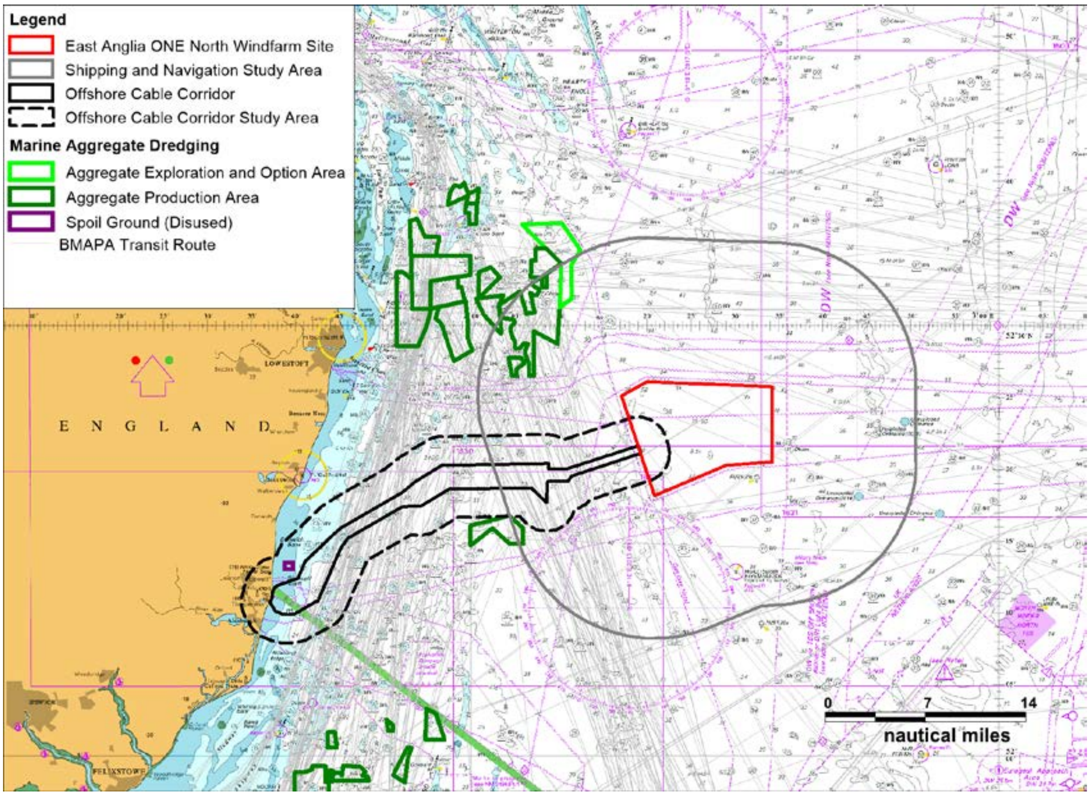

Figure 8.7 Marine Aggregate Dredging

54. A total of six marine aggregate dredging areas intersect the shipping and navigation study area (one of which also intersects the offshore cable corridor study area). However, no marine aggregate dredging areas intersect either the East Anglia ONE North windfarm site or the offshore cable corridor.

55. A spoil ground is charted near the offshore cable corridor landfall, however a note on the charts states that it is disused.

8.10 Cables

56. The cables in the vicinity of the East Anglia ONE North windfarm site and offshore cable corridor are presented in *Figure 8.8*.

57. There are eight telecommunication cables recorded within the shipping and navigation study area. Of these, one intersects the East Anglia ONE North windfarm site and three intersect the offshore cable corridor. It is noted that the East Anglia ONE offshore cable corridor is also located within the shipping and navigation study area.

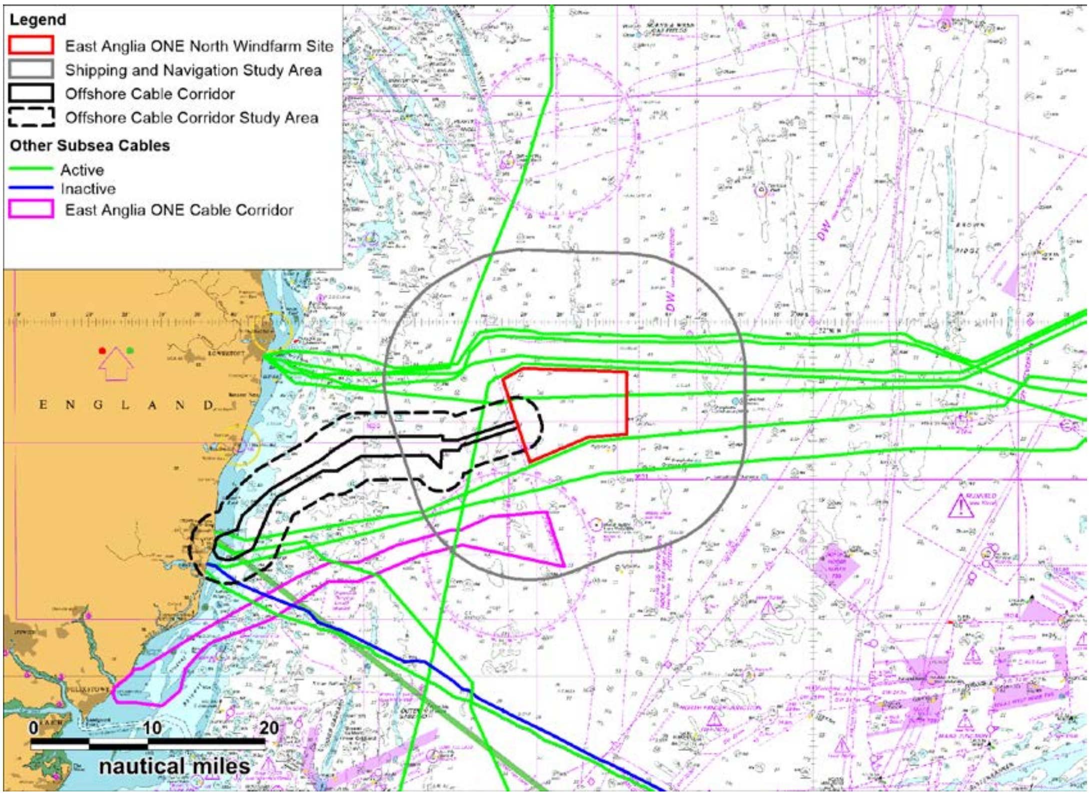

Figure 8.8 Sub-sea Cables

8.11 Marine Environmental High Risk Areas

58. There are no Marine Environmental High Risk Areas (MEHRAs) in the immediate vicinity of the East Anglia ONE North windfarm site, with the nearest being those associated with Harwich and Felixstowe to the south. The MEHRAs are designated as such on the basis of a medium concentration of vulnerable seabirds and a range of fishing and amenity / economic activities.

8.12 Marine Wrecks

59. There are 99 charted wrecks within the study area with one charted wreck within the East Anglia ONE North windfarm site itself as presented in *Figure 8.9*. There are eight charted wrecks within the offshore cable corridor. There are not anticipated to be any navigational safety risks associated with these wrecks. It should be noted that a military wreck is located within the shipping and navigation study area, approximately 7.6nm south of the East Anglia One North windfarm site.

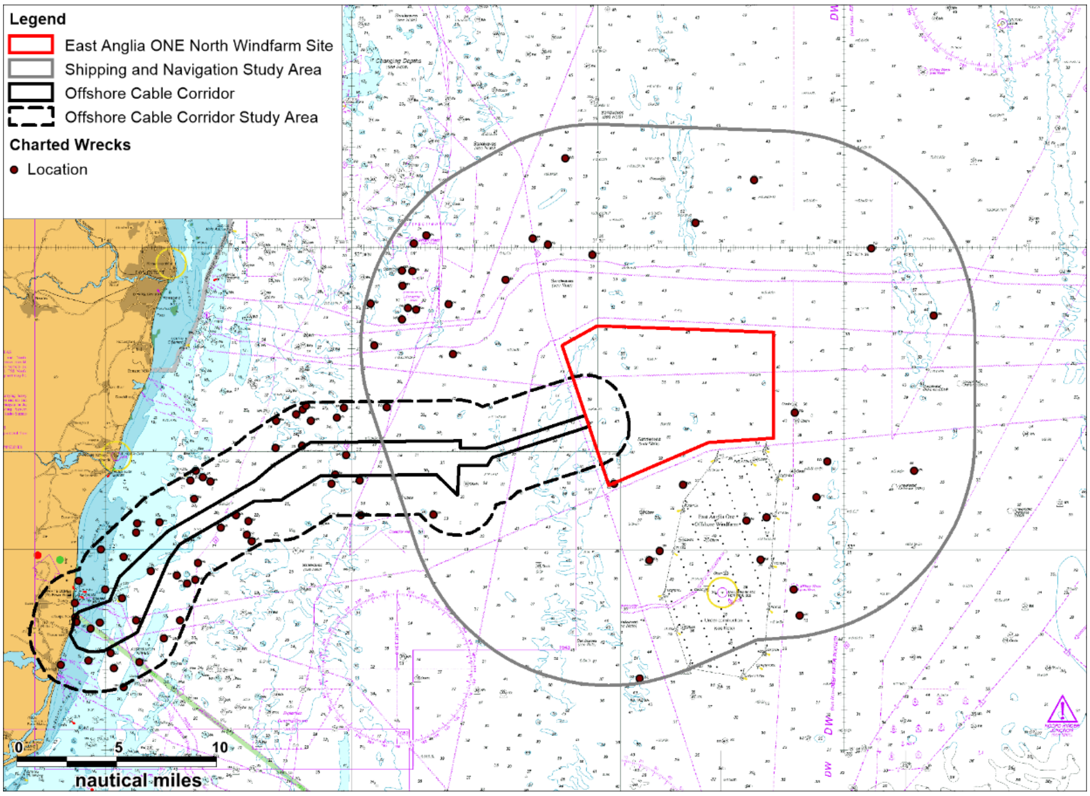

Figure 8.9 Charted Wrecks

9 Metocean Data

9.1 Introduction

60. According to the Admiralty Sailing Directions (UKHO 2016), the East Anglia ONE North windfarm site has a generally mild climate with winds mostly from between the south and north-west. Strong winds and gales are common in the winter months and, in summer, gales become less frequent although winds are often fresh or strong.

61. During winter, rain and snow are common, although precipitation amounts are not large. There is little seasonal variation in rainfall and the summer months are often cloudy and cool. Fog occasionally affects the east coast, particularly in the north.

62. 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.

9.2 Wind Direction

63. Wind direction proportions for the area are presented in *Table 9.1*. The prevalent wind direction was from the southwest.

Table 9.1 Wind Direction Proportions

Wind Direction (°)	Proportion (%)
0	6.8%
30	6.7%
60	6.2%
90	5.3%
120	5.4%
150	6.5%
180	8.8%
210	13.5%
240	14.4%
270	11.3%
300	8.3%
330	6.8%

9.3 Sea State

64. Sea state proportions for the area are presented in *Table 9.2*. The prevalent sea states were calm and moderate.

Table 9.2 Sea State Proportions

Sea State	Proportion (%)
Calm (<1m)	50%
Moderate (1–5m)	50%
Severe (>5m)	0%

9.4 Visibility

65. The HSE Weather Database assumes the proportion of poor visibility (defined as the proportion of a year where the visibility can be expected to be less than 1km) is 3%. This is based upon information available within the Admiralty Sailing Directions for the region.

9.5 Tidal Streams

66. Tidal data used as input to the collision and allision modelling is based upon the information available from UK Admiralty charts 1543 and 1504. *Table 9.3* presents the peak flood and ebb direction and speed values for each of the charted tidal diamonds in proximity to the East Anglia ONE North windfarm site.

Table 9.3 UK Admiralty Chart Tidal Data

Tidal Diamond and Chart	Flood		Ebb	
	Direction (°)	Speed (knots)	Direction (°)	Speed (knots)
C (1543)	175	2.2	356	2.1
M (1543)	179	2.8	13	2.8
P (1543)	184	2.2	6	2.3
R (1543)	188	3.1	9	2.4
S (1543)	194	2.7	15	2.8
S (1504)	198	1.8	20	1.8
T (1504)	192	2.0	17	1.8
U (1543)	197	2.4	19	2.4
U (1504)	205	1.5	17	1.5
V (1504)	186	1.7	8	1.8

10 Emergency Response

10.1 Introduction

67. This section summarises the existing SAR resources in proximity to the offshore development area. It is noted that the East Anglia ONE windfarm site would be required to consider self-help capabilities for its own personnel and vessels.

10.2 SAR Helicopters

68. In March 2013, the Bristow Group were awarded the contract by the MCA (as an executive agency of 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 to the East Anglia ONE North windfarm site is the Lydd base which is approximately 97nm to the south-west. This base operates two Agusta Westland AW189 aircraft.

10.3 RNLI

69. The RNLI is organised into six divisions, with the relevant region for the offshore development area being the East 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 East Anglia ONE North windfarm site it is likely that ALBs from Lowestoft would respond to an incident in proximity to the offshore development area. Locations of RNLI lifeboat stations along the south-east coast of England and details of the types of lifeboats operating out of these stations are given in *Table 10.1*. At each station, lifeboats are available on a 24-hour basis throughout the year.

Table 10.1 UK Lifeboats Operated from Southern North Sea RNLI Stations

Station	Lifeboats	ALB Class	ILB Class	Approximate Distance to East Anglia ONE North windfarm site (nm)
Lowestoft	ALB	Shannon	-	17
Southwold	ILB	-	B Class Atlantic	16.8
Aldeburgh	ALB and ILB	Mersey	D Class	19.3
Great Yarmouth & Gorleston	ALB and ILB	Trent	B Class Atlantic	21.8
Harwich	ALB and ILB	Severn	B Class Atlantic	31.5

10.4 HM Coastguard Stations

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

71. The HM Coastguard 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.

72. All of the MCA's operations, including SAR, are divided into three geographical regions. The England Region covers the south-east coast of England, and therefore covers the area around the East Anglia ONE North windfarm site.

73. Each region is divided into four districts with its own CGOC, which coordinates the SAR response for maritime and coastal emergencies within its district boundaries. The nearest rescue coordination centre to the offshore development area is the CGOC based in Dover, located approximately 80nm from the East Anglia ONE North windfarm site.

10.5 Third Party Assistance

74. Companies operating offshore typically have resources of vessels, helicopters and other equipment available for normal operations that can assist with emergencies offshore. Alongside that all vessels under 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.

75. Notably, vessels associated with the nearby offshore development area, and the Galloper Offshore Windfarm would therefore be able to offer assistance to vessels in trouble within the area.

11 Maritime Incidents

11.1 Introduction

76. This section provides details of marine incidents that have occurred within the vicinity of the offshore development area over the latest available ten year period data. 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.

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

11.2 MAIB

78. 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.

11.2.1 East Anglia ONE North Windfarm Site

79. The locations of accidents, injuries and hazardous incidents reported to the MAIB within the shipping and navigation study area for the ten year period between January 2005 and December 2014 are presented in *Figure 11.1* and are colour-coded by incident type. It should be noted that the MAIB aim for 97% accuracy in reporting locations of incidents.

80. A total of 15 unique incidents were reported within the shipping and navigation study area, corresponding to an average of approximately two incidents per year. None of the incidents occurred within the East Anglia ONE North windfarm site.

81. The most frequently recorded incident type was “Machinery Failure”, representing 33% of the total number of incidents.

82. *Figure 11.2* presents the same set of recorded incidents colour-coded by vessel type. Fishing vessels were the most frequently recorded casualty types, representing approximately 27% of the total number of incidents throughout the ten year period.

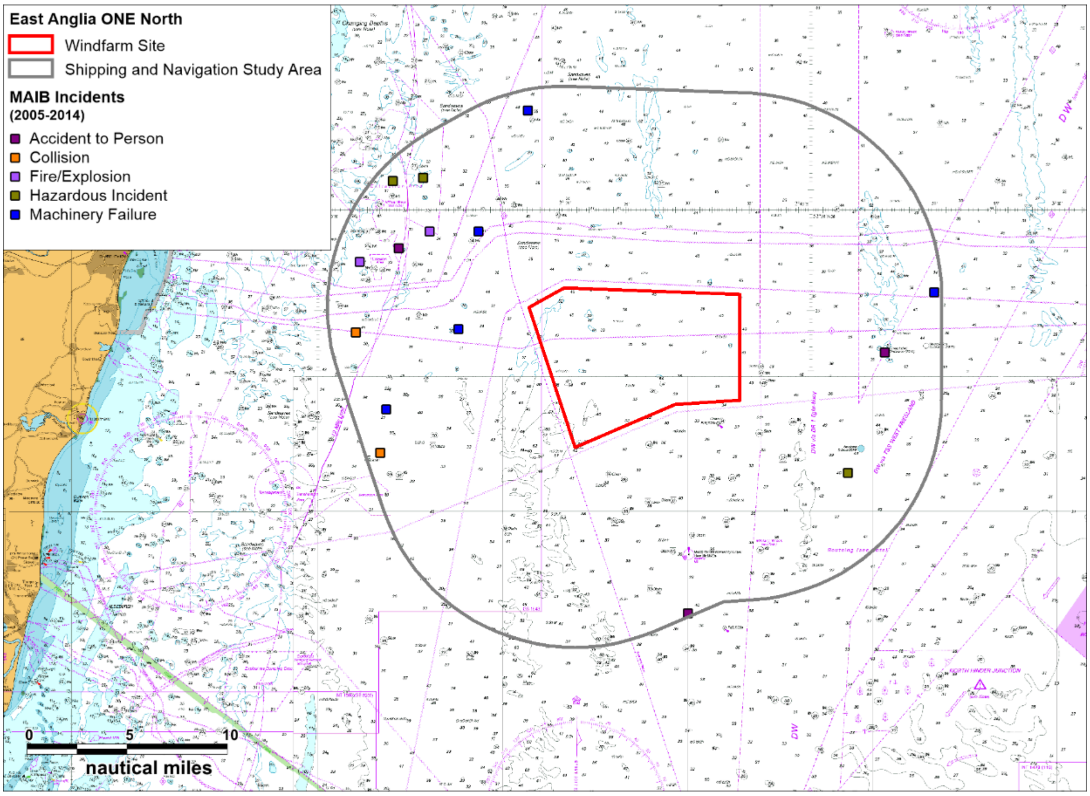

Figure 11.1 MAIB Incident Locations by Type – Windfarm Site (2005-2014)

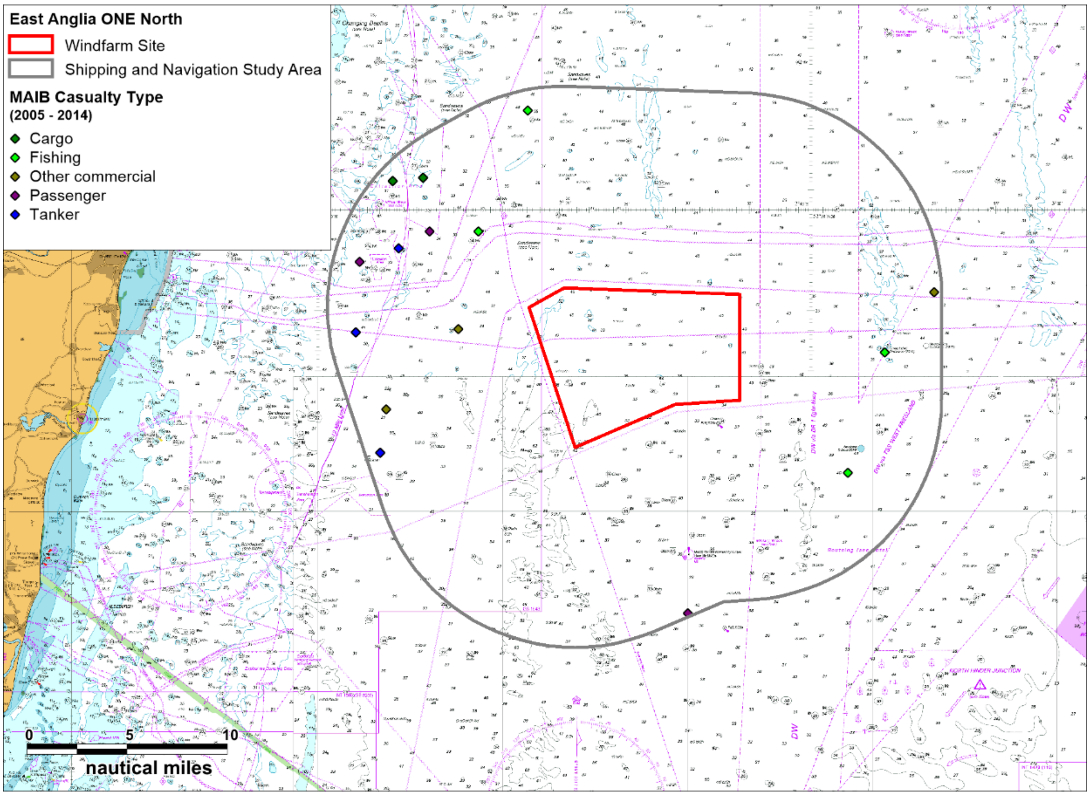

Figure 11.2 MAIB Incident Locations by Casualty Type – Windfarm Site (2005-2014)

83. The locations of accidents, injuries and hazardous incidents reported to the MAIB within the offshore cable corridor study area for the ten year period between January 2005 and December 2014 are presented in *Figure 11.3* and are colour-coded by incident type. It should be noted that the MAIB aim for 97% accuracy in reporting locations of incidents.

84. A total of 12 unique incidents were reported within the offshore cable corridor study area, corresponding to an average of approximately one incident per year. Four of the incidents occurred within the offshore cable corridor.

85. The most frequently recorded incident type was "Machinery Failure", representing 50% of the total number of incidents.

86. *Figure 11.4* presents the same set of recorded incidents colour-coded by vessel type. Fishing vessels were the most frequently recorded casualty types, representing approximately 42% of the total number of incidents throughout the ten year period.

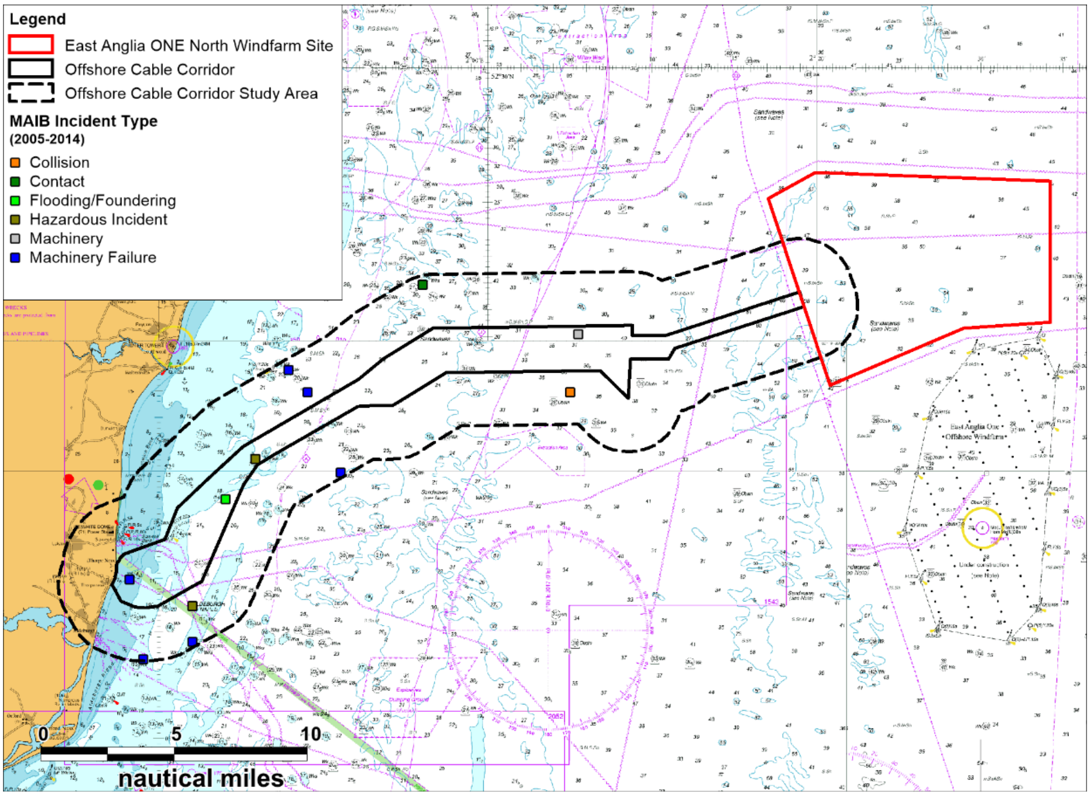

Figure 11.3 MAIB Incident Locations by Type – Offshore Cable Corridor (2005-2014)

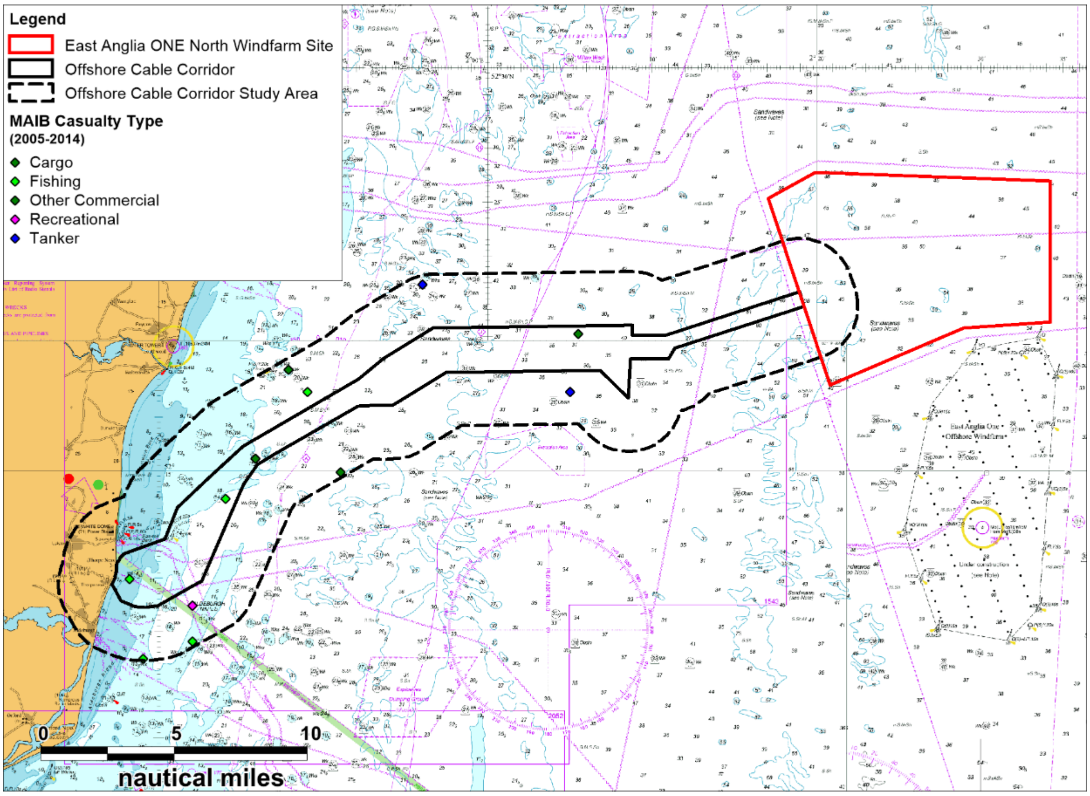

Figure 11.4 MAIB Incident Locations by Casualty Type – Offshore Cable Corridor (2005-2014)

11.3 RNLI

11.3.1 East Anglia ONE North Windfarm Site

87. Data on RNLI lifeboat responses within the offshore windfarm and study area for the ten year period between 2005 and 2014 were analysed, with cases of a hoax or false alarm excluded. The results are presented below. It should be noted that this analysis only includes incidents to which the RNLI were alerted, and subsequently responded to.

88. The locations of incidents responded to by the RNLI (excluding hoaxes and false alarms) within the shipping and navigation study area for the ten year period between January 2005 and December 2014 are presented in *Figure 11.5* and are colour-coded by incident type.

89. A total of 24 launches were reported within the shipping and navigation study area, corresponding to an average of two incidents every year. One of the launches was to a location within the East Anglia ONE North windfarm site.

90. The most frequently recorded incident type was "Machinery Failure", representing approximately 46% of the total number of incidents. Recreational vessels were the

most frequently recorded casualty types, representing 67% of the total number of incidents throughout the ten year period analysed.

91. *Figure 11.6* presents the same set of launch locations colour-coded by vessel type.

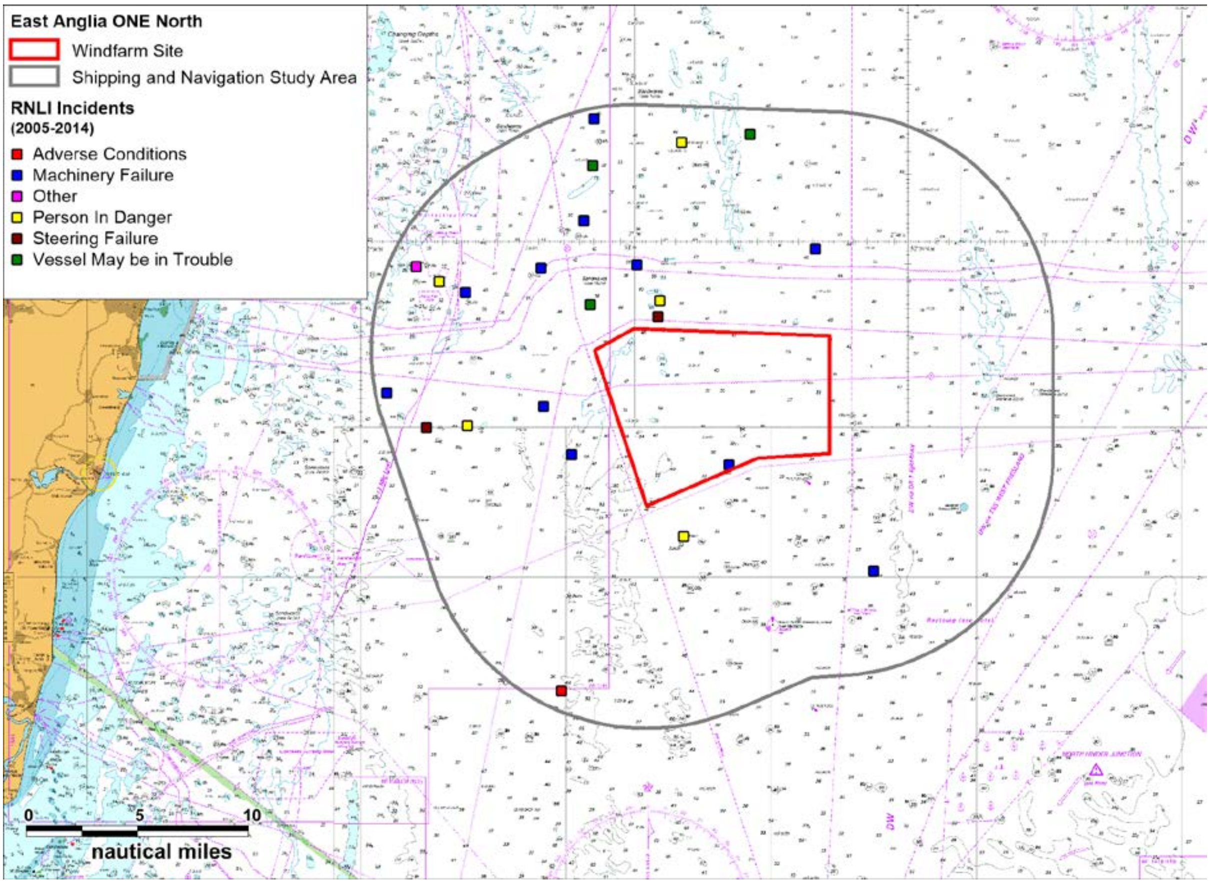

Figure 11.5 RNLI Incident Locations by Incident Type within Shipping and Navigation Study Area (2005 – 2014)

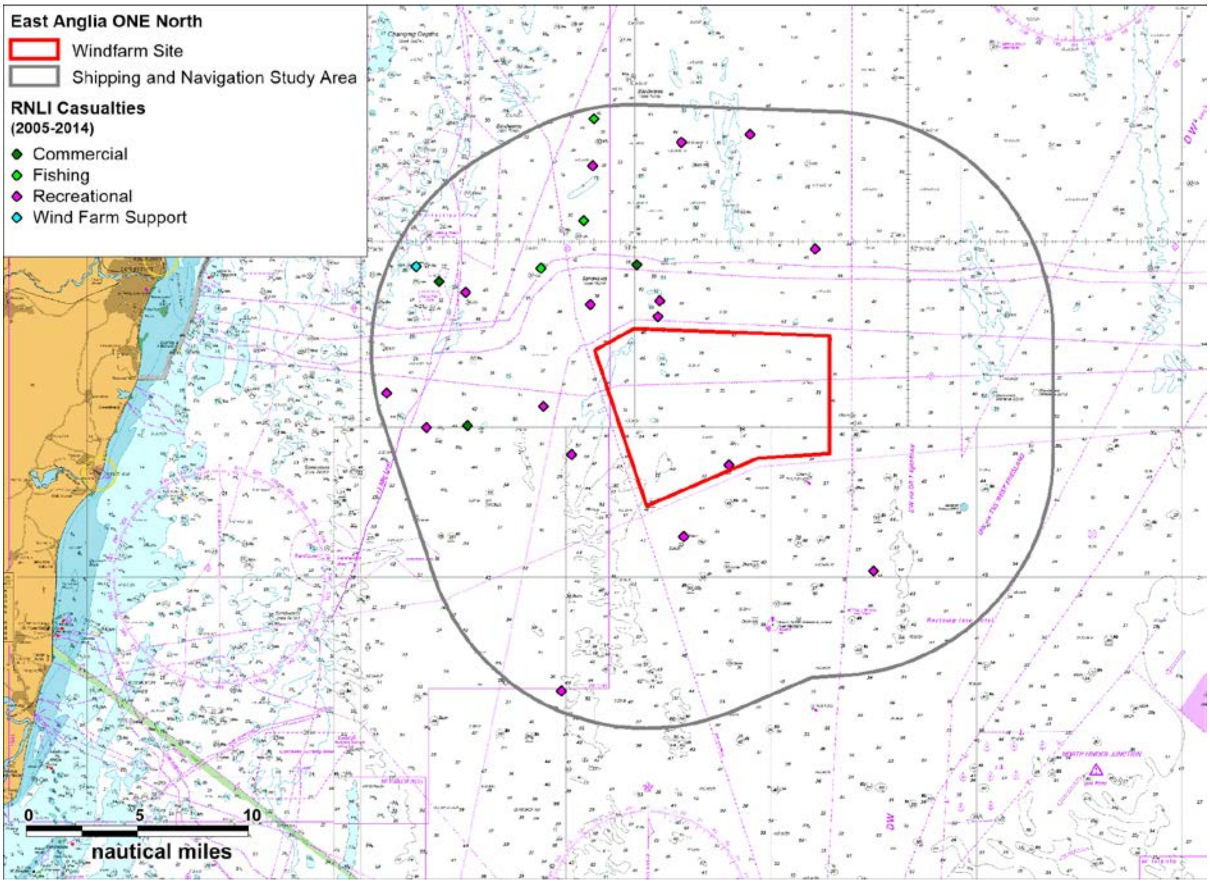

Figure 11.6 RNLI Incident Locations by Casualty Type within Shipping and Navigation Study Area (2005 – 2014)

11.3.2 Offshore Cable Corridor

92. Data on RNLI lifeboat responses within the offshore cable corridor study area for the ten year period between 2005 and 2014 were analysed, with cases of a hoax or false alarm excluded. The results are presented below. It should be noted that this analysis only includes incidents to which the RNLI were alerted, and subsequently responded to.

93. The locations of incidents responded to by the RNLI (excluding hoaxes and false alarms) within the offshore cable corridor study area for the ten year period between January 2005 and December 2014 are presented in *Figure 11.7* and are colour-coded by incident type.

94. A total of 61 launches were reported within the offshore cable corridor study area, corresponding to an average of six incidents every year. Of the launches recorded, 15 were within the offshore cable corridor.

95. The most frequently recorded incident type was "Machinery Failure", representing approximately 43% of the total number of incidents. Recreational vessels were the

most frequently recorded casualty types, representing 46% of the total number of incidents throughout the ten year period analysed.

96. *Figure 11.8* presents the same set of launch locations colour-coded by vessel type.

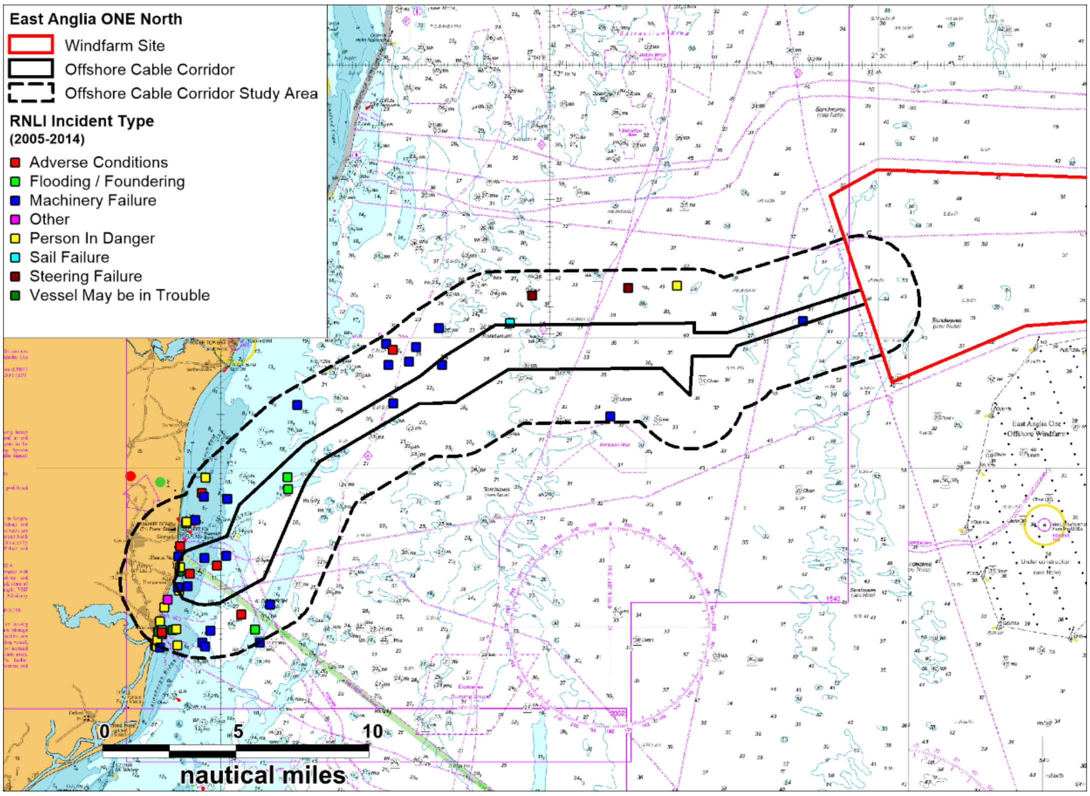

Figure 11.7 RNLI Incident Locations by Incident Type within Offshore Cable Corridor Study Area (2005 – 2014)

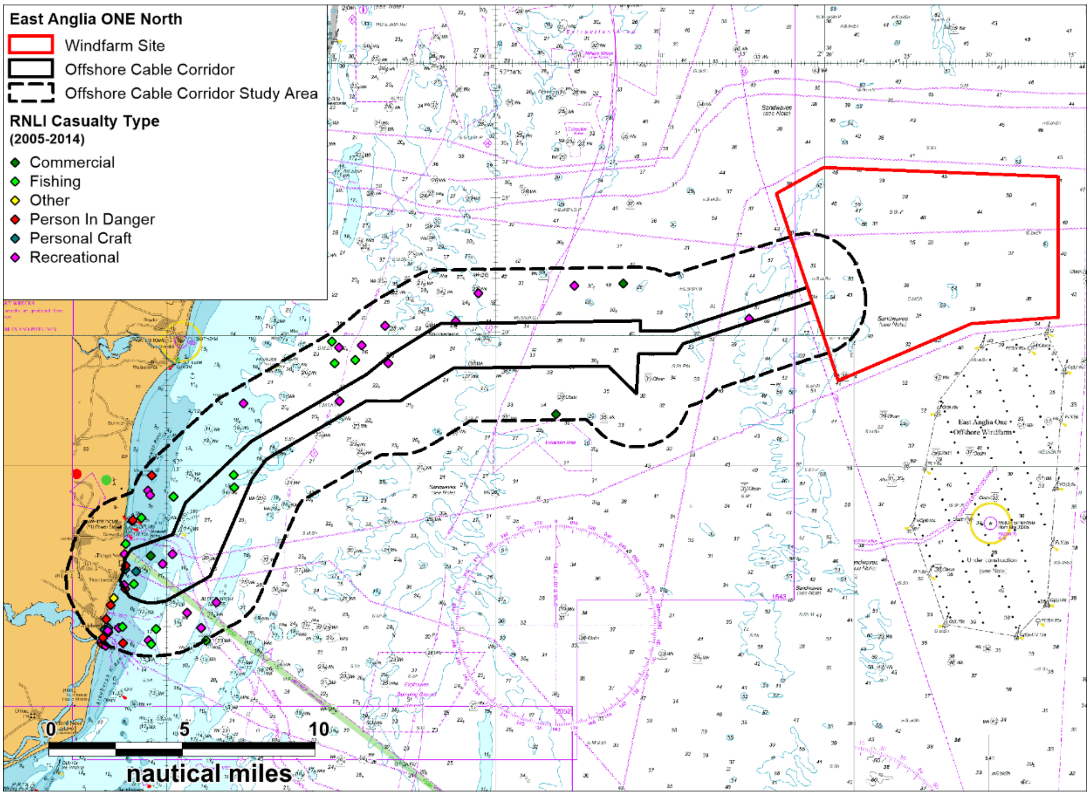

Figure 11.8 RNLI Incident Locations by Casualty Type within Offshore Cable Corridor Study Area (2005 – 2014)

12 Marine Traffic Survey - East Anglia ONE North Windfarm Site

12.1 Introduction

97. This section presents shipping data in relation to the East Anglia ONE North windfarm site. A summer survey was undertaken which recorded marine traffic data via AIS and Radar collection, and AIS data for a winter period was recorded from a Met Mast to account for seasonal variations. The survey periods are as follows:

- Summer 2018
  - 12th July to 14th July 2018;
  - 19th July to 29th July 2018;
- Winter 2017
  - 20th November to 3rd December 2017.

98. In total the marine traffic survey consists of 14 days AIS and Radar data and 14 days of AIS only data, giving a combined total of 28 days.

99. During the summer marine traffic survey, the majority of vessels were recorded via AIS. AIS is now fitted on all commercial vessels operating in UK waters over 300 Gross Tonnage (GT) engaged on international voyages, over 500GRT on domestic voyages, passenger vessels irrespective of size built on or after 1 July 2002 and fishing vessels over 15m. Vessels not broadcasting via AIS were captured by Radar and visual observation wherever possible.

100. The summer survey was carried out by the *Northern Viking* whilst stationed on site at the East Anglia ONE North windfarm site. *Figure 12.1* presents the tracks for the survey vessel during the survey period.

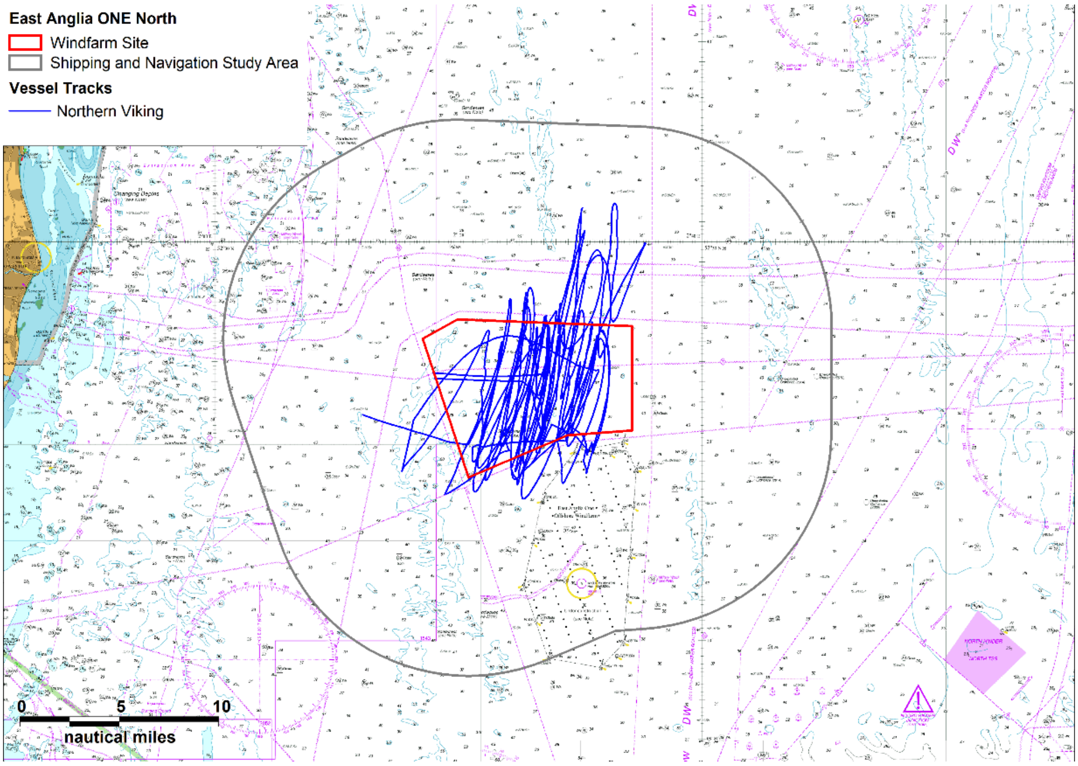

Figure 12.1 Overview of Survey Vessel Tracks within East Anglia ONE North Windfarm Site (14 Days Summer 2018)

101. Plots of vessel tracks recorded within the shipping and navigation study area during the summer period and winter period, colour-coded by vessel type, are presented in *Figure 12.2* and *Figure 12.3*, respectively.

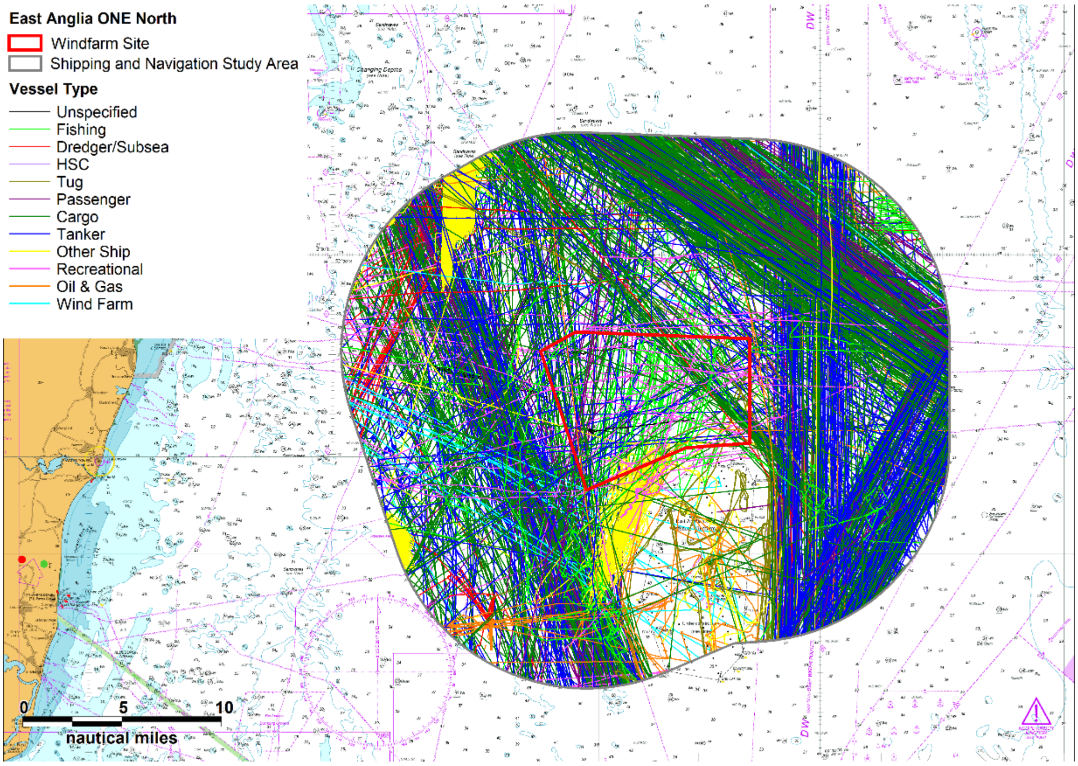

Figure 12.2 Overview of AIS and Radar Data within Shipping and Navigation Study Area (14 Days Summer 2018)

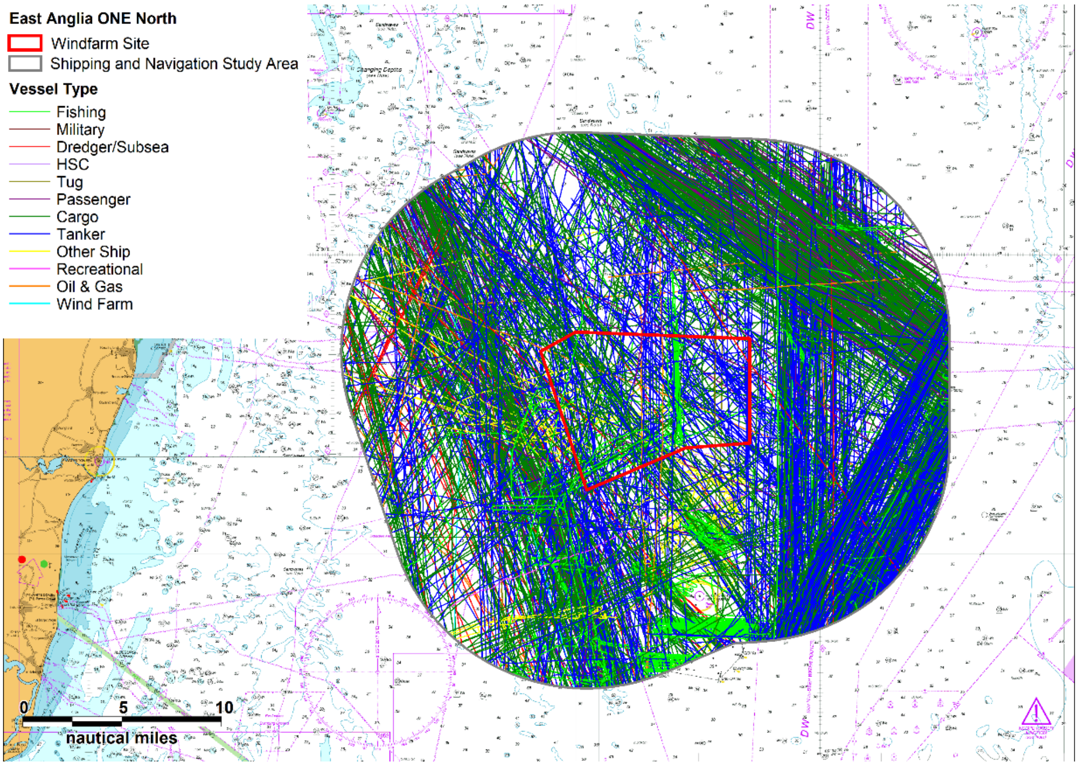

Figure 12.3 Overview of AIS Data within Shipping and Navigation Study Area (14 Days Winter 2017)

102. A number of tracks recorded during the summer survey were classified as temporary (non-routine), such as the tracks of the dedicated survey vessel *Northern Viking* and other vessels working within the East Anglia ONE North site. Temporary traffic was also recorded during the winter period, such as vessels engaged in survey operations or guard duties. These have been excluded from further analysis.

103. Plots of vessel tracks recorded within the shipping and navigation study area during the summer period and winter period, colour-coded by vessel type and excluding temporary traffic are presented in *Figure 12.4* and *Figure 12.5*, respectively. Throughout the summer period, 99% of tracks were recorded on AIS and 1% on Radar.

104. It should be considered when viewing these figures that at vessels were observed to largely be avoiding the East Anglia ONE windfarm site during the summer survey; however such deviations were not yet being utilised during the winter survey. The temporary buoyage marking the East Anglia ONE windfarm site during its construction is shown in section 8.4.

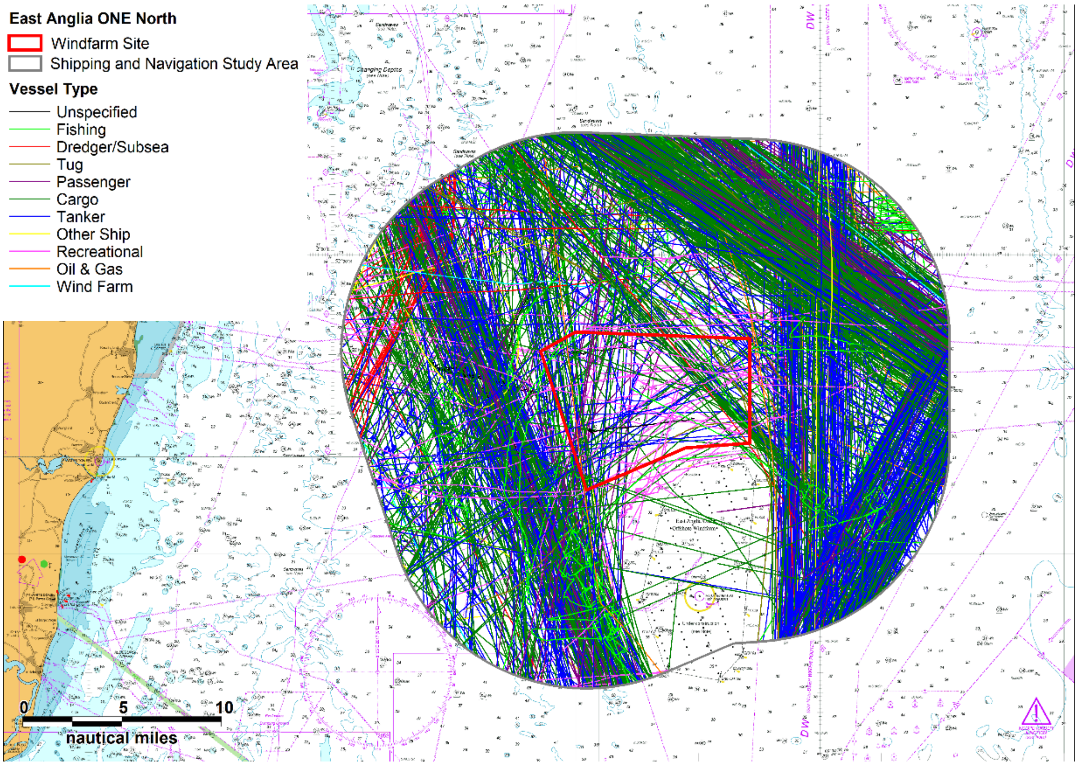

Figure 12.4 Overview of AIS and Radar Data within Shipping and Navigation Study Area Excluding Temporary Tracks (14 Days Summer 2018)

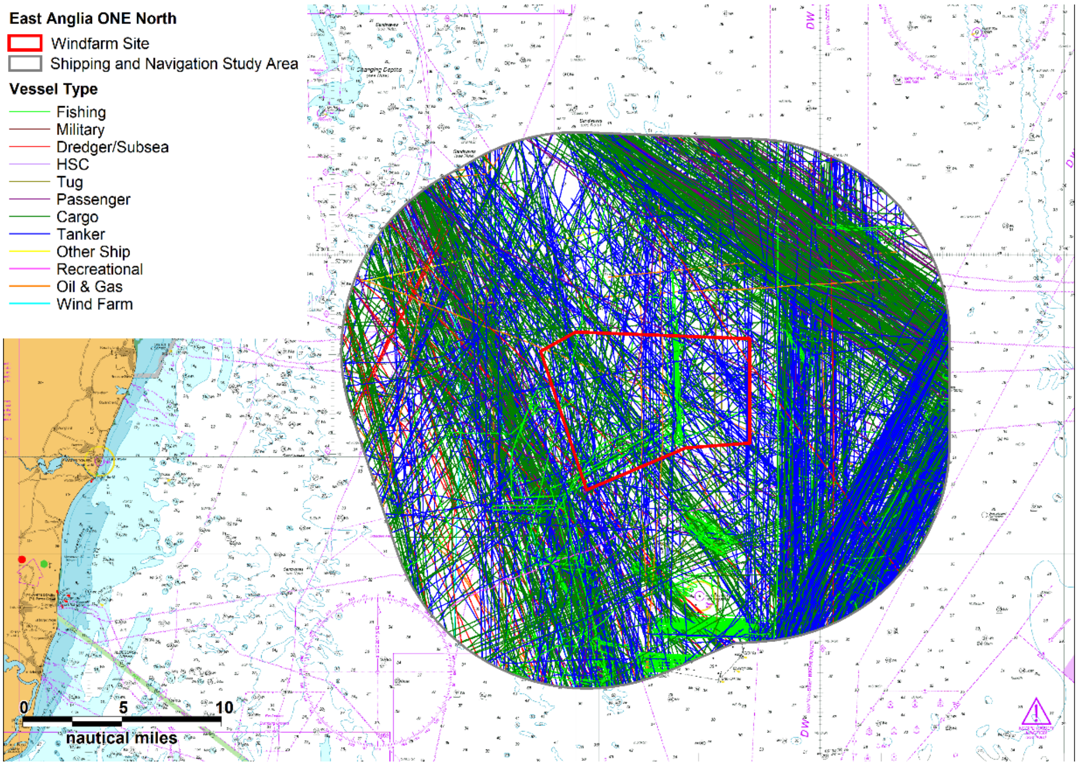

Figure 12.5 Overview of AIS Data within Shipping and Navigation Study Area Excluding Temporary Tracks (14 Days Winter 2017)

105. Corresponding vessel density figures for the summer and winter periods are presented in *Figure 12.6* and *Figure 12.7*, respectively. To allow direct comparison between the summer and winter periods, the same density ranges have been used in both figures.

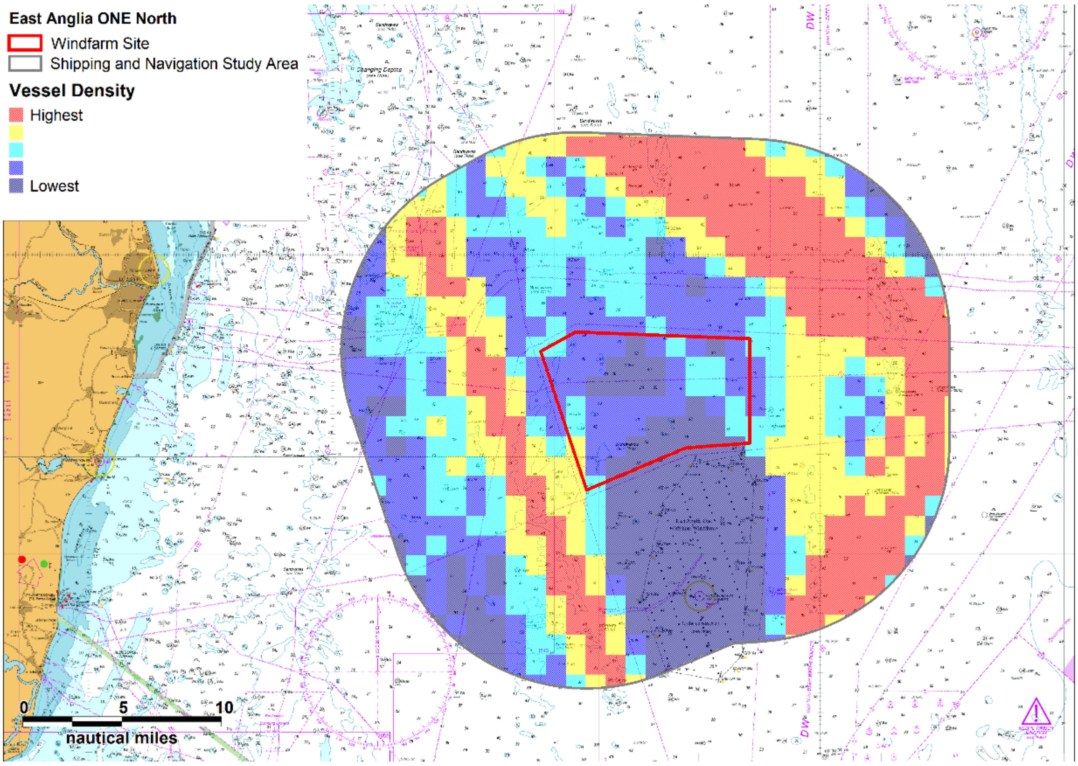

Figure 12.6 Vessel Density from AIS and Radar within Shipping and Navigation Study Area (14 Days Summer 2018)

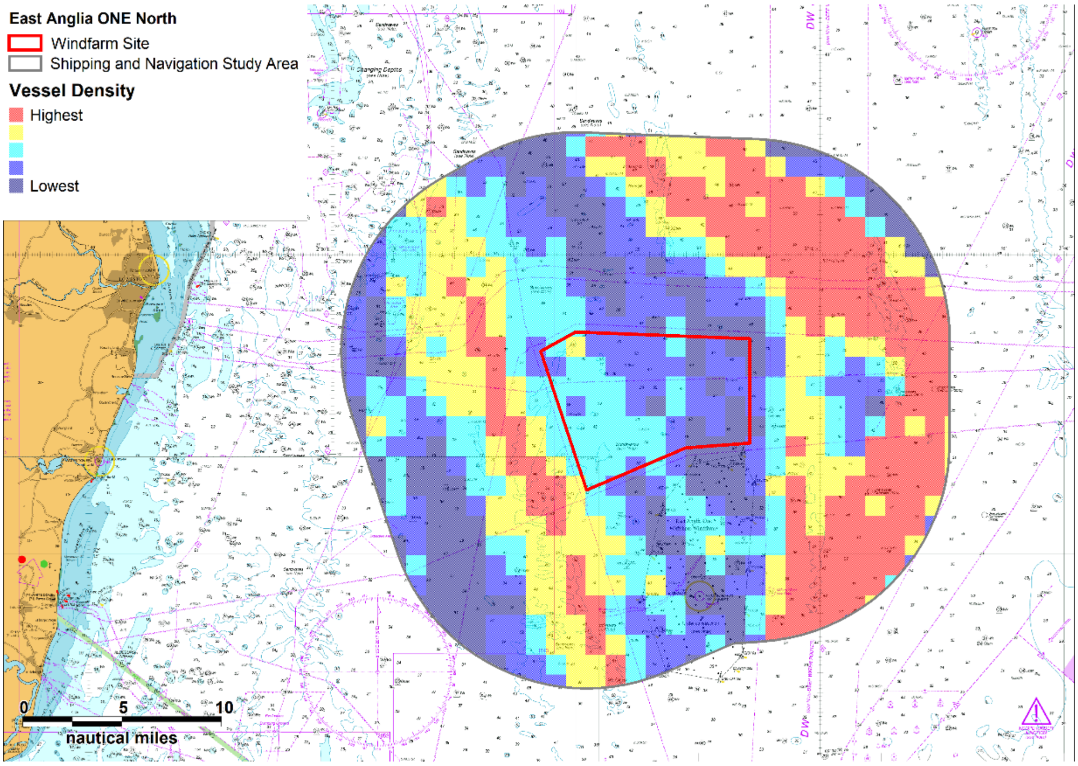

Figure 12.7 Vessel Density from AIS within Shipping and Navigation Study Area (14 Days Winter 2017)

106. During the summer and winter periods, the highest density areas were observed to correspond to vessel routeing within the east and west of the shipping and navigation study, passing east and west of the East Anglia ONE North windfarm site.

107. The vessel density within the East Anglia ONE North windfarm site was observed to be lower during summer than in winter. This was due to a higher number of cargo vessels, tankers and fishing vessels recorded within the site during the winter period compared to the summer period. This may be reflective of updated vessel routeing and behaviour resultant of the construction works within the East Anglia ONE windfarm site.

12.2 Summer Vessel Counts

108. For the 14 days analysed in summer 2018, there was an average of 98 unique vessels per day passing within the shipping and navigation study area, recorded on AIS and Radar. In terms of vessels intersecting the East Anglia ONE North windfarm site, there was an average of 14 unique vessels per day.

109. *Figure 12.8* presents the daily number of unique vessels passing through the shipping and navigation study area during summer 2018.

110. The busiest day recorded throughout the summer survey period was the 19th July 2018 when 123 unique vessels were recorded within the shipping and navigation study area.

111. The quietest day recorded throughout the summer survey period was 29th July 2018 when 64 unique vessels were recorded within the shipping and navigation study area.

112. Throughout the summer survey period, 14% of traffic recorded within the shipping and navigation study area intersected the East Anglia ONE North windfarm site.

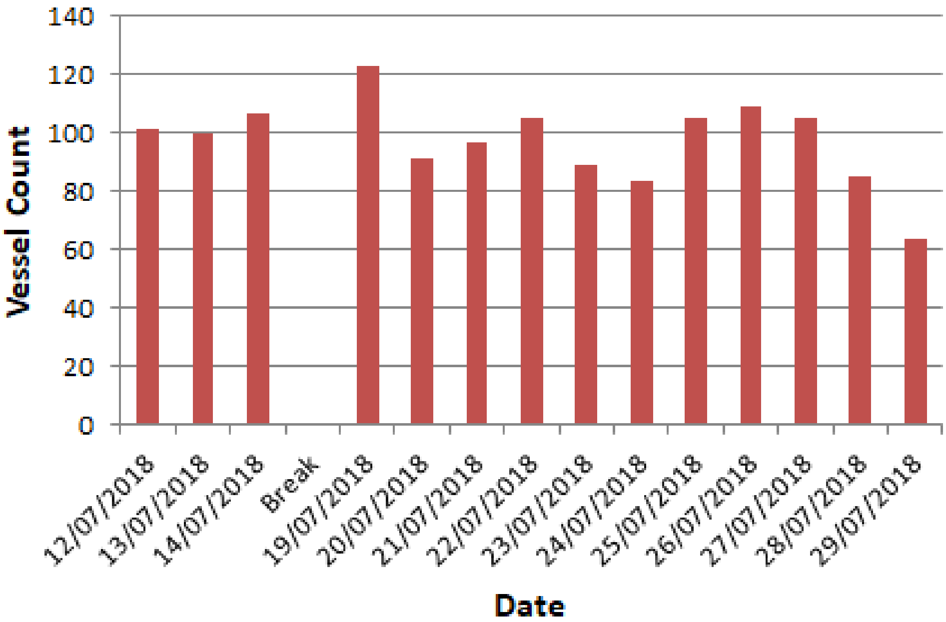

Figure 12.8 Unique Vessels per Day from AIS and Radar within Shipping and Navigation Study Area (14 Days Summer 2018)

12.3 Winter Vessel Counts

113. For the 14 days analysed in winter 2017, there was an average of 101 unique vessels per day passing within the shipping and navigation study area, recorded on AIS. In terms of vessels intersecting the East Anglia ONE North windfarm site, there was an average of 16 unique vessels per day.

114. *Figure 12.9* presents the daily number of unique vessels passing through the shipping and navigation study area during winter 2017.

115. The busiest day recorded throughout the winter survey period was the 28th November 2017 when 121 unique vessels were recorded within the shipping and navigation study area.

116. The quietest day recorded throughout the winter survey period was 27th November 2017 when 79 unique vessels were recorded within the shipping and navigation study area.

117. Throughout the winter survey period, 16% of traffic recorded within the shipping and navigation study area intersected the East Anglia ONE North windfarm site.

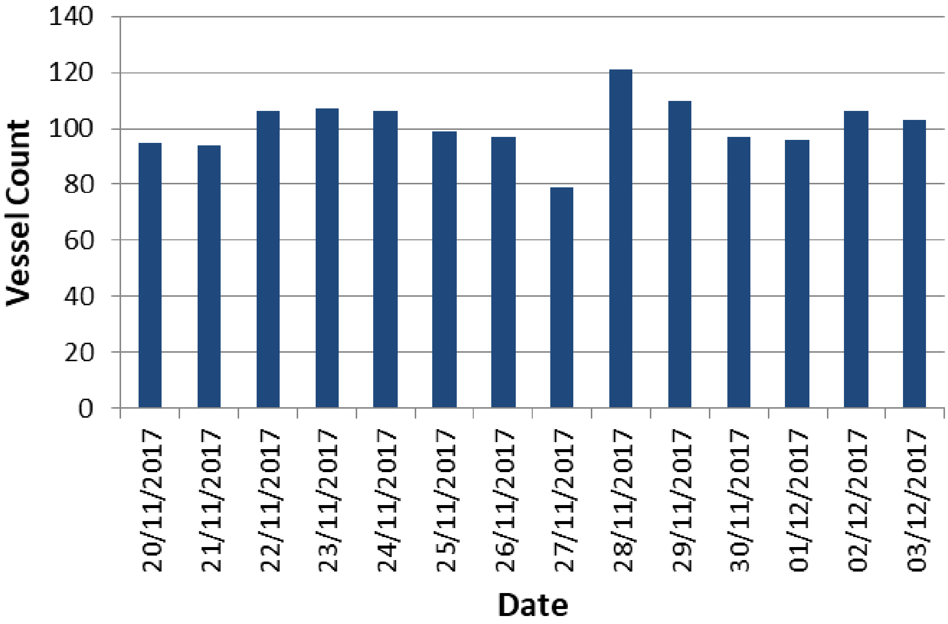

Figure 12.9 Unique Vessels per Day from AIS within Shipping and Navigation Study Area (14 Days Winter 2017)

12.4 Vessel Types

118. Analysis of the vessel types recorded passing within the shipping and navigation study area and the East Anglia ONE North windfarm site throughout both survey periods are presented in *Figure 12.10*. The category of "other" vessels includes those that are not large enough in quantities to be categorised separately, such as survey vessels, a cable layer, a dive vessel, a rapid intervention vessel (RIV), buoy-laying vessels and a fish transport vessel.

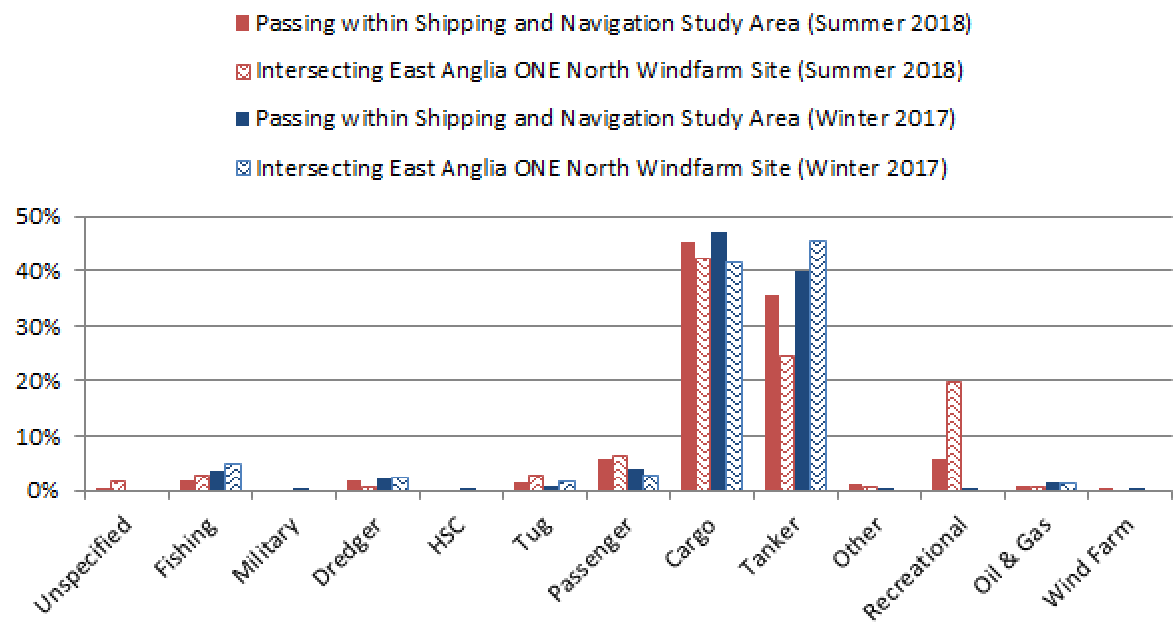

Figure 12.10 Distribution of Vessel Types within Shipping and Navigation Study Area (28 Days Summer 2018 and Winter 2017)

119. Throughout the summer period, the majority of tracks recorded on AIS and Radar were cargo vessels (45% within the shipping and navigation study area) and tankers (36%). Throughout the winter period the majority of tracks were cargo vessels (47% in the shipping and navigation study area) and tankers (40%). It should be noted that the cargo vessel category includes commercial ferries (e.g. DFDS Seaways) operating in the shipping and navigation study area.

120. It can be seen that cargo vessels and tankers were higher during the winter period than summer. This is reflected within the density grid presented in *Figure 12.6* and *Figure 12.7* where vessel density is higher within the south of the shipping and navigation study area during winter than in summer due to commercial vessel transits. However, increased numbers of recreational craft was recorded during the summer period.

121. Less than 1% of tracks recorded within the shipping and navigation study area throughout the summer survey period were unspecified vessels. These consisted of Radar tracks from which vessel types could not be identified.

12.5 Cargo Vessels

122. *Figure 12.11* presents a plot of cargo vessels recorded within the shipping and navigation study area throughout the survey periods, colour-coded by subtype categories. Following this, *Figure 12.12* presents the distribution of the main cargo vessel subtypes. It should be noted that commercial ferries (Roll on Roll off (Ro Ro) cargo) are included.

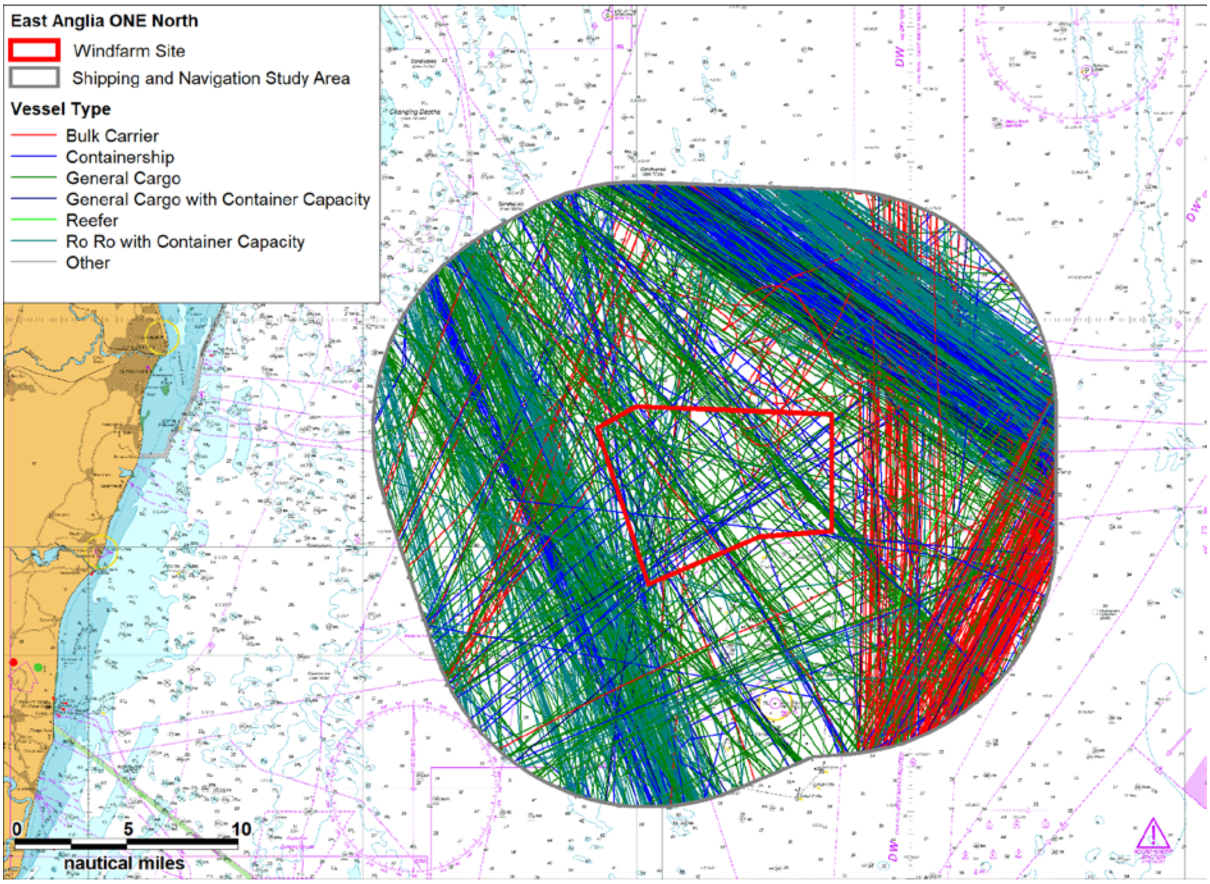

Figure 12.11 AIS and Radar Cargo Vessels by Sub Type within the Shipping and Navigation Study Area (28 Days Summer 2018 and Winter 2017)

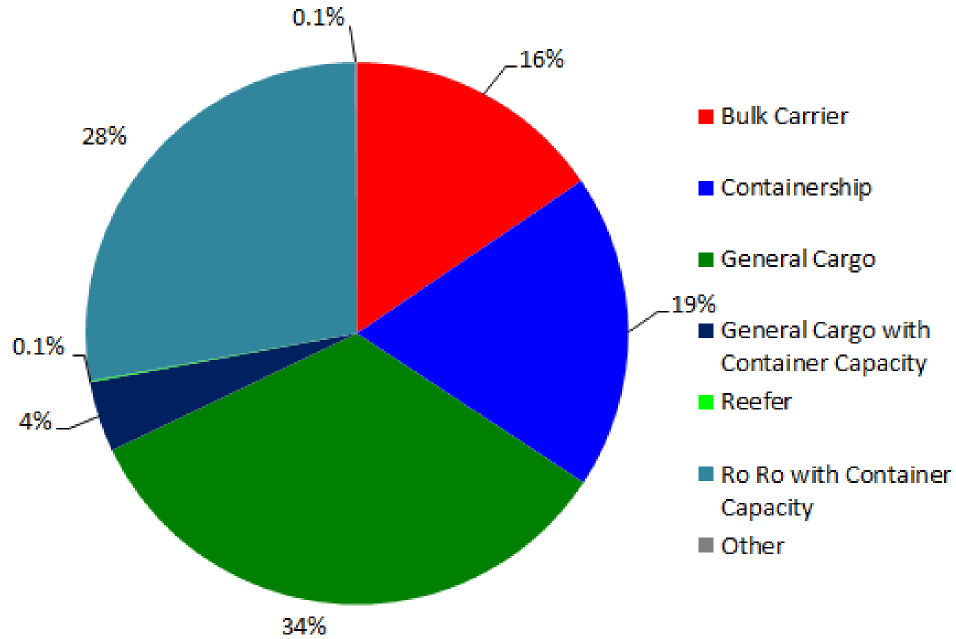

Figure 12.12 Distribution of Main Cargo Vessel Subtypes

123. Throughout the combined summer and winter survey period, an average of 46 unique cargo vessels per day passed within the shipping and navigation study area.

124. It can be seen that the majority of cargo vessels were transiting routes to the east and west of the East Anglia ONE North windfarm site.

125. General cargo vessels (34%) and Ro Ro cargo vessels with container capacity (28%) were the most frequently recorded cargo vessel types transiting through the shipping and navigation study area, followed by containerships (19%). Bulk carriers (16%) were also recorded frequently. Reefers (0.1%) and ‘other’ (0.1%) cargo subtypes were also recorded. The ‘other’ category included a heavy load cargo vessel.

12.6 Tankers

126. *Figure 12.13* presents a plot of tankers recorded within the shipping and navigation study area throughout the survey periods, colour-coded by subtype categories. Following this, *Figure 12.14* presents the distribution of tanker subtypes.

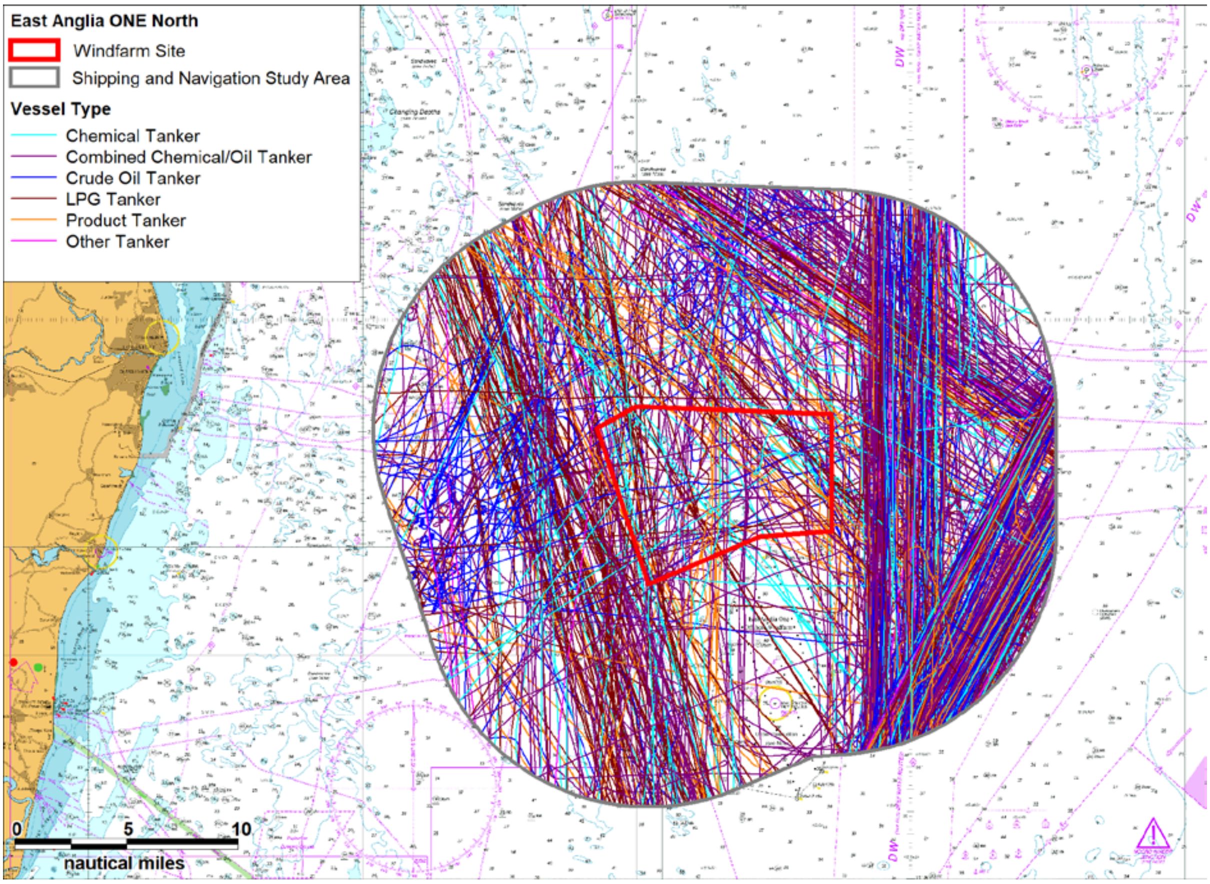

Figure 12.13 AIS and Radar Tankers by Sub Type within the Shipping and Navigation Study Area (28 Days Summer 2018 and Winter 2017)

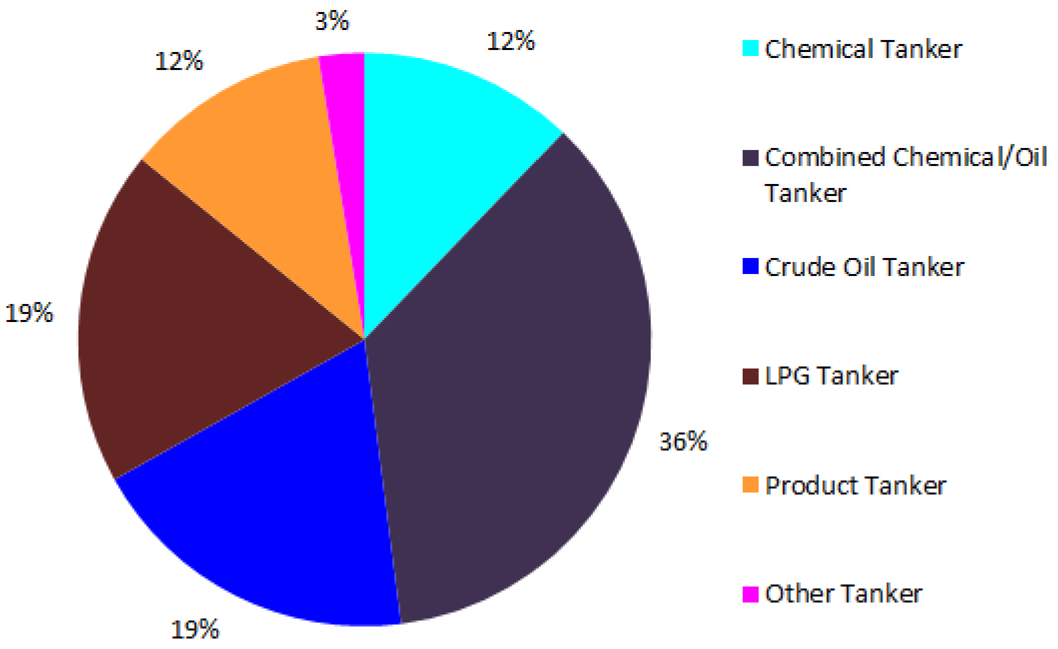

Figure 12.14 Distribution of Tanker Subtypes

127. Throughout the combined summer and winter survey period, an average of 38 unique tankers per day passed within the shipping and navigation study area.

128. It can be seen that the majority of tankers were transiting routes to the east and west of the East Anglia ONE North windfarm site.

129. Combined chemical and oil tankers (36%) were the most frequently recorded tanker type transiting through the shipping and navigation study area, followed by crude oil tankers (19%) and Liquid Petroleum Gas (LPG) carriers (19%). Product tankers (12%), chemical tankres (3%) and 'other' tankers (3%) were also recorded.

130. Tankers engaged in activity rather than transiting were recorded within the shipping and navigation study area as presented in *Figure 12.15*.

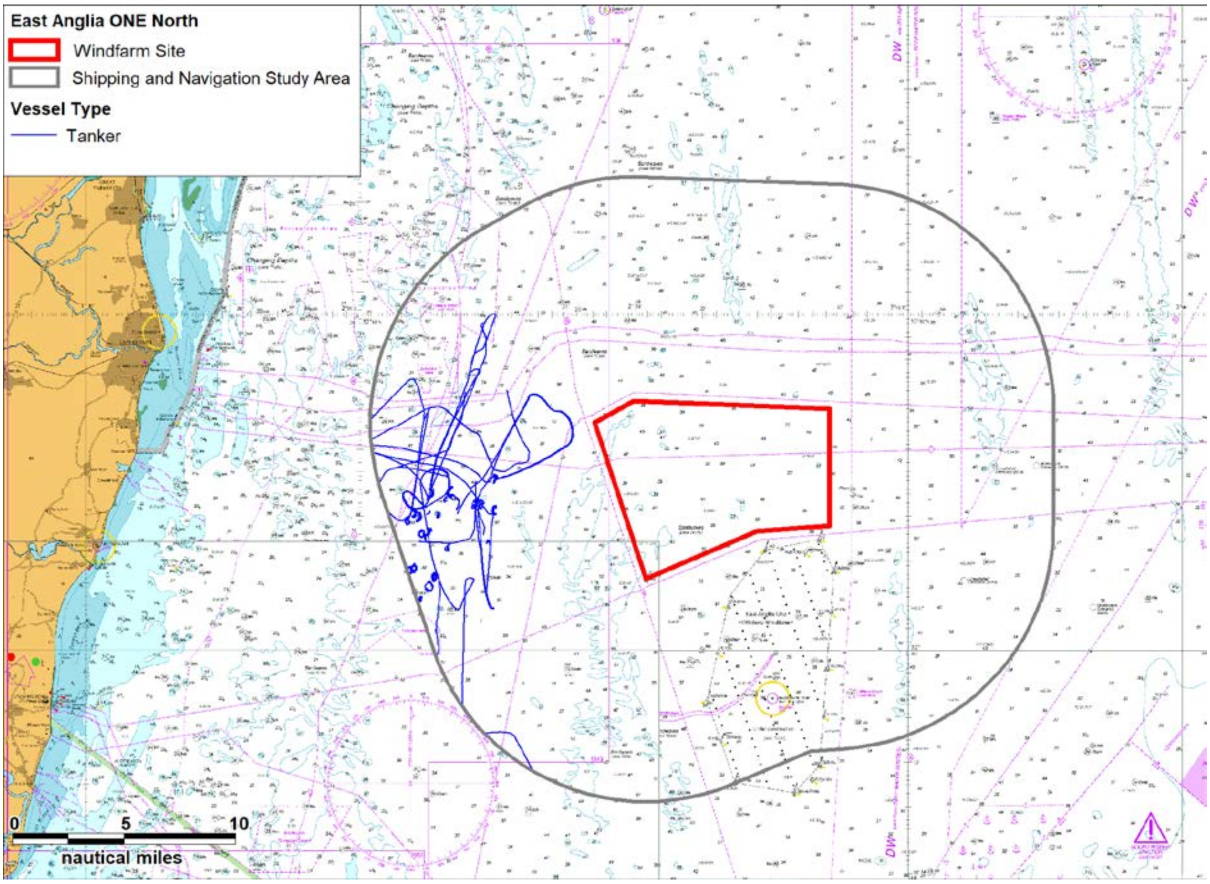

Figure 12.15 AIS and Radar Tanker Activity within the Shipping and Navigation Study Area (28 Days Summer 2018 and Winter 2017)

131. There is a designated Southwold Oil Transhipment Area within the UK territorial sea off the coast of Southwold where Ship-to-Ship (STS) transfers can take place. It can be seen that activity associated with STS transfers was recorded within the west of the shipping and navigation study area.

12.7 Oil and Gas Vessels

132. *Figure 12.16* presents a plot of oil & gas associated vessels recorded within the shipping and navigation study area throughout the survey periods.

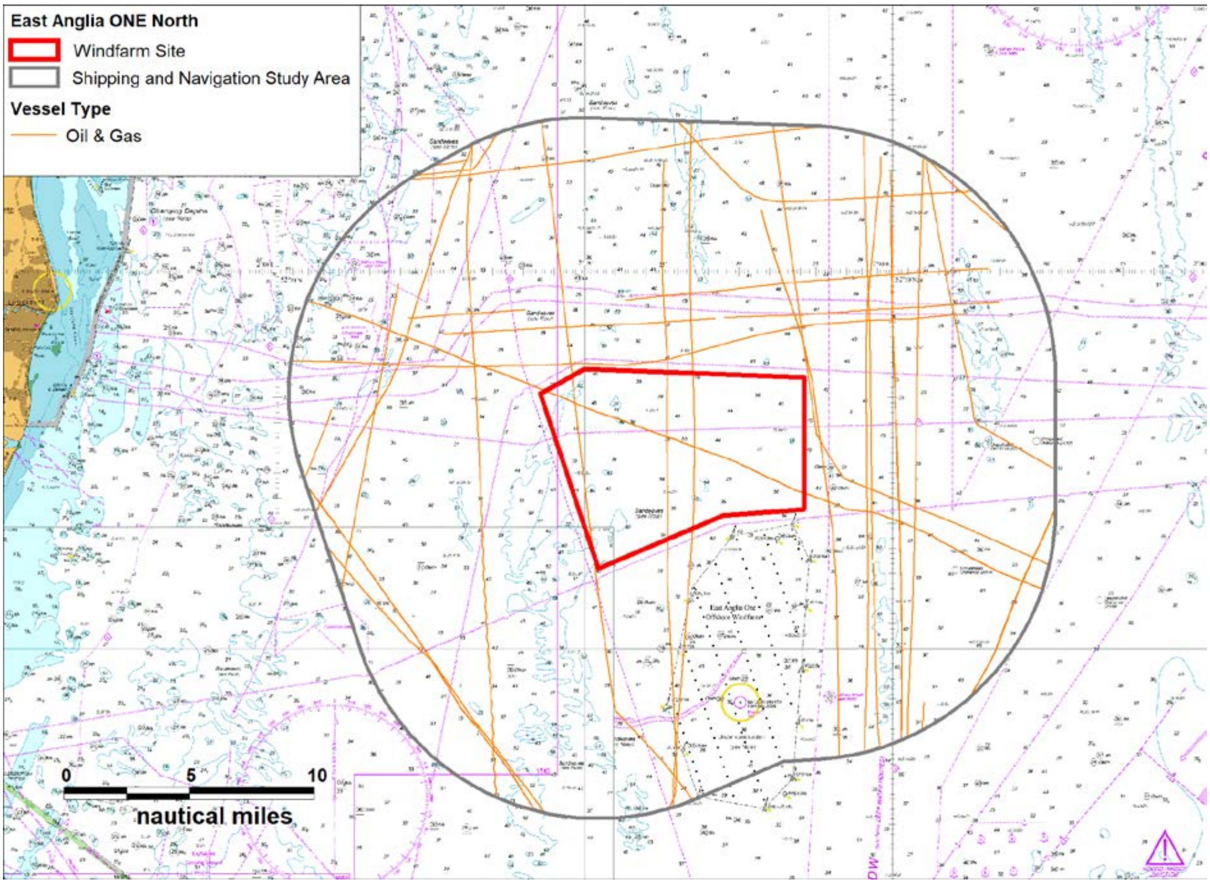

Figure 12.16 AIS and Radar Oil & Gas Vessels within the Shipping and Navigation Study Area (28 Days Summer 2018 and Winter 2017)

133. Throughout the combined summer and winter survey period, an average of one unique oil & gas vessels per day passed within the shipping and navigation study area.

12.8 Passenger Vessel Activity

134. This section reviews the passenger vessel activity within the shipping and navigation study area based upon the marine traffic surveys.

135. *Figure 12.3* presents a plot of passenger vessels recorded within the shipping and navigation study area on AIS and Radar throughout both the summer and winter survey periods.

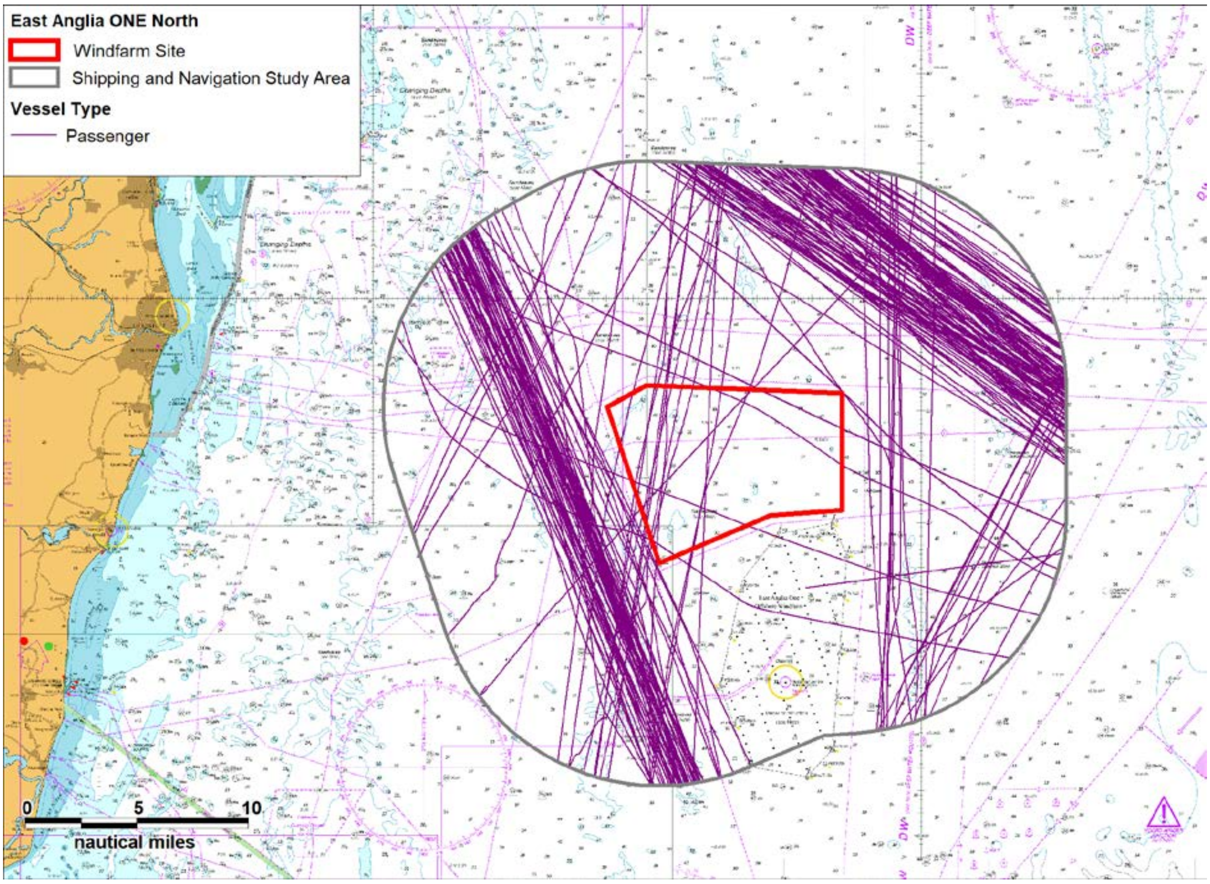

Figure 12.17 AIS and Radar Passenger Vessels within the Shipping and Navigation Study Area (28 Days Summer 2018 and Winter 2017)

136. It can be seen that regular passenger vessel transits were recorded to the north east, east and west of the East Anglia ONE North windfarm site.

137. An average of five unique passenger vessels per day were recorded throughout the combined summer and winter survey periods.

138. The destinations of the passenger vessels recorded throughout the summer and winter survey periods are presented in *Table 12.1*. Vessels transiting between Hull and Rotterdam, Hull and Zeebrugge and Rotterdam and the Humber were the most frequently recorded.

Table 12.1 Passenger Vessel Destinations (28 Days Summer 2018 and Winter 2017)

Vessel Operator	Vessel	Destination
P&O Ferries	Pride of Rotterdam	Europoort (Rotterdam) - Hull
	Pride of Hull	
	Pride of York	Hull - Zeebrugge
	Pride of Bruges	

Vessel Operator	Vessel	Destination
	Britannia	Bergen - Southampton
Stena Line	Stena Transporter	Hoek van Holland (Rotterdam) - Killingholme
	Stena Transit	Hoek van Holland (Rotterdam) - Humber
Princess Cruises	Sapphire Princess	Southampton and Stavanger
	Royal Princess	Le Havre
V. Ships	Saga Pearl II	Kirkwall
Carnival	Queen Victoria	Southampton
	Queen Elizabeth	
	Aurora	Stavanger to Southampton
	Arcadia	Southampton
	Azura	Bergen to Southampton
Viking River Cruises	Viking Sea	Newhaven and Greenwich
	Viking Star	Greenwich
Fred. Olsen	Boudicca	Dover, Malmo and Rosendal
	Black Watch	Invergordon
	Braemar	Torshavn
Crystal Cruises	Crystal Serenity	Dover
Celebrity Cruises	Celebrity Silhouette	Copenhagen and Southampton
	Celebrity Eclipse	Dover
FTI Cruises	Berlin	Zeebrugge
Cruise & Maritime Voyages	Astoria	Lerwick
Voyages to Antiquity	Aegean Odyssey	London
Other	Dolly C	Grenada
	Anne	Not Available
	FS Etoile	Not Available
	Jade 959	Gibraltar
	Lord Nelson	Leith
	Pink Gin	Southampton

12.9 DFDS Routeing

139. DFDS Seaways is a ferry operator within European waters, operating both passenger ferries and freight shipping. Following regular operator consultation (see *Table 5.3*), information on vessel routeing was provided by DFDS Seaways. This is presented in *Figure 12.4*.

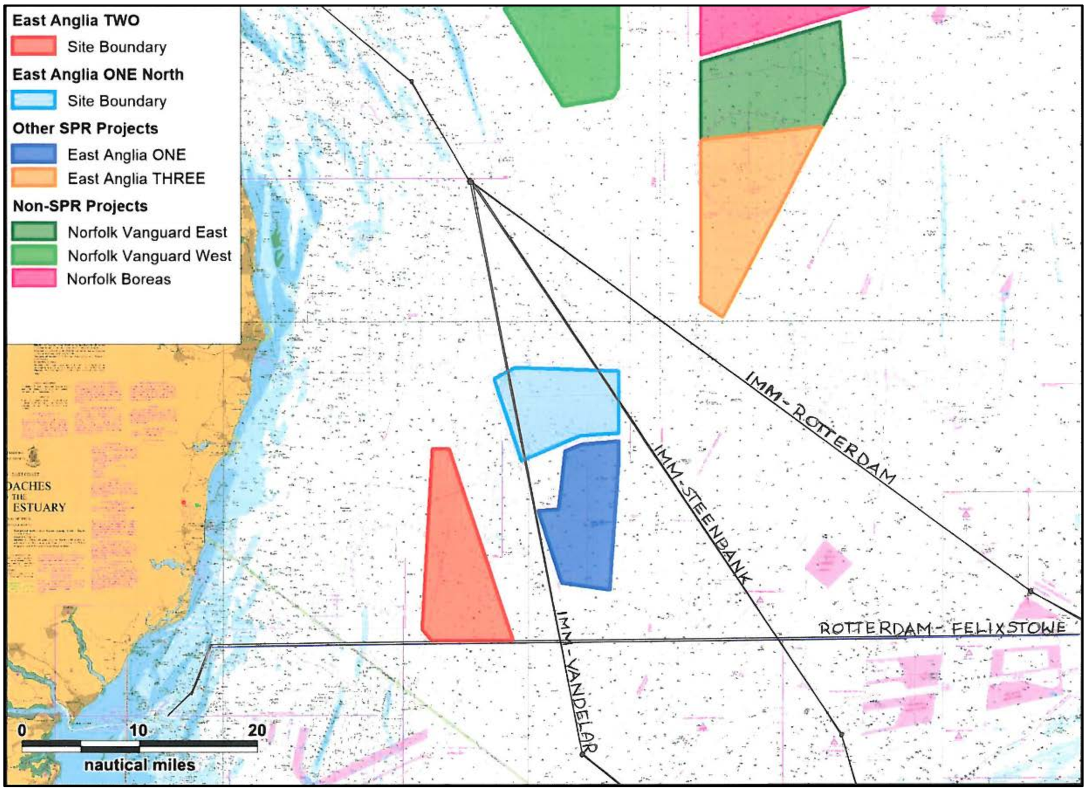

Figure 12.18 DFDS Seaways Vessel Routeing

140. It can be seen that two indicative DFDS vessel routes intersect the East Anglia ONE North windfarm site.

141. Following the routeing provided by DFDS, one year of AIS data (1st January to the 31st December 2017) was analysed from a Met Mast within the former East Anglia Zone to validate the routeing within the vicinity of the East Anglia ONE windfarm site, East Anglia ONE North windfarm site and East Anglia TWO windfarm site. Data was studied within a 15nm buffer of the three sites.

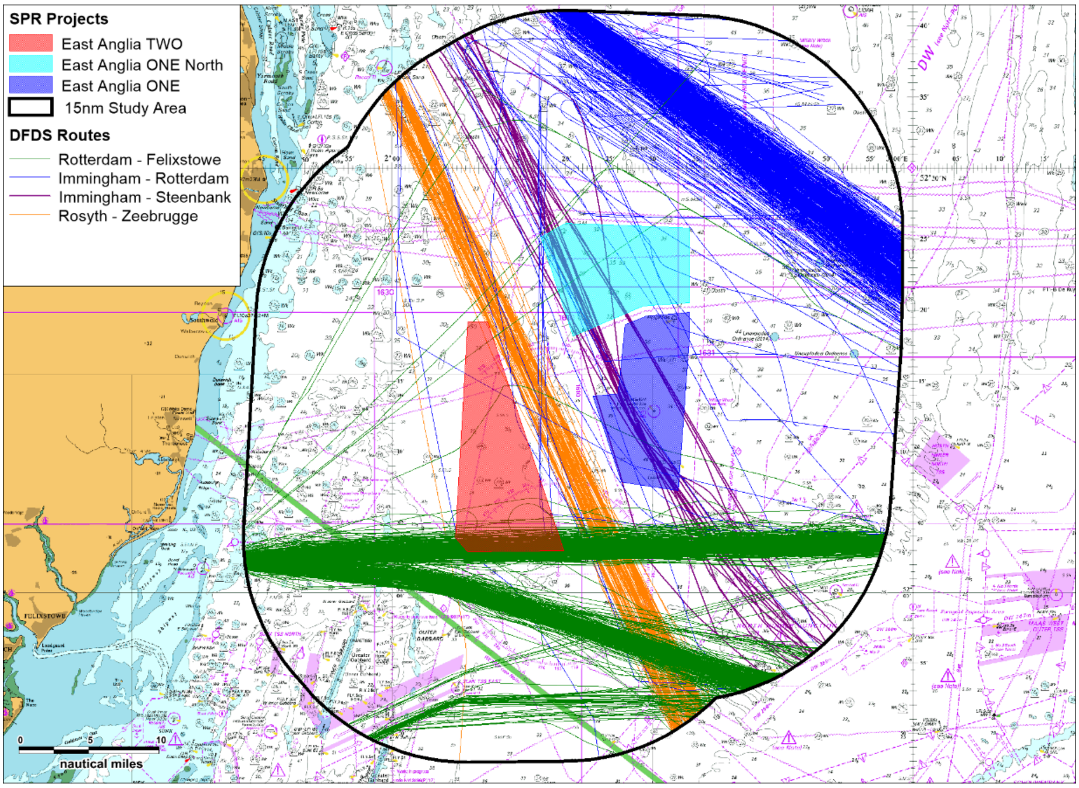

Figure 12.19 DFDS Vessel Routes (Met Mast AIS Data January 1st and 31st December 2017)

142. In comparison to the routeing provided by DFDS, the Rotterdam to Felixstowe route is clearly defined within the AIS data however the route is recorded as split into four rather than one as in *Figure 12.18*. The two higher density routes are recorded transiting eastbound and westbound between the two ports, with one route intersecting the south of the East Anglia TWO windfarm site (approximately 23% of vessel tracks). However two lower density routes are also recorded using the Sunk TSS located within the south-west of the study area in both the eastbound and westbound lanes. It should be noted that vessels with a destination of Felixstowe and Rotterdam were also recorded transiting north of the East Anglia ONE North windfarm site and intersecting the northern boundaries of the East Anglia ONE North windfarm site and the East Anglia TWO windfarm site. These vessel tracks were recorded during the winter period therefore are assumed to be deviations due to adverse weather conditions. One vessel with a destination other than Rotterdam or Felixstowe was also recorded on the route transiting to Gdansk, Poland.

143. The Immingham to Rotterdam route provided by DFDS was recorded between the East Anglia THREE windfarm site and East Anglia ONE North windfarm site. AIS data recorded the same route however it should be noted that some vessel tracks intersected the East Anglia THREE windfarm site (approximately 2% of vessels on the route). Vessels with a destination of Immingham and Rotterdam were also recorded transiting through the East Anglia ONE windfarm site, East Anglia ONE North windfarm site and the East Anglia TWO windfarm site. These are assumed to due to

adverse weather conditions. A small number of vessels with destinations other than Immingham and Rotterdam were also recorded on the route (approximately 0.01% of vessel tracks).

144. The Immingham to Vlaardingen route provided by DFDS is not reflected within the AIS data. However, the Rosyth to Zeebrugge route was recorded in the AIS data transiting the area between the East Anglia TWO windfarm site, East Anglia ONE windfarm site and East Anglia ONE North windfarm site with approximately 0.9% vessel tracks intersecting the East Anglia TWO windfarm site. It was announced by DFDS in April 2018 that they were closing this route.

145. The Immingham to Steenbank route provided by DFDS was recorded as intersecting the East Anglia ONE North windfarm site. Within the AIS data, this route is recorded as transiting further to the west and intersecting both the East Anglia ONE North windfarm site and East Anglia ONE windfarm site.

146. *Table 12.2* presents details of the vessel routes recorded from the Met Mast AIS during 2017.

Table 12.2 DFDS Vessel Routes (Met Mast AIS Data January 1st and 31st December 2017)

Vessel	Route	Average Vessels per Day
Gardenia Seaways	Rotterdam to Felixstowe	1
Corona Seaways		
Britannia Seaways		
Anglia Seaways		
Tulipa Seaways	Immingham to Rotterdam	2
Anglia Seaways		
Magnolia Seaways		
Ark Germania		
Britannia Seaways		
King Seaways		
Princess Seaways		
Corona Seaways		
Hafnia Seaways		
Fionia Seaways		
Jutlandia Seaways		
Gardenia Seaways		

Vessel	Route	Average Vessels per Day
Finlandia Seaways (operations now ceased)	Rosyth to Zeebrugge	1
Anglia Seaways	Immingham to Steenbank	1 every 20 days

147. The most frequently used DFDS route identified during 2017 was the Immingham to Rotterdam route with an average of two vessels recorded per day. The Immingham to Steenbank route was the least used with a vessel transit recorded only once every 20 days.

12.10 Other Operational Vessels

148. *Figure 12.20* presents a plot of other operational vessels recorded within the shipping and navigation study area throughout the survey periods.

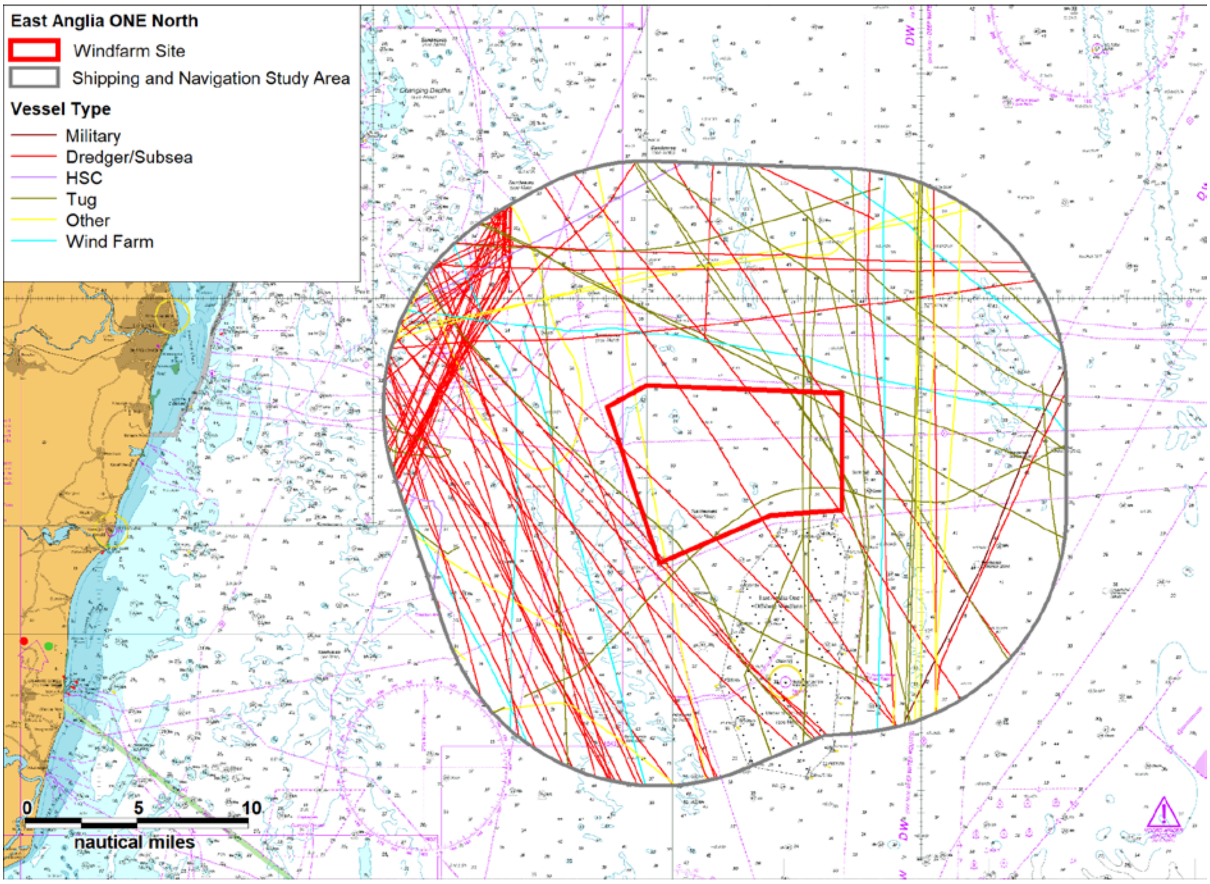

Figure 12.20 AIS and Radar Other Operational Vessels within the Shipping and Navigation Study Area (28 Days Summer 2018 and Winter 2017)

149. It can be seen that the majority of vessels transiting through the shipping and navigation study area were dredgers (48%), with vessels recorded transiting within the west of the shipping and navigation study area as well as through the East Anglia

ONE North windfarm site on routes between marine aggregate dredging areas. Tugs (28%), 'other' vessels (14%), wind farm associated vessels (5%), HSC (3%) and military vessels (2%) were also recorded. As previously mentioned, 'other' vessels include those that are not large enough in quantities to be categorised separately, such as survey vessels, a cable layer, a dive vessel, a RIV, buoy-laying vessels and a fish transport vessel.

12.11 Fishing Vessel Activity

150. Fishing vessel activity recorded within the shipping and navigation study area during the AIS and Radar marine traffic surveys is presented in *Figure 12.21*, colour-coded by fishing gear type. Following this, *Figure 12.22* presents the distribution of fishing gear types.

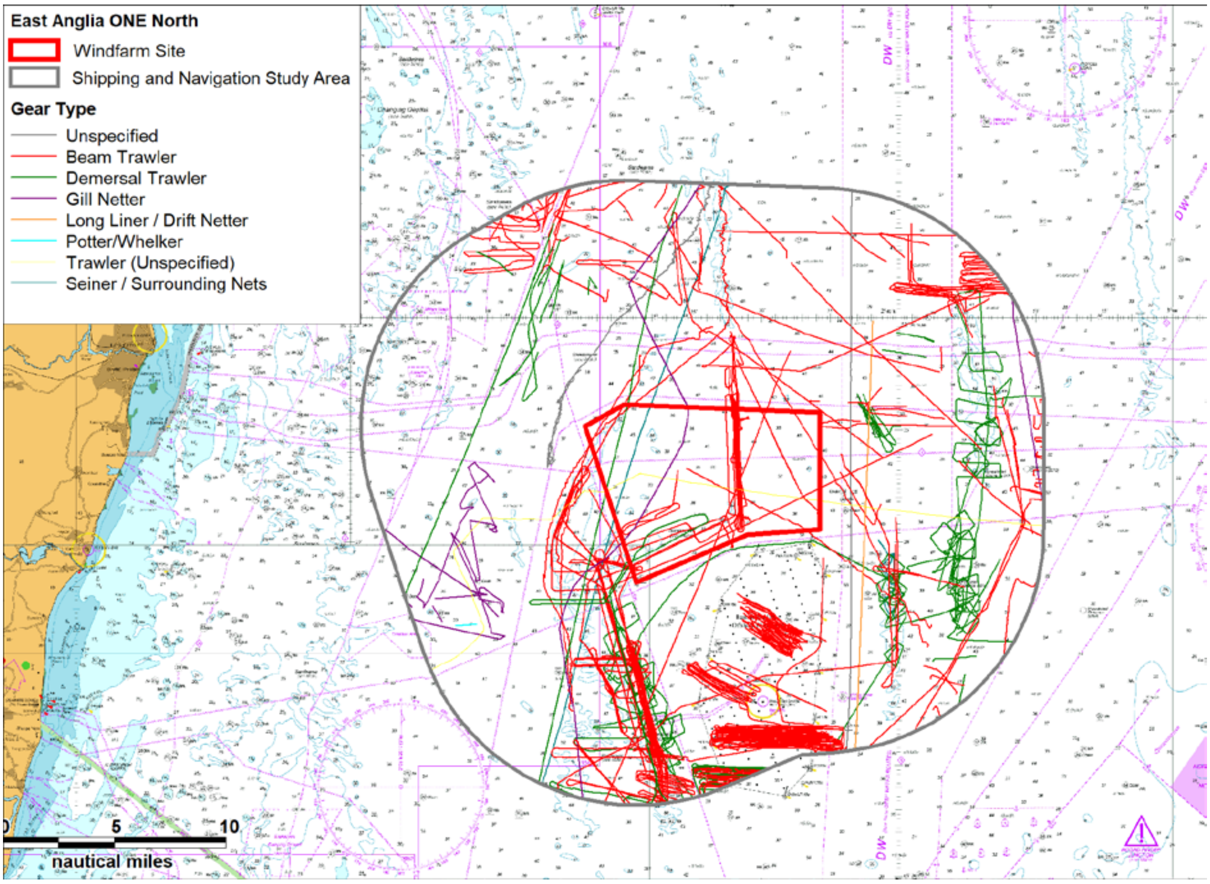

Figure 12.21 AIS and Radar Fishing Vessels within the Shipping and Navigation Study Area (28 Days Summer 2018 and Winter 2017)

151. Throughout the combined summer and winter survey periods, an average of three unique fishing vessels per day passed within the shipping and navigation study area. It can be seen that fishing vessels recorded were recorded engaged in fishing activity and transiting through the shipping and navigation study area. An average of one vessel every two days was recorded within the East Anglia ONE North windfarm site.

152. Flag state (nationality) information was available for approximately 97% of fishing vessels recorded within the shipping and navigation study area with the 3% of unspecified nationalities corresponding to Radar tracks. Of the nationalities identified, the most common was the Netherlands (71%) followed by the UK (21%). Other nationalities recorded included France, Spain, Morocco and Russia, each of which accounted for 1%.

153. Fishing method information was available for 96% of fishing vessels recorded within the shipping and navigation study area. Of the fishing methods identified, the most common were beam trawlers (62%) followed by demersal trawlers (22%). Other fishing methods recorded included gill netters (5%) and seiner / surrounding nets (3%). Long liner/drifter netters, potter/whelkers and unspecified trawlers each accounted for 1% of fishing methods recorded.

12.12 Recreational Vessel Activity

154. Recreational vessel activity recorded within the shipping and navigation study area during the AIS and Radar marine traffic surveys is presented in *Figure 12.22* colour-coded by subtype categories. As per Recreational Craft Regulation 2013 (Directive 2013/53/EU), sailing vessels and motor craft recorded as between 2.5 and 24m in length have been classed as recreational vessels.

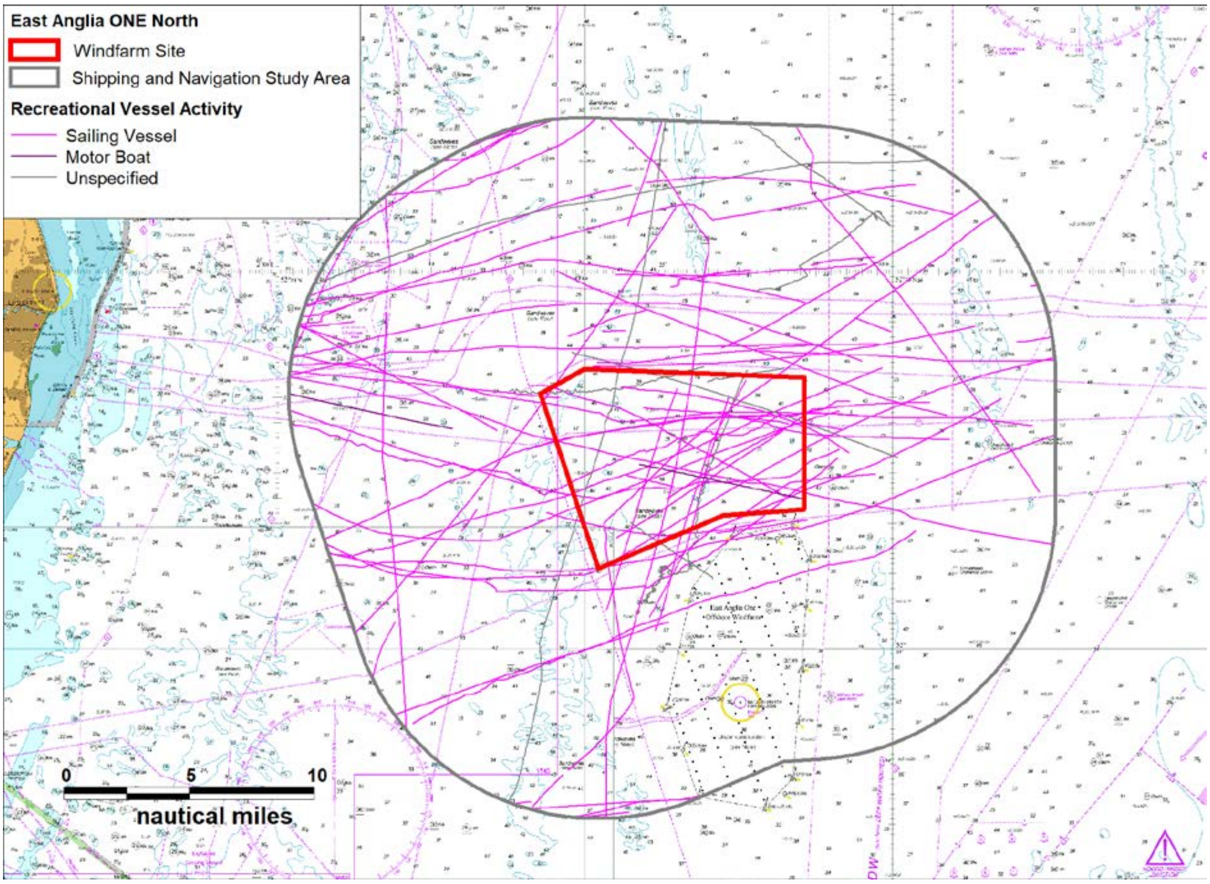

Figure 12.22 AIS and Radar Recreational Vessels within the Shipping and Navigation Study Area (28 Days Summer 2018 and Winter 2017)

155. An average of six unique recreational vessel transits per day were recorded within the shipping and navigation study area during the summer period and a total of one unique vessel recorded during winter. The majority of recreational vessels recorded were sailing vessels (86%).

156. It should be noted that the frequent recreational activity recorded can be attributed to the summer season as well as the proximity of the East Anglia ONE North windfarm site to the coast. Recreational races are common within the area and the levels of recreational activity may be due to this.

12.12.1 RYA Coastal Atlas

157. The RYA Coastal Atlas (RYA, 2016) is presented relative to the East Anglia ONE North windfarm site in *Figure 12.23*. This includes a recreational density grid up to the 12nm UK territorial limit and the locations of clubs, training centres and marinas. To illustrate offshore routeing, the coastal atlas also provides offshore route indicators showing typical recreational routes.

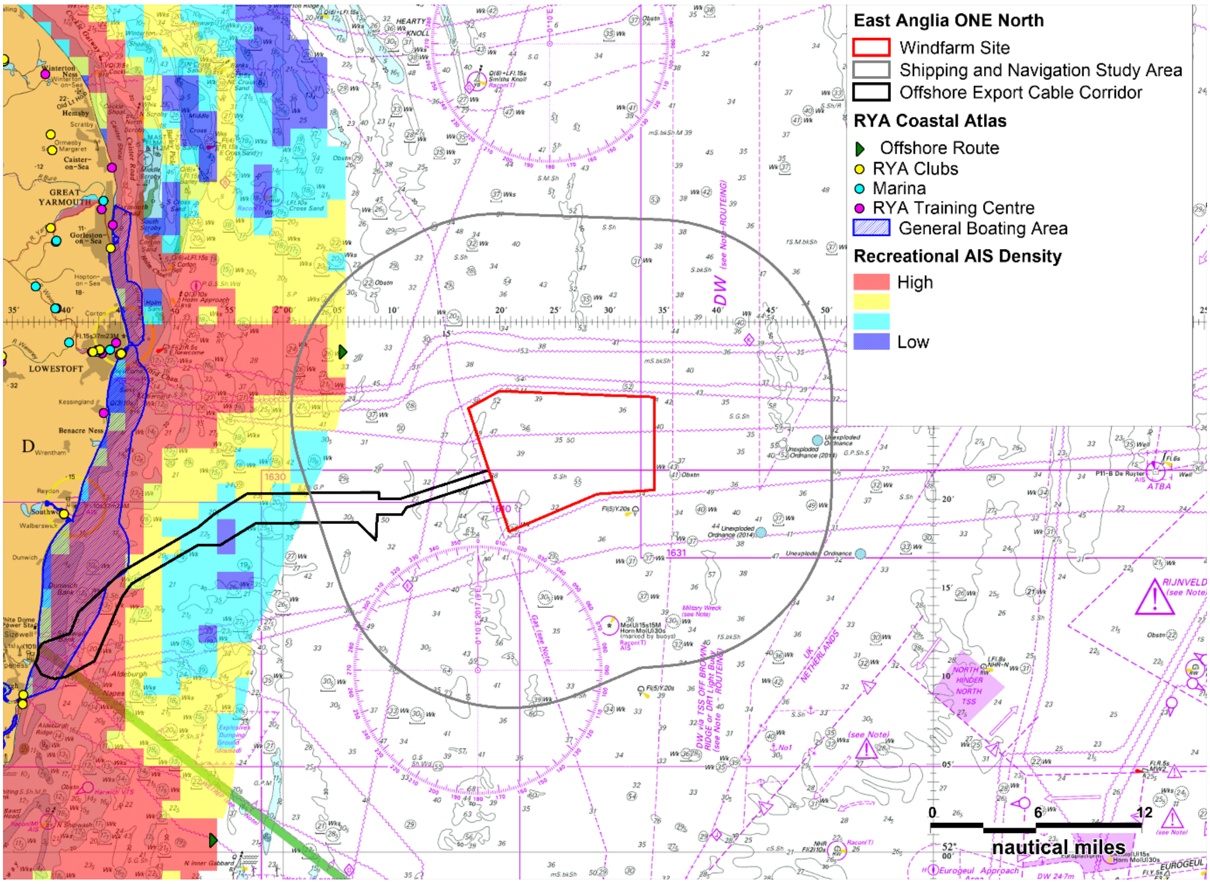

Figure 12.23 RYA Coastal Atlas (2016)

158. Higher recreational density was observed to be largely coastal, with the west of the shipping and navigation study area categorised as low to medium intensity and the north west with areas of high density. There is one offshore route indicator within the shipping and navigation study area, operating in an eastbound direction.

12.13 Anchoring

159. This section presents analysis of the anchoring activity in the vicinity of the shipping and navigation study area. *Figure 12.24* presents a plot of the anchored vessels recorded during the combined summer and winter survey periods.

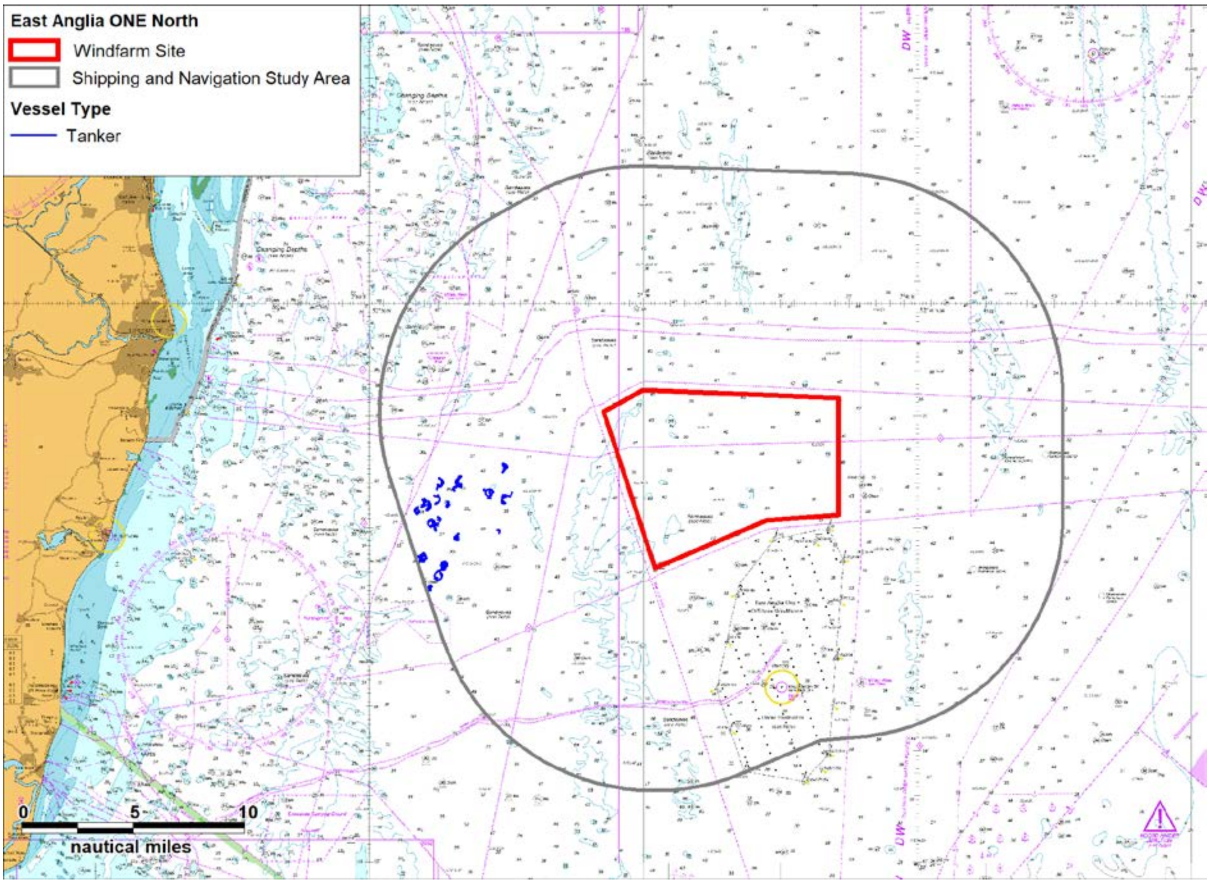

Figure 12.24 AIS and Radar Anchored Vessels within the Shipping and Navigation Study Area (28 Days Summer 2018 and Winter 2017)

160. A total of 18 vessels were recorded at anchor during the combined summer and winter survey periods. No vessels were recorded anchoring within the East Anglia ONE North windfarm site. There is a designated area of the UK territorial sea off the coast of Southwold where STS transfers are permitted (see section 8.5) therefore the anchored tankers within the shipping and navigation study area are likely to be anchored in preparation for a STS transfer with another tanker.

13 Marine Traffic Survey – Offshore Cable Corridor

13.1 Introduction

161. This section presents analysis of marine traffic survey data recorded within the offshore cable corridor study area. It is noted that the study area, and therefore the analysis, is based on a 2nm buffer of the most up to date iteration of the offshore cable corridor available to Anatec at the time of analysis.

162. Given the distance of the windfarm from shore, the marine traffic survey data collected within the East Anglia ONE North windfarm site (see section *12.1*) did not provide coverage of the entirety of the offshore cable corridor, in particular in the vicinity of the landfall. Therefore, the summer and winter survey data has been supplemented with AIS data collected from onshore receivers to ensure comprehensive coverage of the entire export cable corridor, noting that the inclusion of the survey vessel data and Met Mast data ensured good coverage of the offshore extent of the corridor.

163. On this basis, the survey periods assessed for the offshore cable corridor are as follows:

- Summer 2018
  - 12th July to 14th July 2018;
  - 19th July to 29th July 2018;
- Winter 2017
  - 20th November to 3rd December 2017.

164. It is noted that the corridor assessment is AIS only, given that Radar data was only collected from within the East Anglia ONE North windfarm site. It should therefore be considered when viewing the analysis that vessels not required to carry AIS may be underrepresented (notably fishing vessels less than 15m and recreational vessels).

165. As for the assessment undertaken for the East Anglia ONE North windfarm site (see section 12), any traffic deemed temporary has been removed. Notably, this was observed to include traffic associated with the Sizewell power station near the landfall area. Windfarm traffic has also not been included in the main analysis.

166. Plots of the vessel tracks recorded within the offshore cable corridor study area during the summer and winter periods are presented in *Figure 13.1* and *Figure 13.2*, respectively.

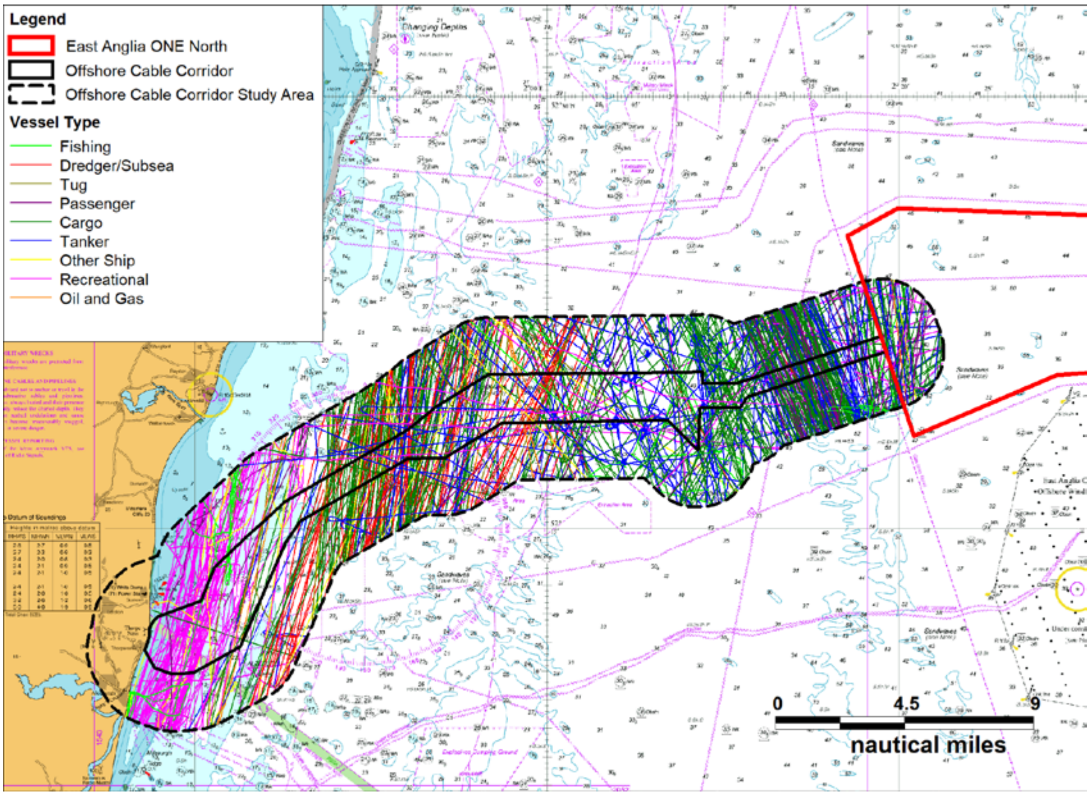

Figure 13.1 Overview of AIS Data excluding Temporary Tracks (14 Days Summer 2018)

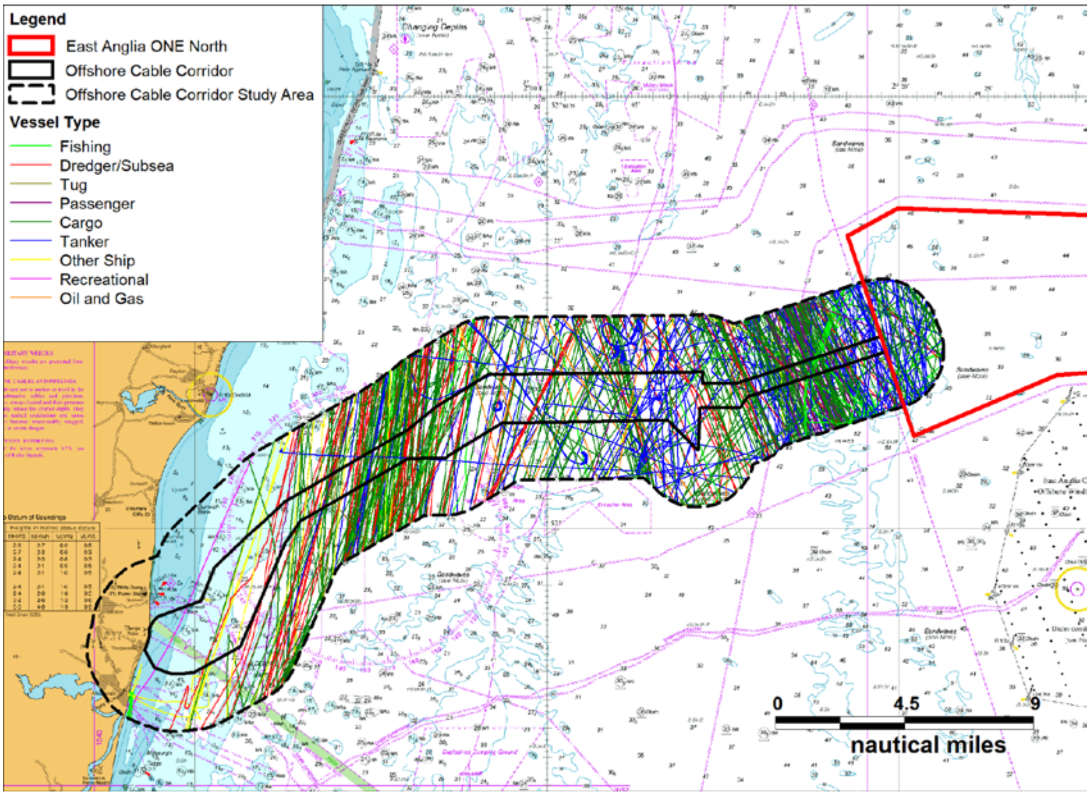

Figure 13.2 Overview of AIS Data excluding Temporary Tracks (14 Days Winter 2018)

167. The most notable difference between the summer and winter marine traffic data was observed to be levels of coastal traffic, with such transits being much more prominent during summer than in winter. This was, in the majority, due to significantly increased levels of recreational traffic recorded during summer than in winter, noting that such vessels (particularly smaller ones) are likely to favour coastal transits, given that this will avoid encounters with larger vessels.

168. In line with this, larger commercial vessels were observed to transit further offshore, with busy routes identified crossing the offshore cable corridor. Commercial anchoring activity was also recorded, including within the offshore cable corridor. This same activity was recorded within the assessment of the East Anglia ONE North windfarm site (see section 12.13), and is considered likely as being associated with the designated Southwold transfer area (see section 8.5).

169. The two periods of marine traffic survey data were used to assess vessel density within the offshore cable corridor study area. The results of this density assessment are shown in *Figure 13.3* and *Figure 13.4* for summer and winter respectively. To allow direct seasonal comparison, the same range brackets have been used in both figures.

170. Vessel density within the offshore cable corridor study area was observed to be highest directly to the west of the East Anglia ONE North windfarm site during both summer and winter. This was resultant of a busy route (Route 6 in section 14.2) mainly utilised by commercial vessels transiting between the UK and mainland Europe.

171. Coastal density was observed to be notably higher in summer than during winter. As discussed above this was largely due to high levels of recreational traffic recorded during summer that was not reflected within the winter data.

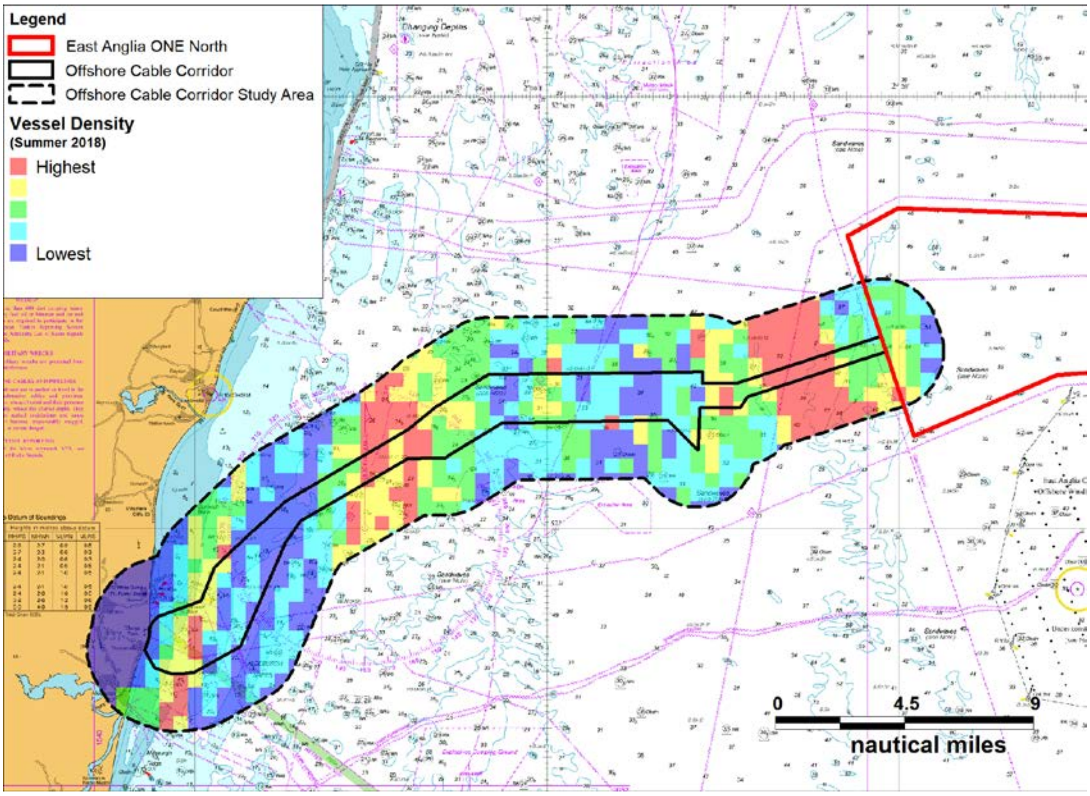

Figure 13.3 Offshore Cable Corridor Vessel Density – Summer 2018

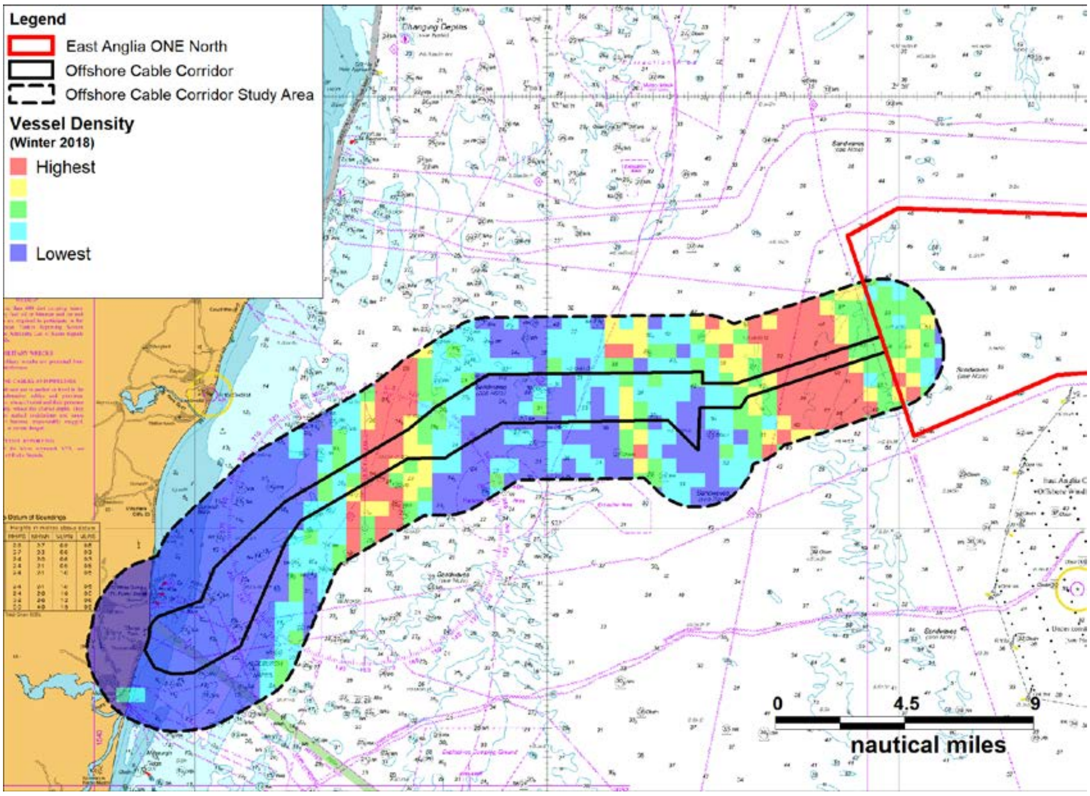

Figure 13.4 Offshore Cable Corridor Vessel Density – Winter 2018

13.2 Vessel Counts

172. Vessel counts per day recorded within the shipping and navigation study area are shown in *Figure 13.5*. Counts are based on summing the number of unique vessels recorded per day.

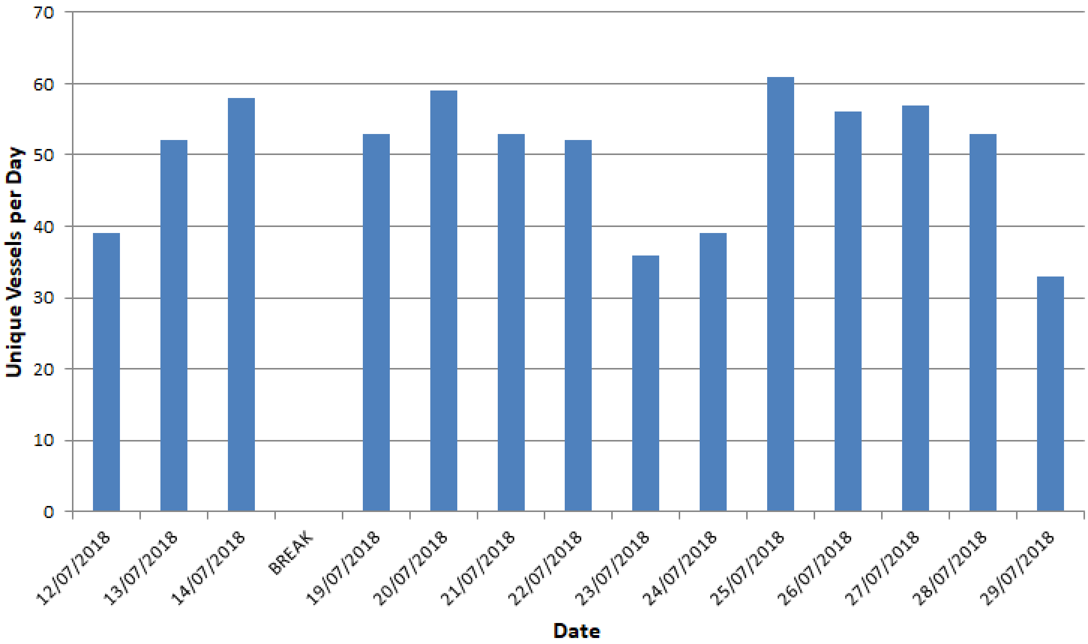

Figure 13.5 Summer 2018 Daily Counts (number of unique vessels per day)

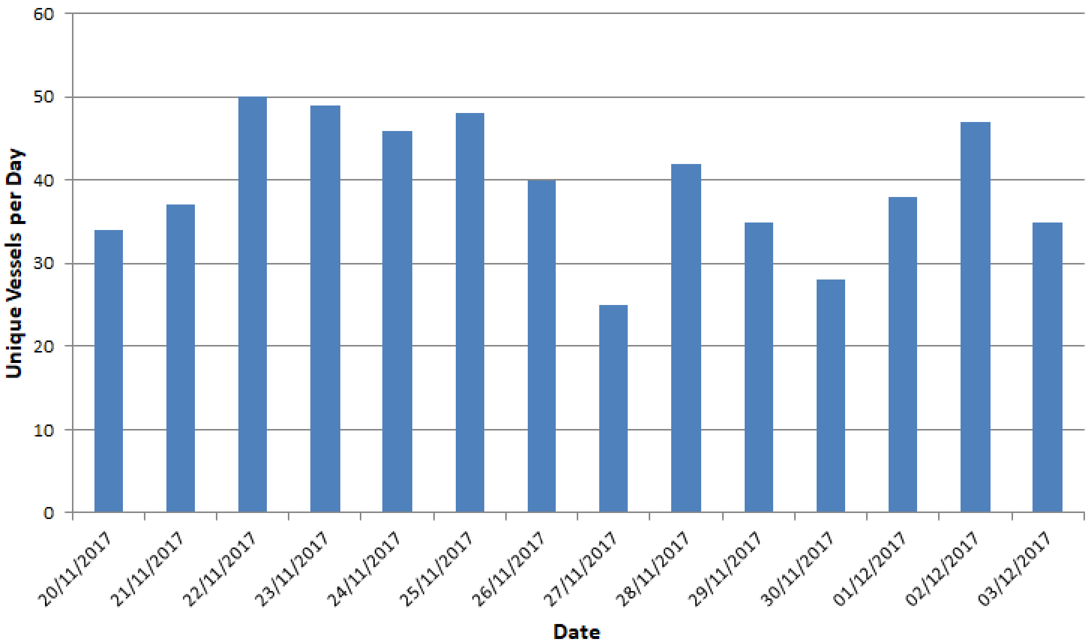

Figure 13.6 Winter 2017 Daily Counts (number of unique vessels per day)

173. An average of 50 unique vessels per day were recorded during the summer survey, falling to 40 per day in winter. Of this traffic, an average of 42 unique vessels per day intersected the offshore cable corridor itself during the summer survey period, falling to 34 in winter.

174. As shown in the vessel type distribution analysis, this decrease is likely due to recreational traffic being significantly lower in winter than in summer.

175. The busiest day during summer was the 25th July 2018, when 61 unique vessels were recorded within the offshore cable corridor. During winter, a total of 50 unique vessels were recorded on the busiest day, which was the 22nd November 2017.

13.3 Vessel Types

176. The distribution of vessel types recorded within the shipping and navigation study area is shown in *Figure 13.7*, split by season. The "other" category contains vessel types recorded in insufficient quantities to warrant their own category (e.g., lifeboats, research vessels).

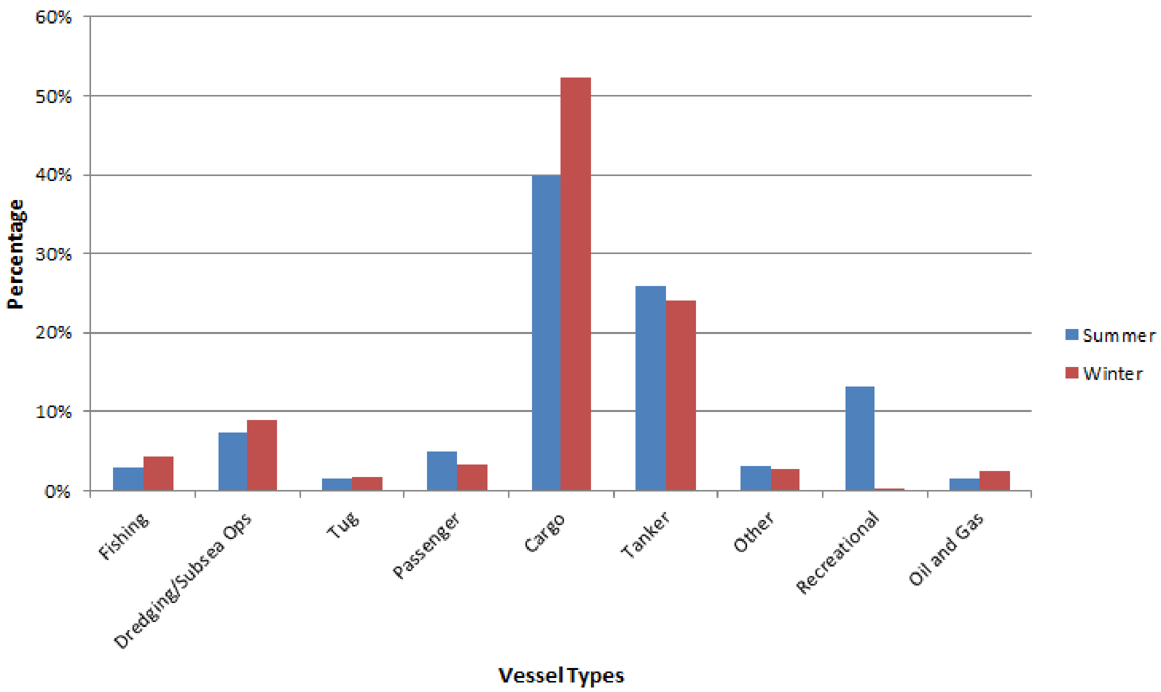

Figure 13.7 Vessel Type Distribution (Offshore Cable Corridor)

177. Overall, there was observed to be good correlation between the summer and winter data sets in terms of vessel type distribution, with the majority of vessels recorded during both periods being commercial (cargo or tanker). The only significant seasonal variation was observed to be in levels of recreational traffic, with such vessels accounting for 13% of the summer traffic, but less than 1% of the winter traffic.

13.4 Cargo Vessels

178. *Figure 13.8* presents a plot of cargo vessels recorded within the offshore cable corridor study area throughout the survey periods. Following this, the distribution of cargo vessel subtypes is shown in *Figure 13.9*.

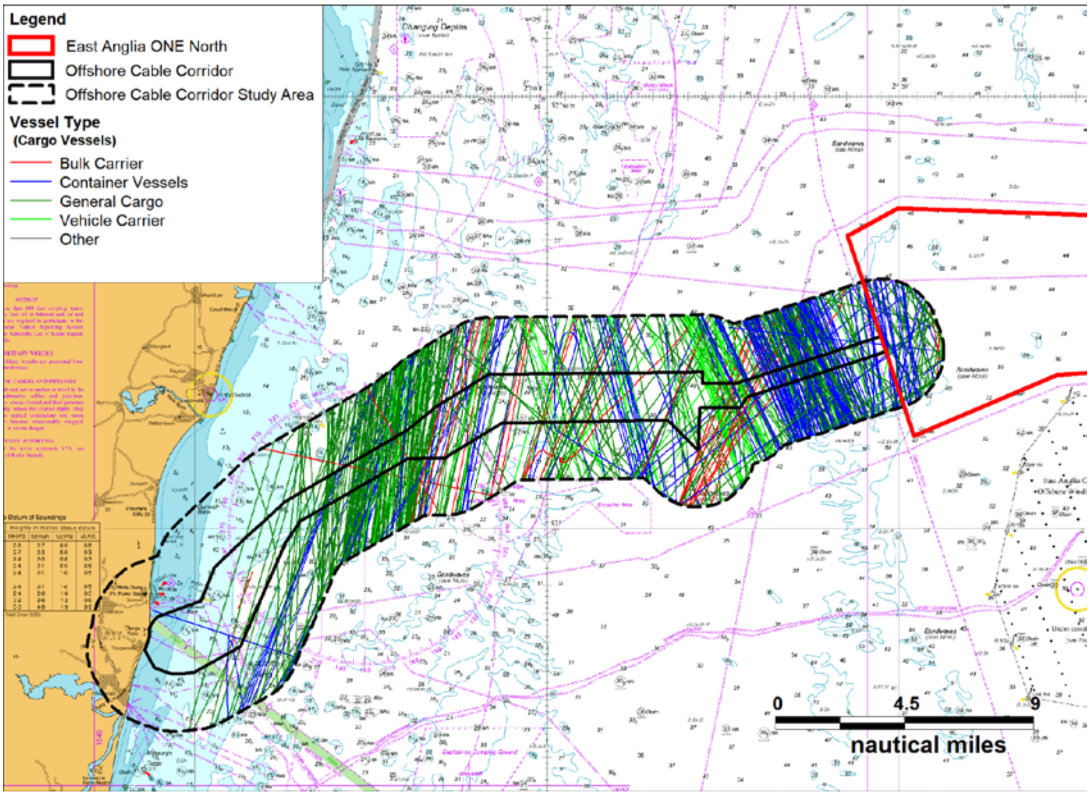

Figure 13.8 Cargo Vessels by Sub Type – Offshore Cable Corridor (28 days)

179. As would be expected, coastal activity from cargo vessels was limited within the offshore cable corridor study area, with the majority of traffic on transits further offshore.

180. Approximately half (53%) of cargo vessel traffic recorded was from general cargo vessels, with a further 30% comprised of container ships. The majority of container ship traffic was observed to transit directly to the west of the East Anglia ONE North windfarm site.

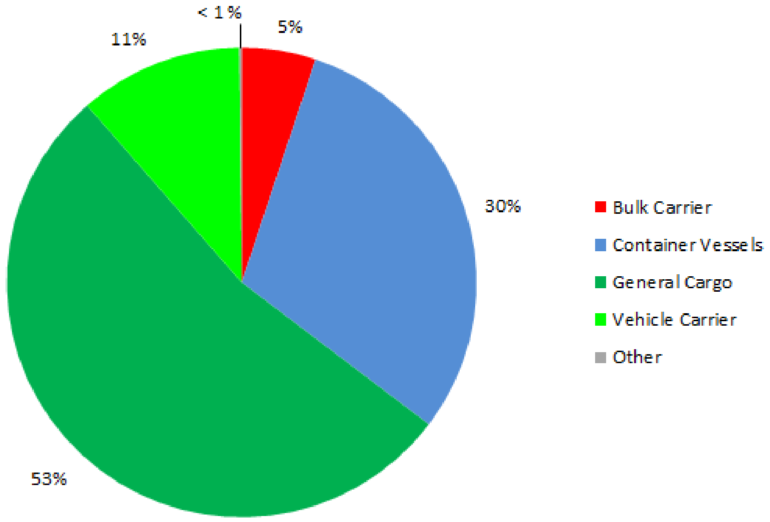

Figure 13.9 Cargo Vessel Type Distribution (28 days)

13.5 Tankers

181. A plot showing the tankers recorded within the offshore cable corridor during the 28 days of marine traffic data studied is shown in *Figure 13.10*.

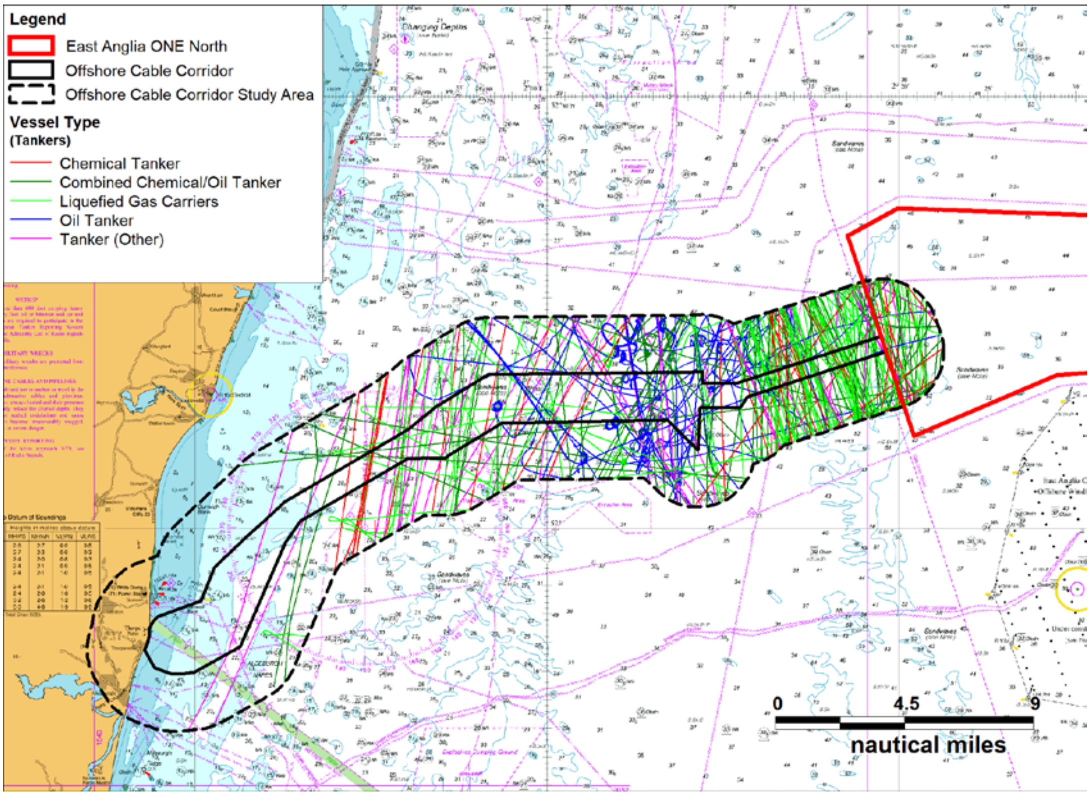

Figure 13.10 Tankers by Sub Type – Offshore Cable Corridor (28 days)

182. As for cargo vessels (see section 13.4), coastal transits from tankers were limited, with the majority of vessels transiting further offshore. Notable levels of anchoring from tankers was also observed within the data, which is discussed further in section 13.10.

183. The most common tanker type recorded was liquefied gas carriers, which accounted for 32% of overall tanker traffic. A summary plot of the type distribution of tanker traffic is shown in *Figure 13.11*.

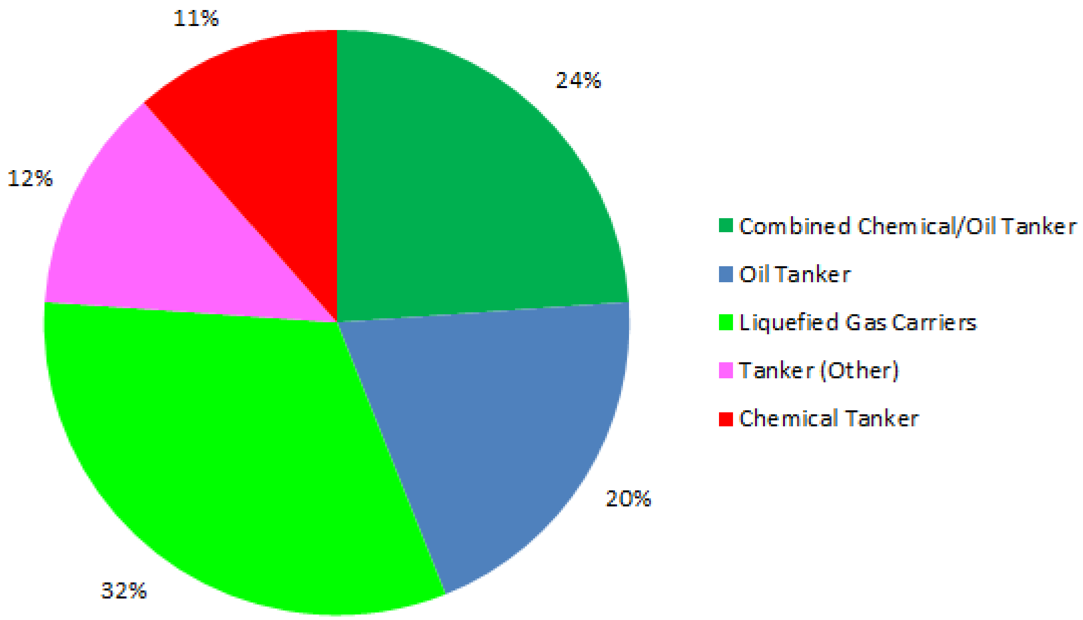

Figure 13.11 Tanker Type Distribution (28 days)

13.6 Oil and Gas Vessels

184. A plot showing the tracks recorded from oil and gas vessels within the offshore cable corridor during the 28 days of marine traffic data studied is shown in *Figure 13.12*. Following this, *Figure 13.13* shows the distribution of type observed within the oil and gas vessels recorded.

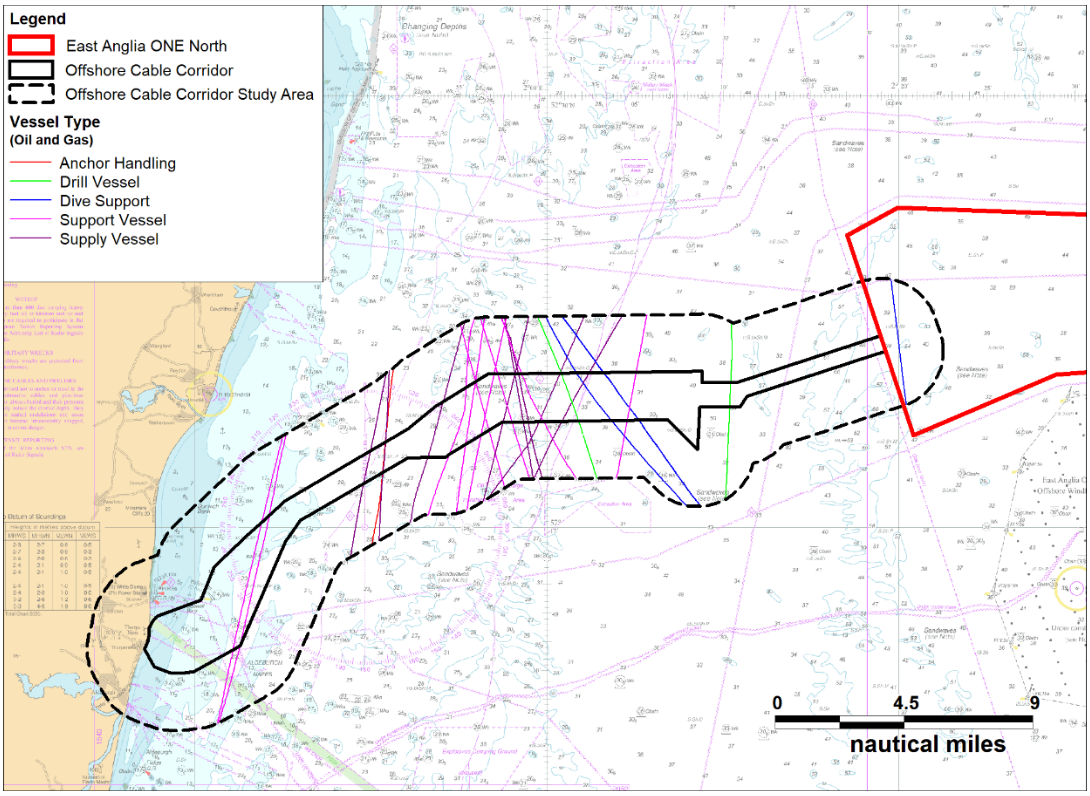

Figure 13.12 Oil and Gas by Sub Type – Offshore Cable Corridor (28 days)

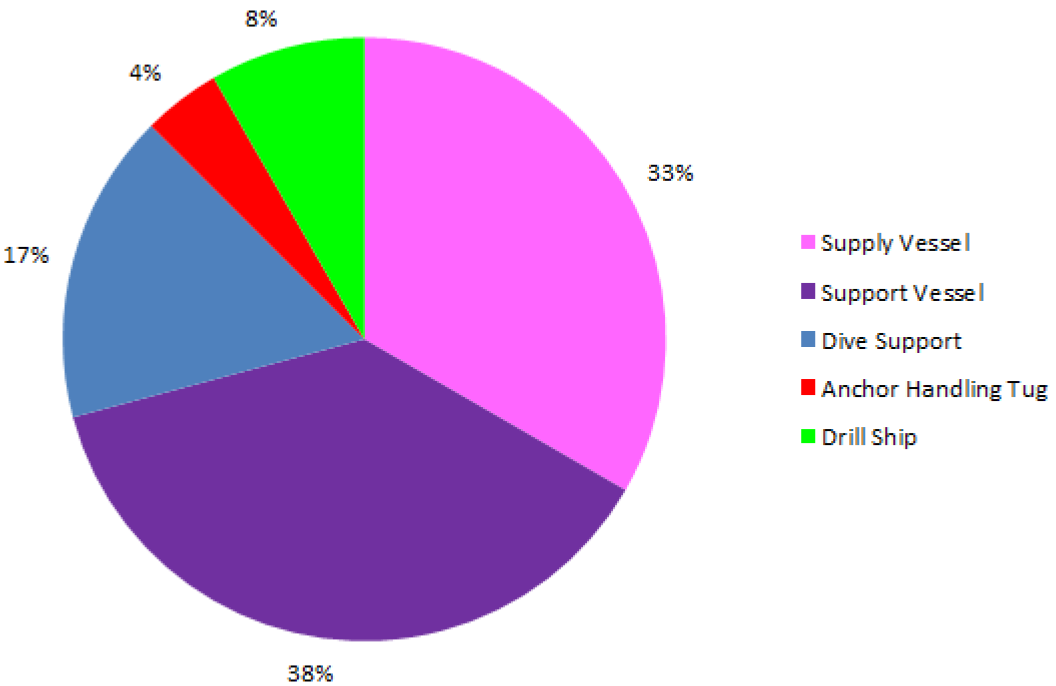

Figure 13.13 Oil and Gas Vessels Type Distribution (28 days)

185. Based on the destinations transmitted via AIS and existing knowledge of oil and gas traffic in the area, it is likely that the majority of oil and gas vessels recorded were associated with Great Yarmouth.

186. The most common vessel types recorded were support vessels (38%) and supply vessels (33%).

13.7 Passenger Vessels

187. A plot showing the tracks recorded from passenger vessels within the offshore cable corridor during the 28 days of marine traffic data studied is shown in *Figure 13.14*. Following this, *Figure 13.15* shows the distribution of type observed within the passenger vessels recorded.

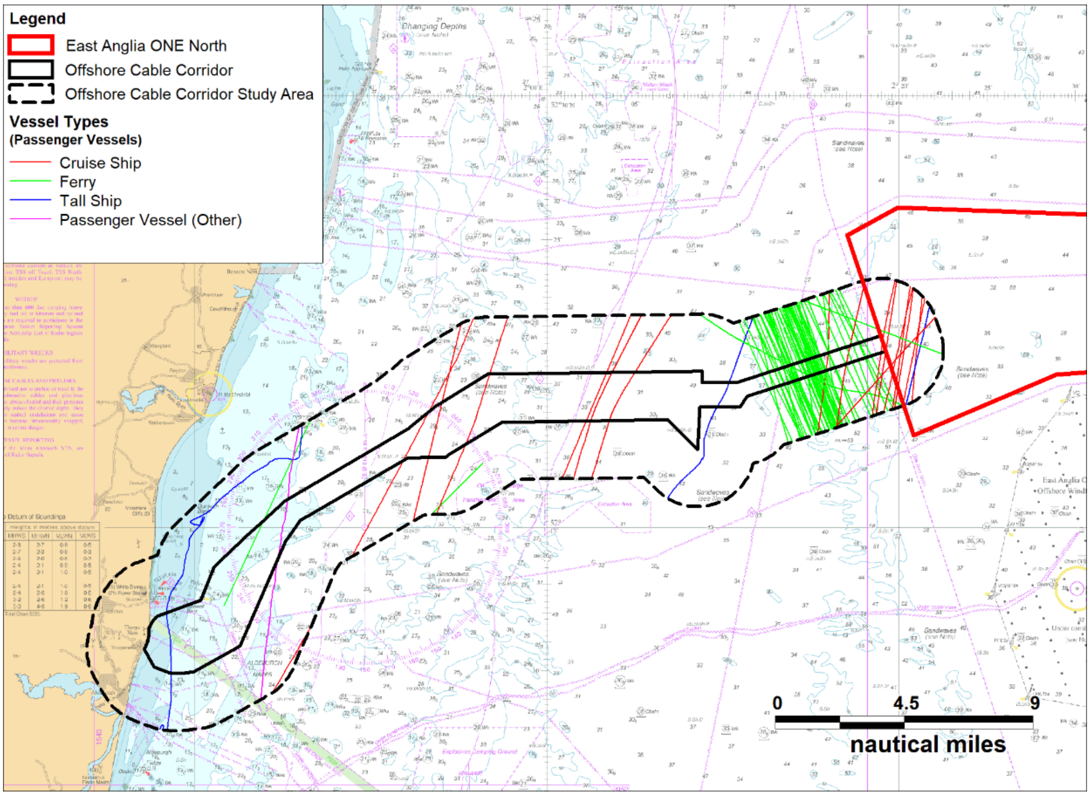

Figure 13.14 Passenger Vessel by Sub Type – Offshore Cable Corridor (28 days)

The majority (63%) of passenger vessels recorded were passenger ferries, most of which were utilising the P&O operated Hull to Zeebrugge route directly to the west of the East Anglia ONE North windfarm site. Large cruise liners were also recorded within the offshore cable corridor.

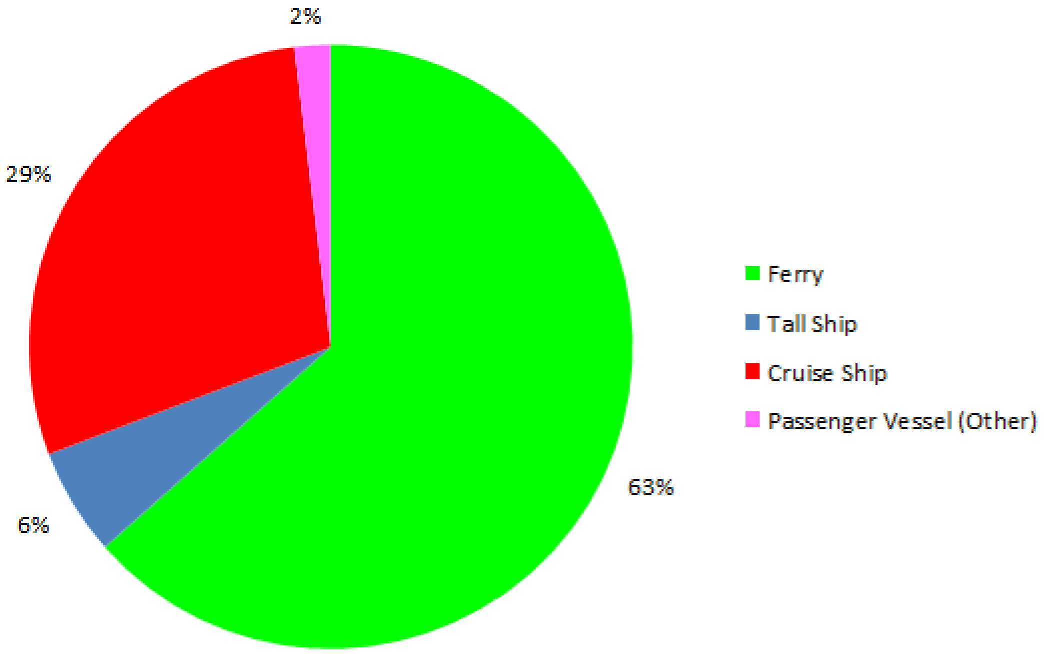

Figure 13.15 Passenger Vessels Type Distribution (28 days)

13.8 Fishing Vessels

188. The fishing vessels recorded within the offshore cable corridor study area over the 28 days of marine traffic data collection are shown in *Figure 13.16*. Where identifiable, the main gear type utilised by the recorded vessels has been determined, and used to colour code the figure.

189. Following this, the distribution of gear type observed over the 28 days is shown in *Figure 13.17*.

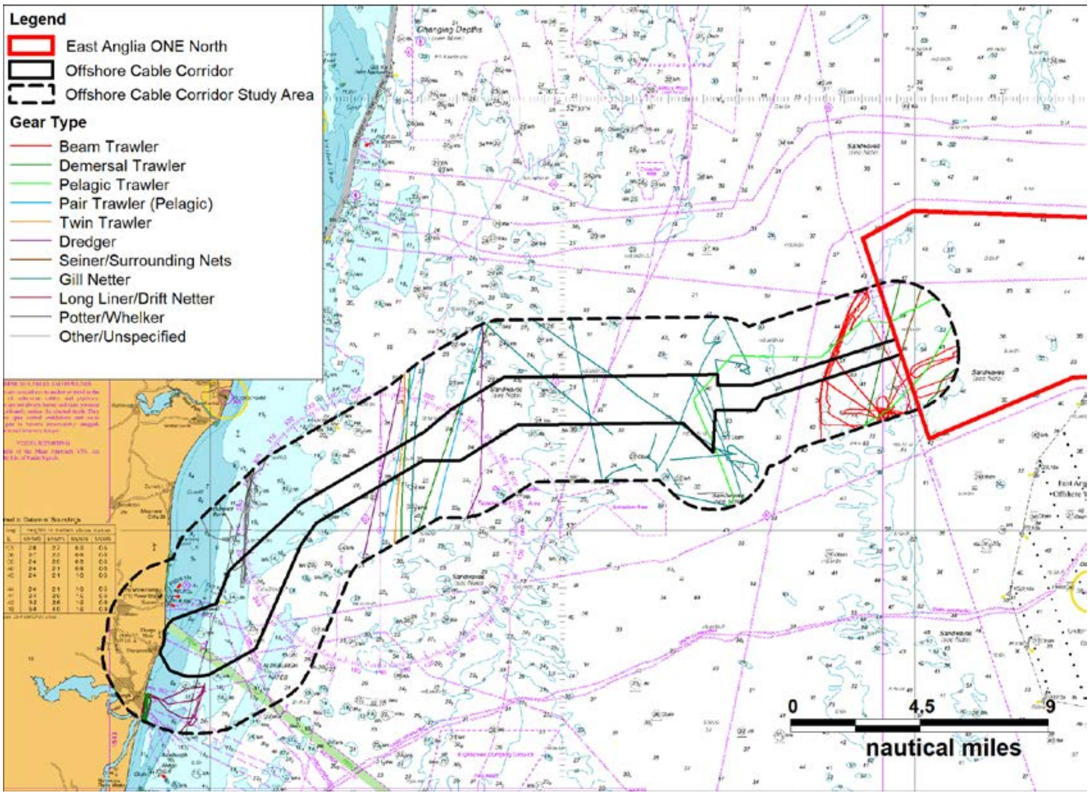

Figure 13.16 Fishing Vessels by Gear Type – Offshore Cable Corridor (28 days)

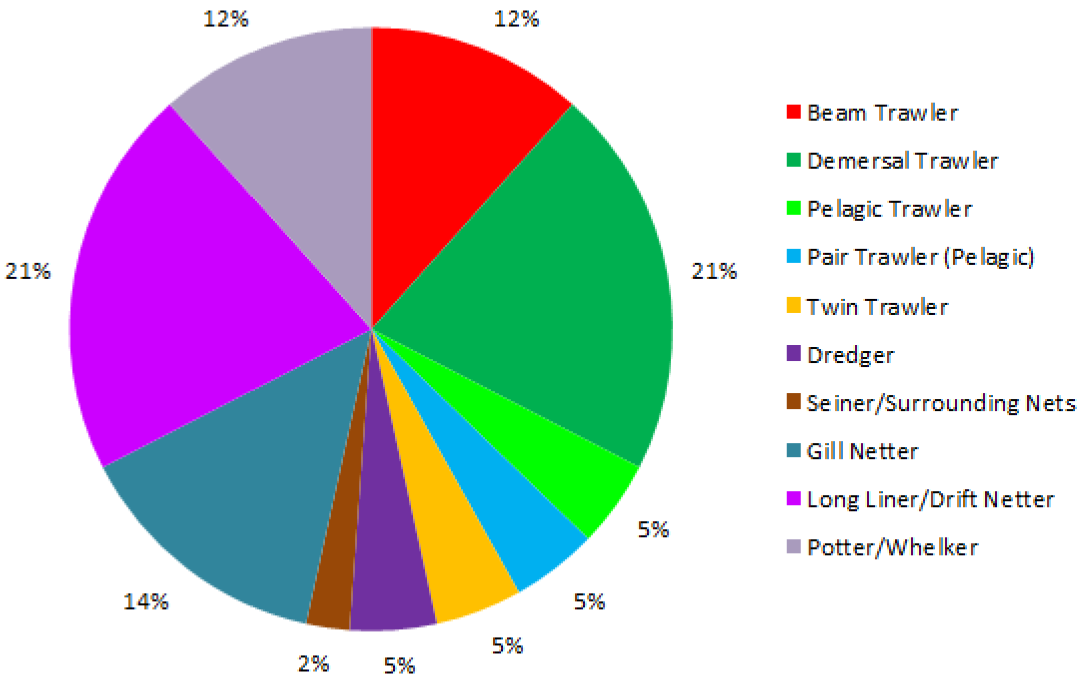

Figure 13.17 Fishing Vessels Gear Type Distribution (28 days)

13.9 Recreational Vessels

190. A plot showing the tracks recorded from recreational vessels within the offshore cable corridor during the 28 days of marine traffic data collection is shown in *Figure 13.18*.

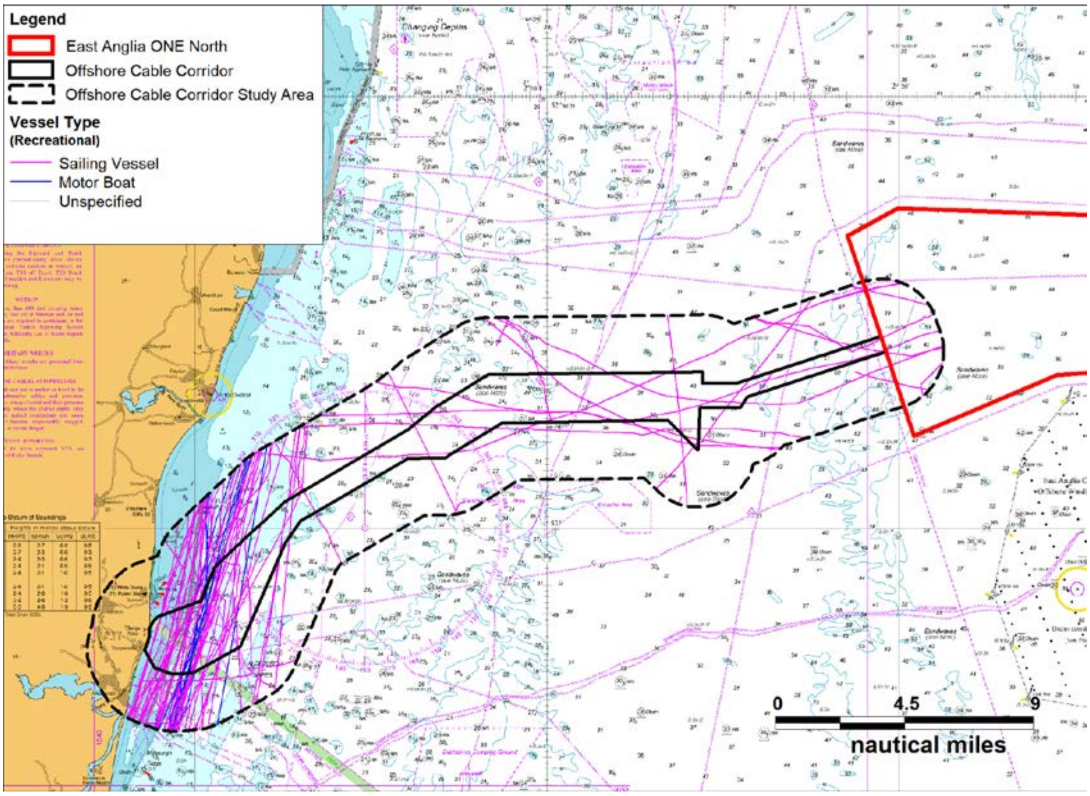

Figure 13.18 Recreational Vessels by Sub Type – Offshore Cable Corridor (28 days)

191. Recreational traffic was largely observed to remain coastal, with transits further offshore limited. In terms of vessel types, the majority of vessels (73%) were sailing vessels, with a further 11% being motor boats. The motor boat transits were all recorded coastally, with the offshore transits all coming from sailing vessels.

192. The RYA Coastal Atlas (RYA, 2016) is shown relative to the offshore cable corridor in *Figure 12.23* (section 12.12.1).

13.10 Anchoring

193. This section presents analysis of the anchoring activity in the vicinity of the offshore cable corridor study area. *Figure 13.19* presents a plot of the recorded vessels identified as potentially being at anchor during the combined summer and winter survey periods.

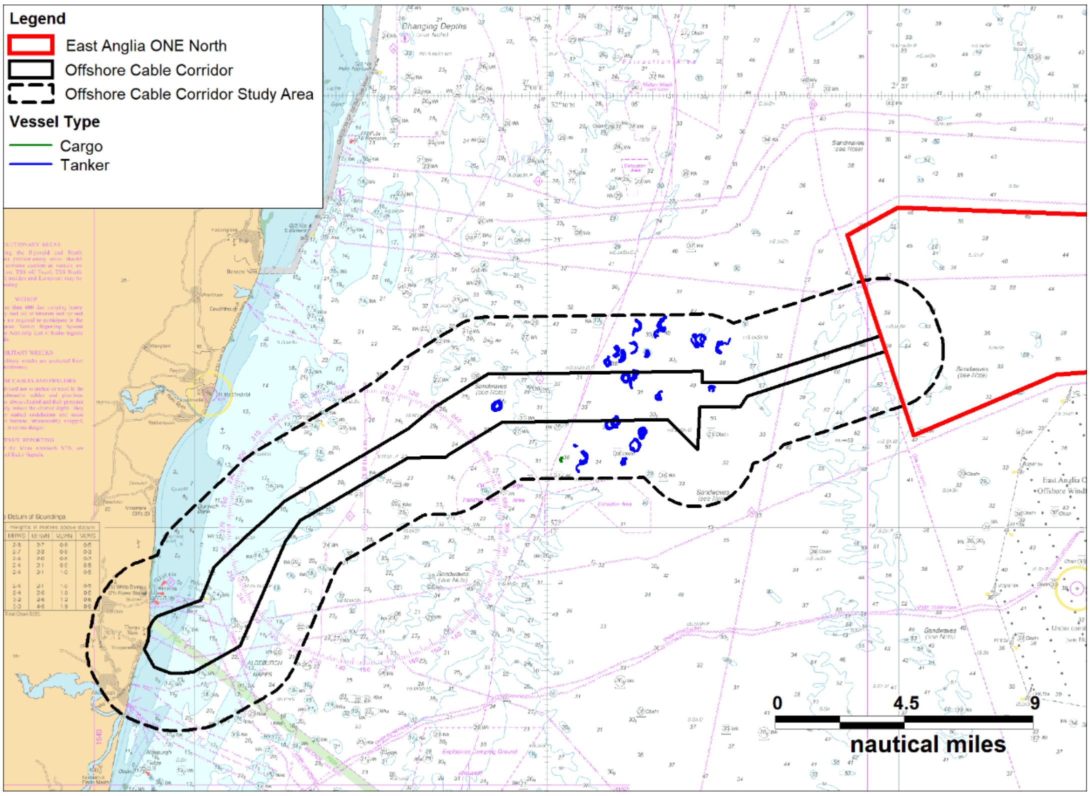

Figure 13.19 Anchored Vessels - Offshore Cable Corridor (28 days)

194. Notable levels of anchoring from tankers was observed, and as previously discussed, it is assumed likely that this activity is associated with the designated area of the UK territorial sea off the coast of Southwold where STS transfers are permitted. It should be noted that such operations may or may not require deployment of anchor by either vessel involved, however given that it was not possible to determine this based on the available data, all such operations have been presented.

195. A single cargo vessel was also recorded at anchor in a similar area. It is considered likely that this vessel was awaiting orders based on its behaviour and the information transmitted via AIS.

14 Base Case Routeing Analysis (Pre Windfarm)

14.1 Introduction

196. The marine traffic survey data shown in section 12 was used to identify the main vessel routes within 10nm of the East Anglia ONE North windfarm site. The information transmitted via AIS and Radar was used to estimate the types and sizes of vessels using each route, and the origin / terminus ports. Anatec's internal UK-wide route database and the charted IMO Routeing measures were then used to validate the findings, and to extend the routes beyond the 10nm threshold of the AIS and Radar data.

197. In addition to being the basis for the 90th percentile analysis provided below, the final routes were also used as input to the collision and allision risk modelling for the offshore development area, as summarised in section 16.

14.2 Main Routes

198. The main routes identified are presented in *Figure 14.1*, with a summary of each route then presented in *Table 14.1*. It is noted that the origin and destination ports for each route shown represent the most common destinations transmitted via AIS and Radar by vessels using those routes within the shipping and navigation study area. Therefore, actual destinations and origin ports may vary per vessel on any given route.

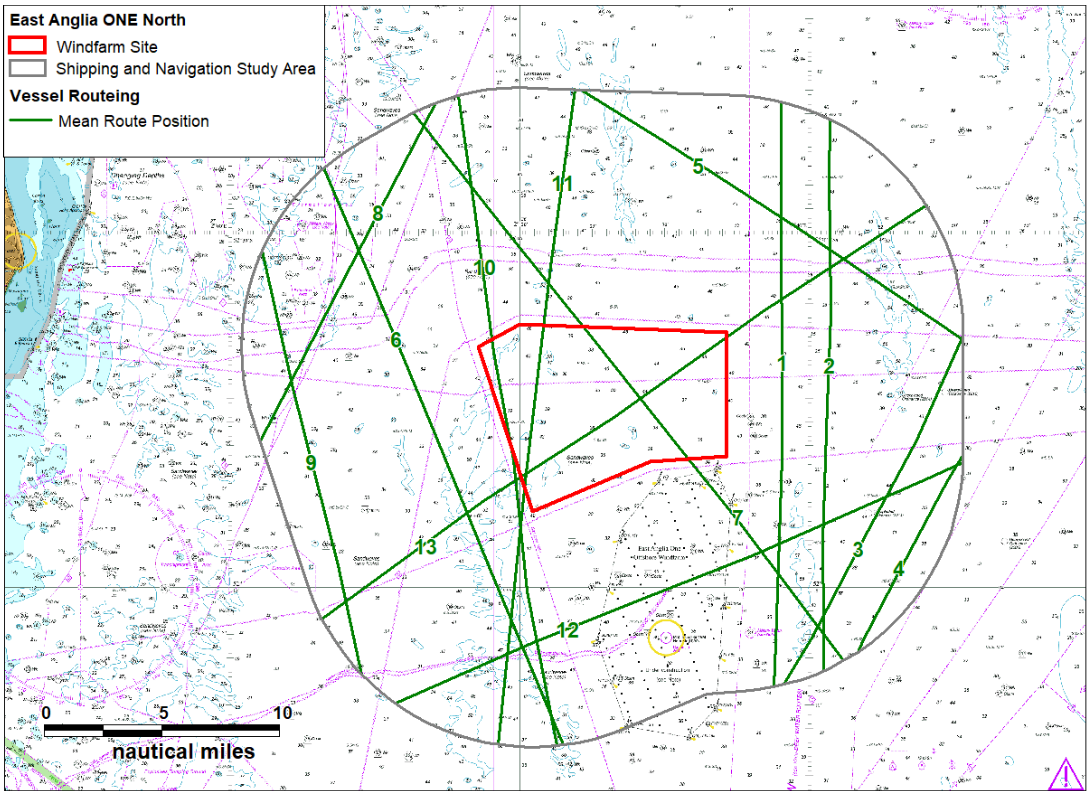

Figure 14.1 Main Routes – Pre Windfarm

Table 14.1 Main Route Details

Route Number	Main Destination and Origin Ports	Vessels per Day	Main Vessel Types	Description
1	Off Botney TSS – Rotterdam	5	Cargo and Tanker	Traffic transiting south between the Off Botney TSS and Rotterdam.
2	Rotterdam – Off Botney TSS	4	Cargo and Tanker	Traffic transiting north and south between Rotterdam and the Off Botney TSS.
3	West Friesland TSS – Rotterdam	13	Cargo and Tanker	Traffic transiting south-west between the West Friesland TSS and Rotterdam.

Route Number	Main Destination and Origin Ports	Vessels per Day	Main Vessel Types	Description
4	Rotterdam – West Friesland TSS	7	Cargo and Tanker	Traffic transiting north-east and south-west between Rotterdam and the West Friesland TSS.
5	Humber / Rotterdam	22	Cargo	Traffic transiting north-west and south-east between Humber and Rotterdam.
6	Tees / Zeebrugge	11	Cargo	Traffic transiting north-west and south-east between Tees and Zeebrugge.
7	Humber / Antwerp	3	Cargo and Tanker	Traffic transiting north-west and south-east between Humber and Antwerp.
8	Tees / Thames	2	Dredger and Tanker	Traffic transiting south-west and north-east between Tees and the Thames.
9	Humber / Zeebrugge	1	Cargo	Traffic transiting north and south between Humber and Zeebrugge.
10	Tees / Zeebrugge	3	Cargo and Tanker	Traffic transiting north-west and south-east between Tees and Zeebrugge.

Route Number	Main Destination and Origin Ports	Vessels per Day	Main Vessel Types	Description
11	Dover Strait / West Friesland TSS	2	Cargo	Traffic transiting north and south between the Dover Strait and the West Friesland TSS.
12	Thames / Off Texel TSS	1	Cargo	Traffic transiting east and west between the Thames and Off Texel TSS.
13	Ipswich / Off Vlieland TSS	1	Cargo	Traffic transiting east and west between Ipswich and the Off Vlieland TSS.

14.3 90th Percentiles

199. The AIS and Radar data was used to estimate the 90th percentiles within the study area surrounding the East Anglia ONE North windfarm site (as per the requirements of MGN 543 (MCA 2016)). The subsequent 90th percentiles are presented in *Figure 14.2*.

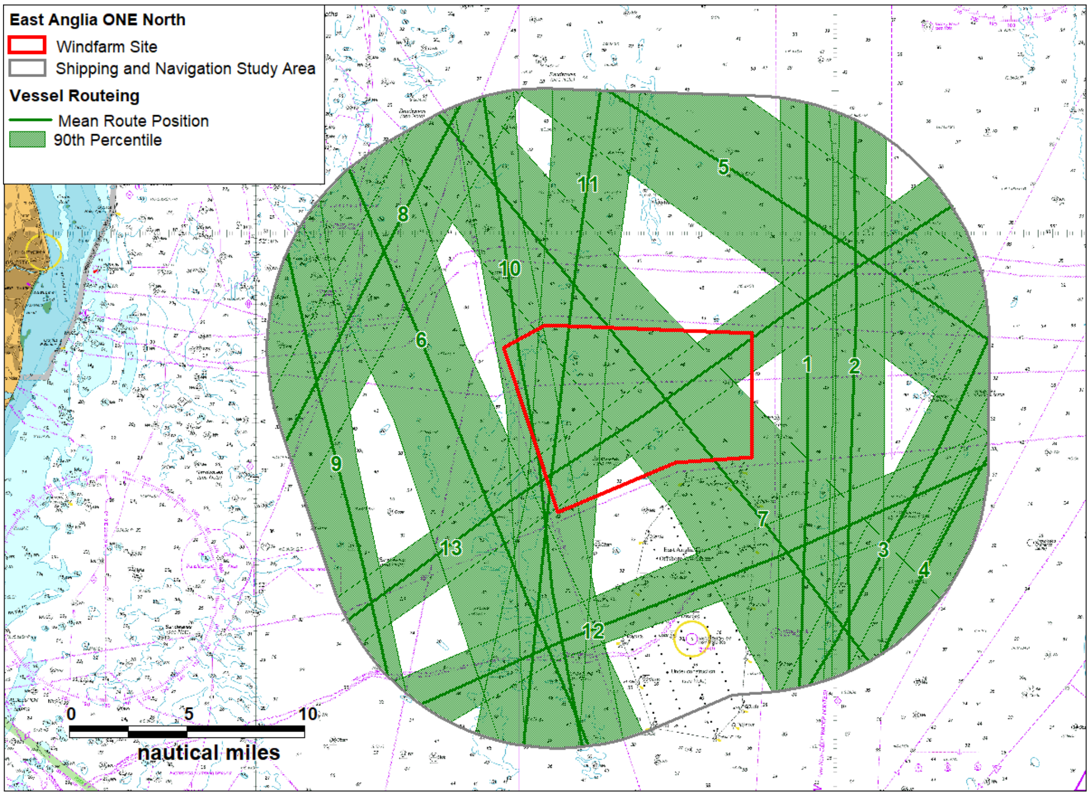

Figure 14.2 90th Percentiles

15 Post Windfarm Routeing Analysis

15.1 Introduction

200. This section assesses the potential impacts of the East Anglia ONE North windfarm site on each of the main routes identified in section 14. For each route which may deviate, the worst case from a modelling perspective has been presented both when considering the East Anglia ONE North windfarm site in isolation and cumulatively with other offshore windfarm developments scoped into the cumulative assessment.

201. Based on the marine traffic presented in section 12, it is considered that four main routes could be potentially affected by the East Anglia ONE North windfarm site. These four routes are presented in *Figure 15.1* and described in more detail below. The cumulative impact of East Anglia ONE North windfarm site with other offshore windfarm developments on vessel routeing has been assessed in section 19.

202. It should be noted that any base case routes recorded intersecting the offshore development area only (i.e., they do not also intersect the East Anglia ONE North windfarm site) have not been deviated as the focus of the post windfarm routeing analysis is the effects of the East Anglia ONE North windfarm site. However, the deviations for routes intersecting both sites have taken account of the East Anglia ONE windfarm site.

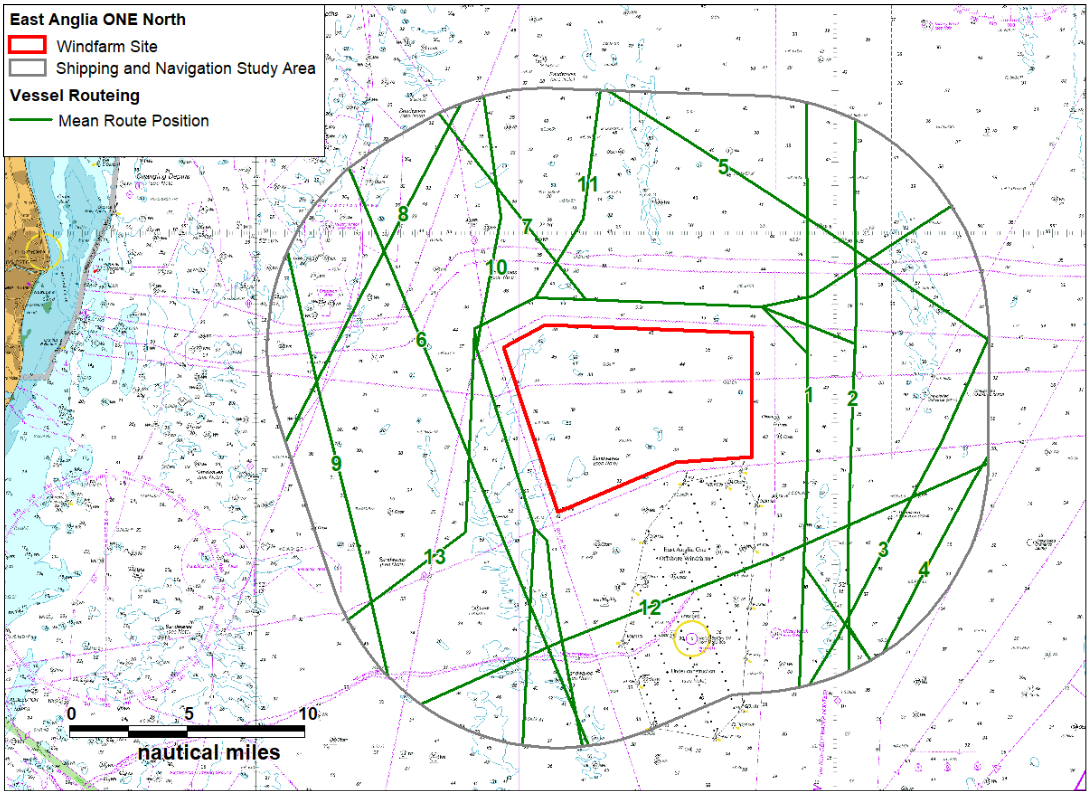

Figure 15.1 Main Routes – Showing Post Windfarm Worst Case Deviations

15.2 Individual Worst Case Route Deviations

The deviations shown in the following sections are worst case whereby a vessel leaves and returns to its original course as soon as possible. These deviations are shown to demonstrate the worst case increase in time and distance, however in reality vessels are likely to passage plan so as to deviating sooner from their existing course and thus reducing time and distance changes.

15.2.1 Route 7

203. The deviation post windfarm of Route 7 is shown in *Figure 15.2*. It is has been assumed that vessels using this route will deviate into the established DWR routeing, noting that this is considered the worst case from a vessel to vessel collision point of view.

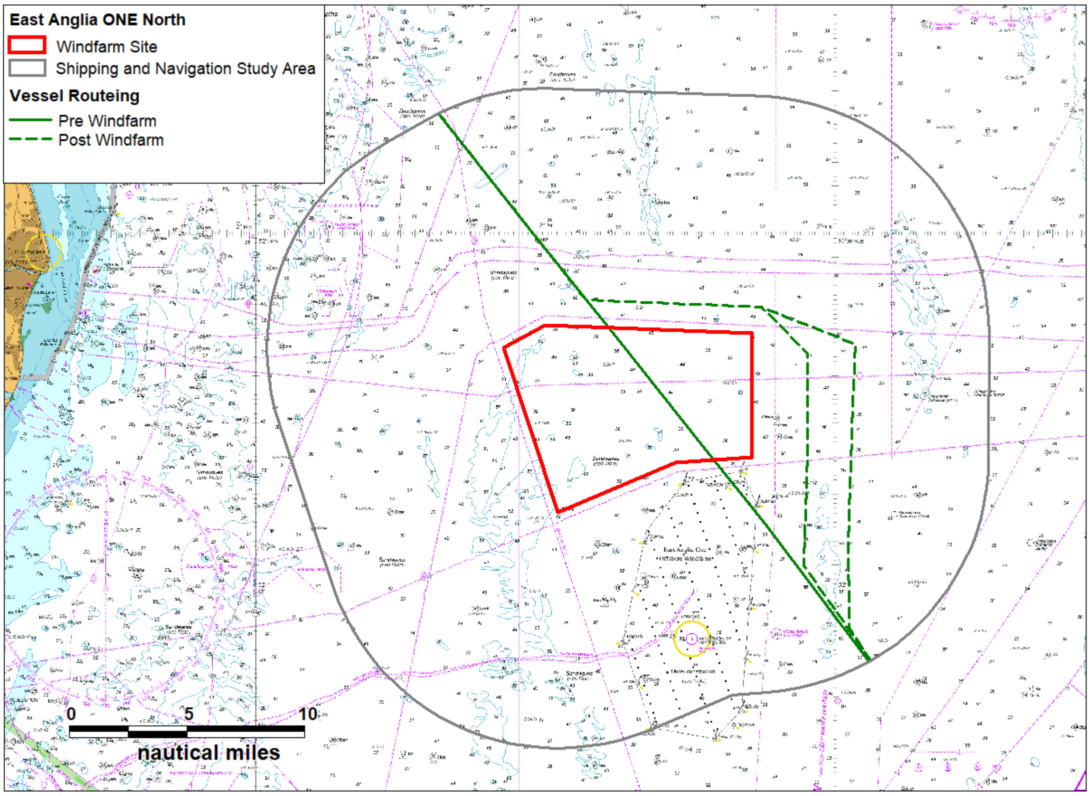

Figure 15.2 Route 7 Deviation

15.2.2 Route 10

204. The deviation post windfarm of Route 10 is shown in *Figure 15.3*. It is anticipated that vessels using Route 10 will shift to the west to avoid the structures within the East Anglia ONE North windfarm site.

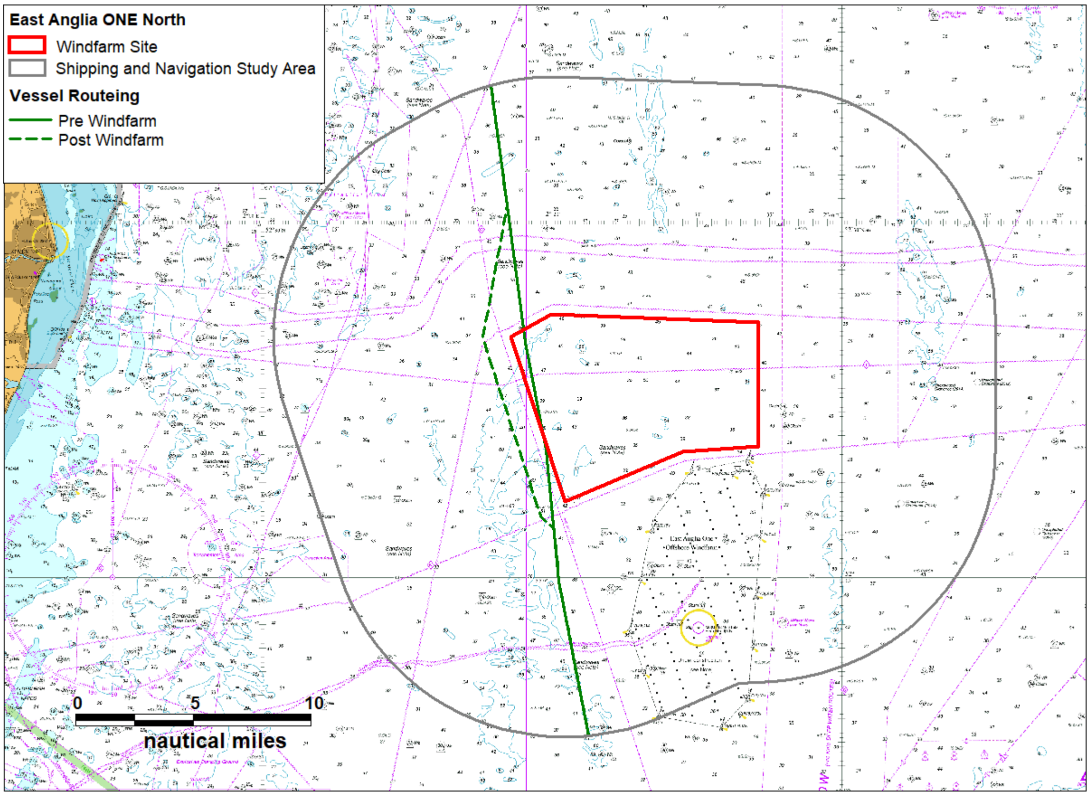

Figure 15.3 Route 10 Deviation

15.2.3 Route 11

205. The deviation post windfarm of Route 11 is shown in *Figure 15.4*. As for Route 10 (see section 15.2.2), it is anticipated that vessels using Route 11 will shift to the west to avoid the structures within the East Anglia ONE North windfarm site.

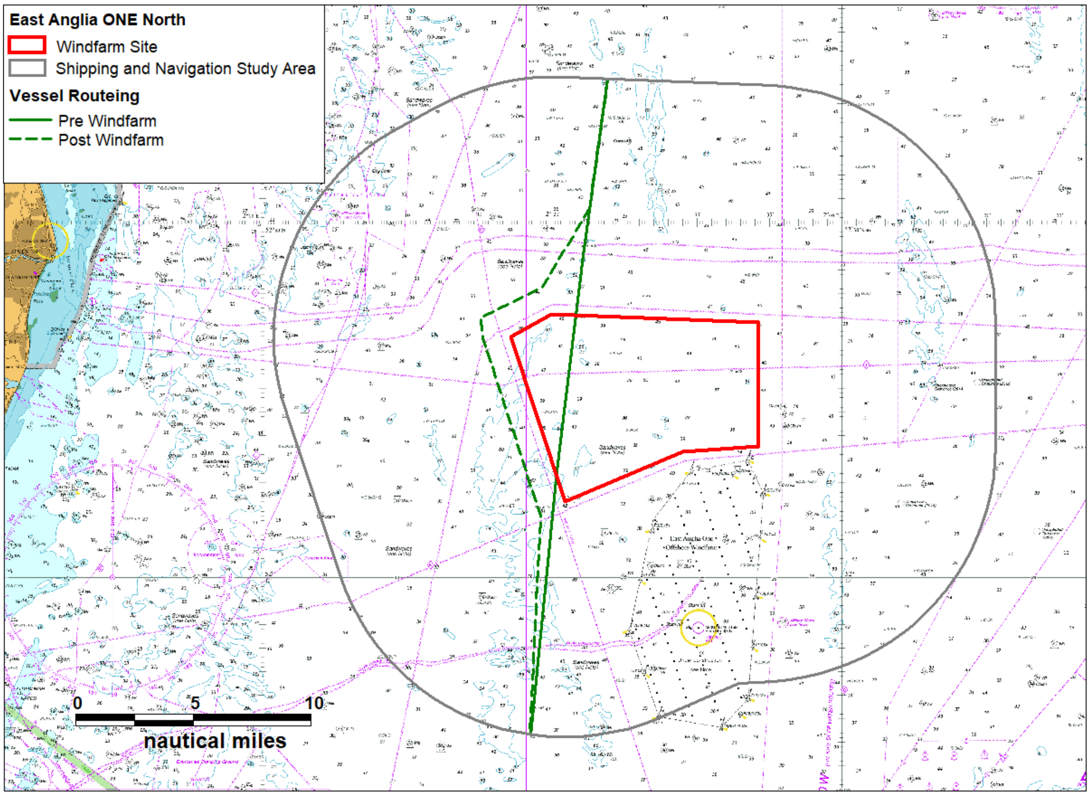

Figure 15.4 Route 11 Deviation

15.2.4 Route 13

206. The deviation post windfarm of Route 13 is shown in *Figure 15.5*. It is anticipated that vessels using Route 13 will pass north of the structures within the East Anglia ONE North windfarm site.

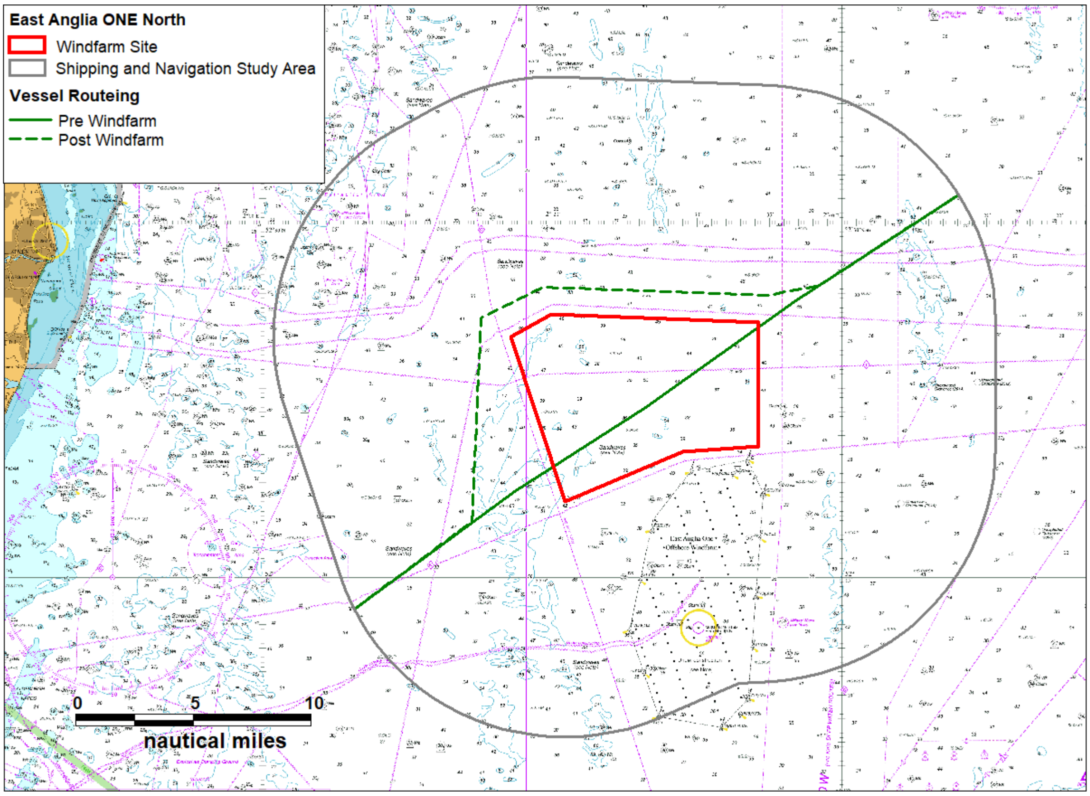

Figure 15.5 Route 13 Deviation

15.3 Simulated AIS

207. To illustrate the anticipated vessel activity from regular routed traffic, the deviated routes presented in *Figure 15.1* 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 15.6*. It is noted that deviations are presented as a realistic worst case and in reality vessels may distance themselves further from the East Anglia ONE North windfarm site through advanced passage planning, in line with MGN 543 (MCA, 2016), depending on weather (notably visibility) and sea state.

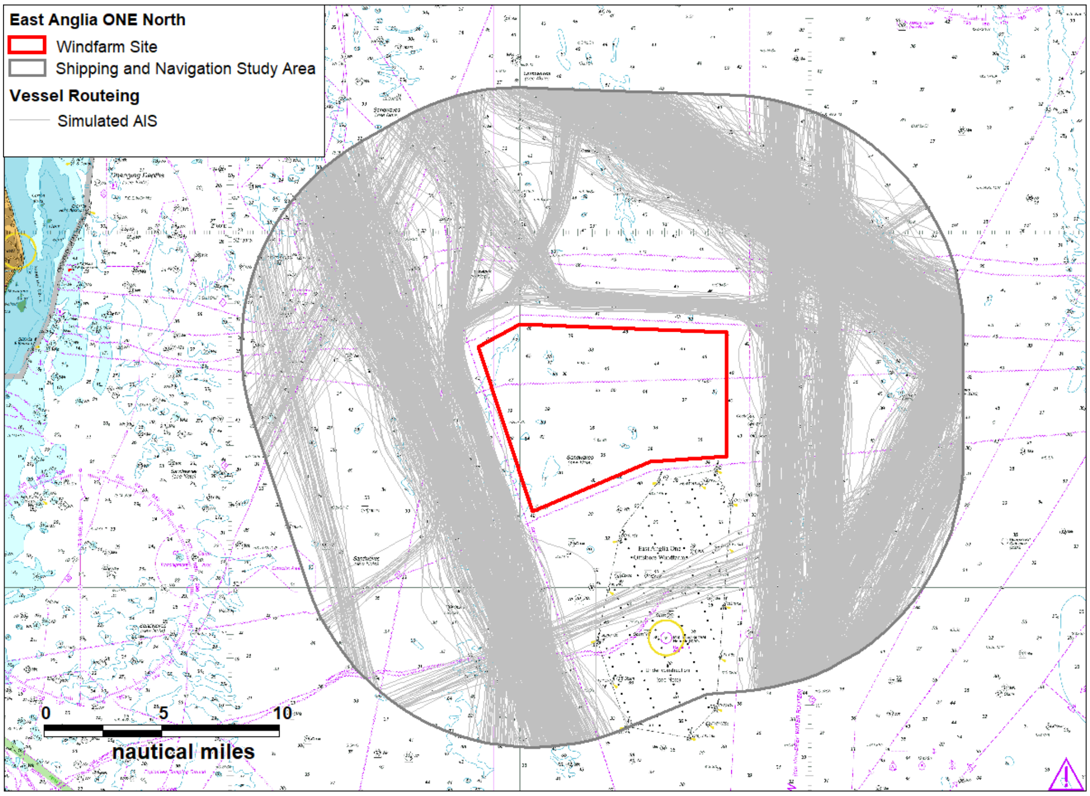

Figure 15.6 Simulated AIS (Post Windfarm)

16 Collision and Allision Risk Modelling Overview

16.1 Introduction

208. The following sections provide quantitative assessment of the major hazards associated with the development of the offshore development area. This is divided into a base case and a future case assessment in terms of traffic levels, and with and without the East Anglia ONE North offshore windfarm. The assessment includes major hazards associated with:

- Increased vessel to vessel collision risk;
- Additional vessel to structure allision risk;
- Additional fishing vessel to structure allision risk;
- Additional risk associated with vessels NUC.

209. The base case assessment used the marine traffic survey data in combination with the consultation responses and other baseline data sources to estimate the current encounter probability, and vessel to vessel collision risk. Conservative assumptions of shipping level increases and route deviations were then made to model future case results.

210. A pre windfarm assessment is provided in section 17, with the post windfarm scenario then assessed in section 18.

16.2 Potential Traffic Increases (Future Case)

211. There is the potential for traffic levels to increase during the lifespan of the East Anglia ONE North 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 windfarms, including the East Anglia ONE Offshore Windfarm and the Norfolk Vanguard Offshore Windfarm 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.

212. The increase was implemented by increasing the total vessel numbers per route shown in *Table 14.1* by 10%, whilst maintaining the breakdowns by vessel type and size. The updated vessel numbers were then rounded up to the nearest whole number.

16.3 Modelled Layout and Structure Dimensions

213. The worst case indicative layout which has been used as input to the modelling process is presented in *Figure 4.2* (section 4.3). The wind turbine and offshore substation dimensions which have been modelled are presented in *Table 16.1*.

214. The orientation modelled consisted of the flat side facing into the predominant wind direction (240°).

Table 16.1 Modelled Dimensions

Structure	Shape	Dimensions
Wind Turbine	Square	55.5 x 55.5m
Offshore Substation	Rectangle	50m x 70m
Construction, Operation and Maintenance Platform	Rectangle	50m x 70m

17 East Anglia ONE North Windfarm Site In Isolation Assessment – Base Case

17.1 Encounters

215. An assessment of current vessel to vessel encounters has been carried out by replaying at high speed the AIS and Radar data collected for the East Anglia ONE North windfarm site. An encounter distance of 1nm has been considered, i.e. two vessels passing within 1nm of each other has been classed as an encounter. This helps to illustrate where existing shipping congestion is highest and therefore where offshore developments, such as windfarms, could potentially increase congestion and therefore also increase the risk of encounters and / or collisions.

216. Any encounters identified that involved multiple vessels engaged in a single operation have been removed. This included vessels in tanker to tanker transfer operations (see section 12.13) and towing operations (i.e., one vessel towing another). This ensured the focus of the assessment was encounters between unassociated vessels.

217. It is noted that as not all vessels recorded by radar during the marine traffic surveys could be identified, there were instances of there being doubt as to if an identified encounter was actually a vessel encountering itself. Cases where an encounter was clearly false have been removed; however cases which could not be confirmed as false have been included in the following analysis.

17.1.1 Encounters Density

218. The output tracks of the assessment were used to estimate the encounter density within the shipping and navigation study area. The densities are shown in *Figure 17.1* and *Figure 17.2* respectively.

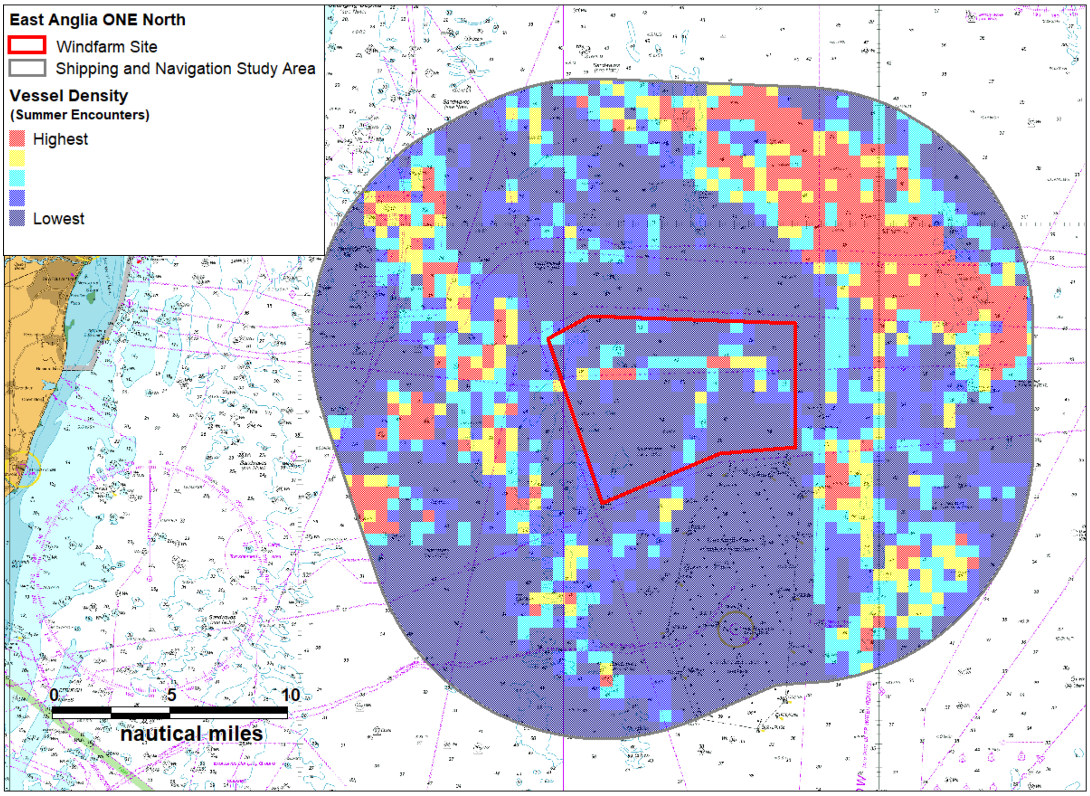

Figure 17.1 Vessel Density – Summer Encounters (14 Days)

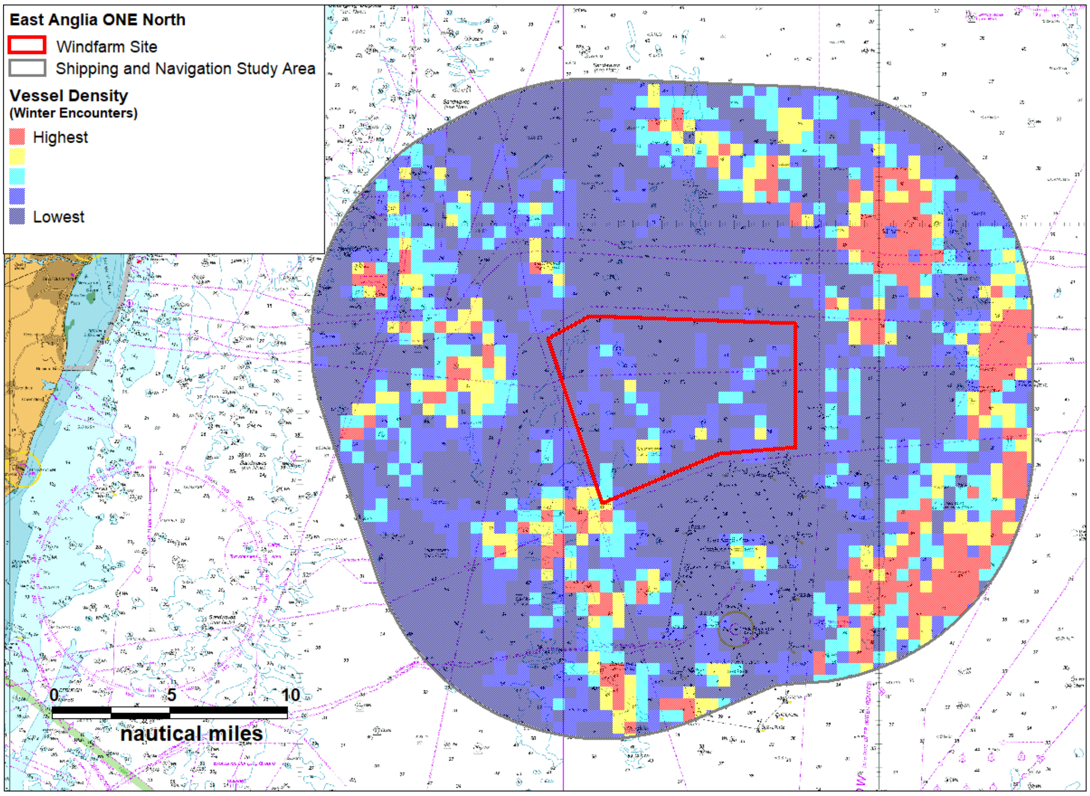

Figure 17.2 Vessel Density – Winter Encounters (14 Days)

219. During both summer and winter, a high level of encounters associated with the busy route passing north of the East Anglia ONE North windfarm site (Route 5 in *Figure 14.1*) was observed to occur. Similarly, encounter density within the DWR to the east was high.

17.1.2 Daily Counts

220. The number of encounters recorded during the summer and winter survey periods are presented in *Figure 17.3*.

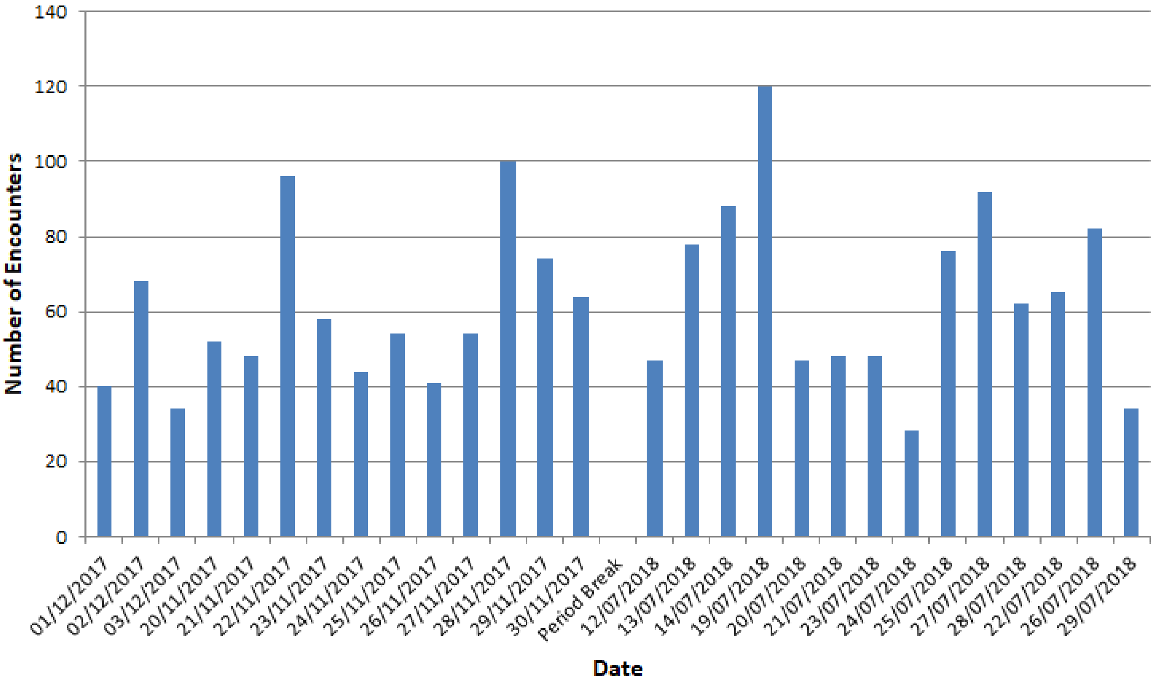

Figure 17.3 Daily Encounter Count

221. An average of 30 encounters per day was recorded during the winter period, rising to 33 per day during the summer period. It should be considered that as the winter survey was AIS only, any encounter involving a non-AIS vessel will not be accounted for. However, given that encounters involving a non-AIS vessel only accounted for 2% of the encounters identified during summer, this is not considered to be a significant assessment limitation, particularly as non-AIS vessels would typically be expected to be less in winter than summer.

17.1.3 Vessel Type Distribution

222. The distribution of type of the vessels identified as being involved in an encounter over the survey periods is presented in *Figure 17.4*.

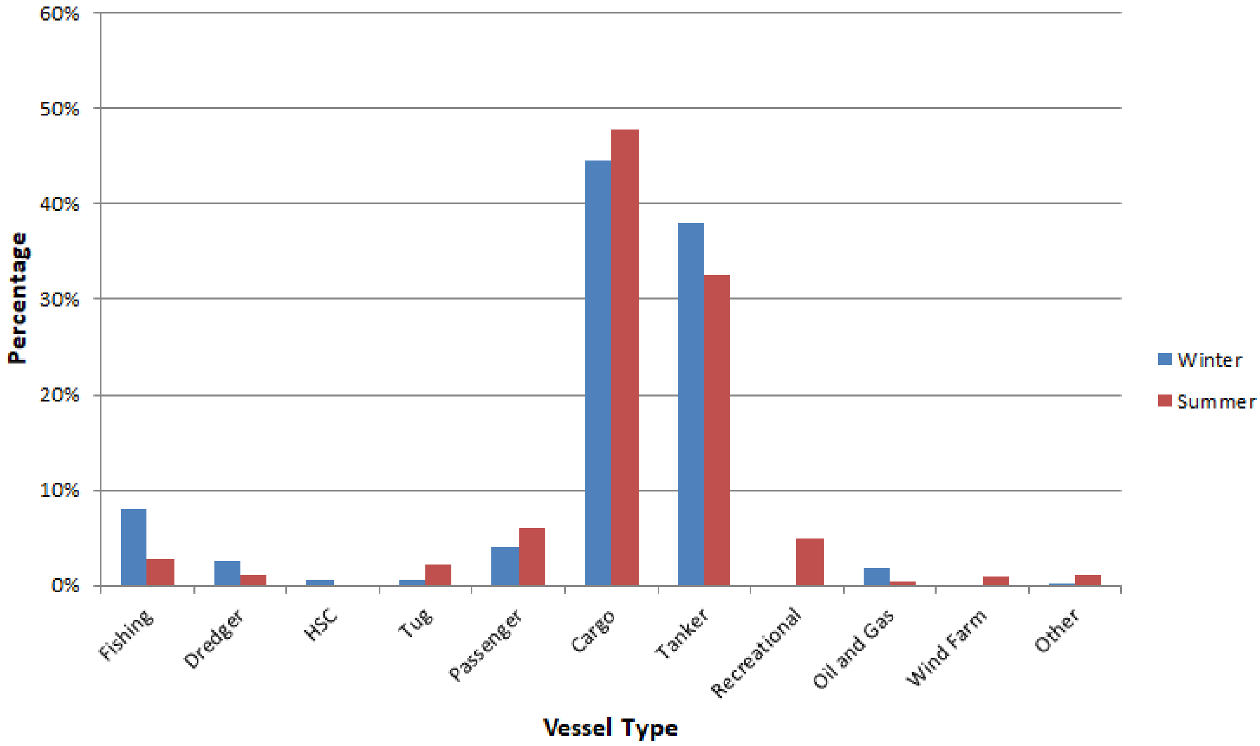

Figure 17.4 Distribution of Vessel Type

223. The majority of encounters involved a commercial vessel (either cargo or tanker) during both summer and winter. This can be attributed to the busy commercial vessel routes present within the vicinity of the East Anglia ONE North windfarm site.

17.2 Vessel to Vessel Collisions

224. The baseline routeing and encounter levels in the area were used as input to the vessel to vessel collision model within Anatec's CollRisk model suite to estimate the base case vessel to vessel collision risk within the vicinity of the East Anglia ONE North windfarm site. The model was then also run assuming a 10% increase in traffic levels (future case). The results are presented as density grids in *Figure 17.5* and *Figure 17.6* respectively.

225. It was estimated that pre windfarm and assuming base case traffic levels, a vessel will be involved in a collision within the shipping and navigation study area once every 19 years. Should traffic increase by 10%, the estimate rises to once every 16 years, which corresponds to an increase in collision risk of approximately 21%.

226. These numbers are reflective of the busyness of the area in terms of baseline passing traffic, noting that the majority of the collision risk was observed to be associated with the DWR to the east of the East Anglia ONE North windfarm site, and with the busy route to the north between Humber and Rotterdam (Route 5 in *Figure 14.1*). It is emphasised that these are the baseline collision frequencies, the effect of

accounting for deviations arising from the East Anglia ONE North windfarm site are studied in section 18.1.

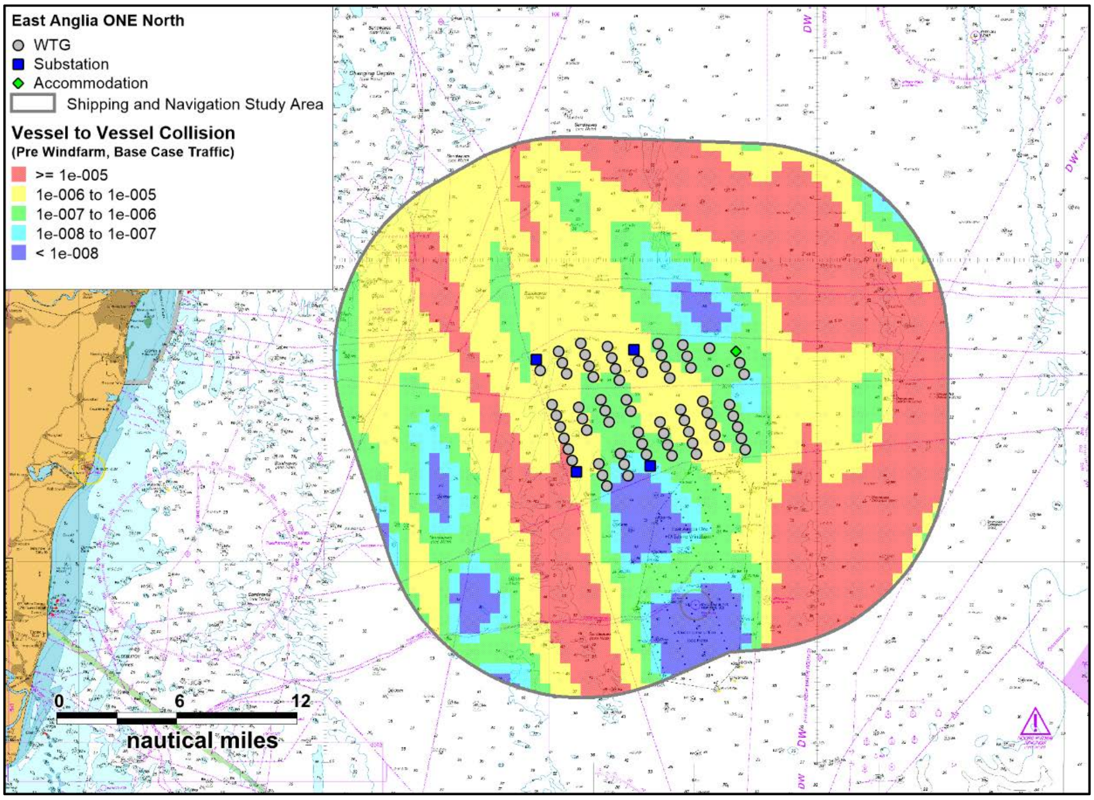

Figure 17.5 Vessel to Vessel Collision (Pre Windfarm, Base Case traffic levels)

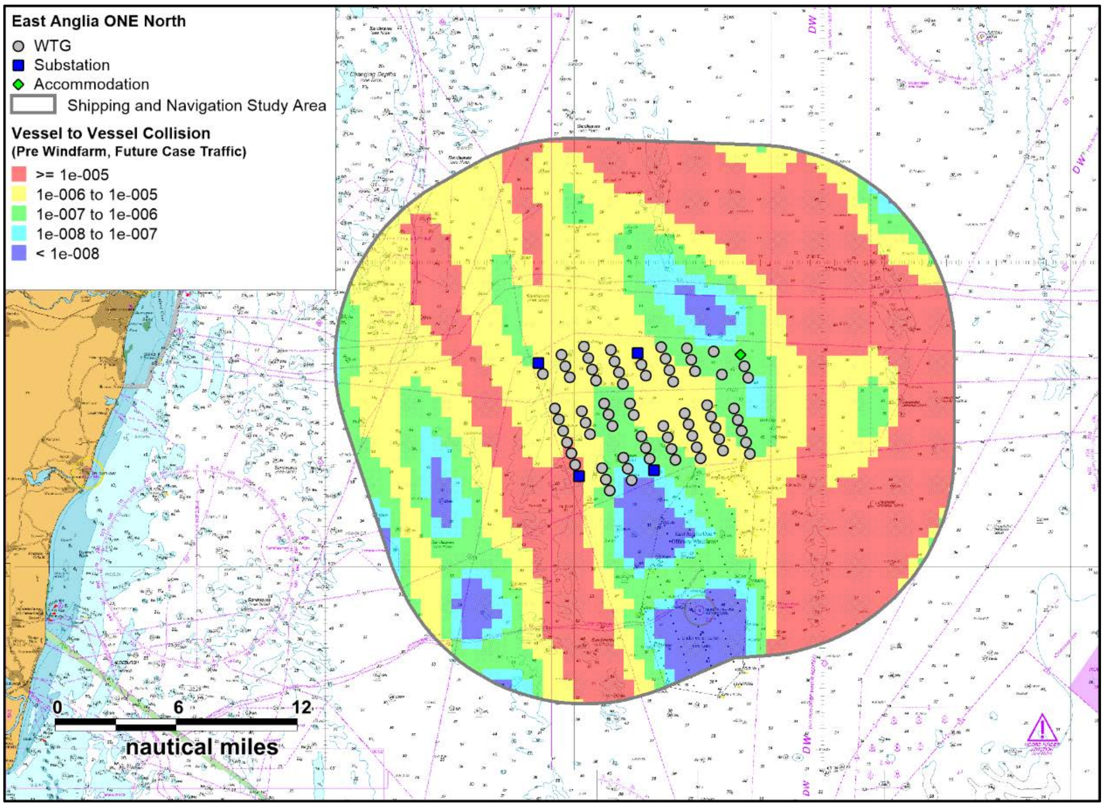

Figure 17.6 Vessel to Vessel Collision (Pre Windfarm, 10% Traffic Increase)

18 East Anglia ONE North Windfarm Site In Isolation Assessment – Future Case

18.1 Vessel to Vessel Collisions

227. The revised routeing shown in section 15 was used as input to the vessel to vessel collision model within Anatec's CollRisk model suite to estimate the potential rise in vessel to vessel collisions as a result of the East Anglia ONE North windfarm site. The results are compared with the pre windfarm results in *Table 18.1*.

Table 18.1 Vessel to Vessel Collision Frequencies

Scenario	Annual Collision Frequency	Return Period (Years)	Increase from Pre Windfarm Case (base case traffic levels)
Pre Windfarm – 0% Traffic Growth	5.33×10^{-2}	19	n/a
Post Windfarm – 0% Traffic Growth	5.53×10^{-2}	18	4%
Pre Windfarm – 10% Traffic Growth	6.45×10^{-2}	16	21%
Post Windfarm – 10% Traffic Growth	6.69×10^{-2}	15	26%

228. Assuming no growth in traffic (i.e., the base case), it was estimated that post windfarm a vessel would be involved in a collision once every 18 years, an increase of approximately 4% over the pre windfarm case. Assuming future case traffic levels for the post windfarm case, it was estimated that a vessel would be involved in a collision once every 15 years, an increase of approximately 26% from the base case pre windfarm. However, it should be considered that the majority of this increase is associated with the increase in traffic rather than the East Anglia ONE North windfarm site, noting that without the windfarm future case traffic levels still increase the risk by an estimated 21% over the pre windfarm base case.

18.2 Vessel Allision with Structure

229. Based on the vessel routeing identified for the area, the anticipated change in routeing due to the offshore development area, and assumptions that effective mitigation measures are in place, the frequency of an errant vessel under power deviating from its route to the extent that it comes into proximity with a structure is not considered to be a probable outcome.

230. From experience at other UK windfarms it is also assumed that merchant vessels would not navigate between wind turbine rows due to the restricted sea room and would be directed by the navigational aids in the area.

18.2.1 Impacts of Structures on Wind Masking / Turbulence or Shear

231. The offshore wind turbines have the potential to affect vessels under sail when passing through the East Anglia ONE North windfarm site from impacts such as wind shear, masking and turbulence.

232. From previous windfarm studies it has been concluded that wind turbines do reduce wind velocity by the order of 10% downwind of a wind turbine. The temporary effect is not considered as being significant and similar to that experienced passing a large vessel 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. A number of windfarms are operational within UK waters and no impacts have been reported by recreational users.

18.2.2 Powered Vessel Allision

233. The deviated routes presented in section 15 were used as input to the powered allision function of Anatec's CollRisk modelling suite. This model estimates the likelihood that a vessel would allide with one of the windfarm structures whilst under power (defined as a powered allision).

234. The results are given in *Table 18.2*. It should be noted that the model has been run assuming the structures will not shield other nearby structures from an allision (i.e., the model assumes a vessel may allide with multiple structures).

Table 18.2 Powered Allision Assessment Results Summary

Scenario	Annual Frequency	Return Period (Years)
Post Windfarm – Base Case	7.07×10^{-3}	141
Post Windfarm – Future Case	7.78×10^{-3}	129

235. The majority of the powered allision risk was observed to be to the turbines on the western boundary. This was largely due to the busy route to the west between Tees and Zeebrugge (Route 6 in *Figure 15.1*), and the other less busy routes predicted to deviate west of the East Anglia ONE North windfarm site. Traffic within the DWR did not contribute significantly, noting the minimum 1nm separation distance.

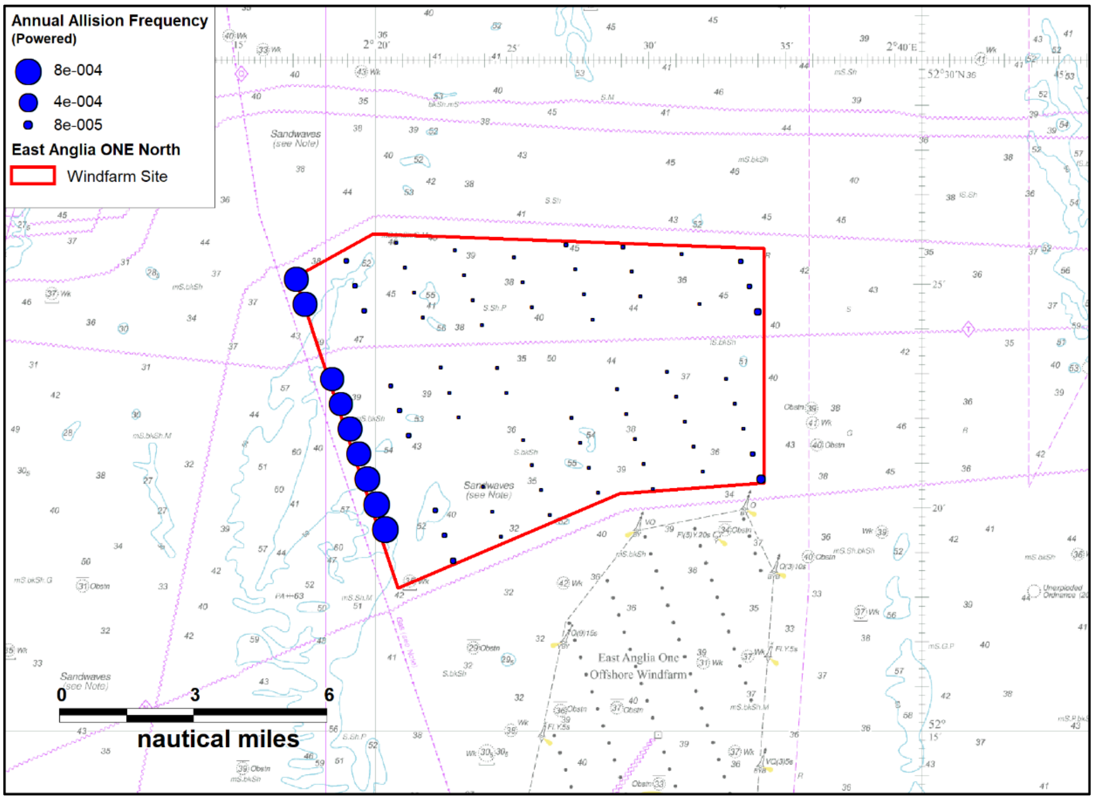

Figure 18.1 Annual Allision Frequency (Powered) – 0% Traffic Increase

18.2.3 Drifting Vessel Allision

236. 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.

237. The exposure times for a drifting scenario are based on the vessel hours spent in proximity to the East Anglia ONE North windfarm site. These were estimated based on the traffic levels, speeds and revised routeing patterns. The exposure was divided by vessel type and size, to ensure these factors, which are based on analysis of historical accident data have been shown to influence accident rates, were taken into account within the modelling.

238. Using this information the overall rate of breakdown within the area surrounding the East Anglia ONE North windfarm site 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.

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

240. The following drift scenarios were modelled:

- Wind (drift direction is determined by wind probabilities);
- Peak spring flood tide; and
- Peak spring ebb tide.

241. The flood tide scenario was observed to produce the worst case results, and has therefore been the scenario assumed for the purposes of assessing the drifting allision risk within this NRA and within *Chapter 15 Shipping and Navigation* (noting that the impact assessment also considers other outputs of the NRA, not just the modelling results).

242. The results of the drifting modelling are given in *Table 18.3*, with the results then presented graphically in *Figure 18.2*. The same graduated ranges have been used for both the drifting and powered plots, allowing direct comparison between *Figure 18.1* and *Figure 18.2*.

Table 18.3 Drifting Allision Assessment Results Summary

Scenario	Annual Allision Frequency	Return Period (Years)
Post Windfarm – Base Case	2.53×10^{-3}	395
Post Windfarm – Future Case	2.78×10^{-3}	359

243. The majority of the allision risk was observed to be to the turbines on the northern boundary of the East Anglia ONE North windfarm site. This is due to moderate traffic to the north (notably routes 7 and 13, see Figure 15.1) and the dominant tidal direction pushing vessels in a southern direction.

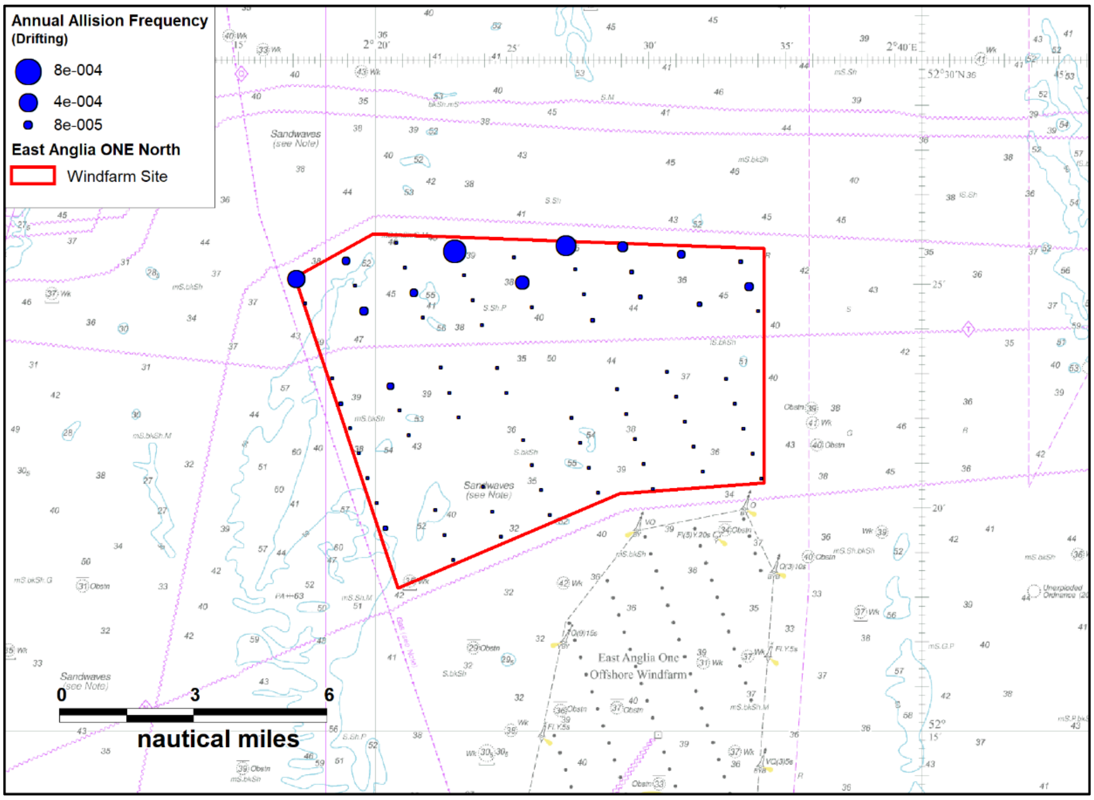

Figure 18.2 Annual Allision Frequency (Drifting) – 0% Traffic Increase

18.3 Fishing Vessel Allision

244. 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 UKCS offshore installations (published by the HSE).

245. 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 area of the East Anglia ONE North windfarm site was estimated using the marine traffic survey data shown in section 12.

246. The results are summarised in *Table 18.4*.

Table 18.4 Fishing Allision Assessment Results Summary

Scenario	Annual Allision Frequency	Return Period (Years)
Base Case – Post Windfarm	1.10×10^{-1}	9
Future Case – Post Windfarm	1.21×10^{-1}	8

247. The fishing allision results are high when compared to the results of the allision assessment of regular routed vessels provided in section 18.2. This reflects the modelling assumption that the presence of structures within the East Anglia ONE North windfarm site would have no impact on current fishing levels, unlike the commercial routeing assessment which assumes routed vessels will deviate to avoid the structures altogether. It is also noted that any allision from a fishing vessel within the East Anglia ONE North windfarm site is expected to be low speed, and therefore lower risk to the crew, vessel, and structure.

18.4 Modelling Results Summary

248. A summary of the collision and allision risk frequency modelling results for the East Anglia ONE North windfarm site is provided in *Table 18.5*.

Table 18.5 Allision and Collision Risk Results Summary

Scenario	Base Case		Future Case	
	Pre Windfarm	Post Windfarm	Pre Windfarm	Post Windfarm
Vessel to Vessel	5.33×10^{-2} (19 years)	5.53×10^{-2} (18 years)	6.45×10^{-2} (16 years)	6.69×10^{-2} (15 years)
Allision – Powered	n/a	7.07×10^{-3} (141 years)	n/a	7.78×10^{-3} (129 years)
Allision – Drifting	n/a	2.53×10^{-3} (395 years)	n/a	2.78×10^{-3} (359 years)
Allision – Fishing	n/a	1.10×10^{-1} (9 years)	n/a	1.21×10^{-1} (8 years)
Total	**5.33×10^{-2} (19 years)**	**1.75×10^{-1} (6 years)**	**6.45×10^{-2} (16 years)**	**1.98×10^{-1} (5 years)**

249. The overall annual level of collision and allision risk is calculated based on the combined risk results from the four scenarios above. This gives an estimate that the annual level of risk would increase due to the East Anglia ONE North windfarm site from one allision/collision every 19 years to approximately one in every 6 years (assuming base case traffic levels). The majority of this increase is attributed to fishing vessel allisions.

18.5 Consequences

250. The consequences associated with the probable outcomes of a collision or allision are 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 14.5 Consequences Assessment*. The consequences assessment is primarily based on the results of the allision and collision modelling undertaken in this NRA.

251. 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 will further mitigate the risk of pollution (for example double hulls). Similarly, in a drifting allision, the proposed windfarm 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).

252. 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).

253. The overall increase in PLL estimated due to the East Anglia ONE North windfarm site is 6.00×10^{-4} fatalities per year (base case), which equates to approximately one fatality per 1,666 years. The annual increase in PLL due to the impact of the East Anglia ONE North windfarm site for the future case is estimated to be 6.61×10^{-4}, which equates to one additional fatality in 1,512 years.

254. In terms of individual risk to people, the incremental increase for commercial vessels (approximately 1.44×10^{-7} 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.

255. For fishing vessels, the change in individual risk attributed to the East Anglia ONE North windfarm site is higher than commercial vessels (approximately 1.56×10^{-5} 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.

256. The overall total increase in oil spilled due to the East Anglia ONE North windfarm site is 0.0060% per year (base case) and 0.0066% per year (future case) (see *Appendix 14.5 Consequences Assessment* for the full assessment). From research undertaken as part of the DfT MEHRA project (DfT 2001) 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 East Anglia ONE North windfarm site is very low compared to the historical average pollution quantities from marine accidents in the UK waters.

257. The impact of the East Anglia ONE North windfarm site 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 East Anglia ONE North windfarm site. There may be additional maritime risks associated

with other offshore windfarm developments in and around the southern North Sea and the UK as a whole, however, the purpose of the EIA is to consider the East Anglia ONE North windfarm site in isolation; with cumulative impacts where interaction is identified.

258. Impacts associated with the allision and collision modelling are considered within *Chapter 14 Shipping and Navigation*.

259. Further detail on the consequences assessment is presented in *Appendix 14.5 Consequences Assessment.*

19 East Anglia ONE North Cumulative Assessment

19.1 Introduction

260. This section provides an assessment of likely cumulative vessel routeing in the vicinity of the East Anglia ONE North windfarm site, if other potential nearby projects are taken into consideration. Data from the marine traffic surveys has been used as the input to the cumulative routeing assessment. This assessment feeds into the CIA undertaken in *Chapter 14 Shipping and Navigation*.

19.2 Methodology of Assessing Cumulative Impacts

261. Cumulative impacts have been considered for shipping and navigation receptors, this includes other offshore projects, as well as activities associated with other marine operations. However, it should be noted that fishing, recreation and marine aggregate dredging transits have been considered as part of the baseline assessment.

262. Other developments which may increase the impacts to shipping and navigation receptors when considered with the offshore development area were assessed, and screened in or out depending upon the outcome of the assessment.

263. Cumulative impacts identified through the Scoping Report (SPR 2017) have then been assessed when considered with the developments scoped in during the screening stage undertaken as part of the NRA process. As raised during consultation, the key cumulative impact was considered to be vessel routeing when considered with the other southern North Sea windfarm developments, however all impacts presented have been considered cumulatively in *Chapter 14 Shipping and Navigation*.

264. Given the limited spatial extent of gas platforms and fields within the area there is not considered to be any cumulative routeing impacts and therefore collision risk associated with existing gas installations in the southern North Sea.

265. Should any future surface gas developments be applied for within the gas fields within the area they would be subject to their own navigational risk assessments, including at a cumulative level.

19.3 Cumulative Screening

266. *Appendix 14.4 Cumulative Impact Assessment* presents the cumulative screening process and highlights projects within 100nm where a potential cumulative impact has been identified. *Table 19.1* presents the projects screened into the assessment as a result of this.

267. Cumulative impacts are initially considered within a 10nm study area around the East Anglia ONE North windfarm site but then extended to 100nm where applicable to encompass vessel routeing. This includes consideration of transboundary offshore windfarm projects and shipping routes. However, for a cumulative or transboundary windfarm to be considered in the cumulative routeing assessment a vessel route needs to be impacted (route through or in proximity to) by both the screened windfarm and the offshore development area.

Table 19.1 Cumulative Project Screening

Development	Distance from East Anglia ONE North Windfarm Site (nm)	Status	Rationale
UK Windfarms			
East Anglia ONE	1	Under Construction	Cumulatively affects a route that has also been displaced by East Anglia ONE North windfarm site.
East Anglia TWO	5	Pre Consent	
East Anglia THREE	8	Pre Construction	
Galloper	21	Fully Commissioned	
Hornsea Project One	83	Under Construction	
Hornsea Project Two	87	Pre Construction	
Hornsea Project Three	78	Application Submitted	
Norfolk Boreas	27	Pre Consent	
Norfolk Vanguard	21	Application Submitted	
Triton Knoll	75	Pre Construction	
EU Windfarms			
Ijmuiden Ver Development Zone	26	Development Zone	Route intersects Development Zone. Authorised windfarm boundaries unavailable and so routes deviated around entire Development Zone.
Hollande Kust West Development Zone	35	Development Zone	

19.4 Cumulative Routeing

268. The routes within the shipping and navigation study area identified as requiring deviation on a cumulative basis are summarised in *Table 2.1*, which shows which

routes are effected by which projects (see *Table 19.1* for a list of projects screened in to the cumulative assessment). The Route ID numbers referenced correspond to those listed in section 14.

269. *Figure 19.1* shows the anticipated cumulative deviations within a 100nm of the East Anglia ONE North windfarm site. These are primarily based on the results of the Southern North Sea Offshore Wind Forum (SNSOWF) Cumulative Routeing Assessment work undertaken in 2013 (SNSOWF, 2013).

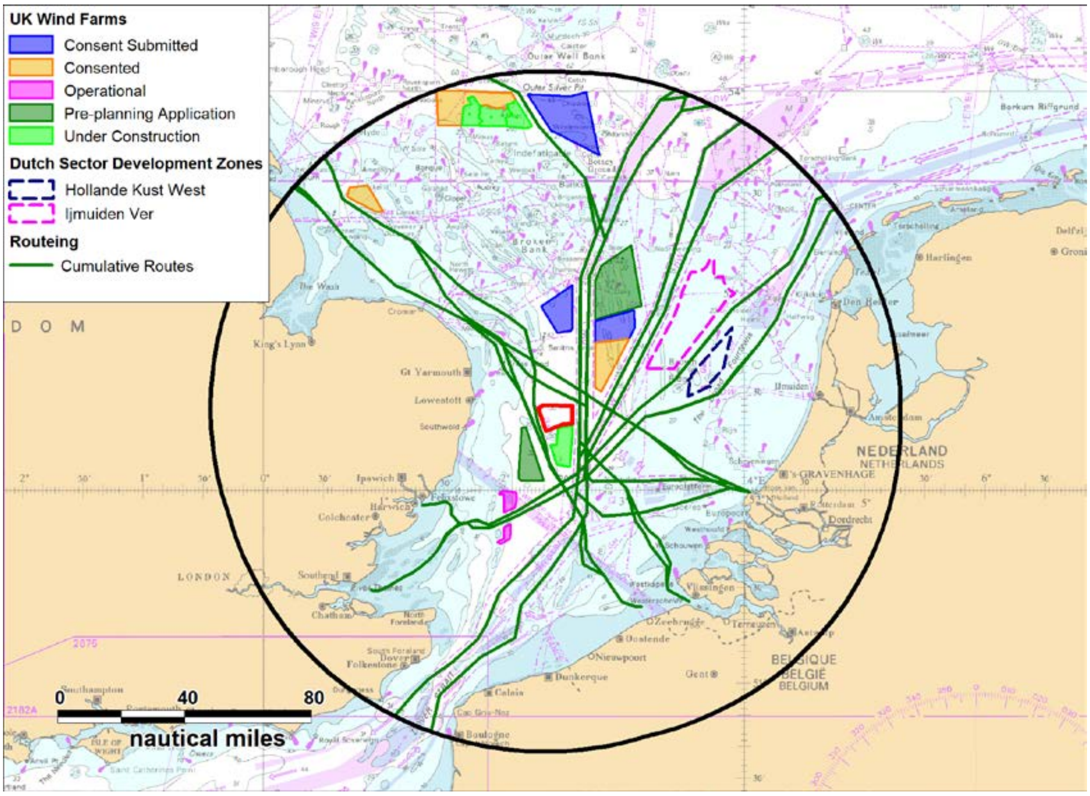

Figure 19.1 Cumulative Routeing within 100nm Study Area

270. It should be noted that the boundaries used are indicative and should any navigational corridor be developed between the East Anglia ONE North offshore development area, East Anglia TWO offshore development area and the East Anglia ONE offshore development area it will comply with MCA and TH requirements.

Table 19.2 Cumulative Routeing Impact Summary

Route	East Anglia ONE North	East Anglia ONE	East Anglia TWO	East Anglia THREE	Galloper	Hornsea Project One	Hornsea Project Two	Hornsea Project Three	Norfolk Boreas	Norfolk Vanguard	Triton Knoll	Ijmuiden Ver Development Zone	Hollande Kuste Development Zone
1	x	x	x	x	x	x	x	x	x	x	x	x	x
2	x	x	x	x	x	x	x	x	x	x	x	x	x
3	x	x	x	x	x	x	x	x	x	x	x	x	x
4	x	x	x	x	x	x	x	x	x	x	x	x	x
5	x	x	x	x	x	x	x	x	x	x	x	x	x
6	x	x	x	x	x	x	x	x	x	x	✓	x	x
7	✓	x	x	x	x	x	x	x	x	x	x	x	x
8	x	x	x	x	x	x	✓	x	x	✓	x	x	x
9	x	x	✓	x	x	x	x	x	x	x	x	x	x
10	✓	x	x	x	x	x	x	x	x	x	✓	x	x
11	✓	x	✓	x	x	x	✓	x	x	✓	x	x	x
12	✓	✓	✓	x	x	x	x	x	x	x	x	x	✓
13	✓	x	✓	✓	x	x	x	x	x	x	x	✓	x

19.5 Spacing between Cumulative Projects

271. Annex 3 of MGN 543 (MCA 2016) provides a template from which the required width of shipping lanes located in a 'corridor' between two or more wind farm sites can be calculated. Where such a lane exists, the MCA require that there is room within the corridor between the wind farms for a vessel to deviate up to 20°. The East Anglia TWO offshore development area, East Anglia ONE North offshore development area and East Anglia ONE offshore development area create a gap, and it was therefore necessary to check this gap against the guidance.

272. Given a gap is only formed if the East Anglia TWO offshore development area and East Anglia ONE offshore development area are also considered (with East Anglia

ONE North), the calculations have been undertaken cumulatively, with the gap defined as running between the southernmost point of the East Anglia ONE offshore development area, and the northernmost point of the eastern East Anglia TWO windfarm site boundary, as this is the span over which turbines are present on both sides of the gap.

273. The gap is required to be of width at least 5nm, based on length of 13.8nm, and the required 20° deviation. The actual width of the gap is 5.4nm, and therefore is compliant with the MGN 543 corridor guidance.

19.6 CIA within the EIA

274. Cumulative impacts have been assessed in *Chapter 14 Shipping and Navigation* and take the projects listed in section 19.2 into account.

20 Hazard Log

20.1 Introduction

275. As per the required MCA methodology (MCA 2015), a Hazard Log has been created detailing the potential hazards to shipping and navigation receptors that may arise from the construction, operation, and decommissioning of the East Anglia ONE North windfarm site. The Hazard Log itself is included in *Appendix 14.3*, with this section providing an overview of the methodology used to create the log, and a summary of the results.

20.2 Hazard Workshop

276. Key to the creation of a Hazard Log is the incorporation of comment and experience of both local and national shipping and navigation stakeholders relevant to the offshore development area. For this reason a Hazard Workshop was held in London on the 9th May 2018 for the purpose of gathering the knowledge and experience of the attendees to use as input to the final Hazard Log. The workshop invitees are listed in *Table 20.1*, including those parties invited but who were unable to attend.

Table 20.1 Hazard Workshop Invitees

Stakeholder	Attended
Brown & May Marine	Yes
CoS	Yes
Cruising Association	Yes
Cobelfret Ferries	Yes
DFDS	Yes
James Fisher Everard	Yes
Associated British Ports	No
BMAPA	No
DfT	No
Hanson Marine	No
Harwich Haven Authority	No
MCA	No
National Federation of Fishermen's Organisations	No
Port of London Authority	No
Rederscentrale (Belgian Fisheries)	No

Stakeholder	Attended
RNLI	No
Royal Yachting Association	No
Stena Line	No
Trinity House	No
VISNED	No

294. The attendees were provided with an overview of the offshore development area, including the intended timeline, and the key relevant parameters. Following this, potential hazards to shipping and navigation receptors associated with the offshore development area were identified and discussed. This included discussion of potential mitigation measures that could be implemented to reduce risk to ALARP where appropriate.

277. Post-workshop, the Hazard Log was drafted and distributed to all attendees, with the final version incorporating the feedback received. The final, agreed version of the Hazard Log is presented in *Appendix 14.3*.

20.3 Results

278. A total of 15 hazards were identified and included in the Hazard Log. These are summarised in *Table 20.1* (noting that construction and decommissioning impacts were grouped on the basis that these phases presented similar scenarios).

Table 20.2 Summary of Impacts identified in the Hazard Log

Phase(s)	Hazard Title	Hazard Detail
Construction, operation and decommissioning	Displacement of vessels.	Activities within the East Anglia ONE North windfarm site may lead to the displacement of established commercial vessel routes and third party marine activity.
Construction, operation and decommissioning	Displacement of vessels during periods of adverse weather.	Activities within the East Anglia ONE North windfarm site may lead to the displacement of established commercial vessel adverse weather routes.
Construction, operation and decommissioning	Increased collision risk between two third party vessels.	The displacement of vessels due to activities within the East Anglia ONE North windfarm site may lead to an increasing number of encounters between third party vessels and therefore an increase in vessel collision risk between third party vessels.

Phase(s)	Hazard Title	Hazard Detail
Construction, operation and decommissioning	Increased collision risk between a third party vessel and project vessel.	The displacement of vessels due to activities within the East Anglia ONE North windfarm site may lead to an increasing number of encounters between a third party vessel and project vessel and therefore an increase in vessel collision risk between a third party vessel and project vessel.
Construction and decommissioning	Creation of allision risk associated with partially constructed / decommissioned windfarm structures.	The presence of a partially constructed or decommissioned windfarm structure may create an allision risk.
Construction and decommissioning	Creation of allision risk for vessels NUC associated with partially constructed / decommissioned windfarm structures.	The presence of a partially constructed or decommissioned windfarm structure may create an allision risk for vessels NUC.
Operation	Creation of allision risk for commercial vessels associated with unmanned windfarm structures.	The presence of windfarm infrastructure may create an allision risk for passing commercial vessels.
Operation	Creation of allision risk for commercial vessels NUC associated with unmanned windfarm structures.	The presence of windfarm infrastructure may create an allision risk for commercial vessels NUC.
Operation	Creation of allision risk for commercial fishing vessels associated with unmanned windfarm structures.	The presence of windfarm infrastructure may create an allision risk for commercial fishing vessels.
Operation	Creation of allision risk for recreational vessels associated with unmanned windfarm structures.	The presence of windfarm infrastructure may create an allision risk for recreational vessels.

Phase(s)	Hazard Title	Hazard Detail
Construction, operation and decommissioning	Creation of allision risk for project vessels associated with unmanned windfarm structures.	The presence of windfarm infrastructure may create an allision risk for vessels associated with the project and operating in proximity to structures.
Operation	Creation of allision risk associated with manned platforms.	The presence of manned construction, operation and maintenance platforms may create an allision risk.
Construction, operation and decommissioning	Anchor interaction with sub-sea cables or structures during normal anchoring operations.	A vessel may drop anchor or drag anchor over sub-sea structures including a sub-sea cable.
Construction, operation and decommissioning	Anchor interaction with sub-sea cables during emergency anchoring operations.	A vessel may drop anchor or drag anchor over sub-sea structures including a sub-sea cable in an emergency situation.
Construction, operation and decommissioning	Diminished emergency response capability within the region.	The increased activity associated with the project may lead to an increase in incidents requiring an emergency response resulting in a reduction in SAR resources available within the region.

21 Next Steps and Embedded Mitigation Measures

279. Following identification of both future case impacts and the outcomes of the FSA, an impact assessment in line with EIA guidance has been undertaken. The impact assessment considers the identified impacts from the NRA with regards to shipping and navigation receptors and assumes embedded mitigation measures will be in place. This EIA is presented in *Chapter 14 Shipping and Navigation.*

280. The EIA requires compiling and reviewing available data. For shipping and navigation this includes the marine traffic surveys, base case assessment and a NRA. The likely impacts of the offshore development area during the construction, operation and decommissioning stages are assessed and feedback provided to the design and engineering teams to mitigate or modify the offshore development area in order to avoid, prevent, reduce and, where possible, offset any significant adverse impacts. Following this is the identification of any residual effects and any further mitigation measures that may be required.

281. Those measures assumed to be embedded mitigation are listed below. The EIA has been undertaken on the understanding that these measures will be in place.

- Application for and use of safety zones during construction, major maintenance work during operations and decommissioning;
- Cable Burial Risk Assessment undertaken pre-construction, including consideration of under keel clearance. All sub-sea cables will be suitably protected based on risk assessment, and the protection will be monitored and maintained as appropriate;
- Compliance from all vessels associated with the offshore development area with international maritime regulations as adopted by the relevant flag state (most notably COLREGS (IMO 1972) and SOLAS (IMO 1974));
- Consideration of MGN 543 – including the SAR annex;
- An ERCoP will be developed and implemented for the construction, operational & maintenance and decommissioning phases. The ERCoP is based on the standard MCA template and will consider the potential for self-help capability as part of the ongoing process;
- Information relevant to the offshore development area will be promulgated via Notice to Mariners and other appropriate media;
- Marine traffic coordination;
- Suitable lighting and marking of the East Anglia ONE North windfarm site complying with IALA Recommendations O-139 (IALA 2013), to be finalised in consultation with TH and the MCA;
- Use of guard vessels when deemed appropriate following risk assessment;
- Wind turbines will have at least 22m clearance above MHWS as required by MGN 543 (MCA 2016) and RYA (RYA 2015) requirements; and
- Wind turbines, cables and substations marked on Admiralty Navigational Charts and Admiralty Sailing Directions.

21.1 Impact Scoping

282. The primary purpose of the NRA is to ascertain which potential receptors (and associated impacts) identified as part of the baseline assessment and consultation stages require further assessment within the EIA undertaken in *Chapter 14 Shipping and Navigation.*

283. The scoping process that has been undertaken on the receptors (and associated impacts) relevant to shipping and navigation identified as part of this NRA is summarised in Table 21.1.

Table 21.1 Impact Scoping

Receptor	Scoped into EIA	Rationale
Construction, Operation and Maintenance, and Decommissioning Phases		
Commercial vessel routeing	Yes	The NRA has identified commercial vessel routes that are anticipated to deviate as a result of the East Anglia ONE North windfarm site. Assessment as to the significance of these deviations is therefore required.
Commercial vessel safe navigation	Yes	The structures East Anglia ONE North windfarm site will create an allision risk to passing traffic, and deviations may also raise collision risk in the area. Assessment as to the significance of these impacts is therefore required.
Fishing vessels	Yes	The structures East Anglia ONE North windfarm site will create an allision risk to fishing vessels, and deviations may also raise collision risk in the area. Assessment as to the significance of these impacts is therefore required.
Recreational vessels	Yes	The structures within the East Anglia ONE North windfarm site will create an allision risk to recreational vessels, and deviations may also raise collision risk in the area. Assessment as to the significance of these impacts is therefore required.
Emergency response capabilities	Yes	The increased levels of personnel and vessels on site may raise incident rates, reducing capabilities of emergency response resources. Assessment as to the significance of this impact is therefore required.

Receptor	Scoped into EIA	Rationale
Marine aggregate dredging	No	As shown in section 8.9, there are no dredging areas in the immediate vicinity of the East Anglia ONE North windfarm site, and dredger transits on affected BMAPA transit routes are considered low frequency. Therefore associated impacts have been scoped out of the EIA.
Communication and position fixing equipment	No	As per *Table 5.1*, it has been agreed with the MCA that associated impacts can be scoped out.

22 Future Monitoring

22.1 Safety Management System and Emergency Response Planning

284. Health and safety documentation, including a policy statement, Safety Management System (SMS) and emergency response plans will be in place for the offshore development area post consent and prior to construction. This will be continually updated throughout the development process. The following sections provide an overview of documentation and how it will be maintained and reviewed with reference where required to specific marine documentation.

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

22.2 Future Monitoring of Marine Traffic

286. The DCO is expected to include the requirement for construction traffic monitoring by AIS, including continual collection of data from a suitable location at the East Anglia ONE North windfarm site with an assessment of a minimum of 28 days submitted to the MCA annually. This is likely to continue through to the first year of operation to ensure the mitigations put in place are effective.

22.3 Sub-sea Cables

287. The sub-sea cable routes will be subject to periodic inspection to monitor the cable protection, including burial depths.

22.4 Hydrographic Surveys

288. As required by MGN 543, detailed and accurate hydrographic surveys will be undertaken periodically at agreed intervals, with results supplied to the MCA as necessary.

22.5 Decommissioning Plan

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

23 Summary

23.1 Marine Traffic

290. Two 14 day marine traffic surveys were undertaken for the offshore development area, with periods chosen to cover seasonal variations. An average of 116 unique vessels per day were recorded within the study area during the summer period, falling to 101 vessels per day. This decrease was considered in part to be due to winter conditions generally being less favourable for transit, particularly for smaller vessels. However it should also be noted that the summer survey included radar recordings, whereas the winter survey was AIS only.

291. The majority of traffic during both periods was observed to be from commercial vessels (cargo and tanker), utilising the IMO routeing measures and other established (but undesignated) routes in the area. Passenger vessels were also recorded, notably including commercial passenger ferry routes between the UK and mainland Europe.

292. The marine traffic data was used to identify the main commercial routes within the area. A total of 13 routes were identified, five of which were anticipated to deviate as a result of the East Anglia ONE North windfarm site.

293. An average of three unique fishing vessels per day were recorded within the shipping and navigation study during the marine traffic surveys, with the majority utilising beam trawls as their primary fishing gear. In particular, it is noted that beam trawling was recorded both within the East Anglia ONE North windfarm site, and within the offshore cable corridor. Notable levels of demersal otter trawling were also recorded.

294. An average of six recreational vessels per day were recorded within the shipping and navigation study during the marine traffic surveys. Only one vessel was recorded during the winter period, which is reflective of summer conditions generally being much more favourable for recreational transit, particularly further offshore.

295. An assessment of anchoring activity identified tankers at anchor to the west of the East Anglia ONE North windfarm site. It is considered likely that these vessels were associated with a designated STS area off Southwold.

23.2 Allision and Collision Modelling

296. The marine traffic baseline was used to model estimated collision and allision risks associated with the structures in the East Anglia ONE North windfarm site.

297. It was estimated that the anticipated displacement would raise vessel to vessel collision risk in the area by 4%, assuming no change in traffic levels. Assuming a 10% increase in traffic yielded an increase of 26% in collision risk, however the majority of

this risk was found to be due to the increased traffic rather than the deviations, noting that modelling the increased traffic levels assuming the project was not constructed still raised collision risk in the area by 21%.

298. An assessment of powered allision estimated that a commercial vessel would allide with a structure within the East Anglia ONE North windfarm site whilst under power once every 141 years at base case traffic levels, rising to once every 129 years assuming a 10% increase in traffic. The corresponding drifting assessment estimated a drifting allision would occur once every 395 years at base case traffic levels, rising to once every 359 years assuming the 10% traffic increase.

299. An allision between a fishing vessel and a structure within the East Anglia ONE North windfarm site was estimated to occur once every 9 years. This value is reflective of the assumption that levels and locations of fishing will be unaffected by the structures. It should also be considered that fishing vessels allisions within a windfarm would be expected to be low speed and low energy, and therefore of low consequence.

23.3 Cumulative Impacts

300. Cumulative impacts have been considered for the offshore development area including the impacts on shipping and navigation arising from other proposed offshore wind developments. This includes consideration for projects within 10nm of the East Anglia ONE North windfarm site and then extended to 100nm to consider cumulative routeing.

301. Following a cumulative screening process in *Appendix 14.4 Cumulative Impact Assessment*, the following projects have been taken forward to the EIA:

- East Anglia ONE;
- East Anglia TWO:
- East Anglia THREE;
- Galloper;
- Hornsea Project One;
- Hornsea Project Two;
- Hornsea Project Three;
- Norfolk Boreas;
- Norfolk Vanguard; and
- Triton Knoll.

302. The Ijmuiden Ver and Holland Kust West Development zones within the Dutch sector have also been scoped in. Individual windfarm boundaries within these Development Zones are unavailable at the time of writing, and the entire zones will therefore be considered.

23.4 Hazard Log

303. Following a hazard workshop, a hazard log was drafted by Anatec to detail all hazards identified following a review of the baseline assessment. Each hazard was ranked in terms of significance, and further mitigation proposed where required. The initial draft was distributed to the relevant shipping and navigation stakeholders, and any responses were taken into consideration in the final version. The final log was then used to inform the significance rankings used within the FSA in the PEIR and the ES, in addition to the modelling results and expert opinion.

23.5 Receptors Carried forward to the EIA

304. Following consideration of the results of the NRA including baseline data, consultation, the hazard log and modelling results, the following receptors identified in the Scoping Report (SPR 2017) were taken forward for consideration in the EIA:

- Commercial vessels;
- Commercial fishing vessels;
- Recreational craft; and
- Emergency response.

305. Impacts on communications, navigation and marine radar interference have been scoped out of the assessment at this stage, as have impacts to marine aggregate dredgers.

24 References

- BEIS. (2011) Standard Marking Schedule for Offshore Installations, London: BEIS.
- BEIS. (2016) The Recreational Craft Directives 2013/53/EU, London: BEIS.
- DfT. (2001) Identification of MEHRAs in the UK, DfT: London.
- IALA. (2013) O-139 the Marking of Man-Made Offshore Structures, Edition 2. Saint Germain en Laye, France: IALA.
- IMO. (1972) COLREGS, London: IMO.
- IMO. (1974) SOLAS, London: IMO.
- IMO. (2002) IMO Guidelines for FSA, London: IMO.
- MCA. (2008) Marine Guidance Notice 372 (MGN 372 M+F) OREIs: Guidance to Mariners Operating in the Vicinity of UK OREIs, Southampton: MCA.
- MCA. (2015) MCA Methodology for Assessing the Marine Navigational Safety of Offshore Wind Farms, Southampton: MCA.
- MCA. (2016) MGN 543 OREIs – Guidance of UK Navigational Practice, Safety and Emergency Response, Southampton: MCA.
- MMO. (2014) East Inshore and East Offshore Marine Plans, London: MMO.
- RYA. (2015) The RYA's Position on Offshore Renewable Energy Developments Paper 1 (of 4) – Wind Energy, RYA: Southampton.
- RYA. (2016) UK Coastal Atlas of Recreational Boating, Southampton: RYA.
- SPR. (2017) East Anglia ONE North Offshore Windfarm Scoping Report, SPR: Glasgow.
- UKHO. (2016) Admiralty Sailing Directions - North Sea West Pilot, NP54, Somerset: UKHO.
- UKHO. (2017) Admiralty Sailing Directions – Dover Strait Pilot, NP28, Somerset: UKHO.