Norfolk Vanguard Offshore Wind Farm

Chapter 15

Shipping and Navigation

Environmental Statement

Volume 1

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For and on behalf of Norfolk Vanguard Limited

Approved by: Rebecca Sherwood and Ruari Lean

Signed: [redacted]

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Table of Contents

15	Shipping and Navigation	1
15.1	Introduction	1
15.2	Legislation, Guidance and Policy	1
15.3	Consultation	4
15.4	Assessment Methodology	21
15.5	Scope	24
15.6	Existing Environment	28
15.7	Potential Impacts	37
15.8	Cumulative Impact Assessment (CIA)	81
15.9	Transboundary Impacts	90
15.10	Inter-relationships	91
15.11	Interactions	92
15.12	Summary	94
15.13	References	103

Tables

Table 15.1 Summary of NPS EN-3 guidance 1
Table 15.2 Summary of NPS EN-3 policy on decision making 2
Table 15.3 Consultation responses 4
Table 15.4 Definitions of frequency levels for shipping and navigation 22
Table 15.5 Definitions of severity levels for shipping and navigation 22
Table 15.6 Impact significance matrix 23
Table 15.7 Risk rankings 23
Table 15.8 Data sources 25
Table 15.9 Route summary in the vicinity of the project 30
Table 15.10 Worst case assumptions 40
Table 15.11 Potential cumulative impacts 81
Table 15.12 Summary of projects considered for the CIA in relation to the shipping 83
Table 15.13 Chapter topic inter-relationships 92
Table 15.14 Potential impacts identified for shipping and navigation 96
Table 15.15 Interaction between impacts 92

Figures (Volume 2)

Figure 15.1 Overview of Norfolk Vanguard

Figure 15.2 Key Navigational Features Overview

Figure 15.3 Overview of AIS and Radar Data within Norfolk Vanguard East Study Area Excluding Temporary Traffic (14 Days Summer 2016)

Figure 15.4 Overview of AIS and Radar Data within Norfolk Vanguard East Study Area Excluding Temporary Traffic (14 Days Winter 2017)

Figure 15.5 Overview of AIS and Radar Data within Norfolk Vanguard West Study Area Excluding Temporary Traffic (14 Days Summer 2016)

Figure 15.6 Overview of AIS and Radar Data within Norfolk Vanguard West Study Area Excluding Temporary Traffic (14 Days Winter 2017)

Figure 15.7 Main Traffic Routes and 90th Percentiles within OWF Sites Study Area

Appendices (Volume 3)

Appendix 15.1 Navigation Risk Assessment

Glossary

AfL	Agreement for Lease
AIS	Automatic Identification System
ALARP	As Low As Reasonably Practicable
CA	Cruising Association
CAA	Civil Aviation Authority
CIA	Cumulative Impact Assessment
COLREGS	Convention on the International Regulations for preventing Collisions at Sea (1972)
CoS	Chamber of Shipping
CTV	Crew Transfer Vessel
DSC	Digital Selective Calling
DWR	Deep Water Route
EEA	European Economic Area
EIA	Environmental Impact Assessment
ERCoP	Emergency Response Cooperation Plan
ERP	Emergency Response Plan
ES	Environmental Statement
EU	European Union
FSA	Formal Safety Assessment
GLA	General Lighthouse Authority
HSE	Health and Safety Executive
HVAC	High Voltage Alternating Current
HVDC	High Voltage Direct Current
IALA	International Association of Marine Aids to Navigation and Lighthouse Authorities
IMO	International Maritime Organization
ITF	International Transport Forum
km	Kilometre
m	Metre
MAIB	Marine Accident Investigation Branch
MCA	Maritime and Coastguard Agency
MCC	Marine Coordination Centre
Met Mast	Meteorological Mast
MGN	Marine Guidance Note
MHWS	Mean High Water Spring
MMO	Marine Management Organisation
MoD	Ministry of Defence
MW	Megawatt
Nm	Nautical Mile
NPS	National Policy Statement
NRA	Navigation Risk Assessment
NUC	Not Under Command
OECD	Organisation for Economic Cooperation and Development
OREI	Offshore Renewable Energy Installation

OWF	Offshore Wind Farm
PEIR	Preliminary Environmental Information Report
PEXA	Practice and Exercise Area
RAM	Restricted in Ability to Manoeuvre
RNLI	Royal National Lifeboat Institution
RYA	Royal Yachting Association
SAR	Search and Rescue
SNSOWF	Southern North Sea Offshore Wind Forum
SOLAS	International Convention on the Safety of Life at Sea (1974)
SoS	Secretary of State
SPS	Significant Peripheral Structure
TH	Trinity House
TSS	Traffic Separation Scheme
UK	United Kingdom
UKCS	United Kingdom Continental Shelf
VHF	Very High Frequency

Terminology

Allision	The act of striking or collision of a moving vessel against a stationary object.
Array cables	Cables which link the wind turbines and the offshore electrical platform.
Automatic Identification System (AIS)	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 15m are required to carry AIS.
Base Case	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.
Deep Water Route (DWR)	A route in a designated area within defined limits which has been accurately surveyed for clearance of sea bottom and submerged articles. They are of particular use to vessels restricted in their ability to manoeuvre due to their draught size.
Formal Safety Assessment (FSA)	A structured and systematic process for assessing the risks and costs (if applicable) associated with the shipping activity.
Future Case	An assessment of future traffic trends by assuming a set increase in vessel numbers on identified routeing within the area.
Hazard Log	Details the impacts upon shipping and navigation that may arise from the construction, operation and maintenance, and decommissioning of Norfolk Vanguard.
IMO Routeing	Predetermined shipping routes established by the International Maritime Organization.
Interconnector cables	Buried offshore cables which link the offshore electrical platforms.
Landfall	Where the offshore cables come ashore at Happisburgh South.
LiDAR	A detection system which works on the principle of Radar, but uses light from a laser.

Marine Guidance Note (MGN)	A system of guidance notes issued by the Maritime and Coastguard Agency 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.
Not Under Command (NUC)	A vessel not moored or anchored and not under control of its course or speed due to mechanical failure.
Offshore accommodation platform	A fixed structure (if required) providing accommodation for offshore personnel. An accommodation vessel may be used instead.
Offshore cable corridor	The corridor of seabed from the Norfolk Vanguard OWF sites to the landfall site within which the offshore export cables will be located.
Offshore electrical platform	A fixed structure located within the wind farm area, containing electrical equipment to aggregate the power from the wind turbines and convert it into a more suitable form for export to shore.
Offshore export cables	The cables which transmit electricity from the offshore substation platform to the landfall.
Offshore project area	The overall area of Norfolk Vanguard East, Norfolk Vanguard West and the offshore cable corridor.
Offshore Renewable Energy Installation (OREI)	Offshore Renewable Energy Installations (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 Environmental Impact Assessment, OREI can mean offshore wind turbines and the associated infrastructures such as accommodation platforms and sub station platforms.
Radar	Radio Detection And Ranging – an object-detection system which uses radio waves to determine the range, altitude, direction, or speed of objects.
Safety Zone	A marine zone outlined for the purposes of safety around a possibly hazardous installation or works / construction area under the Energy Act 2004.
The Applicant	Norfolk Vanguard Limited
The OWF sites	The two distinct offshore wind farm areas, Norfolk Vanguard East and Norfolk Vanguard West.
The project	Norfolk Vanguard Offshore Wind Farm, including the onshore and offshore infrastructure.
Traffic Separation Scheme (TSS)	A traffic-management route-system ruled by the International Maritime Organization. The traffic-lanes (or clearways) indicate the general direction of the vessels in that zone; vessels navigating within a TSS all sail in the same direction or they cross the lane in an angle as close to 90 degrees as possible.

15 SHIPPING AND NAVIGATION

15.1 Introduction

1. This chapter summarises the shipping and navigation baseline for the proposed Norfolk Vanguard offshore wind farm (herein 'the project'), the impacts arising as a result of the proposed project, the proposed mitigation, and the anticipated residual effects.

2. This chapter has been prepared by Anatec Ltd with reference to the relevant National Policy Statement (NPS), namely the Overarching NPS for Energy (EN-1) (July 2011) and the NPS for Renewable Energy Infrastructure (EN-3) (July 2011).

3. In line with Maritime and Coastguard Agency (MCA) requirements, their methodology (MCA, 2015) for assessing marine navigational risk has been used along with the International Maritime Organization Formal Safety Assessment (FSA) (IMO, 2002) to assess risks associated with the development of Norfolk Vanguard within the Navigation Risk Assessment (NRA) (Appendix 15.1). The NRA is a technical document which scopes out impacts that are not significant for the Environmental Impact Assessment (EIA) within the Environmental Statement (ES). The results of the NRA are summarised in this chapter.

15.2 Legislation, Guidance and Policy

4. Guidance on the issues to be addressed for offshore renewable energy projects are set out in the Overarching NPS for Energy (EN-1) (DECC, 2011b) and the NPS for Renewable Energy Infrastructure (EN-3) (DECC, 2011a).

5. Only NPS EN-3 includes guidance specific to shipping and navigation, although the overarching guidance principles set out in NPS EN-1 have been considered. A summary of the relevant guidance from NPS EN-3 and where it has been addressed within the chapter is shown in Table 15.1.

Table 15.1 Summary of NPS EN-3 guidance

Summary of NPS EN-3 Guidance	Paragraph in NPS EN-3	Where Addressed in the ES
Stakeholders in the navigation sector should be engaged in the early stages of the development phase and this should continue throughout construction, operation and decommissioning.	2.6.153	Section 15.2 summarises consultation undertaken with stakeholders relevant to shipping and navigation.
Consultation should be undertaken with the Marine Management Organisation (MMO), MCA, relevant General Lighthouse Authority (GLA), relevant industry bodies and representatives of recreational users	2.6.154	Section 15.2 summarises consultation undertaken with the organisations stated. Consultation with the MMO is ongoing at an overarching

Summary of NPS EN-3 Guidance	Paragraph in NPS EN-3	Where Addressed in the ES
		project level.
Information on internationally recognised sea lanes should be considered prior to undertaking assessments.	2.6.155	Section 15.6.1 provides information on IMO Routeing Measures in the vicinity of the proposed project. These sea lanes are considered throughout the assessment.
An NRA should be undertaken in accordance with Government guidance.	2.6.156	See Appendix 15.1.
The potential effect on recreational craft, such as yachts, should be considered in any assessment.	2.6.160	Sections 15.7 and 15.8 consider the impacts and cumulative impacts respectively of the proposed project upon recreational craft.

6. NPS EN-3 also highlights a number of factors relating to the determination of an application and in relation to mitigation. A summary of these factors and where they have been addressed within this chapter is shown in Table 15.2.

Table 15.2 Summary of NPS EN-3 policy on decision making

Summary of NPS EN-3 Policy on Decision Making	Paragraph in NPS EN-3	Where Addressed in the ES
Consent shall not be granted to the construction or extension of an offshore wind farm if the development is likely to interfere with recognised sea lanes essential to international navigation.	2.6.161	Section 15.6.1 provides information on IMO Routeing Measures in the vicinity of the proposed project. These sea lanes are considered throughout the assessment.
Site selection should have been made with a view to avoiding or minimising disruption or economic loss to the shipping and navigation industries.	2.6.162	Sections 15.7 and 15.8 consider the impacts and cumulative impacts of the proposed project including analysis of the disruption and economic loss to the shipping and navigation industry.
Negative impacts on less strategically important shipping routes should be reduced to As Low as Reasonably Practicable (ALARP).	2.6.163	Section 15.6.2 includes an analysis of all shipping and main routes in the vicinity of the proposed project.
A detailed Search and Rescue (SAR) Response Assessment should be undertaken prior to the commencement of construction.	2.6.164	Section 11 of Appendix 15.1 outlines emergency response resources relative to the proposed project and sections

Summary of NPS EN-3 Policy on Decision Making	Paragraph in NPS EN-3	Where Addressed in the ES
		15.7 and 15.8 consider potential impacts and cumulative impacts upon emergency response.
Applications which pose unacceptable risks to navigational safety after all possible mitigation measures have been considered will not be consented.	2.6.165	Sections 15.7 and 15.8 consider the impacts and cumulative impacts of the proposed project, including relevant mitigation for each impact.
The scheme must be designed to minimise the effect on recreational craft.	2.6.166	Section 15.7.1 summarises embedded mitigation, including measures designed to minimise the effect on recreational craft.
The extent and nature of any obstruction of or danger to navigation which is likely to be caused by the development will be considered.	2.6.168	Sections 15.7 and 15.8 consider the impacts and cumulative impacts of the proposed project, including risks posed to navigation caused by the proposed project.
Cumulative effects of the development with other relevant proposed, consented and operational wind farms will be considered.	2.6.169	Section 15.8 considers the cumulative impacts of the proposed project.

7. The primary guidance considered for this chapter is the MGN 543 (MCA, 2016), which highlights issues requiring to be considered when assessing the impact upon shipping and navigation from Offshore Renewable Energy Installation (OREI)s. The impact assessment has been carried out based on the IMO FSA Process (IMO, 2002), as required by the MCA Methodology for Assessing Marine Navigation Risk (MCA, 2013).

8. Other guidance considered is listed below:

- MGN 372 (MGN 372 M+F) Offshore Renewable Energy Installations (OREIs) Guidance to Mariners Operating in the Vicinity of United Kingdom (UK) Offshore Renewable Energy Installations (OREIs) (MCA, 2008);
- IALA Recommendation O-139 on the Marking of Man-Made Offshore Structures, Edition 2 (IALA, 2013);
- The RYA's Position on Offshore Renewable Energy Developments: Paper 1 – Wind Energy (RYA, 2015); and
- BEIS Standard Marking Schedule for Offshore Installations (2011).

15.3 Consultation

9. Stakeholders relevant to shipping and navigation have been consulted throughout the process to date. Relevant responses from consultees received to date are summarised in Table 15.3 below. The table includes responses received under Section 42 of the Planning Act 2008 in response to the Preliminary Environmental Impact Report (PEIR), and Regulation 11 of the Infrastructure Planning (EIA) Regulations 2009.

10. It is noted that additional consultation was undertaken specifically for the hazard log (required by the MCA methodology). Further details on the hazard log, including responses, are summarised in section 25 of Appendix 15.1.

Table 15.3 Consultation responses

Consultee	Date /Document	Comment	Response / where addressed in the ES
MCA and TH	12th January 2016 Meeting with MCA and TH.	Overview of initial proposed project. MCA advised on guidance including the updated MGN 543. Boundaries between Deep Water Routes (DWRs) were discussed.	This chapter has been informed by the relevant guidance (including MGN 543) as shown in section 15.2. An assessment of the DWRs relative to Norfolk Vanguard is presented in Appendix 15.1.
Secretary of State (SoS)	Scoping Opinion November 2016	The environmental statement should assess the impacts on ports and harbours which could be affected by the development, such as increased traffic at the ports and changes to shipping times and durations as a result of routes being diverted around or through the development. The Secretary of State recommends consultation with the appropriate harbour Authorities.	An assessment of deviation of vessel routeing resulting from the project is presented in Appendix 15.1. Harbour authorities were contacted during the consultation process (including Lowestoft, Great Yarmouth, and Rotterdam), with relevant responses included in this table. Allision and collision modelling (section 21 of Appendix 15.1) has been undertaken assuming a 10% growth in traffic. At the request of the CoS, collision rates have also been modelled assuming a 20% growth in traffic.
SoS	Scoping Opinion November 2016	As the layout of the array will not be fixed at the point of the application, the Environmental Statement (ES) should consider a worst case scenario in its navigation assessment. The ES	A description of the worst case assessed within this chapter, and the rationale by which it has been chosen is presented

Consultee	Date /Document	Comment	Response / where addressed in the ES
		should set out how such a worst case scenario has been determined.	in section 15.7.2.
SoS	Scoping Opinion November 2016	The Secretary of State welcomes the proposed Navigational Risk Assessment (NRA) and directs the Applicant's attention to the comments of the Maritime and Coastguard Agency (MCA) and Trinity House (TH) (Appendix 3 of this Opinion) for their comments on the proposed assessment. The ES should provide details of the collision risk modelling used within the NRA.	The MCA and TH comments have been addressed, as summarised in this table. Results of the collision risk modelling have been summarised in this chapter within the relevant impact discussions in section 15.7, with full details available in Appendix 15.1.
SoS	Scoping Opinion November 2016	Paragraph 614 of the Scoping Report states that the NRA modelling will assume a 10% increase in future traffic. The ES should justify the 10% future case increase.	As traffic trends are difficult to predict, cases of 0%, 10%, and 20% increases in traffic have been assessed within the allision and collision modelling, the results of which are available in the NRA. This chapter has presented the 10% case in line with other similar projects. The 20% case was included at the request of the Chamber of Shipping (CoS).
SoS	Scoping Opinion November 2016	This chapter of the ES should identify and consider within the assessment any necessary safety or buffer zones.	The application of safety zones is assumed to be embedded mitigation, and is discussed in section 15.7.1.
Norfolk County Council	Scoping Opinion November 2016	The Scoping Report (page 179, paragraph 659) refers to the potential cumulative impacts on shipping and navigation arising from other sites in the former East Anglia Zone. This needs to be extended to the wider cumulative impacts arising from other operational, consented and proposed wind farms off the Norfolk Coast (i.e. taking into account wind farms consented under earlier consenting rounds / licencing regimes). The impacts need to be considered in terms of (a) commercial shipping; (b) fishing vessels and (c) recreational vessels. The County Council	Appendix 15.1 includes an assessment of the cumulative impact on routes from southern North Sea wind farms, which are then assessed in section 15.8. All impacts to commercial, fishing and recreational vessels were assessed as being within tolerable levels (with additional mitigation implemented where necessary).

Consultee	Date /Document	Comment	Response / where addressed in the ES
		acknowledges that it will be a matter for the appropriate regulatory bodies to comment on the detailed matters relating to shipping and navigation, however, the County Council is keen to ensure that there will not be any demonstrable negative impact on Norfolk's ports as a consequence of the proposed offshore wind farms and any potential change in shipping and navigational routes.	
Norfolk County Council	Scoping Opinion November 2016	The EIA 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 EIA will need to consider the wider cumulative impacts taking into account existing operational wind farm; those under construction; those consented and those in planning.	Embedded mitigation measures are listed in section 15.7.1. Where identified as necessary, proposed additional mitigation measures are presented in section 15.11. With additional mitigation in place, all impacts were assessed to be within tolerable levels. Cumulative impacts have been assessed in section 15.8. Again, these were all within tolerable levels with additional mitigation in place where necessary.
MCA	Scoping Opinion November 2016	The ES should supply detail on the possible impacts on navigational issues for both commercial and recreational craft: a) Collision risk; b) Navigational safety; c) Visual intrusion and noise; d) Risk Management and Emergency response; e) Marking and lighting of site and information to mariners; f) Effect on small craft navigational and communication equipment; g) The risk to drifting recreational craft in adverse weather or tidal	An assessment of the relevant impacts to commercial and recreational vessels is provided in section 15.7: a) Collision risk to both commercial vessels and recreational vessels has been assessed b) Appendix 15.1 and Chapter 15 Shipping and Navigation have been authored for the purpose of ensuring navigational safety of all vessels c) Visual intrusion and noise impact are covered in section 23 of Appendix

Consultee	Date /Document	Comment	Response / where addressed in the ES
		conditions; and h) The likely squeeze of small craft into the routes of larger commercial vessels.	15.1. d) Section 15.7 provides an assessment of the identified impacts. This assessment includes (where identified as necessary) additional risk management measures. An ERCoP will be created as per the embedded mitigation listed in section 15.7.1. e) Marking and lighting of the site and promulgation of information have been assumed to be embedded mitigation, and are listed in section 15.7.1. f) Effects on position fixing and communication equipment are assessed within section 23 of Appendix 15.1. g) Allision risks to recreational vessels is covered in section 15.7 h) Displacement impacts have been assessed within section 15.7.
MCA	Scoping Opinion November 2016	An 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 Offshore Renewable Energy Installations (OREI). This NRA should be accompanied by a detailed MGN 543 Checklist which can be downloaded from the MCA website.	The NRA is available in Appendix 15.1, and includes the completed MGN 543 checklist as an appendix.
MCA	Scoping Opinion November 2016	It is noted that traffic data had been collected between September 2012 and April 2014 and that a further 28 day traffic survey (AIS, Radar and visual observations) will be conducted to	The project will comply with the requirements of MGN 543 as per embedded mitigation – section 15.7.1. This includes the collection of 28 days of

Consultee	Date /Document	Comment	Response / where addressed in the ES
		ensure data is up to date. MGN 543 Annex 2 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 reports to the MCA Hydrography Manager. Failure to report the survey or conduct it to Order 1a might invalidate the NRA if it was deemed not fit for purpose.	marine traffic survey data. The data collected has been analysed, the results of which are shown in section 12 of Appendix 15.1.
MCA	Scoping Opinion November 2016	Particular attention should be paid to cabling routes and where appropriate burial depth for which a Burial Protection Index study should be completed and, subject to the traffic volumes, an anchor penetration study may be necessary. If cable protection is required e.g. rock bags, concrete mattresses, the MCA would be willing to accept a 5% reduction in surrounding depths referenced to Chart Datum.	As described in section 15.7.1, a Cable Burial Risk Assessment will be undertaken post consent. This will include an assessment of expected cable burial depths and a plan for other forms of protection where necessary.
MCA	Scoping Opinion November 2016	The Radar effects of a wind farm on ships' Radars are an important issue and the effects, particularly with respect to adjacent wind farms 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.	Effects on marine Radar are assessed within section 23 of Appendix 15.1. The assessment includes discussion of previous radar trials undertaken with MCA involvement.
MCA	Scoping Opinion November 2016	The development area carries a significant amount of through traffic and liner routes. Attention needs to be paid to routeing; particularly in heavy weather ensuring shipping can continue to make safe passage without significant large scale deviations.	Impacts on vessel routeing are considered within the impact assessment and Appendix 15.1. This includes an assessment of routeing during adverse weather (section 16).
MCA	Scoping Opinion November 2016	Particular consideration will need to be given to the implications of the site size and location of SAR resources and Emergency Response Cooperation	The project will comply with the requirements of MGN 543 as per embedded mitigation –

Consultee	Date /Document	Comment	Response / where addressed in the ES
		Plans (ERCoP). Attention should be paid to the level of Radar surveillance, AIS and shore-based Very High Frequency (VHF) radio coverage and give due consideration for appropriate mitigation such as Radar, AIS receivers and in-field, Marine Band VHF radio communications aerial(s) (VHF voice with Digital Selective Calling (DSC)) that can cover the entire wind farm sites and their surrounding areas.	section 15.7.1. Existing SAR resources relative to the project are summarised in section 10 of Appendix 15.1. As listed in section 15.7.1, an ERCoP will be created post consent.
TH	Scoping Opinion November 2016	The NRA should include: • Comprehensive vessel traffic analysis in accordance with MGN 543; and • Assessment of the possible cumulative and in-combination effects on shipping routes and patterns. Any proposed layouts should conform with MGN 543; however, should some structures such as OSPs lie out with the actual wind farm turbine layout, then additional risk assessment should be undertaken.	An MGN 543 checklist has been completed as part of Appendix B in Appendix 15.1. Up to date marine traffic survey data has been used to assess current shipping levels and patterns within the vicinity of the project. The results of the analysis are available in section 12 of Appendix 15.1. Vessel routeing has been considered on a cumulative basis in section 19 of the Appendix 15.1. Associated impacts have been assessed in this chapter in section 15.8.
TH	Scoping Opinion November 2016	We consider that the wind farm(s) will need to be marked with marine aids to navigation by the developer/operator in accordance with the general principles outlined in International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) Recommendation O 139 on the Marking of Man-Made Offshore Structures as a risk mitigation measure. In addition to the marking of the structures themselves, it should be borne in mind that additional aids to navigation such as buoys may be necessary to mitigate the risk posed to the mariner, particularly during the construction phase. All marine navigational marking, which will be required to be provided and thereafter maintained by the developer, will need to be addressed and agreed with TH.	The project will comply with the requirements of IALA O-139 as per embedded mitigation – section 15.7.1. All lighting and marking will be agreed with TH prior to implementation.

Consultee	Date /Document	Comment	Response / where addressed in the ES
		This will include the necessity for the aids to navigation to meet the internationally recognised standards of availability.	
		Appropriate buffer zones surrounding the two IMO Deep Water Routes (DWRs) should be fully considered.	Appendix 15.1 includes an assessment of the cumulative impact (including buffer zones) on routes from southern North Sea wind farms, which are then assessed in section 15.8. Spacing between the OWF sites and the DWRs has been agreed with the MCA.
		Any possible national trans-boundary issues should be assessed, through consultation with the Dutch authorities.	Consultation was undertaken with the Dutch Authorities through Rijkswaterstaat (Ministry of Infrastructure and the Environment), as shown in this table. Transboundary issues are discussed in section 15.9.
		A Decommissioning Plan, which includes a scenario where upon decommissioning and upon completion of removal operations an obstruction is left on site (attributable to the wind farm) which is considered to be a danger to navigation and which it has not proved possible to remove, should be considered. Such an obstruction may require to be marked until such time as it is either removed	A Decommissioning Plan will be prepared post consent. Impacts associated with the decommissioning of the project are considered in section 15.12.3.

Consultee	Date /Document	Comment	Response / where addressed in the ES
		or no longer considered a danger to navigation, the continuing cost of which would need to be met by the developer/operator.	
		The possible requirement for navigational marking of the export cables and the vessels laying them. If it is necessary for the cables to be protected by rock armour, concrete mattresses or similar protection which lies clear of the surrounding seabed, the impact on navigation and the requirement for appropriate risk mitigation measures needs to be assessed.	As described in section 15.7.1, a Cable Burial Risk Assessment will be undertaken post consent. This will include identification of any sections of cable requiring protection other than burial. Any associated risks will be assessed within the Cable Burial Risk Assessment.
MCA and TH	24th May 2016 Meeting with MCA and TH.	Agreement was reached on the survey methodology proposed by Norfolk Vanguard including dates and time period.	The marine traffic survey is summarised in section 15.6.2.
MCA	17th March 2017 Minutes from meeting held with TH and MCA.	Indicative position of substations or other platforms had not yet been agreed; MCA noted that the platforms should be in rows with wind turbines.	As shown in Chapter 5 Project Description, platforms have been kept in a grid format with the wind turbines.
MCA	17th March 2017 Minutes from meeting held with TH and MCA.	MCA require two lines of orientation but would be content to see a safety case for one line of orientation.	Regular grid layouts have been assessed within the NRA; if a single line of orientation is considered post consent it will be supported by a relevant safety case.
MCA	17th March 2017 Minutes from meeting held with TH and MCA.	Both marine and aviation lighting was discussed. MCA noted that synchronisation between East Anglia three, Norfolk Vanguard East and Norfolk Boreas was important especially for aviation lighting.	Lighting and marking of the Offshore Wind Farm (OWF) sites is discussed in the NRA. All lighting and marking will be agreed in consultation with TH, the MCA, and the Civil Aviation Authority (CAA).
TH	17th March 2017 Minutes from	TH noted that they preferred straight edges and no isolated turbines.	Norfolk Vanguard Limited will work with MCA and TH post consent to agree edges and

Consultee	Date /Document	Comment	Response / where addressed in the ES
	meeting held with TH and MCA.		peripheral turbine locations.
CoS	11th April 2017 Email correspondence	What is most important is that stakeholders get the opportunity to feed in concerns and issues.	Section 15.2 summarises all relevant consultation received to date, and indicates where in this document (or supporting documents) the points raised have been addressed. This includes responses to the PEIR.
CoS	8th May 2017 Minutes from consultation meeting with CoS.	The CoS want to see the impact on the affected (deviated) routes entirety and not just within 10 nautical miles (nm) i.e., a holistic review of the overall route from port to port to assess deviations.	The purpose of the ES is to assess the impact of the project primarily in isolation. However, Appendix 15.1 includes cumulative main routes (section 19.3) which are then assessed in section 15.8 of this chapter.
CoS	8th May 2017 Minutes from consultation meeting with CoS.	Access points will be needed for wind farm service vessels in the area, and it will need to be known where they are likely to be crossing the Deep Water Route (DWR). It should be ensured that the impact of wind farm construction and operational traffic is considered in the NRA.	Entry and exit points for wind farm construction, operation and maintenance and decommissioning vessels will be agreed as mitigation post consent and has been considered additional mitigation
CoS	8th May 2017 Minutes from consultation meeting with CoS.	Transboundary issues should be considered and the Dutch authorities/stakeholders consulted.	Section 15.9 includes consideration for Transboundary issues. The Dutch authorities have been consulted with, as summarised in this table.
BP Shipping	7th April 2017 Email correspondence	BP Shipping would appreciate if the impact of the proposed wind farms could be reviewed with specific focus upon shipping density in the region – the loss of navigational space and the impact upon the shipping which will be navigating in and or around the DWRs. The loss of sea-room remains a concern for BP Shipping and we would appreciate visibility of the existing review of regional vessels Automatic	Appendix 15.1 includes cumulative main routes which are then assessed in section 15.8. A review of navigation through the DWRs post installation of the project is included in section 17 of Appendix 15.1. Up to date marine traffic survey data (including AIS) is

Consultee	Date /Document	Comment	Response / where addressed in the ES
		Identification System (AIS) tracks within this area and the considered opinion of the regulator upon traffic densities within this region when adjusted for regional growth within the major ports and the impact on maritime trade of the UK's withdrawal from the European Union (EU). We would suggest port growth which should be reviewed are: • Rotterdam / Europort including Mass flack 1 and 2; • Hamburg / Willhelmshaven; and • London gateway terminal including Thames estuary.	assessed in section 12 of Appendix 15.1, with a summary provided in this chapter in section 15.6.2. This data was used to assess baseline vessel routeing within the vicinity of the project. Allision and collision modelling (section 21 of Appendix 15.1) has been undertaken assuming a 10% growth in traffic. At the request of the CoS, collision rates have also been modelled assuming a 20% growth in traffic.
BP Shipping	15th May 2017 Minutes from consultation meeting with BP.	Transboundary issues should be considered and the Dutch authorities and relevant Dutch stakeholders should be consulted.	Section 15.8 includes consideration of cumulative impact and 15.8 notes Transboundary elements. The Dutch authorities have been consulted with, as summarised in this table.
BP Shipping	15th May 2017 Minutes from consultation meeting with BP.	BP expressed concerns with respect to oil spill risk in the area increasing with the wind farms and emergency response in the event of a drifting vessel and a potential oil spill clean-up operation in the southern North Sea.	Sections 15.7 and 15.8 consider the impacts and cumulative impacts of the proposed project including analysis of the impact upon emergency response arising from the proposed project. Emergency response plans will be laid out in full within the Emergency Response Plan (ERP) and ERCoP post consent.
Boston Putford	8th May 2017 Email correspondence	When the fields are established extra time will need to be given in order for our vessels to meet the required relief times. Consideration will need to be given for vessels returning to port from the mentioned locations. It really is a time factor we have to deal with here taking into consideration: • Weather conditions for the	Sections 18 and 19 of Appendix 15.1 provide an assessment of vessel routeing, both pre- and post-wind farm. This includes the identified oil and gas routes, based on a review of marine traffic survey data. Adverse weather routeing is considered in section 16 of

Consultee	Date /Document	Comment	Response / where addressed in the ES
		vessels concerned; • Extra distances involved by avoiding the proposed fields; • Vessels arriving on location in time for platforms manning up; and • Vessels arriving on time to relieve any vessel that is returning to port for cargo or crew change. With the above stated It will be down to operations and logistics to consult with vessel Masters in order to get an accurate ETA for any requirements when transiting these areas.	Appendix 15.1. Changes in route lengths are assessed in section 19.2 of Appendix 15.1. Impacts associated with deviations to vessel routes are assessed in section 15.7 of this chapter.
Royal Yachting Association (RYA)	8th May 2017 Minutes from consultation meeting with RYA.	One of the main issues for the RYA would be the cable landfall, and any resultant reduction in water depths in this area.	A Cable Burial Risk Assessment will be undertaken prior to installation; this will include consideration of under keel clearance.
Cruising Association (CA)	8th May 2017 Minutes from consultation meeting with CA.	The key concern is the cumulative impact of all the projects in the former East Anglia Zone as opposed to just that from the Norfolk Vanguard and Norfolk Boreas sites.	A cumulative assessment of routes is presented within section 19.3 of Appendix 15.1.
CA	8th May 2017 Minutes from consultation meeting with CA.	Two lines of orientation and any convertor stations/accommodation platforms etc. in line with the turbines.	Grid layouts have been assessed within the NRA; if a single line of orientation is considered post consent it will be supported by a relevant safety case. Norfolk Vanguard Limited will work with MCA and TH post consent to agree edges and peripheral turbine locations.
CA	8th May 2017 Minutes from consultation meeting with CA.	It was raised that the "area has a high proportion of bad visibility (i.e. mist and fog)." It was suggested the latest pilot book was reviewed for visibility information.	Various sources of visibility data have been assessed and considered, as summarised within Appendix 15.1. This included the Pilot Book.

Consultee	Date /Document	Comment	Response / where addressed in the ES
Peel Ports – Great Yarmouth	11th May 2017 Response to hazard log.	No comments to add.	n/a
Rijkswaterstaat (Ministry of Infrastructure and the Environment)	19th May 2017 Written response to initial correspondence	Norfolk Vanguard is situated within a nautically important area, close to IMO DWRs. One of the main concerns for the Dutch government is the safety of shipping in these routes. We would ask you to take these guidelines (IMO, 2016) into consideration when designing the layout of the wind farm.	As priority the development will consider MCA guidance; however, consideration will be given to the importance of IMO routeing measures and thus the IMO guidelines. An assessment of the project relative to the DWRs against the IMO guidance is presented in section 17 of Appendix 15.1.
ABP Humber	25th May 2015 Response to hazard log.	No foreseeable impacts on the port of Humber.	n/a
P&O Ferries	1st June 2017 Response to hazard log.	A possible additional risk is "allision caused by deliberate act". Additional scenario is a vessel that has been hijacked by persons and to increase to the impact of their act they take the vessel through a wind farm. Highly unlikely but the type of incident we are preparing for.	Impact included within the updated hazard log within Appendix 15.1 to include deliberate act of allision.
Rijkswaterstaat (Ministry of Infrastructure and the Environment)	15th June 2017	We appreciate the systematic approach with regard to the content and the stakeholder process very much and would like to stay in touch on a regular basis in the remainder of the process. Regarding the nautical safety aspects of Norfolk Vanguard, we would like to refer to the documents as presented in our letter dated 19th May 2017 in which the design criteria for safe distances between shipping lanes and OWFs are attached.	Section 17 of Appendix 15.1 demonstrates compliance of the project with the referenced documents. It is noted that the buffers between the OWF sites and the DWRs were agreed as part of the former East Anglia Zone process.
VISNED (Coöperatie Kottervisserij Nederland	9th June 2017 Response to hazard log.	"The displacement will be influenced by how big the turbines will turn out to be. Fishermen I talk to aren't really happy about the prospects of fishing	Issues in relation to displacement of fishing activity are covered within the ES in Chapter 14 Commercial

Consultee	Date /Document	Comment	Response / where addressed in the ES
U.A.)		inside an array. The spacing between the turbines will have a major impact on a skipper's decision to trawl there. The smaller the spacing between turbines, the smaller the chances are of skippers taking the risks. Correct me if I'm wrong but when opting for the 7 MW turbines the spacing would be about 900 meters between. Most fishermen won't take their chances with such a small area to manoeuvre. In that case the most likely consequence will be the same as the worst case scenario: loss of fishing grounds and a major impact on businesses, especially when the cumulative effects of other arrays are taken into effect. This last point bothers us quite a bit since the effects of large wind arrays on fishing are always presented individually and never accumulated as they should be in our view. We think the largest turbines (15 MW) with the biggest spacing will be the best options for having the least impact on our members and their activities."	Fisheries.
RYA	15th Nov 2017 PEIR Response	The most up to date RYA position on offshore renewable wind energy developments (paper 1 of 4) is dated September 2015" Otherwise the PEIR reflects the RYA concerns and observations arising from our discussions on 8 May 2017.	Section 15.2 (Legislation and Guidance) references the most up to date RYA guidance as required.
CA	7th Dec 2017 PEIR Response	We note that between 90 and 257 turbines are proposed. Each will be an obstruction to navigation and potential danger to small vessels so we therefore urge selection of the largest generators possible giving the fewest obstructions. From the point of view of navigation safety all should be located within Norfolk Vanguard East rather than Norfolk Vanguard West area as suggested so that when considered in	Allision and collision modelling has been undertaken assuming the worst case parameters from a shipping and navigation perspective (maximum number of structures). Noted that following PEIR, the maximum number of wind turbines has been reduced to 200.

Consultee	Date /Document	Comment	Response / where addressed in the ES
		combination with the proposed Boreas site a smaller east-west obstruction is presented.	The final layout will be agreed with the MCA post consent.
CA	7th Dec 2017 PEIR Response	We note that proposed spacing between turbines will be a minimum of 616m. This is just adequate but our experience is that spacing of 1,000m or greater is required for problem free navigation of small craft and urge selection of generator size large enough to require this.	Following PEIR, the worst case (minimum) turbine spacing has been increased to 680m. The final layout will be agreed with the MCA post consent.
CA	7th Dec 2017 PEIR Response	We have no views on the type of foundations proposed except to ensure a minimum navigable depth at all times of at least 3m round the visible part of the towers even if a Safety Zone of 50m is provided round each tower.	Navigable depth will be maintained in line with MCA guidance. See embedded mitigations 15.7.1.
CA	7th Dec 2017 PEIR Response	Our layout preference is strongly towards turbine patterns in straight rows and lines in order to preserve the essential 'see-through' characteristic required for easiest navigation through from all directions and to assist SAR operations. We are pleased therefore to note that you will adopt at least a single line of orientation and to note that all ancillary structures (accommodation platforms, electrical stations, etc) will be in line with rows and lines to preserve sightlines through the tower field. We strongly support straight edges with no isolated structures.	The final layout will be considered in line with MGN 543 and a safety case will be submitted as required to demonstrate that it is within As Low As reasonably Practicable Parameters.
CA	7th Dec 2017 PEIR Response	Whichever port is finally chosen it is likely that the Vanguard projects, and Boreas to come, will generate high traffic between it and the offshore sites and that much of this will be specialised construction or support vessels and vessels Restricted in their ability to Manoeuvre (RAM). While the Collision Regulations can deal with most situations our experience is that heavy work traffic can greatly increase	Promulgation of information will be undertaken, as per Section 15.7.1 (Embedded Mitigation). The RYA request a minimum of 4m under keel clearance and the Norfolk Vanguard OWF sites are expected to achieve this

Consultee	Date /Document	Comment	Response / where addressed in the ES
		the risks to small vessels particularly in or near harbour exits. Consideration should therefore be given to defined and publicised routing of working vessels which can become known in advance.	
CA	7th Dec 2017 PEIR Response	We can confirm the recreational craft routing given in the PEIR but have cause to doubt the low frequency of yachts recorded. While we cannot offer survey data we suggest that an average of 10-30 yachts per day may be expected to cross the corridor at maximum in the summer season. Our doubt concerning the number of yachts captured in the surveys does not affect the overall assessment.	Marine traffic analysis within the Offshore Cable Corridor was AIS only. Given that the RYA Coastal Atlas (RYA, 2016) has also been considered, the available data is considered to provide a good indication of the levels and locations of recreational activity.
TH	8th Dec 2017	At this stage Trinity House would like to advise that the layout of Norfolk Vanguard East must align with adjoining wind farm projects, such as East Anglia Three. Therefore, continuous dialogue with such projects is imperative throughout the consenting process of Norfolk Vanguard.	Continuous dialogue is ongoing with the developers of East Anglia Three.
CAA	11th Dec 2017	The CAA has no comment to make on this proposal.	n/a
MCA	11th Dec 2017	We note that the development area carries a significant amount of through traffic, and attention needs to be paid to routeing, particularly in heavy weather ensuring shipping can continue to make safe passage without significant large scale deviations."	Vessel routeing is assessed in Sections 18 (base case) and 19 (future case) of the NRA (Appendix 15.1), with associated impacts assessed in this chapter in section 15.7. Adverse weather is discussed in section 16 of the NRA (Appendix 15.1), with associated impacts assessed in this chapter in section 15.7.
MCA	11th Dec 2017	The possible cumulative and in combination effects on shipping routes	An assessment of likely cumulative routeing is

Consultee	Date /Document	Comment	Response / where addressed in the ES
		should be considered taking into account the proximity to other windfarm developments; Norfolk Vanguard East, Norfolk Vanguard West, Norfolk Boreas, the alignment with East Anglia Three and other operations throughout the Southern North Sea.	presented in section 19.3 of the NRA (Appendix 15.1), which takes the wind farms mentioned within the MCA response into account. Collision has been assessed on a cumulative basis in section 22 of the NRA (Appendix 15.1). Associated impacts are assessed in this chapter in section 15.7.
MCA	11th Dec 2017	MGN 543 Annex 2 Paragraph 6 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 EIA stage.	As per Entry (6) of the MGN543 Checklist (Appendix B), the Applicant will supply hydrographic data compliant with MGN543 requirements.
MCA	11th Dec 2017	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. Existing charted anchorage areas should be avoided. Where burial depths are not achieved consultation will need to take place with MCA regarding the locations, impact and potential risk mitigation measures.	As per the embedded mitigation listed in section 15.7.1, a Cable Burial Risk Assessment will be undertaken post consent, which will present in detail the intended cable protection to be implemented. The approach taken for cable sections where protection may reduce water depths by more than 5% will be agreed with the MCA.
MCA	11th Dec 2017	The turbine layout design will require MCA approval prior to construction to minimise the risks to surface vessels, including rescue boats, and Search and	The final layout will be agreed with the MCA post consent.

Consultee	Date /Document	Comment	Response / where addressed in the ES
		Rescue 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 Search and Rescue requirements, as per MGN 543 Annex 5, will be agreed at the approval stage. The layout design should take into account East Anglia 3 and should align, ideally with information sharing agreements in place with the associated developers.	
MCA	11th Dec 2017	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, with significant evidence from the construction phase in addition to the baseline NRA required supporting the case.	As per the embedded mitigation listed in section 15.7.1, standard safety zones will be applied for during construction, major maintenance, and decommissioning. There is the potential for the safety zone application to include provision for operational safety zones around permanently manned accommodation platforms to protect the personnel onboard. Further consultation will be undertaken prior to submission of the safety zone application.
MCA	11th Dec 2017	An Emergency Response Cooperation Plan is required to meet the requirements of MCA guidance. The template is available on the MCA website at www.gov.uk. An approved ERCOP will need to be in place prior to construction. The ERCoP is an active operational document and must remain current at all stages of the project including during construction, operations & maintenance and decommissioning. A SAR checklist will be discussed post consent to track all requirements detailed in MGN 543 Annex 5. The checklist will be adapted to suit Norfolk Vanguard.	As per the embedded mitigation listed in section 15.7.1, an ERCoP will be produced post consent using the MCA template. The new MCA SAR checklist will be discussed with the MCA post consent.

Consultee	Date /Document	Comment	Response / where addressed in the ES
MCA	11th Dec 2017	The boundary turbines, where they are more than 900m apart, must be lit with a single 2000 candela, red aviation light, flashing Morse 'W' in unison with all other boundary turbines. All other turbines must be fitted with a fixed single red 200 candela aviation light, visible through 360°, for SAR purposes. Further consultation with the CAA and MCA should be sought by the applicant where additional mitigation may be identified. We would expect consistency with lighting across East Anglia 3, Norfolk Vanguard East and West and Norfolk Boreas.	Lighting and marking of Norfolk Vanguard will be agreed with TH, MCA, Ministry of Defence (MOD) and the CAA, and will be in line with IALA-O139.
Rijkswaterstaat	11th Dec 2017	I am happy to note that you comply with the arrangements for East Anglia as commented by Rijkswaterstaat (distance between shipping route and wind park) with reference in Appendix 15.1 section 17.3.2 to the IMO advice.	The assessment referenced is available in section 17.3.2 of the NRA (Appendix 15.1). A meeting was offered with Rijkswaterstaat which they declined.

15.4 Assessment Methodology

15.4.1 Impact Assessment Methodology

11. Shipping and navigation impacts have been assessed using the FSA process, as required by the MCA. The FSA assigns each impact a "frequency" ranking, and a "severity" ranking as defined in the proceeding sections. These rankings are then used to determine the "significance" of each impact. It is noted that this approach is broadly similar to that used for the EIA (see Chapter 6 EIA Methodology).

12. Identified impacts and their initial significance rankings were provided to the relevant shipping and navigation stakeholders in the form of a hazard log, with a request for input. All responses received were considered prior to finalisation of the log, and the final log was agreed with all stakeholders. The responses received are available in the NRA (Appendix 15.1). The rankings in the log were used in conjunction with the modelling results and expert opinion to inform the rankings used in the FSA.

15.4.1.1 Frequency

13. The definitions of "frequency" used to assess shipping and navigation impacts are presented in Table 15.4.

Table 15.4 Definitions of frequency levels for shipping and navigation

Rank	Frequency	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

15.4.1.2 Consequence

14. The definitions of "severity of consequence" used to assess shipping and navigation impacts are presented in Table 15.5**.**

Table 15.5 Definitions of severity levels for shipping and navigation

Rank	Magnitude	Definition
1	**Negligible**	No injury to persons. No significant damage to infrastructure or vessel. No significant environmental impacts. 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 (> £100M). Tier 3 pollution assistance (marine pollution). Major international business (safety), operation or reputation impacts (> £10M).

15.4.1.3 Impact significance

15. Once an impact is assigned a frequency and severity ranking, its significance is then determined based on the matrix shown in Table 15.6 as either Broadly Acceptable, Tolerable, or Unacceptable. Definitions of the significance rankings are given in Table 15.7.

Table 15.6 Impact significance matrix

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

Table 15.7 Risk rankings

	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 (with or without mitigation)	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.

15.4.2 Cumulative Impact Assessment

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

17. Other developments which may increase the effect of impacts to shipping and navigation receptors when considered with the project were assessed, and screened

in or out depending upon the outcome of the assessment. The full cumulative screening process is presented in Appendix 15.1.

18. All impacts presented in section 15.7 of this chapter were then assessed for potential cumulative impact when considered with the developments scoped in during the screening stage undertaken as part of the NRA process (Appendix 15.1). As raised during consultation, the key cumulative impact was considered to be vessel routeing when considered with the other southern North Sea wind farm developments, however all impacts presented have been considered cumulatively.

15.4.3 Transboundary Impact Assessment

19. Transboundary impacts of offshore wind developments with regards to vessel routeing and international ports have been considered in section 15.9. Fishing vessel, recreational vessel, and marine aggregate dredging vessel impacts, although they have the potential to be internationally owned or located, have been considered as part of the baseline assessment.

15.5 Scope

15.5.1 Study Areas

20. To ensure focus on the traffic relevant to the project is considered, the marine traffic survey data described in the following section (which formed the primary input to the NRA) has been assessed within a 10nm buffer of the two offshore wind farm areas (hereafter referred to as the "OWF sites study area"). This study area encompasses all relevant shipping routes within the vicinity of the proposed project, including those associated with the IMO Routeing Measures passing the OWF sites. It is noted that in some cases, data sets have been considered beyond the 10nm extent if considered appropriate. In particular, cumulative routeing has been assessed over a wider geographical area, as vessel displacement can impact routeing beyond 10nm.

21. In addition to the OWF sites, marine traffic data (AIS only) has also been considered within a 5nm buffer of the offshore cable corridor (hereby referred to as the "offshore cable corridor study area").

22. Cumulative impacts are again considered within a 10nm buffer around the project but then extended where applicable to encompass vessel routeing (hereby referred to as the "cumulative study area"). This includes consideration of transboundary offshore wind farm projects and shipping routes. However, for a cumulative or transboundary wind farm 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 wind farm and the project.

23. The study areas for the OWF sites and for the offshore cable corridor are presented in Figure 15.1.

15.5.2 Data Sources

24. The data sources considered in the NRA and within this chapter are summarised in Table 15.8.

Table 15.8 Data sources

Data	Year	Coverage	Confidence	Notes
Marine traffic survey data collected for the former East Anglia Four (now Norfolk Vanguard East) (AIS, visual and Radar)	2012/2013/2014 (four ten day surveys)	10nm study area around the former East Anglia Four.	High	Data collected by a survey vessel stationed on site. Non-AIS vessels were recorded via Radar and visual observations. Data used to inform the initial methodology.
Marine traffic survey data collected within Norfolk Vanguard East and West (AIS, visual and Radar)	2016 / 2017 (28 days per OWF site)	10nm study area around the OWF sites.	High	Data collected by a survey vessel stationed on site. Non-AIS vessels were recorded via Radar and visual observations.
Marine traffic survey data (AIS)	2016 / 2017 (28 days)	5nm study area around the offshore cable corridor	Moderate	Data collected from shore-based receivers. Data set was AIS only.
Anatec Ship Routes database	2017	10nm study area around the OWF sites and 5nm study area around the offshore cable corridor	High	Data developed by Anatec to assist in identifying shipping passing in proximity to proposed offshore developments.
Marine incident data from the Marine Accident Investigation Branch (MAIB)	2005 to 2014	10nm study area around the OWF sites and 5nm study area around the offshore cable corridor	Moderate	Data covers all incidents involving commercial UK vessels or non-UK commercial vessels within UK 12nm territorial waters.
Marine incident data from the Royal National Lifeboat Institution (RNLI)	2005 to 2014	10nm study area around the OWF sites and 5nm study area around the offshore cable corridor	Moderate	Data covers all incidents responded to by the RNLI excluding cases of a hoax or false alarm.
UKHO Admiralty charts	2017	Southern North Sea	High	Charts 1408, 1503, 1504, 1631 and 2182a used to

Data	Year	Coverage	Confidence	Notes
				identify relevant navigational features.
Admiralty Sailing Directions – North Sea (West) Pilot NP54	2016	Southern North Sea	High	Used to identify relevant navigational features and marine conditions.
Marine aggregate dredging areas (The Crown Estate)	2017	Southern North Sea	High	Data provides location of dredging areas including the current types (production, option etc.)
RYA Coastal Atlas of Recreational Boating	2016	Southern North Sea	Moderate	Data provides approximate cruising routes used by recreational users.
MetOcean data recorded within Norfolk Vanguard East, the Northern Meteorological Mast (Met Mast), UK Admiralty Charts, and the Pilot Book	2013 to 2016	Southern North Sea	Moderate	Data collected from the various sources used to estimate the typical MetOcean conditions in the vicinity of the project.

15.5.3 Assumptions and Limitations

25. Assumptions that have been made in relation to, or limitations associated with, the data sources presented in Table 15.8 are described in the subsections below.

15.5.3.1 Marine traffic survey data

26. The following assumptions have been made in relation to the marine traffic survey data:

- Vessels under a legal obligation to broadcast via AIS will do so; and
- The details transmitted via AIS are accurate (e.g., vessel type, vessel dimensions) unless there is clear evidence to the contrary.

27. The following limitations associated with the available marine traffic survey data are acknowledged:

- During the OWF site surveys, visual identification of vessels recorded via radar was not always possible, depending on visibility conditions;
- The coverage of AIS can be affected by atmospheric conditions;
- The marine traffic survey data used to assess the offshore cable corridor was AIS only (i.e., vessels not carrying AIS such as fishing vessels less than 15m in length and recreational vessels were not accounted for);

- Limited coverage was available of Norfolk Vanguard West on the 10th and 11th September 2016 due to an emergency steering drill; and
- Some downtime was recorded from the onshore coastal receivers used to supplement the marine traffic survey data to provide comprehensive coverage of the offshore cable corridor. However, multiple onshore feeds were used to ensure coverage was continuous (i.e., there was no point during the 28 day period when no onshore receiver was active).

15.5.3.2 MAIB incident data

28. 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.

15.5.3.3 UKHO Admiralty charts

29. It is noted that the Admiralty charts are updated on a periodic basis. As a result information shown on the charts may not reflect the real time features within the sea with 100% accuracy. For example, the Horne and Wren platform was decommissioned in 2017, but is still shown on Admiralty charts located approximately 1.01nm to the east of Norfolk Vanguard West at the time of writing.

15.5.3.4 MetOcean data

30. MetOcean conditions have been estimated based on various sources, including buoys within Norfolk Vanguard East, the Northern Met Mast, UK Admiralty Charts, and the Pilot Book (UKHO, 2016).

31. Wave data recorded within Norfolk Vanguard East was used to estimate the likelihood of calm, moderate, and severe weather conditions to use as input to the risk modelling undertaken within the NRA. The conditions estimated have been assumed to be indicative of the surrounding area, including Norfolk Vanguard West.

32. Wind data was recorded from the Northern Met Mast, located north of the OWF sites. This data has been used to estimate wind direction probabilities for the purposes of the NRA risk modelling. The results are assumed to be indicative of the project area, and have been validated against Anatec's in-house wind data.

33. The probability of poor visibility has been estimated based on information given in the Pilot Book (UKHO, 2016), average statistics for the southern North Sea, and additional data recorded from a Met Mast stationed near Ijmuiden. Based on the available data, the UK North Sea average was assumed to be representative of the project area.

34. Tidal stream information has been taken from UK Admiralty Charts, and it has been assumed that the provided details are accurate.

15.6 Existing Environment

35. The existing environment baseline has been established using the data sources presented in Table 15.8, and is summarised below. The full baseline assessment is provided in the NRA.

15.6.1 Navigational Features

36. The navigational features in the immediate vicinity of the project are presented in Figure 15.2. The key navigational features are the IMO Routeing Measures, most notably the DR1 Lightbuoy DWR and the West Friesland DWR. The DR1 Lightbuoy DWR passes between Norfolk Vanguard East and Norfolk Vanguard West (approximately 1nm from both OWF sites), and connects to the Off Botney Ground Traffic Separation Stream (TSS), located approximately 20 to 25nm north of the OWF sites. This DWR intersects the offshore cable corridor. The West Friesland DWR passes approximately 2nm to the east of Norfolk Vanguard East, and links to the Off Brown Ridge TSS. The two DWRs join approximately 25nm south of the OWF sites.

37. There are no charted anchorages in the vicinity of the proposed project. However, it is noted that the Pilot Book (UKHO, 2016) states that vessels may anchor coastally within The Would between Bacton and Winterton Ness. The next closest preferred anchorage areas to the proposed project are the Yarmouth and Caister Road anchorage areas located approximately 5.74nm south of the offshore cable corridor, as shown in Figure 15.2.

38. There are no Ministry of Defence (MoD) Practice and Exercise Areas (PEXAs) intersecting the OWF sites or the offshore cable corridor.

39. Figure 15.2 presents the oil and gas surface installation platforms in the vicinity of the proposed project. There are no oil or gas surface platforms located within the offshore project area itself, with infrastructure concentrated to the north of the OWF sites. The nearest offshore surface installation to the proposed project is the Thames AR Platform, located approximately 2.54nm the north-west of Norfolk Vanguard West. The landfall site is located in close proximity to the Bacton Gas Terminal and its associated pipelines. There are ten such pipelines, all of which are active, and all landing at Bacton. None of these pipelines are within the offshore cable corridor at the landfall site itself; however two pipelines do cross the corridor further offshore.

40. There are no marine aggregate dredging areas intersecting the OWF sites or offshore cable corridor. The two closest aggregate dredging areas are both production areas located approximately 3.14nm south of the offshore cable corridor (see Figure 15.2).

41. Other offshore wind farm developments in the vicinity of the proposed project which are currently operational are presented in Figure 15.2. The closest operational wind farm project relative to the project is the Scroby Sands Offshore Wind Farm, located approximately 7.3nm south-west of the offshore cable corridor.

15.6.2 Marine Traffic

15.6.2.1 OWF sites

42. The marine traffic survey data collected on site by vessels stationed within the OWF sites was used to establish the shipping baseline for the OWF sites. The data collected is shown in Figures 15.3 to 15.6.

43. Throughout the summer period of the marine traffic survey, there was on average 69 unique vessels per day recorded within the Norfolk Vanguard East study area, and 46 unique vessels per day recorded within the Norfolk Vanguard West study area. Throughout the winter period of the marine traffic survey, there was on average 63 unique vessels per day recorded within the Norfolk Vanguard East study area, and 39 unique vessels per day recorded within the Norfolk Vanguard West study area.

44. The majority of traffic recorded within the OWF study areas was observed to be cargo vessels and tankers. The majority of these vessels utilised the IMO Routeing Measures in the area; however other main routes were identified outwith the DWRs, including routes which intersected the OWF sites. Fishing activity was also notable in the area (see section 15.6.4).

45. The marine traffic survey data and Anatec's internal vessel routes database were used to estimate the positions of the main routes and their corresponding 90th percentiles within the OWF sites study area, as shown in Figure 15.7. A summary of each route is presented in Table 15.9. It is noted that the origin and destination ports shown represent the most common destinations transmitted via AIS by vessels using those routes within the OWF sites study area. Actual origins and destinations may vary per vessel.

Table 15.9 Route summary in the vicinity of the project

Route	Main Origin and Destination	Vessels per Day	Intersects Norfolk Vanguard West	Intersects Norfolk Vanguard East	Comments
1	Off Brown Ridge TSS / Rotterdam	17	No	No	Southbound traffic leaving the Off Brown Ridge TSS and transiting the West Friesland DWR.
2	Rotterdam / Off Brown Ridge TSS	11	No	No	Northbound traffic in the West Friesland DWR, bound for the Off Brown Ridge TSS.
3	Off Botney TSS / Rotterdam	4	No	No	Southbound traffic in the DR1 Lightbuoy DWR, originating from the Off Botney TSS.
4	Rotterdam / Off Botney TSS	5	No	No	Northbound traffic in the DR1 Lightbuoy DWR, bound for the Off Botney TSS.
5	Off Brown Ridge TSS / Rotterdam	4	No	No	Southbound traffic leaving the Off Brown Ridge TSS, but then exiting the West Friesland DWR.
6	Rotterdam / Off Brown Ridge TSS	3	No	No	Northbound traffic joining the West Friesland DWR at the access point to the northbound lane of the Off Brown Ridge TSS.
7	Amsterdam – Immingham	1	Yes	Yes	Commercial traffic route which crosses both DWRs and intersects both OWF sites.
8	Rotterdam – Tees	1	No	Yes	Commercial traffic route which intersects Norfolk Vanguard East and crosses the West Friesland DWR.
9	Rotterdam – Immingham	1	Yes	No	Commercial traffic route which intersects Norfolk Vanguard West and crosses the DR1 Lightbuoy DWR.
10	Antwerp – Immingham	1	Yes	No	Commercial traffic route utilising the DR1 Lightbuoy DWR. Route intersects Norfolk Vanguard West.
11	Great Yarmouth – Leman Field	1	No	No	Oil and gas route associated with the Leman field.
12	Killingholme – Rotterdam	2	No	No	Commercial traffic route. Includes commercial ferry traffic between the UK and mainland Europe (DFDS and P&O).

Route	Main Origin and Destination	Vessels per Day	Intersects Norfolk Vanguard West	Intersects Norfolk Vanguard East	Comments
13	Immingham – Rotterdam	7	No	No	Commercial traffic route. Includes commercial ferry traffic between the UK and mainland Europe (DFDS and P&O).
14	Northfleet – Jelsa	1	Yes	No	Commercial traffic route intersecting Norfolk Vanguard West. Route adjoins DR1 Lightbuoy DWR.
15	Grangemouth – Antwerp	1	Yes	No	Commercial traffic route intersecting the Norfolk Vanguard West site.
16	Rotterdam – Tees	1	Yes	Yes	Commercial traffic route intersecting both OWF sites and crossing both DWRs.
17	Grangemouth – Amsterdam	0 to 1	Yes	Yes	Commercial traffic route intersecting both OWF sites and crossing both DWRs.
18	Grangemouth – Rotterdam	0 to 1	Yes	No	Commercial traffic route intersecting Norfolk Vanguard West and crossing both DWRs.
19	Great Yarmouth – Victor Field	1	Yes	No	Oil and gas route mainly associated with the Victor field. Route intersects Norfolk Vanguard West.
20	Immingham – Amsterdam	1	No	No	Commercial traffic route passing south of the OWF sites and crossing both DWRs.
21	Rochester – Bergen	0 to 1	No	No	Commercial traffic route passing between the OWF sites, and crossing the DR1 Lightbuoy DWR.
22	Great Yarmouth – Davy Field	0 to 1	Yes	No	Oil and gas route associated with the Davy field. Intersects Norfolk Vanguard West and crosses the DR1 Lightbuoy DWR.
23	The Wash – Hamburg	0 to 1	No	No	Cargo vessel route passing south of the OWF sites and crossing both DWRs
24	Great Yarmouth – Hamburg	0 to 1	No	No	Cargo vessel route intersecting Norfolk Vanguard East and crossing both DWRs.

46. The busiest routes were those utilising the IMO Routeing Measures:

- Routes 1 and 2: Southbound (route 1) and northbound (route 2) traffic in the West Friesland DWR (heading from / to the Off Brown Ridge TSS) comprised approximately 17 and 11 vessels per day respectively;
- Routes 3 and 4: Southbound (route 3) and northbound (route 4) traffic in the DR1 Lightbuoy DWR (heading from / to the Off Botney Ground TSS) comprised four and five vessels per day respectively; and
- Routes 5 and 6: Southbound (route 5) and northbound (route 6) traffic heading from / to the Off Brown Ridge TSS via the West Friesland DWR (although vessels leave / join the DWR on approach to the TSS) comprised four and three vessels per day respectively.

47. There were approximately seven vessels per day recorded on route 13, with this route including commercial ferry traffic (including both DFDS Seaways and P&O Ferries vessels) on regular routes between the UK and mainland Europe.

15.6.2.2 Offshore cable corridor

48. The marine traffic survey data collected via a shore-based receiver was used to establish the shipping baseline for the offshore cable corridor. The data collected is shown in section 16 of Appendix 15.1.

49. Throughout the summer period of the marine traffic survey, there was on average 96 unique vessels per day recorded within the offshore cable corridor study area. Throughout the winter period of the marine traffic survey, there was on average 92 unique vessels per day recorded within the offshore cable corridor study area.

50. Similarly to the OWF sites, the most significant vessel types recorded within the offshore cable corridor study area were cargo vessels and tankers, which comprised more than 70% of the traffic across the survey periods.

15.6.3 Recreational Vessel Activity

51. Recreational vessel activity presented in this section includes all sailing vessels and motor craft recorded via AIS or Radar with length between 2.4 and 24m.

15.6.3.1 OWF sites

52. Throughout the summer period of the marine traffic survey, there were eight unique recreational transits recorded within the Norfolk Vanguard East study area, and four unique recreational transits recorded within the Norfolk Vanguard West study area. Ten out of the 12 recreational vessels recorded were identified as sailing vessels, with the type of the two remaining vessels not possible to confirm.

53. Throughout the winter period of the marine traffic survey, there were no recreational vessels recorded within the Norfolk Vanguard East study area, and just one recreational vessel recorded within the Norfolk Vanguard West study area; this was a sailing vessel.

15.6.3.2 Offshore cable corridor

54. Throughout the summer period of the marine traffic survey, there was on average one unique recreational vessel transit recorded every two days, with the majority of transits taking place along the UK coast. The recreational vessels were a combination of sailing vessels and motor yachts.

55. During the winter period of the marine traffic survey, just two unique recreational vessel transits were recorded, with both transits taking place along the UK coast. Both recreational vessels were motor yachts.

15.6.3.3 RYA coastal atlas

56. The RYA Coastal Atlas (RYA, 2016) showed areas of recreational activity to be largely coastal, however offshore routeing was indicated as occurring to the south of the OWF sites. A general boating area is located approximately 5nm north west of the offshore cable corridor landfall.

15.6.4 Fishing Vessel Activity

15.6.4.1 OWF sites

57. Throughout the summer period of the marine traffic survey, there were on average 12 unique fishing vessels per day recorded within the Norfolk Vanguard East study area, and four unique fishing vessels per day recorded within the Norfolk Vanguard West study area. During the winter period of the marine traffic survey, there were on average six unique fishing vessels per day recorded within the Norfolk Vanguard East study area, and one unique vessel per day recorded within the Norfolk Vanguard West study area.

58. The majority of fishing vessels recorded throughout the marine traffic surveys were beam trawlers (72% within the Norfolk Vanguard East study area and 83% within the Norfolk Vanguard West study area), with a significant number of these trawlers actively engaged in fishing activity. Demersal trawling, pelagic trawling and seiner activity was also recorded within both OWF sites.

59. In terms of nationality, the majority of fishing vessels recorded throughout the marine traffic surveys were from the Netherlands (80% within the Norfolk Vanguard East study area and 87% within the Norfolk Vanguard West study area).

15.6.4.2 Offshore cable corridor

60. Throughout the summer period of the marine traffic survey, there were on average five to six unique fishing vessels per day recorded within the offshore cable corridor study area. Throughout the winter period of the marine traffic survey, there were on average one to two unique fishing vessels per day recorded within the offshore cable corridor study area.

61. The majority of fishing vessels recorded throughout the marine traffic survey were beam trawlers (74% within the offshore cable corridor study area), with a significant number of these trawlers actively engaged in fishing activity, whilst others were transiting near the UK coast. Potting activity associated with Sea Palling was also observed near the landfall site.

62. In terms of nationality, the majority of fishing vessels recorded throughout the marine traffic surveys were from the Netherlands (66% within the offshore cable corridor study area). However, it is noted that the majority of vessels within the UK 12nm territorial limit were UK registered (approximately 70%).

15.6.5 Anchoring Activity

15.6.5.1 OWF sites

63. One vessel was observed to transmit a navigational status of “At Anchor” within the OWF sites study area during the marine traffic surveys. However, this was a 300m tanker undertaking a vessel to vessel manoeuvre, and based upon a visual check of the vessel’s movements it is not considered likely that the vessel’s anchor was actually deployed at the time. No other anchor activity was recorded during the marine traffic surveys undertaken for the OWF sites.

15.6.5.2 Offshore cable corridor

64. Two vessels were recorded at anchor within the offshore cable corridor study area during the marine traffic survey. One of the vessels anchored within the offshore cable corridor itself, this being a 142m cargo vessel which anchored for a week before departing for Hamburg. An 87m tanker was also recorded anchoring 0.3nm south of the offshore cable corridor, before departing for Immingham after 24 hours.

65. It should be noted that as only AIS data was included in the marine traffic survey for the offshore cable corridor, anchoring activity from vessels not required to transmit AIS was not accounted for. As discussed in section 15.6.1, the Pilot Book (UKHO, 2016) states that anchorage is available coastally within The Would between Bacton and Winterton Ness, and there is therefore the potential that recreational or fishing vessels may anchor within this area, although this was not observed.

15.6.6 Maritime Accidents and Incidents[1]

15.6.6.1 OWF sites

66. Throughout the ten year period between January 2005 and December 2014, a total of nine unique incidents were reported to the MAIB within the OWF sites study area, corresponding to an average of approximately one incident per year. None of the incidents occurred within the proposed OWF sites. The most frequently recorded incident type was "Accident to Person", representing three of the nine incidents. The most frequently recorded vessel type was oil and gas associated vessels, accounting for three of the nine incidents.

67. Throughout the ten year period between January 2005 and December 2014, a total of 11 launches were reported by the RNLI within the OWF sites study area, corresponding to an average of approximately one incident per year. One of the launches was to a location within the Norfolk Vanguard West site, with this being a large fishing vessel which experienced flooding. The most frequently recorded incident types were "Person in Danger" and "Machinery Failure", each representing 36% of the total number of incidents. The most frequently recorded vessel type was recreational vessels, accounting for 45% of the total number of incidents.

15.6.6.2 Offshore cable corridor

68. Throughout the ten year period between January 2005 and December 2014, a total of 83 unique incidents were reported to the MAIB within the offshore cable corridor study area, corresponding to an average of eight to nine incidents per year. The majority of incidents reported occurred in the vicinity of the UK east coast. Of the incidents reported within the offshore cable corridor study area, 17% occurred within the offshore cable corridor. The most frequently recorded incident type was "Machinery Failure", representing 36% of the total number of incidents. The most frequently recorded vessel type was fishing vessels, accounting for 30% of the total number of incidents.

69. Throughout the ten year period between January 2005 and December 2014, a total of 102 launches were reported by the RNLI within the offshore cable corridor study area, corresponding to an average of approximately 10 incidents per year. The majority of incidents reported occurred in the nearshore area. Of the incidents reported within the offshore cable corridor study area, 26% occurred within the offshore cable corridor, although only 3% of these incidents occurred outside of the nearshore area. The most frequently recorded incident type was "Person in Danger" followed by "Machinery Failure", representing 42% and 32% of the total number of

[1] The latest ten year period where data is available (2005 to 2014) has been used for assessment of marine incidents.

incidents respectively. The most frequently recorded vessel type was recreational vessels, accounting for 45% of the total number of incidents.

15.6.7 Anticipated Trends in Baseline Conditions

70. The baseline assessment in section 15.6.2 shows the area in the vicinity of Norfolk Vanguard is busy in terms of commercial traffic, largely due to the IMO routeing measures in the area. Given that traffic trends are affected by market conditions, predicting future trends is difficult.

71. Based on Department for Transport statistics (as presented within Appendix 15.1: NRA), there has been an overall decline in vessel callings at the key ports nearest Norfolk Vanguard over the period between 2009 and 2015, namely Great Yarmouth (calling numbers peaking in 2012), Lowestoft (calling numbers peaking in 2009), and King's Lynn (calling numbers peaking in 2010). Great Yarmouth and Lowestoft are known bases for oil and gas traffic, and the decreases may be related to ongoing decommissioning within the North Sea, with overall oil and gas traffic expected to reduce further as more fields are decommissioned. However, it should be noted that wind farm related traffic may increase from these ports as more renewable projects are built.

72. Commercial (cargo and tanker) traffic level fluctuations are difficult to predict; however, they will continue to be substantial in the area given the presence of the IMO routeing measures. A study by the International Transport Forum (ITF) at the Organisation for Economic Cooperation and Development (OECD) on the impact of 'Mega Ships' (OECD/ITF, 2015) indicates that the use of larger container ships is resulting in lower overall port callings, despite cargo tonnage levels rising. If this trend continues there may be fewer, larger vessels (in line with the port callings data mentioned above). The study showed that container ships have grown at the fastest rates, with moderate growth rates observed in other vessel types including RoRo ferries, passenger vessel and cruise ships. The average size of general cargo vessels has been observed to decline overall.

73. Fishing trends are discussed further in Chapter 14 Commercial Fisheries.

74. Based on future case modelling undertaken in the NRA (Appendix 15.1), collision rates were also estimated should Norfolk Vanguard not be constructed. Based on this, a rise in collision rates of between 21% and 44% was estimated, depending on the extent of traffic growth. Full details are provided in the NRA.

15.7 Potential Impacts

75. This section details the impacts that have been identified based on the available data, and the established existing environment baseline.

76. The impact assessment has been divided into sections to consider each impact on different shipping and navigation receptors. The following receptors have been identified as potentially being impacted during the construction, operation and maintenance, and decommissioning phases of the proposed project:

- Commercial vessels;
- Fishing vessels (impacts on navigation);
- Recreational vessels; and
- Emergency response responders i.e. SAR helicopters.

77. The hazard log identified both a realistic and a worst case ranking, with the final assessment considering multiple sources to identify the ranking under the FSA. These hazard log rankings have then been considered against marine traffic survey results, quantitative modelling, consultation and expert knowledge to identify EIA rankings.

15.7.1 Embedded Mitigation

78. Norfolk Vanguard Limited has committed to a number of techniques and engineering designs/modifications inherent as part of the project, during the pre-application phase, in order to avoid a number of impacts or reduce impacts as far as possible. Embedding mitigation into the project design is a type of primary mitigation and is an inherent aspect of the EIA process.

79. A range of different information sources has been considered as part of embedding mitigation into the design of the project (for further details see Chapter 5 Project Description, Chapter 4 Site Selection and Assessment of Alternatives) including engineering requirements, ongoing discussions with stakeholders and regulators, commercial considerations and environmental best practice.

80. For the purpose of this impact assessment, it has been assumed that, where possible, the embedded mitigation measures (relevant to shipping and navigation) listed below would be in place:

- Application for 500m safety zones surrounding all fixed structures where work is being undertaken by a construction vessel or maintenance vessel;
- Application for 50m safety zones around all surface structures up until the point of commissioning;
- Cable Burial Risk Assessment undertaken pre-construction, including consideration of under keel clearance. All subsea cables suitably protected

based on risk assessment, and the protection monitored and maintained as appropriate;

- Compliance from all vessels associated with the proposed project with international maritime regulations as adopted by the relevant flag state (most notably International Convention for the Prevention of Collision at Sea (COLREGS) (IMO, 1972) and International Convention for the Safety of Life at Sea (SOLAS) (IMO, 1974));
- Final site design to include consideration of lighting and marking. Suitable lighting and marking of the OWF sites complying with IALA Recommendations O-139 (IALA, 2013), to be finalised in consultation with TH and the MCA;
- Site design to ensure no outlying or extreme peripheral turbines and regular edges either side of the DWR;
- Continued dialogue with the developers of East Anglia Three;
- Foundations to be considered post consent to ensure they do not impact on vessels transiting within the array (under keel clearance issues). The RYA request a minimum of 4m under keel clearance and the Norfolk Vanguard OWF sites are expected to achieve this;
- Floating foundation mooring lines to be independently verified by a third party and meet required ISO standards;
- Information relevant to the proposed project to be promulgated via Notice to Mariners and other appropriate media including provision of information for use in fish plotters (where available);
- Marine traffic coordination to manage Norfolk Vanguard construction and operation vessels;
- MGN 372 (MCA, 2008), COLREGs (IMO, 1972) and SOLAS (IMO, 1974) which set out rules and regulations for third party vessels operating in the area including advice on navigating in proximity to a wind farm to be followed;
- Structures and all cables (offshore export and array) to be clearly marked on appropriately scaled nautical charts and electronic charts;
- The proposed project to be constructed in accordance with MGN 543 where applicable (MCA, 2016);
- Use of guard vessel during the deployment of safety zones, and during any other key construction periods; and
- Wind turbines to have at least 22m clearance above Mean High Water Spring (MHWS).

15.7.2 Monitoring

81. Details of the intended monitoring plans relevant to Shipping and Navigation are set out in section 28 of the NRA (Appendix 15.1). In summary, the following monitoring will be undertaken:

- Marine traffic monitoring during construction as per the Navigation Monitoring Strategy (as per the Deemed Marine Licence (DML) Requirement 19(4) of DCO Schedules 9 and 10 and Requirement 14(4) of DCO Schedules 11 and 12);
- Third party verification of mooring lines (Regulatory expectations on moorings for floating wind and marine devices; MCA & HSE 2017);
- Monitoring of cable protection as per the DML Requirement 14.(1)(g)(iii) of DCO Schedules 9 and 10 and Requirement 9.(1)(g)(iii) of DCO Schedules 11 and 12; and
- Hydrographic surveys (as per MGN 543 (MCA, 2016)).

82. Monitoring arrangements in relation to the above will be agreed with the MCA prior to commencement of construction.

15.7.3 Worst Case

83. The layout of the wind turbines will be defined post consent. The maximum capacity across the widest area (and hence the worst-case scenario from a shipping and navigation perspective) is 1,800 Megawatts (MW), split across both OWF sites (i.e. 100% of the potential turbines). For the purpose of the modelling undertaken in the NRA (Appendix 15.1) an indicative layout has been assessed which considered the maximum deployment of wind turbines across the maximum project area within both Norfolk Vanguard East and Norfolk Vanguard West at the time at which modelling commenced (to inform PEIR), causing the maximum displacement.

84. Following the Section 42 consultation, the Project Design Envelope used within this chapter represents a reduced number of wind turbines over that modelled as part of the PEIR process given that the minimum wind turbine size is now 9MW (meaning the maximum number of wind turbines possible is 200 not 257). However, given that the worst case scenario for shipping and navigation is the maximum number of structures over the greatest development area (within both the OWF sites) the modelling is considered to represent worst case results and any alternative configurations (or reduced wind turbine numbers) would return lower results. Therefore, any impacts assessed will be equal to or less than the residual ranking. Full details of the modelling parameters considered are presented in the NRA (Appendix 15.1).

85. Indicative programmes for the phased construction approaches under consideration (including the worst case considered within this chapter) are provided in Chapter 5 Project Description. In summary, the overall duration of construction activity could be as follows, within an indicative construction window of up to 4 years, depending on the time between commencement of phases:

- Single phase – approximately 23 months; or
- Two phase - approximately 12 months per phase, 24 months in total.

86. Within the project, several different sizes of wind turbine are being considered in the range of 9MW to 20MW. In order to achieve the maximum 1,800MW export capacity, there would be between 90 (20MW wind turbines) and 200 (9MW wind turbines). The maximum number of structures, 200 wind turbines of 9MW, has been considered the worst case given the largest deployment area required and the maximum number of structures, regardless of the size of those structures.

87. In addition, up to two offshore electrical platforms, two offshore accommodation platforms, two Met Masts, two LiDARS, two wave buoys, plus offshore export cables are considered as part of the worst case scenario.

88. The worst case scenarios with regard to shipping and navigation are presented by impact in Table 15.10. Parameters are based upon Chapter 5 Project Description. The worst case scenario assumes embedded mitigation (as per section 15.7.1) is in place.

Table 15.10 Worst case assumptions

Impact	Parameter	Notes
Construction		
Effects on vessel routeing and / or displacement	Largest extent of buoyed construction area and areas of consecutive cable installation over longest construction period.	**OWF sites construction area and duration** • Offshore project constructed as two phases) for which the buoyed construction area will be deployed; • Buoyed construction area deployed around the maximum extent of the OWF sites including 500m construction safety zones and 50m pre- commissioning safety zones; and • Indicative maximum construction duration of four years. **Array, interconnector and offshore export cable installation** • Maximum export cable trench length 200km (for two cables). Approximately 30km per cable pair may extend into the OWF sites, the rest will be within the offshore cable corridor which is 75km for Norfolk Vanguard West and 90km for Norfolk Vanguard East;

Impact	Parameter	Notes
		• Maximum array cables of 600km; • Installation of up to three interconnector cables, up to 50km; and • Minimum safe passing distances around cable installation vessels.
Increased vessel to vessel collision risk	Maximum extent of buoyed construction area and increased number of vessels operating in the area over the longest construction period.	**OWF sites construction area and duration** • Offshore project constructed in two phases for which the buoyed construction area will be deployed; • Buoyed construction area deployed around the maximum extent of the OWF sites, including 500m construction safety zones and 50m pre- commissioning safety zones; and • Indicative maximum construction duration of four years. **Array, interconnector and offshore export cable installation** • Maximum offshore cable corridor (90km for Norfolk Vanguard West and 100km for Norfolk Vanguard East); • Maximum array cables of 600km; • Installation of up to three interconnector cables; and • Minimum safe passing distances around cable installation vessels. **Number of vessels and personnel** • Estimated number of vessel movements of one to two per day, with a maximum number of 57 on site at any one time; • Maximum number of personnel on site; and • Total number of vessel movements of 1,180.
Increased vessel to structure allision risk	Maximum number and position of pre-commissioned structures over the longest construction period.	**OWF sites construction area and duration** • Offshore project constructed in up to two phases; for which the buoyed construction area will be deployed; • Buoyed construction area deployed around the maximum extent of the OWF sites, including 500m construction safety zones and 50m pre- commissioning safety zones; • Indicative maximum construction duration of four years; • Up to 200 pre- commissioned wind turbines; • Up to two offshore accommodation platforms (one in each OWF site); • Up to two offshore electrical platforms (in either OWF site); • Up to two Met Masts; and • Up to two LiDARS.
Anchor interaction and snagging	Maximum	**OWF sites construction area and duration**

Impact	Parameter	Notes
	number and position of pre-commissioned structures and pre-installed cables over the longest construction period.	• Offshore project constructed in up to two phases for which the buoyed construction area will be deployed; • Buoyed construction area deployed around the maximum extent of the OWF sites, including 500m construction safety zones and 50m pre- commissioning safety zones; • Indicative maximum construction duration of four years; • Up to 200 pre- commissioned wind turbines; • Up to two offshore accommodation platforms (one in each OWF site); • Up to two offshore electrical platforms (in either OWF site); • Up to two Met Masts; and • Up to two LiDARS. **Array, interconnector and offshore export cable installation** • Maximum offshore cable corridor (90km for Norfolk Vanguard West and 100km for Norfolk Vanguard East); • Maximum array cables of 600km; • Installation of up to three interconnector cables; and • Minimum safe passing distances around cable installation vessels.
Diminishing emergency response resources	Maximum number and personnel on site over the longest construction period.	**Number of vessels and personnel** • Estimated number of vessel movements is one to two per day, with a maximum number of 57 on site at any one time; • Maximum number of personnel on site; • Total number of vessel movements for two phases is 1,180; and • Indicative maximum construction duration of four years.
Operation		
Effects on vessel routeing and / or displacement	Largest operational area over longest operational life.	**OWF sites and operational life** • Maximum turbine deployment over both wind farm sites; • Up to 200 9MW turbines split between Norfolk Vanguard West and Norfolk Vanguard East; • Minimum clearance above sea level of 22m MHWS; • Three blades; • Minimum spacing of 680m; • Up to two Met Masts (not modelled); • Up to two Liars (not modelled); • Two offshore accommodation platforms (one in each OWF site) on piled or suction foundations (at water line dimensions of 90

Impact	Parameter	Notes
		x 60m); • Two offshore electrical platforms (in either OWF site) at water line dimensions of 90 x 60m; • Estimated design life of approximately 30 years; and • Maintenance safety zones of up to 500m. **Foundation** • Tensioned leg floating platforms (at water line dimensions of 45 x 45m[2]) with up to 12 moorings lines (3,084 mooring lines in total) of 20m in length (assuming 40m water depth); • Up to 10 metre (m) excursion; • Up to seven degree nacelle movement; and • Angle of mooring line from structure to seabed vertical or up to 30°.
Increased vessel to vessel collision risk	Largest operational area over longest operational life causing maximum displacement of vessels and activities.	**OWF sites and operational life** • Maximum turbine deployment over both wind farm sites; • Up to 200 9MW turbines split between Norfolk Vanguard West and Norfolk Vanguard East; • Minimum clearance above sea level 22m MHWS; • Three blades; • Minimum spacing of 680m; • Up to two Met Masts (not modelled); • Up to two LiDARs (not modelled); • Two offshore accommodation platforms (one in each OWF site) on piled or suction foundations (at water line dimensions of 90 x 60m); • Two offshore electrical platforms (in either OWF site) at water line dimensions of 90 x 60m; • Estimated design life of approximately 30 years; and • Maintenance safety zones of up to 500m. **Foundation** • Tensioned leg floating platforms (at water line dimensions of 45 x 45m) with up to 12 moorings lines (3,084 mooring lines in total) of 20m in length (assuming 40m water depth); • Up to 10m excursion; • Up to seven degree nacelle movement; and

[2] 45 x 45m is based on the dimensions worst case layout of 200 9MW turbines split between Norfolk Vanguard West and Norfolk Vanguard East; which present the greatest surface area for allision risk. The largest foundation under consideration for the project overall is 70 x 70m, however this assumes the minimum number of turbines.

Impact	Parameter	Notes
		• Angle of mooring line from structure to seabed vertical or up to 30°.
Increased vessel to structure allision risk	Maximum number of structures presenting the greatest surface area for allision risk over the longest operational period.	**OWF sites and operational life** • Maximum turbine deployment over both wind farm sites; • Up to 200 9MW turbines split between Norfolk Vanguard West and Norfolk Vanguard East; • Minimum clearance above sea level 22m MHWS; • Three blades; • Minimum spacing of 680m; • Up to two Met Masts (not modelled); • Up to two LiDARs (not modelled); • Two offshore accommodation platforms (one in each OWF site) on piled or suction foundations (at water line dimensions of 90 x 60m); • Two offshore electrical platforms (in either OWF site) at water line dimensions of 90 x 60m; • Estimated design life of approximately 30 years; and • Maintenance safety zones of up to 500m. **Foundation** • Tensioned leg floating platforms (at water line dimensions of 45 x 45m) with up to 12 moorings lines (3,084 mooring lines in total) of 20m in length (assuming 40m water depth); • Up to 10m excursion; • Up to seven degree nacelle movement; and • Angle of mooring line from structure to seabed vertical or up to 30°.
Anchor interaction and snagging	Maximum number of cables and mooring lines presenting the greatest risk of anchoring snagging.	**Foundation** • Tensioned leg floating platforms (at water line dimensions of 45 x 45m) with up to 12 moorings lines (3,084 mooring lines in total) of 20m in length (assuming 40m water depth); • Up to 10m excursion; • Up to seven degree nacelle movement; and • Angle of mooring line from structure to seabed vertical or up to 30°. **Array, interconnector and offshore export cables** • Up to three interconnector cables; • Maximum export cable length (100km for Norfolk Vanguard East and 90km for Norfolk Vanguard West); • Export cable to be protected or buried; • 600km of array cables; and • Reburial of the array cables once every five

Impact	Parameter	Notes
		years.
Diminishing emergency response resources	Maximum number of vessels, aircraft and personnel on site for the longest operational life.	**Number of vessels, aircraft and personnel** • 14 helicopter trips to OWF sites per week; • Estimated number of vessel movements is one to two per day; • Up to 440 movements per year; and • O&M crew transfer vessels are likely to operate from Great Yarmouth and / or Lowestoft.
Decommissioning		
Effects on vessel routeing and / or displacement	Largest extent of buoyed decommissioning area over three non-consecutive decommissioning phases.	**OWF sites decommissioning area and duration** • Indicative decommissioning period of one year per phase (up to two, potentially not consecutive); and • Buoyed decommissioning area deployed for each decommissioning phase. **Array, interconnector and offshore export cable decommissioning** • Some or all of the array cables, interconnector cables, and offshore export cables may be removed. Scour and cable protection would likely be left *in situ.*
Increased vessel to vessel collision risk	Largest extent of buoyed decommissioning area over three non-consecutive decommissioning phases.	**OWF sites decommissioning area and duration** • Indicative decommissioning period of one year per phase (up to two, potentially not consecutive); and • Buoyed decommissioning area deployed for each decommissioning phase. **Array, interconnector and offshore export cable decommissioning** • Some or all of the array cables, interconnector cables, and offshore export cables may be removed. Scour and cable protection would likely be left *in situ.*
Increased vessel to structure allision risk	Maximum number and position of decommissioning structures over three non-consecutive decommissioning phases.	**OWF sites decommissioning area and duration** • Indicative decommissioning period of one year per phase (up to two, potentially not consecutive). • Buoyed decommissioning area deployed for each decommissioning phase.
Anchor interaction and snagging	Maximum number and position of decommissioning structures and cables over three non-consecutive	**OWF sites decommissioning area and duration** • Indicative decommissioning period of one year per phase (up to two, potentially not consecutive); and • Buoyed decommissioning area deployed for each decommissioning phase. **Array, interconnector and offshore export cable decommissioning**

Impact	Parameter	Notes
	decommissioning phases.	• Some or all of the array cables, interconnector cables, and offshore export cables may be removed. Scour and cable protection would likely be left *in situ.*
Diminishing emergency response resources	Maximum number and personnel on site over three non-consecutive decommissioning phases.	**Number of vessels and personnel** • Maximum number of decommissioning vessels on site; and • Maximum number of personnel on site.
Cumulative		
Cumulative effects on deviation	Maximum number of offshore wind farm developments within the southern North Sea.	Worst case assumption for the project plus UK and EU wind farms.
Cumulative effects on allision	Maximum number of offshore wind farm developments (and maximum number of structures) within the southern North Sea.	Worst case assumption for the project plus UK and EU wind farms.
Cumulative effects on emergency response	Maximum number of offshore wind farm developments within the southern North Sea; with significant construction overlap.	Worst case assumption for the project plus UK and EU wind farms.

15.7.4 Potential Impacts during Construction Phase

15.7.4.1 Effects on vessel routeing and / or displacement – OWF sites including interconnector and array cables

89. The physical presence of pre- commissioned structures and associated works could have an effect on vessel routeing and displacement of activities within the OWF sites study area and the offshore cable corridor study area (discussed in section 15.7.4.2).

15.7.4.1.1 Commercial vessels

90. Marine traffic movements within the OWF sites study area and the offshore cable corridor study area have been captured through dedicated marine traffic surveys and AIS surveys as noted in section 15.6.2. The marine traffic survey data assessments have been considered alongside historical analysis in the form of the former East Anglia Zone assessments and vessel route databases (Anatec, 2016) to define a full and detailed picture of commercial vessel movement.

91. Maximum deviations during the construction phase would be associated with the buoyed construction area, which will be defined by TH pre-construction. However, this could be expected to extend 500m beyond the Agreement for Lease (AfL) boundary or the final layout. The buoyed construction area would only be deployed with TH authority and guidance and it is therefore assumed that it would be designed so as to minimise impacts on vessels within the DWR. The worst case assumes that the buoyed construction area will be in place for the entire construction period (up to four years).

92. As is standard for construction within UK waters, the buoyed construction area would allow vessels access through areas currently not being installed (which would be marked by 500m safety zones), allowing greater freedom through the OWF sites. Experience at other UK wind farms shows that generally commercial vessels will avoid the buoyed construction area but that smaller vessels such as recreational and fishing vessels will enter but stay clear of ongoing activities.

93. Ongoing activities would be promulgated through Notice to Mariners, KIS-ORCA and other standard methods of communication to ensure that vessel Masters are able to effectively passage plan to minimise deviations and avoid current areas of activity. Given the flexible access to the OWF sites throughout construction, main route deviations are only considered within the impacts for the operation and maintenance phase (see section 15.7.5.1).

94. It is noted that installation of the array and interconnector cables may also temporarily displace traffic during installation, however given the minimum safe passing distances (around Restricted in Ability to Manoeuvre (RAM) vessel(s) used

for installation) will be small, likely 1,000m or less the fact that the location of installation vessel(s) will regularly change and that COLREGS (IMO, 1972) effectively manages manoeuvres there are not expected to be any identifiable impacts.

95. Noting that the main purpose of the NRA is to assess navigational safety risk not commercial impacts, the severity of consequence is considered to be **minor** for the OWF sites given that any displacement or deviations during construction will not adversely increase navigational safety risk to vessels operating on the deviated routes. This is due to there being negligible risk to persons or the environment, but the potential for some business impacts associated with safety, i.e. increased bridge manning.

96. The frequency of the effect is considered to be reasonably probable and is based on the possibility that a deviation will occur but that there will be only a minor measurable consequence to users. The impact has therefore been classed as **tolerable**, noting that promulgation of information would enable the vessel Masters to effectively passage plan to minimise disruption. This impact is considered not significant under EIA terms with embedded mitigation in place.

15.7.4.1.2 Recreational vessels

97. Recreational vessel (classed as 2.5 to 24m length) movements were very low during the marine traffic surveys and there are no RYA cruising routes passing through the OWF sites. Given the low number of vessels, consultation responses indicating no concerns over the project, the continued ability to transit through the buoyed construction area and embedded mitigation of promulgation of information, the displacement of recreational vessels from the proposed project has no perceptible effects and is not significant in EIA terms (**no impact**).

15.7.4.1.3 Fishing vessels in transit

98. Throughout the survey periods there was an average of eight (Norfolk Vanguard East) and three (Norfolk Vanguard West) unique fishing vessels recorded per day passing with the OWF study areas. The majority of vessels were non- UK beam trawlers.

99. Chapter 14 Commercial Fisheries considers commercial fishing displacement. From a navigational safety perspective, fishing vessels would be able to transit through the buoyed construction area during construction using the embedded mitigation of promulgation of information (noting areas of current construction activity). Given the smaller size of fishing vessels navigating within the area and their ability to navigate through the buoyed construction area, the frequency of deviations and re-routeing (of vessels in transit) is expected to be lower than that of commercial vessels.

100. The severity of consequence from the OWF sites is considered to be negligible and the frequency of effect is considered to be remote. The impact has therefore been classed as **broadly acceptable** for navigational safety during transit which is not significant under EIA terms.

15.7.4.2 Effects on vessel routeing and / or displacement – Offshore cable corridor

15.7.4.2.1 Commercial vessels, recreational vessels and fishing vessels in transit

101. Given that the offshore cable corridor will create a negligible deviation during installation (an anticipated safe passing distance around RAM installation vessel(s)), any impact on vessels is not considered to have a perceptible effect with regards to navigational safety (**no impact**).

15.7.4.3 Increased vessel to vessel collision risk – OWF sites, including interconnector and array cables

102. The physical presence of pre commissioned structures and associated works could result in the displacement of vessels and activities within the OWF sites study area and offshore cable corridor study area and therefore increased encounters and vessel to vessel collision risk.

15.7.4.3.1 Commercial vessels

103. For the construction phase this impact can be separated into three impacts, increased encounters and collision risk between a third party vessel and a Norfolk Vanguard construction vessel, increased encounters and collision risk between third party vessels, and increased encounters and collision risk in adverse weather.

104. A two phased construction period (with a construction window of approximately four years) has been identified as the worst case as it is assumed that the buoyed construction area would be deployed to the fullest extent over the largest area regardless of phasing.

Increased encounters and vessel to vessel collision risk between third party vessels and construction vessels

105. The increased level of vessel activity required for the project may lead to an increase in encounters and therefore vessel to vessel collision risk due to displacement of third party vessels and increased encounters with construction vessels. During the construction phase it is estimated that up to 57 vessels[3] could be used to construct the worst case scenario of 200 wind turbines, including foundation installation, cable installation and wind turbine installation vessels, most of which would remain within the construction area for extended periods and therefore reduce the potential for interaction with third party vessels. In total there are estimated to be 1,180 vessel

[3] Indicative number of 57 vessels on site at any one time

movements during the construction phase with approximately 100 crew transfer vessel (CTV) movements likely to be operating out of Great Yarmouth or Lowestoft. All construction vessel movements will be managed by a Marine Coordinator who will ensure that construction traffic does not interact with third party vessels.

106. Embedded mitigation would be in place to manage increased traffic levels and encounters between construction and third party vessels. These are likely to include:

- Buoyed construction area clearly identifying the overall area of construction;
- 500m safety zones around installations attended by a vessel;
- MGN 372 (MCA, 2008) which provides advice to mariners navigating within proximity to a wind farm;
- Marine traffic coordination; and
- Promulgation of information noting the current area of construction.

107. When considering experience at other constructing wind farms it is identified that third party vessels do consider Notice to Mariners during passage planning and avoid current areas of construction. There has not been any recorded incident within the buoyed construction area of a UK wind farm whereby a third party vessel has collided with a construction vessel. It is also likely in reality that vessels will pass clear of the edge of the buoyed construction area, meaning that, given the sea room, the number of hot spots where vessels would be likely to meet would be reduced, thus lowering the risk of encounter.

Increased encounters and collision risk between third party vessels

108. As noted in section 15.7.4.1, there is expected to be some level of displacement associated with the construction of the project. The majority of denser routes would not be deviated and those routes which would require deviation are transited by at most one vessel per day. Therefore, when considered against the low number of deviated vessels, the embedded mitigation in place and the fact that the DWR width and operation is not impacted, there are not expected to be any notable hot spots of encounters or collision created during the construction phase. Embedded mitigation includes:

- Compliance with Flag State regulations including International Maritime Organization (IMO) Conventions including COLREGs (IMO, 1972) and the Safety of Life at Sea (SOLAS) (IMO, 1974);
- MGN 372 (MCA, 2008); and
- Promulgation of Information.

Increased encounters and collision risk in adverse weather

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

110. The probability of occurrence in a particular sea state may differ for each vessel. Adverse weather is considered most significant for passenger vessels, due to the potential health and safety risks (as well as the effect on passenger comfort) to people on board (such as sea sickness and difficulty moving around the vessel). This can also have implications for regular timetabled vessels, due to increases in journey time and potential cancellations. Mitigations for vessels include adjusting their heading to position themselves 45° to the wind, altering or delaying sailing times, reducing speed and potentially cancelling journeys. Due to the distance from shore and the feedback received as part of the hazard log it is likely that most adverse weather routes would track close to the UK before crossing the southern North Sea at the shortest or most protected point. Any vessel navigating within adverse weather within the DWR would have to consider the presence of the OWF sites construction areas within their passage plan; however, there is ample sea room to navigate and a Marine Coordinator will ensure that project vessels do not enter the DWR or restrict the movement of third party vessels in adverse weather (outside of the buoyed construction area).

111. The project would be marked and lit in accordance with requirements defined by TH and this will include fog horns to alert vessels to the position of structures when visibility is poor. Vessels are also required to take appropriate measures with regards to safe speed under the COLREGS (IMO, 1972 plus amendments), which considers determining a safe speed in conjunction with the state of visibility, the wind, sea and current as well as the proximity of navigational hazards. The project would also have additional resources on site that may be used under SOLAS obligations to assist third party vessels in difficulty in adverse weather.

112. The severity of consequence from the OWF sites is considered to be minor, noting that the most likely consequences are increased encounters rather than collision. The frequency of effect is therefore considered to be reasonably probable. The

impact is therefore expected to be **tolerable** noting the mitigation of managing construction traffic. This impact is therefore not significant under EIA terms.

15.7.4.3.2 Recreational vessels

113. Based on the marine traffic surveys, a recreational vessel was on average recorded within the OWF sites study area once every two days during the summer surveys. Only one recreational vessel was recorded throughout the winter surveys. Therefore, recreational activity was considered to be very low within the OWF sites.

Encounters and vessel to vessel collision risk between third party vessels and construction vessels

114. As with consideration of commercial vessels there would be some risk for recreational craft associated with construction vessels transiting in the area. However, given the very low levels of recreational traffic and embedded mitigation (including guard vessels and marine traffic coordination) there are not expected to be any perceptible effects.

Increased encounters and collision risk between third party vessels

115. During construction, it is anticipated that the presence of the buoyed construction area (containing the active construction work and safety zones) will displace the existing recreational activity from within the OWF sites; however, experience at other UK wind farm developments shows that recreational vessels will transit within buoyed construction areas where no current activity is occurring, meaning that recreational vessels would stay out with areas used by construction vessels.

116. For the OWF sites, there are not expected to be any effects associated with recreational craft encountering or colliding with construction or other third party vessels and therefore this impact is considered not significant under EIA terms (**no impact**).

15.7.4.3.3 Fishing vessels in transit

117. Moderate levels of fishing activity were recorded within the OWF sites study area during the marine traffic surveys. The marine traffic surveys identified an average of 11 unique fishing vessels per day throughout the survey periods. The majority of vessels were recorded within Norfolk Vanguard East. As with impacts associated with displacement it is considered likely that the construction activities will displace any existing fishing activity during the construction phase; however, as the NRA is considered with fishing vessels transiting there are not expected to be any perceptible effects associated with the construction of the OWF sites (**no impact**).

118. The installation of the offshore export cables would cause temporary displacement to existing fishing vessels transiting; however, as this work will be limited to a small

geographical area moving along the offshore export cable route, the impact from the installation itself would be minor. It should be noted that the installed cable may have a permanent displacement impact upon active fishing, as fishing vessels could choose to avoid the risk of a gear snagging. This is considered in more detail within Chapter 14 Commercial Fisheries.

15.7.4.4 Increased vessel to vessel collision risk – Offshore cable corridor

15.7.4.4.1 Commercial vessels

119. The vessels associated with laying the offshore export cables would cause some displacement to existing routes and activities; however, this impact would be temporary and limited to a small geographical area surrounding the installation activity.

120. Given embedded mitigation including minimum safe passing distances and COLREGS (IMO 1972) plus amendments), the severity of consequence from the offshore cable corridor is considered to be minor, and the frequency of effect is considered to be remote. The impact is therefore expected to be **broadly acceptable** which is again not significant under EIA terms**.**

15.7.4.4.2 Recreational vessels and fishing vessels in transit

121. There are no perceptible impacts associated with the construction of the offshore export cable for recreational vessels and fishing vessels in transit (**no impact**).

15.7.4.5 Increased vessel to structure allision risk - OWF Sites, including interconnector and array cables

122. The physical presence of pre- commissioned structures would create a vessel to structure allision risk for a vessel navigating within the OWF sites and offshore cable corridor.

15.7.4.5.1 Commercial vessels

123. During the construction phase, the presence of partially constructed structures, or structures that have been completed but not yet commissioned, creates an allision risk to passing commercial traffic. It is noted that during the construction phase, the final lighting and marking of the structures may not yet have been implemented.

124. It is assumed that through effective promulgation of information, passing commercial vessels would be aware of the ongoing construction, and would passage plan in advance to avoid the OWF sites. The temporary lighting and marking in place during construction would also provide an indication to passing vessels of the allision hazard, and furthermore guard vessels would be deployed where required to protect sensitive areas of construction. It is considered extremely unlikely that a commercial vessel would deliberately enter the buoyed construction area and approach ongoing

construction operations, and any allision scenario is likely to be due to human error or machinery failure.

125. Experience in wind farm construction for developers, their contractors and the vessel operators is now extensive, with a number of operational wind farms having been constructed within dense shipping and development areas. Consequently, standard mitigation measures, as outlined in embedded mitigation section 15.7.1, are tried and tested within the industry.

126. Phased project layouts are not available at this stage but any layout would be agreed in advance with the MMO (in conjunction with the MCA and TH) as per the DCO requirements (Condition 14 of Schedules 9 and 10 Condition 9 of Schedules 11 and 12).

127. The severity of consequence from the OWF sites is considered to be minor given the embedded mitigation in place, and the frequency of effect considered to be extremely unlikely. The impact has therefore been classed as **broadly acceptable** which is not significant under EIA terms**.**

15.7.4.5.2 Recreational vessels

128. It is expected that the majority of recreational activity would avoid the buoyed construction area altogether and promulgation of information would ensure recreational users are well informed of the site. Embedded mitigation would ensure that recreational users are aware of ongoing construction activities (including current safety zones) although some recreational craft could still enter the buoyed construction area, including accidentally. If a recreational vessel were to enter into the buoyed construction area, a guard vessel (or other vessels on site) would inform the vessel of the ongoing works.

129. The impact on recreational vessel transits throughout the construction period would not differ greatly regardless of the construction approach adopted and has been assessed as such throughout this subsection. The severity of consequence from the OWF sites is considered to be minor given the low energy and low speed of any allision incident, and the frequency of effect is considered to be negligible. Following consideration of embedded mitigation, the risk is expected to be **broadly acceptable** and is not significant under EIA terms.

15.7.4.5.3 Fishing vessels in transit

130. It is considered unlikely that vessels would engage in fishing activity within the buoyed construction area near areas of ongoing activity or installed structures during the construction phase. As with recreational craft, the promulgation of information would ensure that fishermen are well informed of the site. There will also be guard

vessels on site in the case that a fishing vessel did enter the buoyed construction area. Any allision scenario involving a fishing vessel is therefore likely to be due to machinery failure, adverse weather or human error.

131. Consequently, this impact should be mitigated with proactive promulgation of information as well as ongoing consultation with the fishing community. The safety zones and guard vessels would also ensure that fishing vessels are safely displaced from areas that may present a risk to them. Therefore, the severity of consequence from the OWF sites is considered to be moderate, and the frequency of effect is considered to be extremely unlikely, due to embedded mitigation measures. The impact has therefore been classed as **broadly acceptable** which is not significant under EIA terms.

15.7.4.6 Increased vessel to structure allision risk – Offshore cable corridor

15.7.4.6.1 Commercial vessels, recreational vessels and fishing vessels in transit

132. There is no allision risk associated with the offshore export cables during the construction phase for commercial vessels, recreational vessels or fishing vessels in transit; there are no surface structures within the offshore cable corridor (**no impact**).

15.7.4.7 Anchor interaction and snagging risk – OWF Sites, including interconnector and array cables

133. The presence of pre-commissioned structures with mooring lines or cables could create an increased snagging risk for vessels navigating within the OWF sites study area and offshore cable corridor study area.

15.7.4.7.1 Commercial vessels

134. With the exception of the tanker manoeuvre described in section 16.10 of Appendix 15.1, no vessels transmitted a navigational status of “At Anchor” within the OWF sites (excluding cases where vessels transmitted such a status, but a visual check of the vessel’s movements indicated that the vessel was unlikely to be at anchor at the time). Additionally, a speed analysis was undertaken to identify any vessels transmitting a status other than “At Anchor” but exhibiting behaviour suggesting they were anchored at the time. No such vessels were identified. Therefore, it is assumed that anchoring within the OWF sites is low to negligible.

135. It is considered extremely unlikely that a commercial vessel would deliberately anchor within the buoyed construction area during the construction phase, and any anchor interaction is therefore anticipated to be from a vessel dragging anchor from outside the buoyed construction area, or a vessel anchoring in an emergency (e.g. a

vessel anchoring to avoid drifting into a structure). It is noted that such scenarios are also considered unlikely.

136. During the construction phase installation vessels would be compliant with COLREGS (IMO, 1972) and display RAM status; they would also ask for minimum safe passing distance to ensure that any third party vessels do not come into close proximity with construction activities. The cable would be buried and / or protected where it is installed. When this has not yet been carried out and there is a risk to navigational safety, additional temporary mitigation such as buoyage may be deployed. However, given the route of the offshore cable corridor and the levels of anchoring, the frequency of any potential interaction is considered to be very low.

137. Given the mitigations in place during the construction phase including Marine Coordination, promulgation of information and safety zones that will prevent vessels approaching areas not fully installed, the severity of consequence from the OWF sites is considered to be minor and the frequency of effect is considered to be remote. The impact has therefore been classed as **broadly acceptable** which is not significant under EIA terms.

15.7.4.7.2 Recreational vessels

138. Recreational vessels (and their anchors) are typically much smaller than commercial vessels. Interaction with subsea cables or mooring lines could therefore have more serious implications for a recreational vessel, with the worst case being a snagging leading to a capsize, following loss of stability. The crew of a recreational vessel may also lack the marine experience of that of a commercial vessel, and are therefore more likely to enter into the buoyed construction area, either deliberately or accidently. However, the majority of the sea area within the OWF sites is of a depth greater than 30m and so small recreational vessels are considered unlikely to attempt to anchor in such depths.

139. It is noted that although the marine traffic survey for the OWF sites did include AIS and Radar data, the marine traffic survey for the offshore cable corridor included only AIS data, and this may have resulted in recreational vessel anchoring not being recorded. However, given the exposed nature of the coastline and the fact that there are no charted or designated anchorages, it is unlikely that there would be a significant number of recreational vessels anchoring.

140. The severity of consequence from the OWF sites is considered to be negligible given the size of recreational vessels and their anchors and the frequency of effect is considered to be negligible given the very low frequency of anchoring. The impact has therefore been classed as **broadly acceptable** which is not significant under EIA terms**.**

15.7.4.7.3 Fishing vessels in transit

141. In addition to potential for anchor snagging, fishing vessels may also snag their gear on the cables or mooring lines; this is considered separately within Chapter 14 Commercial Fisheries.

142. As with recreational vessels, fishing vessels are typically small when compared to commercial vessels but are likely to have larger anchors than recreational vessels; therefore, the severity of consequence from the OWF sites is considered to be minor and the frequency of effect is considered to be remote given the water depths. The impact has therefore been classed as **broadly acceptable** which is not significant under EIA terms**.**

15.7.4.8 Anchor interaction and snagging risk – Offshore cable corridor

15.7.4.8.1 Commercial vessels

143. For the offshore cable corridor study area, two vessels were recorded anchoring, with one of these located within the offshore cable corridor.

144. The severity of consequence from the offshore cable corridor is considered to be minor (given the assessment in section 15.7.4.7) and the frequency of effect is considered to be remote. The impact has therefore been classed as **broadly acceptable** and not significant under EIA terms**.**

15.7.4.8.2 Recreational vessels and fishing vessels in transit

145. For recreational vessels, the severity of consequence from the offshore cable corridor is considered to be negligible and the frequency of effect is considered to be extremely unlikely given that recreational vessels are more likely to anchor near shore either to shelter from adverse weather or to make emergency repairs. This impact has therefore been classed as **broadly acceptable** which is not significant under EIA terms**.**

146. For fishing vessels, the severity of consequence for the offshore cable corridor is considered to be minor and the frequency of effect is considered to be remote given that fishing vessels are more likely to transit in adverse weather and anchor near shore. The impact has therefore been classed as **broadly acceptable** which is not significant under EIA terms**.**

15.7.4.9 Diminishing emergency response resources – OWF sites, including interconnector and array cables

15.7.4.9.1 All sea users

147. The construction of the project, including the increased presence of vessels and people within the offshore study area may impact upon the ability of emergency

responders to respond to incidents. The total number of vessel movements for two construction phases is predicted to be 1,180 or on average one to two vessels per day. The construction period could last up to four years.

148. Under national and international law, the operators of Norfolk Vanguard would be required to comply with existing emergency response requirements, as detailed in the NRA, as well as give consideration to other response groups within the area. Owing to the increased level of activity in and around the proposed project there would be expected to be some increased demands on SAR facilities within the area. The project could also increase traffic and activity to a level such that self-help emergency response would be required and consideration in the ERCoP would be given to what resources would be required to provide a level of response that would ensure that response time and resources are not impacted.

149. Embedded mitigation includes compliance with MGN 543 and the development of an ERCoP. Norfolk Vanguard would comply with the requirements of MGN 543 including Annex 4 'Safety and mitigation measures recommended to OREIs during construction, operation and decommissioning' and Annex 5 'Search and Rescue and emergency response matters'.

150. An ERCoP should include the following but may also consider site specific parameters:

- Facilitation of SAR responders (helicopters);
- Place of safe refuge;
- Remote monitoring and control; and
- Marking and lighting.

151. Those sectors of emergency response in which Norfolk Vanguard considers it could directly cooperate and contribute (as well self-help capability) include:

- SAR as defined by the SAR convention of 1979 and subsequent amendments;
- The rendering of assistance to vessels in distress as detailed in the SOLAS (IMO, 1974) and in subsequent amendments;
- First response as described in the salvage convention of 1989; and
- First response in respect of the National Contingency Plan for Marine Pollution for shipping and offshore installations (currently being updated by the MCA).

152. Due to the increased level of personnel and vessels on site during the construction phase there would be an increased risk of an incident occurring, thus diminishing the overall ability of the current level of emergency response facilities, including pollution response.

153. Potential residual impacts identified following consideration of embedded mitigation include reduced emergency response capability / oil spill response owing to the presence of the project.

154. For emergency response, Norfolk Vanguard Limited would undertake a gap analysis to identify which resources may be required. This could include the establishment of a self-help capability as part of its ERCoP and Safety Management Systems. It is possible that Norfolk Vanguard would also generally increase facilities in the area for all third party users; however, during construction the increased number of personnel and vessels (associated with the project) would decrease the capacity of SAR current resources but increase on site resources within an area that was previously void.

155. Given the increased number of vessels on site and the potential for moderate damage to vessels, including multiple or single serious injuries and Tier 2[4] pollution incidents which require assistance, the severity of consequence from the OWF sites is considered to be moderate. However, the frequency of this level of incident is considered to be remote (based on predicted vessel and personnel numbers). The impact will therefore be expected to be **tolerable**, noting the mitigation of the increase in self-help capabilities and other resources to assist third parties on site. This is not considered significant under EIA terms.

15.7.4.10 Diminishing emergency response resources – Offshore cable corridor

15.7.4.10.1 All users

156. There are not expected to be any perceptible impacts associated with the offshore cable corridor given the low level of personnel and vessels working on the installation (**no impact**).

15.7.5 Potential Impacts during Operation and Maintenance Phase

15.7.5.1 Effects on vessel routeing and displacement – OWF sites, including interconnector and array cables

157. The physical presence of the OWF sites could result in effects on vessel routeing and displacement of activities within the OWF sites study area.

158. It is noted that given the distance from aggregate sites and the distance that the OWF sites are located from the coastline and therefore ports, no effects were identified on marine aggregates dredgers and they were therefore screened out of the assessment in the NRA (Appendix 15.1).

[4] A Tier 2 spill is larger than a Tier 1 spill, but is still one that occurs in the area of the producing company's facilities. Tier 2 spills usually require the aid of other companies and resources, including the government.

15.7.5.1.1 Commercial vessels

159. The worst case scenario for the project assumes that all 200 turbines, two offshore electrical platforms, two offshore accommodation platforms, Met Masts and two LiDARs will be deployed across both OWF sites, causing the maximum area of displacement.

160. Following principles set out in MGN 543 (MCA, 2015), 24 main routes were identified transiting within the OWF sites study area. Given the location of the OWF sites between the DR1 Lightbuoy and West Friesland DWRs, the majority of vessels on these routes will not be impacted by the operation of the project. The busiest route (17 vessels per day) is located to the east of both sites (Off Brown Ridge TSS / Rotterdam) and does not require any deviation due to the project.

161. Of the 24 main routes identified, 12 will require a deviation if the project is built to its fullest extent. Of the 12 routes requiring deviation all are operated by no more than one vessel per day.

162. Only one route requires a deviation of greater than 5% of its total journey length. The Great Yarmouth–Victor Field route would require a worst case deviation of between 11.5% and 13.8% of the total journey length; however, this route is only operated on average by one vessel every two days.

163. Six routes have deviations of greater than 1% but less than 5% of the total journey length. Again, these are worst case deviations with the greatest being 3.3% for the Great Yarmouth–Hamburg route, used by one vessel every three days.

164. As a standard approach required by consultees these worst case deviations assume that the vessel deviates and returns to its historical route as soon as possible. In reality vessels could take more realistic routeing options, with less severe course alterations, that would significantly decrease the overall deviation.

165. Norfolk Vanguard, as with other UK projects, would be open to vessels wishing to enter; however, consultation feedback with commercial operators indicates that it is highly unlikely that commercial vessels will navigate through the array. There are factors that would influence a mariner's decision (including recreational sailors) to navigate through, around or avoid a wind farm and the choice is influenced by a number of factors including the vessel's characteristics, the weather and the sea conditions; however MGN 372 (MCA, 2008) concluded that "Although offshore renewable energy installations present new challenges to safe navigation around the UK coast, proper voyage planning, taking into account all relevant information, should ensure a safe passage and the safety of life and the vessel should not be compromised."

166. The increase in route distances for vessels displaced by the project would be minimised by embedded mitigation including promulgation of information (such as notice to mariners) and charting which would enable vessels to effectively passage plan in advance of encountering the OWF sites.

167. The severity of consequence from the OWF sites is considered to be minor as there are no notable navigational safety impacts expected and the frequency of effect is considered to be reasonably probable given that this effect would happen on a regular basis. The impact has therefore been classed as **tolerable** which is not significant under EIA terms**.**

15.7.5.1.2 Recreational vessels

168. Based on the latest RYA Cruising Routes (2016), there are no cruising routes, general sailing areas, or racing areas within the OWF sites. The offshore cable corridor does intersect with general sailing areas near shore and four medium use cruising routes cross the offshore cable corridor (two of which do so within 2.5nm of the coastline).

169. The minimum spacing between turbines is 680m and at least one line of orientation will be maintained which should allow (based on consultation feedback) adequate sea room for recreational craft to navigate through the OWF sites. Recreational users are likely to take due consideration for the weather conditions and passage plan accordingly to ensure safe transits. It is assumed that in adverse weather and winter periods limited recreational activity would be present within the OWF sites.

170. As with the construction phase, given the very low numbers of recreational vessels, consultation responses indicating no concerns over the proposed project and the embedded mitigation (promulgation of information), displacement of recreational vessels from the proposed project has no perceptible effects and is not significant under EIA terms (**no impact**).

15.7.5.1.3 Fishing vessels in transit

171. As with the equivalent construction impact, Chapter 14 Commercial Fisheries considers commercial displacement. From a navigational safety perspective, fishing vessels would be able to transit through the OWF sites as noted in paragraph 99.

172. Given the size of fishing vessels (on average 42m length) navigating within the area, the ability to transit through the OFW sites is expected to be higher than that of commercial vessels and hence the consequences lower (given that fishing vessels are smaller and more manoeuvrable; with impacts resulting in lower levels of damage). As with the impact on recreational vessels, minimum spacing between turbines is 680m which should allow adequate sea room for fishing vessels to navigate through

the OWF sites, again noting that a minimum of one line of orientation would be maintained.

173. The severity of consequence from the OWF sites is considered to be negligible and the frequency of effect is considered to be remote. The impact has therefore been classed as **broadly acceptable** for navigational safety during transit which is not significant under EIA terms.

15.7.5.2 Effects on vessel routeing and displacement – Offshore cable corridor

15.7.5.2.1 Commercial vessels, recreational vessels and fishing vessels in transit

174. Given that the offshore export cables would be buried and / or protected, there is no displacement and therefore no impact identified. This assumes that any under keel clearance issues which could cause a deviation are assessed as part of the Cable Burial Risk Assessment that would be undertaken post consent (embedded mitigation) (**no impact**).

15.7.5.3 Increased vessel to vessel collision risk – OWF sites, including interconnector cables and array cables

175. The physical presence of the project could result in the displacement of vessels and activities within the OWF sites study area and offshore cable corridor study area and therefore increase encounters and vessel to vessel collision risk.

15.7.5.3.1 Commercial vessels

176. As part of the assessment of vessel to vessel collision risk within the NRA, the following scenarios have been considered:

- Base case without wind farm (i.e., based on the current non- deviated routes);
- Future case with wind farm (assuming 0% traffic growth);
- Future case with wind farm (assuming 10% traffic growth); and
- Future case with wind farm (assuming 20% traffic growth).

177. The case of a 20% increase in traffic was requested by the CoS, and has therefore included in the modelling of vessel to vessel collision risk within the NRA. This chapter references the 10% results given that this is the standard increase assumed within North Sea NRAs.

Increased encounters and collision risk between third party vessels

178. The baseline assessment showed that the most significant commercial traffic routes in the vicinity of the OWF sites utilised the IMO Routeing Measures (DWRs) passing between or to the east of the OWF sites. While any impact from the OWF sites to the mean position of these routes is likely to be negligible, there is the potential for the

number of vessels using the routes to increase if vessels on other established routes outside of the DWRs deviate into them as a result of the proposed project. Further assessment on traffic levels within the DWRs is considered in section 18 of the Appendix 15.1.

179. The baseline assessment also identified a number of routes intersecting the locations of the proposed OWF sites. As stated above, it is likely that some of this traffic would re-route into the DWRs, but a proportion could opt to cross the DWRs either north or south of the OWF sites.

180. The majority of encounters between vessels (defined as at least two vessels positioned within close proximity to each other – further information is provided in Appendix 15.1) identified within the OWF sites study area in the marine traffic survey occurred within the DR1 Lightbuoy and West Friesland DWRs, along the Immingham–Rotterdam commercial ferry route located to the south-west of the OWF sites, and at the Leman Field located to the north-west of the OWF sites. By comparison there were relatively few encounters within the OWF sites, although there was a number of fishing vessel encounters within Norfolk Vanguard East. The majority of vessels involved in encounters were observed to be commercial vessels, with 58% of involved vessels being either cargo vessels or tankers. The majority of encounters recorded within the OWF sites were fishing vessels actively engaged in fishing activities and encountering transiting vessels.

181. The change in potential vessel to vessel collision frequency due to the construction of the project, based upon a 10% growth in traffic, was estimated to be 1.52×10^{-2} per year[5]. This represents a 22% increase from the pre- wind farm collision risk for the area considered, with a high proportion of this increase occurring within the DR1 Lightbuoy DWR. Larger increases in the collision frequency were also observed in the dense routes that already exist around the periphery of the OWF sites. However, as Table 22.1 of the NRA shows, this increase is largely associated with increases in vessel numbers in the conservative future case assessments (10% and 20%) rather than the deviated routes. It is noted that the vessel to vessel collision risk within the West Friesland DWR (to the east of Norfolk Vanguard East) was largely unaffected by the deviated routes.

182. With consideration for the deviations and encounters between vessels, increases in collision risk are expected to be minor overall given the lower densities of traffic on the deviated routes (meaning those routes do not significantly increase vessel to vessel collision risk), embedded mitigation and good seamanship such as continuous

[5] Collision modelling is based on full development (maximum displacement) of the OWF sites and is therefore not influenced by the number of wind turbines.

compliance with COLREGs (IMO, 1972). Compliance with COLREGS includes the conduct of vessels in restricted visibility, following safe speed principles and compliance with the "give way" rules.

IMO routeing measures (DWR) and agreed buffers

183. Following consultation undertaken with regulators as part of the former East Anglia Zone it was agreed that a 1nm clearance from the edge of the DR1 DWR and 2nm from the West Friesland DWR would allow sufficient room for safe navigation (given the varying traffic levels and types). Therefore, in order to maintain uniformity of future sites, including Norfolk Vanguard, this 1nm buffer from the DR1 DWR agreed as part of the original former East Anglia Zone consultation has been maintained, noting stakeholder preference (notably the MCA and TH) to ensure that wind farm boundaries align consistently to existing shipping routes.

184. Potential constraints on navigation must be considered when defining transit corridors. Notably these include the constraints associated with weather, sea and tidal conditions that may be expected at the location and mean that it will not always be possible for a vessel to make good a planned course. The MCA (2016) note "that experience shows that in heavy sea conditions it is much harder to turn the vessel around and it may not be possible to achieve a dead stop. Deviations from the planned course by as much as 20° or more are common and must be considered in developing corridors". For Norfolk Vanguard, the OWF sites form a corridor (considered as wind turbines directly opposite either side of a route) of 2.9nm length and 6.8nm width which satisfactorily meets the requirements of MGN 543 (MCA, 2016).

185. The buffers and distances between sites should also prevent crossing encounters or collisions associated with east to west traffic and the DWRs by allowing sufficient sea room for vessels to visually and electronically acquire targets before crossing the DWR.

186. It is considered unlikely that larger commercial vessels would transit through the OWF sites, given the size and manoeuvrability of vessels. Most regular operators should be familiar with the proposed project by the start of the operation and maintenance phase, and the OWF sites will be marked on nautical charts, thus ensuring that vessels have the information to deviate as necessary and allow full flexibility to avoid encounters and therefore minimise collision risk.

Encounters and collision risk between third party vessels and operation and maintenance vessels

187. It is noted that vessels associated with the project during the operation and maintenance phase would number around one to two vessels per day and up to 460

per year. These vessels are likely to operate from Great Yarmouth or Lowestoft and can be effectively managed by Marine Coordination to ensure that they avoid entering denser areas of shipping or the DWRs and contributing to increased encounters and collision risk.

Adverse weather

188. As with the construction phase, due to the distance from shore and the feedback received as part of the hazard log it is likely that most adverse weather routes would track close to the UK before crossing the southern North Sea at the shortest or most protected point. Any vessel navigating within adverse weather within the DWR will have ample sea room to manoeuvre as required, based on guidance within MGN 543 (MCA, 2016), MGN 372 (MCA, 2008) and COLREGs (IMO, 1972).

189. Given the low level of potential damage caused by a vessel to vessel collision, the severity of consequence from the OWF sites is considered to be minor. With mitigation in place (such as lighting, marking and charting) alongside experience that is developed about the proposed project by mariners and general good seamanship the frequency of effect is considered to be remote. The impact has therefore been classed as **broadly acceptable** which is not significant under EIA terms.

15.7.5.3.2 Recreational vessels

190. The wind turbine spacing within the OWF sites (minimum of 680m) provides ample spacing for smaller recreational vessels to safely transit through the OWF sites during the operation and maintenance phase should they choose to. A minimum of one line of orientation would also be maintained which is preferred by recreational consultees. Despite the very low level of recreational activity there may be a small increase in encounters with other vessels; however, given adherence to COLREGs (IMO, 1972) (in particular in relation to crossing the DWR) and good seamanship, there are not expected to be any perceptible effects associated with recreational vessels with regards to collision risk and therefore this impact is considered not significant under EIA terms (**no impact**).

15.7.5.3.3 Fishing vessels in transit

191. As with recreational vessels, fishing vessels may still choose to transit through the OWF sites based on the wind turbine spacing (minimum spacing of 680m); however, it is noted that certain foundation types will have an impact on levels of active fishing due to the snagging risk associated with mooring lines. This is considered further within Chapter 14 Commercial Fisheries.

192. As the NRA considers fishing vessels in transit only, there are not expected to be any perceptible effects associated with the development of the OWF sites (**no impact**). Impacts on Commercial Fisheries are considered further in Chapter 14.

15.7.5.4 Increased vessel to vessel collision risk – Offshore cable corridor

15.7.5.4.1 Commercial vessels

193. Given that the offshore export cables will be buried, there is no associated displacement and therefore no collision risk impact identified (**no impact**). This assumes that any under keel clearance issues are assessed as part of the Cable Burial Risk Assessment (embedded mitigation) that will be undertaken post consent.

15.7.5.4.2 Recreational vessels and fishing vessels in transit

194. As with commercial vessels, given that the offshore export cables will be buried, there is no associated displacement and therefore no collision risk impact identified (**no impact**). This assumes that any under keel clearance issues are assessed as part of the Cable Burial Risk Assessment that will be undertaken post consent.

15.7.5.5 Increased vessel to structure allision risk – OWF sites, including interconnector cables and array cables

195. The physical presence of structures would create a vessel to structure allision risk for a vessel navigating within the OWF sites and offshore cable corridor.

15.7.5.5.1 Commercial vessels

196. During the operation and maintenance phase, the structures within the OWF sites would create an allision risk to passing commercial traffic, either from a vessel transiting under power, or a Not Under Command (NUC) vessel. It is not considered likely that commercial vessels would choose to transit through the OWF sites (based on consultation feedback) and therefore any allision risk is expected to be (in the majority) from a commercial vessel intending to use the IMO Routeing Measures, or intending to pass to the north or south of the OWF sites.

197. Modelling was undertaken for both vessel allision risk under way and allision risk associated with vessels NUC. The full results can be found in section 21 of Appendix 15.1.

198. Based on modelling of the revised routeing following the complete installation and commissioning of the project, and assuming a 10% growth in traffic, the frequency of a passing powered commercial vessel allision is estimated to be 3.86 x 10^{-4} per year, corresponding to a return period of 2,590 years[6]. The allision return period is lower than the historical average of 5.3 x 10^{-4} (one in 1,900 years) per installation year for offshore installations on the United Kingdom Continental Shelf (UKCS) (Health and Safety Executive (HSE), 2010). Other percentage increases have been demonstrated

[6] This result is worst case as it assumes a larger number of wind turbines overall than currently within the design envelope. Modelling results would either be equal to or less than these results.

within Appendix 15.1; however, the 10% has been detailed within this chapter to allow consistency with other projects.

199. Should a commercial vessel allide with a structure within the OWF sites, there is a very low potential for the vessel to founder, resulting in loss of life. Larger commercial vessels may also have the capacity to seriously damage the allided structure.

200. Evidence at other wind farm projects shows that vessels are able to navigate safely and effectively in close proximity to a wind farm. Embedded mitigations are well tested and include consideration for wind turbine array layout. Notably:

- The avoidance of extreme peripheral turbines;
- Regular shapes and edges to aid effective navigational marking; and
- A minimum of one line of orientation is preferred by recreational consultees, MCA and TH.

201. It is also noted that the increased minimum spacing in Round Three OWF projects (compared to Round One and Round Two projects) allows increased room to manoeuvre and thus navigational safety.

202. Compliance with COLREGS (IMO, 1972) will also ensure vessels navigate with consideration for the visibility, sea state and other factors that affect a vessel's ability to acquire a target (either visually or electronically) and take corrective action.

203. It is also noted that any layouts will need to be assessed post consent to ensure that are within ALARP parameters. Continued dialogue with the developers of East Anglia Three will ensure that mitigation is in place management alignment or proximity between the two sites.

204. The severity of consequence from the OWF sites is considered to be minor given the potential for minor damage to vessels, and the frequency is considered to be remote which is higher than the construction phase allision risk due to the removal of mitigations such as construction buoyage. This impact has therefore been classed as **broadly acceptable** and not significant under EIA terms.

15.7.5.5.2 Recreational vessels

205. There is the potential for a recreational vessel to allide with a structure within the OWF sites during the operation and maintenance phase. Unlike commercial vessels, recreational vessels may choose to transit through the OWF sites on a regular basis, and allision from a vessel intending to be within the OWF sites is therefore considered a possibility. It is not considered likely that a recreational vessel would

transit through the OWF sites at high speed and at this distance from shore, recreational users will tend to be better equipped and more experienced.

206. The air clearance between wind turbines rotors and sea level at MHWS would not be less than 22m, as per guidance, and this would minimise the risk of interaction between rotor blades and yacht masts.

207. Under keel allision, especially with tension leg floating platforms, should be considered to ensure that navigational safety is not impacted in relation to small craft that may approach the structures. The RYA request a minimum of 4m under keel clearance and the Norfolk Vanguard OWF sites are expected to achieve this.

208. Should a recreational vessel allide with a structure within the OWF sites, any damage to the structure is unlikely to be as severe as that from a larger commercial vessel. However, there is a greater potential for damage to a recreational vessel and a greater risk of capsize.

209. The severity of consequence from the OWF sites is considered to be moderate and the frequency of effect is considered to be extremely unlikely given the low level of recreational activity. The impact has therefore been classed as **broadly acceptable** and not significant under EIA terms.

15.7.5.5.3 Fishing vessels in transit

210. There is the potential for a fishing vessel to allide with a structure within the OWF sites during the operation and maintenance phase. As with recreational vessels, fishing vessels may choose to transit through the OWF sites during the operation and maintenance phase. There is also potential for an allision to occur whilst engaged in fishing activity and although gear snagging is considered in Commercial Fisheries Chapter 14, the NRA assessed only the impact of waterline allisions.

211. There is potential for fishing activity to be impacted by the OWF sites during the operation and maintenance phase. The worst case fishing vessel to structure allision risk is estimated to be 2.91×10^{-1}, corresponding to a return period of 3.4 years[7] (defined by the maximum number of installations and the maximum target area) However this estimation assumes that all vessels are in transit. In reality, any allision incident would be likely to occur whilst engaged in fishing activity (should a fishing vessel have its gear deployed it may have reduced mobility compared to a transiting vessel, and would therefore have less scope for initiating avoidance manoeuvres when on an allision course). Consequently, any allision incident would likely occur at slow speed and with low energy. It is also noted that during the operation and

[7] This result is worst case as it assumes a larger number of wind turbines overall than currently within the design envelope. Modelling results would either be equal to or less than these results.

maintenance phase vessels are likely to be more familiar with the layout (locations programmed into fish plotter etc.) and therefore the frequency of allision would be lower than during the construction phase.

212. As with recreational vessels there is the potential that fishing vessels may get close to turbines (whilst fishing) and any potential under keel allision risks would need to be effectively mitigated (i.e., through additional marking).

213. Allision consequences for fishing vessels are more similar to recreational vessels than for commercial vessels (i.e., increased potential for capsize); however, it should be noted that fishing vessels (average of 42m recorded within the vessel surveys) may be considerably larger than a typical recreational vessel.

214. The severity of consequence from the OWF sites is considered to be moderate given the potential for damage including from under keel allision, and the frequency of effect is considered to be remote given the level of fishing recorded within the marine traffic surveys. The impact has therefore been classed as **tolerable** noting that further mitigation (depending upon the foundation type selected) may be required to ensure risk remains ALARP and not significant under EIA terms**.**

15.7.5.6 Increased vessel to structure allision risk – Offshore cable corridor

15.7.5.6.1 Commercial vessels, recreational vessels and fishing vessels in transit

215. There is no allision risk associated with the offshore export cables during the operation and maintenance phase for commercial vessels, recreational vessels or fishing vessels in transit; there are no surface structures within the offshore cable corridor (**no impact**).

15.7.5.7 Anchor interaction and snagging risk – OWF sites, including interconnector cables and array cables

216. The physical presence of structures with mooring lines or cables could create an increased snagging risk for vessels navigating within the OWF site study area and offshore cable corridor study area.

15.7.5.7.1 Commercial vessels

217. As stated in the equivalent impact for the construction phase, with the exception of the tanker manoeuvre described in section 16.10 of Appendix 15.1, no vessels transmitted a navigation status of “At Anchor” within the OWF sites (excluding cases where vessels transmitted such a status, but a visual check of the vessel’s movements indicated that the vessel was unlikely to be at anchor at the time). Additionally, a speed analysis was undertaken to identify any vessels transmitting a status other than “At Anchor”, but exhibiting behaviour suggesting they were

anchored at the time. No such vessels were identified. Therefore, it is assumed that anchoring within the OWF sites is low to negligible.

218. Where possible the interconnector and array cables would be buried and where additional protection is required, an assessment will be carried out to understand the risks in relation to anchoring, emergency anchoring or under keel clearance.

219. The foundation mooring lines associated with the tensioned floating foundations may also create a minor snagging risk to the anchors of commercial vessels (given that they will extend to 11.5m beyond the foundation platform). All mooring lines would be subject to a third party validation.

220. The severity of consequence from the OWF sites is considered to be negligible, and the frequency of effect is considered to be extremely unlikely. The impact has therefore been classed as **broadly acceptable** which is not significant under EIA terms**.**

15.7.5.7.2 Recreational vessels

221. As stated in the equivalent impact for the construction phase, recreational vessels (and their anchors) are typically much smaller than commercial vessels. Interaction with subsea cables or mooring lines could therefore have more serious implications for a recreational vessel, with the worst case being a snagging leading to a capsize, following loss of stability. The crew of a recreational vessel may also lack the marine experience of that of a commercial vessel, and are therefore more likely to enter into the OWF sites, either deliberately or accidently. It is also noted that mitigation measures such as lighting and marking of structures and cable protection could be implemented if required. The majority of the sea area within the OWF sites is of a depth greater than 30m, and so small recreational vessels are considered unlikely to attempt to anchor in such depths.

222. The severity of consequence from the OWF sites is considered to be negligible given the size of recreational vessels and their anchors and the frequency is considered to be negligible given the very low frequency of anchoring. The impact has therefore been classed as **broadly acceptable** which is not significant under EIA terms**.**

15.7.5.7.3 Fishing vessels in transit

223. As stated in the equivalent impact for the construction phase, in addition to potential for anchor snagging, fishing vessels may also snag their gear on the cables or mooring lines; this is considered separately within Chapter 14 Commercial Fisheries.

224. As with recreational vessels, fishing vessels are typically small when compared to commercial vessels but are likely to have larger anchors than recreational vessels;

therefore the severity of consequence from the OWF sites is considered to be minor and the frequency of effect is considered to be extremely unlikely given the water depths and mitigations (such as cable burial, protection and charting) that would be deployed. The impact has therefore been classed as **broadly acceptable** which is not significant under EIA terms**.**

15.7.5.8 Anchor interaction and snagging risk – Offshore cable corridor

15.7.5.8.1 Commercial vessels and fishing vessels in transit

225. For the offshore cable corridor study area; two vessels were recorded anchoring, with one of these located within the offshore cable corridor. It is noted that the marine traffic survey for the offshore cable corridor included only AIS data, and this may have resulted in some fishing vessel anchoring not being recorded. However, given the exposed nature of the coastline and the fact that there are no charted or designated anchorages, it is unlikely that there would be a significant number of vessels anchoring.

226. Where possible the export cable would be buried and where protection is required, a cable risk assessment will be carried out to understand risks in relation to anchoring, emergency anchoring or under keel clearance

227. The size of commercial vessels in the area indicates that should an anchor interaction occur with the offshore export cables, the most likely outcome is damage to the cable, rather than a snagging. Fishing gear snagging is considered within Chapter 14 Commercial Fisheries.

228. The severity of consequence for the offshore cable corridor is considered to be minor and the frequency of effect is considered to be remote given that commercial and fishing vessels are more likely to transit in adverse weather and anchor near shore. The impact has therefore been classed as **broadly acceptable** which is not significant under EIA terms**.**

15.7.5.8.2 Recreational vessels

229. The severity of consequence for the offshore cable corridor is considered to be negligible and the frequency of effect is considered to be extremely unlikely given that recreational vessels are more likely to anchor in coastal areas (either to break their journey, shelter from weather or to make emergency repairs) than they are directly on or within the export cable route. Therefore, recreational vessels are unlikely to come in proximity or interact with the cables. This impact has therefore been classed as **broadly acceptable** which is not significant under EIA terms.

15.7.5.9 Diminishing emergency response resources – OWF sites, including interconnector and array cables

15.7.5.9.1 All sea users

230. As with the equivalent impact for the construction phase, the operation and maintenance phase would be expected to put increased demand on SAR facilities within the area. However, as the maximum number of personnel and vessels is considered lower than during the construction phase, the frequency is reduced.

231. Potential residual impacts identified include reduced emergency response capability / oil spill response owing to the presence of the project; however, project ERPs would take into consideration managing a self-help capability.

232. Due to the reduction in activity on site the frequency of effect is reduced to extremely unlikely and the severity of consequence is considered to be minor meaning the impact is considered **broadly acceptable** and not significant under EIA terms.

15.7.5.10 Diminishing emergency response resources – Offshore cable corridor

15.7.5.10.1 All sea users

233. There are not expected to be any impacts associated with the offshore cable corridor given the low level of personnel and vessels working on the offshore export cables during periods of maintenance (**no impact**).

15.7.6 Potential Impacts during Decommissioning Phase

15.7.6.1 Effects on vessel routeing and / or displacement – OWF sites, including interconnector and array cables

234. The physical presence of decommissioning structures and associated works could have an effect on vessel routeing and displacement of activities within the OWF sites study area and the offshore cable corridor study area.

15.7.6.1.1 Commercial vessels

235. Marine traffic movements within the OWF sites study area and the offshore cable corridor study areas have been captured through dedicated marine traffic surveys and AIS surveys as noted in section 15.6.2. As stated in the equivalent impact for the construction phase, when marine traffic survey data assessments are considered alongside historical analysis in the form of the former East Anglia Zone assessments and vessel route databases (Anatec, 2016) a full and detailed picture of commercial vessel movement is defined.

236. Maximum deviations during the decommissioning phase would be associated with the buoyed decommissioning area. The layout consisting of 200 wind turbines plus

associated structures spread across the entirety of both OWF sites has been considered as the worst case parameters for deviations associated with the proposed project. The buoyed decommissioning area would only be deployed with TH authority and guidance and it is therefore assumed that the buoyed decommissioning area would be designed so as to minimise impacts on vessels within the DWR. As standard for UK waters the buoyed decommissioning area would allow vessels access through areas currently not being worked on, allowing greater freedom through the site. Notice to Mariners and other methods of information promulgation would also ensure that vessel Masters are able to effectively passage plan to minimise deviations. Given the flexible access to the OWF sites throughout decommissioning, main route deviations are only considered within the impacts for the operation and maintenance phase (see section 15.7.5.1).

237. Noting that the main purpose of the NRA is to assess navigational safety risk, the severity of consequence is considered to be minor for the OWF sites given that any displacement or deviations during decommissioning will not increase risk to vessels operating on the deviated routes. This is due to there being negligible risk to persons or environment, but the potential for some business impacts associated with safety, i.e. increased bridge manning. The frequency of effect is considered to be reasonably probable. This is based on the possibility that a deviation will occur but that there will be some measurable consequence to users. The impact has therefore been classed as **tolerable**, noting that promulgation of information would enable the vessel Masters to effectively passage plan to minimise disruption. This impact is considered not significant under EIA terms.

15.7.6.1.2 Recreational vessels

238. As stated in the equivalent impacts for the construction and operation and maintenance phases, recreational vessel movement was low during the marine traffic surveys and there are no RYA cruising routes passing through the OWF sites. Given the low vessel numbers, consultation responses indicating no concerns over the project, the continued ability to transit through the decommissioning area and the embedded mitigations of promulgation of information, the displacement of recreational vessels from the proposed project has no perceptible effects and is not significant under EIA terms (**no impact**).

15.7.6.1.3 Fishing vessels in transit

239. As stated in the equivalent impacts for the construction and operation and maintenance phases, throughout the survey periods there was an average of eight and three unique fishing vessels recorded per day passing within the Norfolk Vanguard East and Norfolk Vanguard West study areas respectively. The majority of vessels were non- UK beam trawlers.

240. Chapter 14 Commercial Fisheries considers commercial displacement. From a navigational safety perspective, fishing vessels would be able to transit through the decommissioning area during decommissioning using the embedded mitigation of promulgation of information (noting areas of current decommissioning activity). Given the smaller size of fishing vessels navigating within the area and their ability to navigate through the decommissioning area, the frequency is expected to be lower than that of commercial vessels.

241. The severity of consequence from the OWF sites is considered to be negligible, and the frequency of effect is considered to be remote. The impact has therefore been classed as **broadly acceptable** for navigational safety during transit which is not significant under EIA terms.

15.7.6.2 Effects on vessel routeing and / or displacement – Offshore cable corridor

15.7.6.2.1 Commercial vessels, recreational vessels and fishing vessels in transit

242. The vessels associated with decommissioning the offshore export cables would cause some minor displacement to existing commercial routes; however, this would be temporary and limited to a small geographic area surrounding the decommissioning activity. Post commissioning, there is unlikely to be any deviations to vessels resulting from any cables left in situ; however, this does assume that an assessment of under keel clearance would be undertaken as part of the Decommissioning Plan (**no impact**).

15.7.6.3 Increased vessel to vessel collision risk – OWF sites, including interconnector and array cables

243. The physical presence of decommissioning structures and associated works could result in the displacement of vessels and activities within the OWF sites study area and offshore cable corridor study area and therefore increased encounters and vessel to vessel collision risk.

15.7.6.3.1 Commercial vessels

244. During decommissioning, there would be an increased vessel presence within the OWF sites, which may cause vessel displacement. However, as commercial vessels are unlikely to be transiting through the OWF sites during the operation and maintenance phase, any additional deviation impact from the vessels associated with decommissioning the wind turbines and other structures is expected to be minimal (including the potential for safety zones around fixed structures). Deviation resulting from the OWF sites post decommissioning would be dependent on what infrastructure is left in situ; however, there would be no additional deviations to those experienced during the operation and maintenance phase.

245. The severity of consequence from the OWF sites is considered to be minor, noting that the most likely consequences are increased encounters rather than collision. Frequency of effect is considered to be reasonably probable. The impact has therefore been classed as **tolerable**, noting the mitigation of managing construction traffic. This impact is therefore not significant under EIA terms.

15.7.6.3.2 Recreational vessels

246. The increased vessel presence (including the potential for safety zones around fixed structures) associated with the decommissioning of the wind turbines and other structures may displace recreational vessels, noting that recreational users may have been previously transiting the OWF sites during the operation and maintenance phase. Post decommissioning, any recreational displacement associated with the OWF sites would be dependent upon any structures left in situ; however, there would be no additional displacement to that observed during the operation and maintenance phase.

247. For the OWF sites, there are not expected to be any effects associated with recreational craft encountering or colliding with decommissioning or other third party vessels and therefore this impact is considered not significant under EIA terms (**no impact**).

248. Similarly, to the construction phase, within the offshore cable corridor and near shore there was some recreational activity recorded which would be temporarily displaced around a decommissioning vessel. However, as this work would be limited to a small geographical area moving along the offshore export cable route (1km around the installation vessel) the impact of any displacement would be negligible unless under keel clearance was significantly reduced. As a mitigation measure, under keel clearance would be assessed and managed as part of the Cable Burial Risk Assessment to ensure that recreational routes are not impacted.

15.7.6.3.3 Fishing vessels in transit

249. The increased vessel presence (including the potential for safety zones around fixed structures) associated with the decommissioning of the wind turbines and other structures may displace fishing vessel activity, noting that fishing vessels may have been using the OWF sites during the operation and maintenance phase, for either transit or fishing purposes. Post decommissioning, fishing vessel displacement will be dependent on any structures left in situ. It is noted that should any subsurface structures be left in place, the gear snagging risk may displace fishing activity, even if the surface structures are removed; however, as the NRA considers only fishing vessels transiting there are not expected to be any perceptible effects associated with the construction of the OWF sites (**no impact**).

250. The decommissioning of the offshore export cables would cause temporary displacement to existing fishing vessels transiting; however, as the work will be limited to a small geographical area moving along the offshore export cable route, the impact from the decommissioning itself would be minor. Any cables left in situ could cause displacement due to the gear snagging risk dissuading active fishing, as fishing vessels may have concerns with fishing over inactive cables (as protection measures are no longer monitored and maintained).

15.7.6.4 Increased vessel to vessel collision risk –Offshore cable corridor

15.7.6.4.1 Commercial vessels, recreational vessels and fishing vessels in transit

251. The vessels associated with decommissioning the offshore export cables would cause some minor displacement to existing commercial routes; however, this would be temporary and limited to a small geographic area surrounding the decommissioning activity. Post decommissioning, there is unlikely to be any deviations to vessels resulting from any cables left in situ; however, this does assume that an assessment of under keel clearance would be undertaken as part of the decommissioning plan (**no impact**).

15.7.6.5 Increased vessel to structure allision risk –OWF sites, including interconnector and array cables

252. The physical presence of decommissioned structures would create a vessel to structure allision risk for a vessel navigating within the OWF sites and offshore cable corridor.

15.7.6.5.1 Commercial vessels

253. The allision risk to commercial vessels post decommissioning would be dependent upon which structures from the operational layout are left in place. Should any surface structures be left in place, there is the potential for allision from a commercial vessel, particularly as operational lighting and marking could no longer be active. However commercial vessels are considered unlikely to transit within the immediate vicinity of decommissioned structures. It is noted that lighting and marking of decommissioned structures would be implemented in consultation with TH, and any such structures would be clearly marked on nautical charts.

254. The severity of consequence from the OWF sites is considered to be minor given the embedded mitigations in place and the frequency of effect is considered to be extremely unlikely. The impact has therefore been classed as **broadly acceptable.**

15.7.6.5.2 Recreational vessels

255. The allision risk to recreational vessels post decommissioning would be dependent upon which structures from the operational layout are left in place. Should any

surface structures be left in place, there is the potential for allision from a recreational vessel, particularly as operational lighting and marking could no longer be active. It is noted that recreational users may pass significantly closer to decommissioned structures than a commercial vessel would, due to vessel size, marine inexperience, and the potential for curiosity from a leisure user.

256. Lighting and marking of decommissioned structures would be implemented in consultation with TH, and any such structures would be clearly marked on nautical charts.

257. Similarly, to the equivalent impact for the construction phase, the impact on recreational vessel transits throughout the decommissioning period (regardless of the decommissioning approach adopted) would not differ greatly and has been assessed as such throughout this subsection. The severity of consequence from the OWF sites is considered to be minor given the low energy and low speed of any allision incident, and the frequency of effect is considered to be negligible. Following consideration of embedded mitigation, the risk is considered to be **broadly acceptable** and is not significant under EIA terms.

15.7.6.5.3 Fishing vessels in transit

258. The allision risk to fishing vessels post decommissioning would be dependent upon which structures from the operational layout are left in place. Similarly, to recreational vessels, fishing vessels may pass significantly closer to decommissioned structures than a commercial vessel would, and it should be noted that operational lighting and marking could no longer be active.

259. However, lighting and marking of decommissioned structures would be implemented in consultation with TH, and any such structures would be clearly marked on nautical charts.

260. Similarly to the equivalent impact for the construction phase, the impact on fishing vessel transits throughout the decommissioning period (regardless of the decommissioning approach adopted) would not differ greatly and has been assessed as such throughout this subsection. The severity of consequence from the OWF sites is considered to be moderate and the frequency of effect is considered to be extremely unlikely. The impact has therefore been classed as **broadly acceptable** which is not significant under EIA terms.

15.7.6.6 Increased vessel to structure allision risk –Offshore cable corridor

15.7.6.6.1 Commercial vessels, recreational vessels and fishing vessels in transit

261. There is no allision risk associated with the offshore export cables during the decommissioning phase; there are no structures outside of the OWF sites (**no impact**).

15.7.6.7 Anchor interaction and snagging risk –OWF sites, including interconnector and array cables

262. The presence of decommissioning structures and infrastructure left in situ post decommissioning with mooring lines or cables could create an increased risk for vessels navigating within the OWF site study area and offshore cable corridor study area.

15.7.6.7.1 Commercial vessels

263. It is considered extremely unlikely that a commercial vessel would anchor within the OWF sites during the decommissioning phase, particularly as there would be an increase in vessel presence / activity surrounding active decommissioning work, including the potential for safety zones. For this reason, a commercial vessel anchor interaction with the mooring lines is considered to be an unlikely event.

264. Post decommissioning, any infrastructure left in situ within the OWF sites could cause a snagging risk. If surface structures are removed, then it should be noted that there would be less indication of the presence of subsurface infrastructure, particularly if operational lighting and marking are also removed. However, it is assumed that any commercial vessel anchoring within the OWF sites would take charted information into account prior to anchoring.

265. Given the mitigation in place during the decommissioning phase including Marine Coordination, promulgation of information and potentially safety zones that will prevent vessels approaching areas not fully decommissioned, the severity of consequence from the OWF sites is considered to be minor and the frequency of effect is considered to be extremely unlikely. The impact has therefore been classed as **broadly acceptable** which is not significant under EIA terms.

15.7.6.7.2 Recreational vessels

266. Water depths within the OWF sites suggest that recreational anchoring is unlikely, particularly during decommissioning when there would be an increase in vessel presence / activity surrounding active decommissioning work, including the potential for safety zones. It should be noted that post decommissioning, the risk of snagging on subsurface infrastructure within the OWF sites would increase if surface structures and operational lighting and marking are also removed.

267. The severity of consequence from the OWF sites is considered to be negligible given the size of recreational vessels and their anchors, and the frequency of effect is considered to be negligible given the very low frequency of anchoring. The impact has therefore been classed as **broadly acceptable** which is not significant under EIA terms**.**

15.7.6.7.3 Fishing vessels in transit

268. It is considered unlikely that fishing activity would occur within the vicinity of active decommissioning work. Post decommissioning, levels and locations of fishing within the OWF sites would depend upon what infrastructure is left in situ. It is assumed that any snagging hazards left in situ (i.e. subsurface infrastructure) would be marked on nautical charts. Water depths within the OWF sites suggest that fishing vessel anchoring is unlikely.

269. As with recreational vessels, fishing vessels are small when compared to commercial vessels but are likely to have larger anchors than recreational vessels. Therefore, the severity of consequence from the OWF sites is considered to be minor and the frequency of effect is considered to be extremely unlikely given the water depths. The impact has therefore been classed as **broadly acceptable** which is not significant under EIA terms**.**

15.7.6.8 Anchor interaction and snagging risk –Offshore cable corridor

15.7.6.8.1 Commercial vessels

270. Post decommissioning, any offshore export cables left in situ within the offshore cable corridor would create a snagging risk, and it is noted that operational maintenance and monitoring would no longer be active. However, it is assumed that the charted presence of the abandoned offshore export cables would be taken into consideration by commercial vessels prior to anchoring.

271. It is therefore assumed that the decommissioning phase would present the same impact as the construction and operation and maintenance phase. The severity of consequence for the offshore cable corridor is considered to be minor and the frequency of effect is considered to be remote given that commercial vessels are more likely to transit in adverse weather and anchor near shore. The impact has therefore been classed as **broadly acceptable** which is not significant under EIA terms**.**

15.7.6.8.2 Recreational vessels

272. Post decommissioning, any offshore export cables left in situ within the offshore cable corridor would create a snagging risk, and it is noted that operational maintenance and monitoring would no longer be active. However, it is assumed that

the charted presence of the abandoned offshore export cables would be taken into consideration by recreational vessels prior to anchoring.

273. Should a snagging occur, the relatively small size of a typical recreational vessel means that loss of stability and subsequent capsize is considered a possibility.

274. The severity of consequence for the offshore cable corridor is considered to be negligible and the frequency of effect is considered to be extremely unlikely given that recreational vessels are more likely to anchor near shore either to shelter from adverse weather or to make emergency repairs. This impact has therefore been classed as **broadly acceptable** which is not significant under EIA terms.

15.7.6.8.3 Fishing vessels in transit

275. Should the offshore export cables be left in place post decommissioning, there is the potential for fishing gear / anchor snagging, and it should be considered that operational maintenance and monitoring of the cable protection would no longer be active.

276. Due to the size of a typical fishing vessel, should a snagging occur, loss of stability with the potential for capsize is a risk. However, the more likely outcome is damage to, or loss of the gear. Any damage to the offshore export cable at this stage would be non-consequential.

277. The severity of consequence for the offshore cable corridor is considered to be minor, and the frequency of effect is considered to be remote given that fishing vessels are more likely to transit in adverse weather and anchor near shore. The impact has therefore been classed as **broadly acceptable** which is not significant under EIA terms**.**

278. Future case monitoring of offshore cables shall be considered.

15.7.6.9 Diminishing emergency response resources — OWF sites, including interconnector and array cables

279. As with the equivalent impact for the construction and operation and maintenance phases, the decommissioning phase would be expected to put increased demand on SAR facilities within the area.

280. Given the potential for moderate damage to vessels, multiple or single serious injuries and Tier 2 pollution incidents which require assistance, the severity of consequence from the OWF sites is considered to be moderate and the frequency of effect of this level of incident considered to be remote. The impact has therefore been classed as **tolerable**, noting the mitigation of the increase in self-help

capabilities and other resources to assist third parties on site. This impact is therefore considered not significant under EIA terms.

15.7.6.10 Diminishing emergency response resources – Offshore cable corridor

15.7.6.10.1 All sea users

281. There are not expected to be any perceptible impacts associated with the offshore cable corridor given the low level of personnel and vessels working on the decommissioning (**no impact**).

15.8 Cumulative Impact Assessment (CIA)

282. The presentation of cumulative impact has been a two stage process. Firstly, all the impacts from previous sections have been presented and assessed for cumulative impacts with scoped in projects noted in Table 15.12. Then those impacts which have an effect have been assessed and ranked as per the FSA process detailed in section 15.4.

15.8.1 Cumulative Effects with Oil and Gas Platforms

283. 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. With regards to allision risk it is also noted that the Horne and Wren platform could have posed a small cumulative increase in collision risk when considered against the project. However, it is understood from the operators that Horne and Wren had its topside removed in 2017 (despite still being shown on the nautical charts used within this chapter and the NRA) and is expected to be fully decommissioned by the end of the year.

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

15.8.2 Cumulative Effects Summary

Table 15.11 Potential cumulative impacts

Impact	Potential for cumulative impact	Data confidence	Rationale
Construction			
Vessel routeing and / or displacement	Yes	Medium	This was raised as a key point to be considered during consultation.
Increased vessel to	Yes	Medium	This was raised as a key point

Impact	Potential for cumulative impact	Data confidence	Rationale
vessel collision risk			to be considered during consultation.
Increased vessel to structure allision risk	Yes	Medium	Only with projects located within the former East Anglia Zone (Norfolk Vanguard, Norfolk Boreas, East Anglia Three, East Anglia One, East Anglia Two and East Anglia One North)
Anchor interaction and snagging risk	No	Medium	Snagging risk during anchoring operations is localised to the offshore cables and cannot have a cumulative effect. The offshore cable corridor is also not situated with other cables within a known or charted anchorage area.
Diminishing emergency response resources	Yes	Low	Increase in activity cumulatively within the southern North Sea area.
Operation and Maintenance			
Vessel routeing and / or displacement	Yes	Medium	This was raised as a key point to be considered during consultation.
Increased vessel to vessel collision risk	Yes	Medium	This was raised as a key point to be considered during consultation.
Increased vessel to structure allision risk	Yes	Medium	Only with projects located within the former East Anglia Zone (Norfolk Vanguard, Norfolk Boreas, East Anglia Three, East Anglia One, East Anglia Two and East Anglia One North).
Anchor interaction and snagging risk	No	Medium	Snagging risk during anchoring operations is localised to the offshore cables and cannot have a cumulative effect. The offshore cable corridor is also not situated with other cables within a known or charted anchorage area.
Diminishing emergency response	Yes	Low	Increase in activity cumulatively within the south

Impact	Potential for cumulative impact	Data confidence	Rationale
resources			North Sea area.
Decommissioning			
Vessel routeing and / or displacement	Yes	Medium	This was raised as a key point to be considered during consultation.
Increased vessel to vessel collision risk	Yes	Medium	This was raised as a key point to be considered during consultation.
Increased vessel to structure allision risk	Yes	Medium	Only with projects located within the former East Anglia Zone (Norfolk Vanguard, Norfolk Boreas, East Anglia Three, East Anglia One, East Anglia Two and East Anglia One North).
Anchor interaction and snagging risk	No	Medium	Snagging risk during anchoring operations is localised to the offshore cables and cannot have a cumulative effect. The offshore cable corridor is also not situated with other cables within a known or charted anchorage area.
Diminished emergency response resources	Yes	Low	Increase in activity cumulatively within the southern North Sea area.

285. Table 15.12 shows those projects that are deemed to have a cumulative effect. Due to the national and international nature of shipping, impacts on vessel routeing can occur a significant distance from the project being assessed. Therefore, the cumulative list for shipping and navigation includes all constructed, consented or planned wind farms within the southern North Sea that could cumulatively influence a vessel's navigational routeing.

Table 15.12 Summary of projects considered for the CIA in relation to the shipping

Project	Status	[8]Distance from Norfolk Vanguard sites (km)	Rationale
UK Wind Farms			
Doggerbank Creyke Beck A	Consented	184	Cumulatively affects route that passes within the OWF
Doggerbank Creyke Beck B	Consented	207	

[8] Shortest distance between the considered project and Norfolk Vanguard – unless specified otherwise.

Project	Status	[8]Distance from Norfolk Vanguard sites (km)	Rationale
Doggerbank Teesside A	Consented	213	sites study area.
Doggerbank Teesside B	Consented	201	
Dudgeon	Fully commissioned	66	
East Anglia ONE	Consented	49	
East Anglia ONE North	Pre-planning application	38	
East Anglia Three	Consented	0	
East Anglia TWO	Pre-planning application	56	
Galloper	Under construction	93	
Greater Gabbard	Active / in operation	96	
Gunfleet Sands Demo	Active / in operation	148	
Gunfleet Sands I	Active / in operation	143	
Gunfleet Sands II	Active / in operation	141	
Hornsea Project Four	Pre-planning application	115	
Hornsea Project One	Under construction	95	
Hornsea Project Three	Pre-planning application	73	
Hornsea Project Two	Consented	107	
Humber Gateway	Active / in operation	153	
Inner Dowsing	Active / in operation	127	
Kentish Flats 1	Active / in operation	174	Cumulatively affects route that passes within the OWF site study area.
Kentish Flats 2	Active / in operation	175	
Lincs	Active / in operation	122	

Project	Status	[8]Distance from Norfolk Vanguard sites (km)	Rationale
London Array 1	Active / in operation	138	
Lynn	Active / in operation	125	
Norfolk Boreas	Pre-planning application	1	
Race Bank	Under construction	99	
Scroby Sands	Active / in operation	45	
Sheringham Shoal	Active / in operation	75	
Thanet	Active / in operation	156	
Thanet Extension	Pre-planning application	159	
Triton Knoll	Consented	101	
Westermost Rough	Active / in operation	169	
EU Wind Farms			
Belwind	Fully commissioned	116	Cumulatively affects route that passes within the OWF site study area.
Belwind Alstom Haliade Demonstration	Fully commissioned	118	
Borssele Site I	Consent authorised	108	
Borssele Site II	Consent authorised	118	
Borssele Site III	Consent authorised	114	
Borssele Site IV	Consent authorised	109	
Borssele Wind Farm Zone	Development zone	108	
Egmond aan Zee	Fully commissioned	88	Cumulatively affects route that passes within the OWF site study area.
Eneco Luchterduinen	Fully commissioned	85	
Hollandse Kust Noord	Concept / early	74	

Project	Status	[8]Distance from Norfolk Vanguard sites (km)	Rationale
Holland I (Tender 2019)	planning		
Hollandse Kust Noord Holland II (Tender 2019)	Concept / early planning	74	
Hollandse Kust Zuid Holland I (Tender 2017)	Concept / early planning	76	
Hollandse Kust Zuid Holland II (Tender 2017)	Concept / early planning	76	
Hollandse Kust Zuid Holland III (Tender 2018)	Concept / early planning	76	
Hollandse Kust Zuid Holland IIII (Tender 2018)	Concept / early planning	76	
IJmuiden Wind Farm Zone	Development zone	16	
Irene Vorrink	Fully commissioned	168	
Leeghwater - Turbine Demonstration Facility	Consent authorised	110	
Mermaid	Consent authorised	113	
Nobelwind	Consent authorised	116	
Nord-Holland boven Noordzeekanaal Potentiele Zoekgebieden	Development zone	83	
Norther	Consent authorised	132	
Northwester 2	Consent authorised	115	
Northwind	Fully commissioned	124	
Poseidon P60 - Mermaid	Concept / early planning	116	
Prinses Amaliawindpark	Fully commissioned	79	
Rentel	Pre-construction	127	
Seastar	Consent authorised	121	Cumulatively affects route that passes within the OWF sites study area.
Thornton Bank phase I	Fully commissioned	134	

Project	Status	[8]Distance from Norfolk Vanguard sites (km)	Rationale
Thornton Bank Phase II	Fully commissioned	131	
Thornton Bank Phase III	Fully commissioned	133	
Voorde Hollandse kust Zoekgebieden	Development zone	39	
Westermeerwind	Fully commissioned	168	
Windpark Fryslân	Consent application submitted	144	
Zuid-en Noord-Holland onder het Noordzeekanaal Potentiele Zoekgebieden	Development zone	89	

15.8.3 Effects on Deviation and Vessel to Vessel Collision Risk Associated with Cumulative Projects within the Southern North Sea

15.8.3.1.1 Commercial vessels, recreational vessels and fishing vessels in transit

286. As shipping and navigational receptors can be cumulatively impacted by a number of offshore projects, the principles of the cumulative assessments have been extended to 100nm from the project. The routes passing through the project have been assessed and when considered alongside other projects only the following projects have a notable effect on cumulative routeing:

- East Anglia Three (consented);
- East Anglia One (constructing);
- East Anglia Two (pre-scoping);
- East Anglia One North (pre-scoping); and
- Norfolk Boreas (scoping),

287. In order to assess the cumulative issues arising from the proposed projects within the other Round Three zones in the southern North Sea (the former East Anglia Zone, former Hornsea Zone and Dogger Bank Zone) the three developers undertook a joint report as part of the Southern North Sea Offshore Wind Forum (SNSOWF) in 2013. This work has been updated by Norfolk Vanguard Limited using more recent data (Anatec, 2018). This updated work has been used as input to the cumulative routeing assessment contained within the NRA (Appendix 15.1), forming input to the EIA.

288. The majority of traffic within the area is contained within IMO Routeing Measures which have been left clear of cumulative development and therefore remains undeviated. However, it is noted that an increase in vessel numbers within these routes may be observed depending upon future traffic trends.

289. There are a number of developments located to the west of the project including Triton Knoll (consented), Dudgeon (commissioned), Race Bank (under construction) and Sheringham Shoal (operational) whereby vessels are required to navigate on distinct routes (due to water depths) through sand banks prior to reaching them. This combined with the size of the projects and minimum deviation associated with Triton Knoll, Race Bank, Dudgeon and Sheringham Shoal, means there is not expected to be any cumulative impacts greater than those assessed for the project in isolation.

290. Overall, given the separation distance from Round One and Two wind farms and other mainland European wind farms and considering the cumulative routeing with regards to other Round Three zones, the frequency of a collision incident occurring is considered reasonably probable and of a moderate consequence meaning this impact is considered to be **tolerable** with mitigation. However, the change in frequency for a base case level of traffic is 0.5% (i.e., the change between base case and future case collision risk assuming no increase in traffic levels) demonstrating that collision risk is already high within the area. Mitigation such as COLREGS (IMO, 1972) and good seamanship ensure that in reality traffic operates safely within the area and can continue to so.

291. It is noted that vessel to vessel collision risk (and all other impacts) has been assessed using the worst case parameters as laid out in Table 15.10. The significance of impacts is therefore likely to be less than assessed within this chapter.

292. No impacts have been identified on cumulative displacement of fishing and recreational activity, and thus collision risks. This is due to recreational and fishing vessels in the majority transiting within the wind turbine arrays avoiding the majority of displaced commercial traffic. Vessels related to the construction, operation and maintenance or decommissioning of any of the cumulative projects will be managed by the Marine Coordinators.

15.8.4 Effects on Vessel to Structure Allision Risk Associated with Cumulative Projects within the Southern North Sea

293. Following assessment of the cumulative routeing it has been identified that the development of Norfolk Vanguard, Norfolk Boreas, East Anglia Three, East Anglia One, East Anglia One North and East Anglia Two has the potential to cumulatively

impact upon navigational transits and thus to cumulatively increase vessel to structure allision risk. Cumulative allision is considered to affect vessels transiting within the cumulative study area including recreational and fishing vessels.

15.8.4.1 Alignment either side of the DWR

294. In order to facilitate vessel transits within the DWR, wind turbines adjacent to the proposed navigational corridor must be aligned in a straight line. Lighting and marking (of the proposed navigational corridor) requires consideration alongside lighting of other projects in line with TH guidance to ensure that it aids vessel navigation within the site. It is noted that non-linear boundaries and peripheral turbines can cause negative effects on marine Radar and visual navigation by obscuring or preventing position fixing. When defining layouts or phasing, Norfolk Vanguard will give full consideration to navigational safety.

15.8.4.2 Cumulative lighting and marking causing confusion due to the proliferation of AtoNs

295. As well as lighting and marking in general, cumulative lighting (notably the array boundaries bordering the DWR) must be considered in order to minimise any potential effects and avoid confusion from a proliferation of aids to navigation in a high density development of turbines. The mariner would use SPS lights (similar to entering a port) to navigate with, including fixing their position. Following agreement on the final layout post consent, the applicant (for the project and other cumulative sites) will identify aids to navigation, in consultation with TH, which are most appropriate within the DWR.

15.8.4.3 NUC vessels within the DWR

296. Within the proposed navigational corridor, emergency anchoring (dependent on the vessel's speed) could be used to prevent allision with a structure. As an existing IMO routeing measure the DWR is hazard free which will generally allow safe anchoring. A vessel will have emergency anchoring procedures for areas where there may be subsea hazards (such as port approaches), and these procedures would likely be used within the proposed navigational corridor. It is noted that Rule 9 of COLREGS (IMO, 1972) prevents anchoring within a narrow channel under normal conditions.

297. For other types of emergency incidents, it is noted that the cumulative projects will all be significant marine operations, with each including a variety of support vessels during the construction and operation and maintenance phases that will be able to provide emergency support (noting potential downtime during periods of adverse weather).

15.8.4.4 Differing design envelopes

298. Norfolk Boreas and East Anglia Three, given the different times at which they were assessed, may include different design envelopes to that proposed for the project. The final layout of the project may include differing size wind turbines, spacing and floating foundations and therefore consideration would need to be given to the alignment with wind turbines on directly opposing sides of an AfL area. This is to ensure that the projects comply fully with MGN 543 and allow SAR functions to be undertaken effectively.

299. The impact as a whole is considered to be of moderate consequence given the potential for damage to be caused to vessels in the event of allision and reasonably probable given the low frequency of occurrence. Therefore, the impact is expected to be **tolerable** with mitigation. Post consent discussions would include consideration of cumulative lighting, consideration of directly adjacent wind farm boundaries and alignment of wind turbines that face the DWR (in conjunction with TH) to ensure that differing design envelopes do not adversely affect shipping and navigation.

300. No impacts have been identified on cumulative displacement of recreational or fishing vessels in transit.

15.8.5 Diminishing Emergency Response Resources due to Cumulative Projects within the Southern North Sea

301. With developments both within UK waters and transboundary developments there is likely to be a collective increase in emergency response requirements within the southern North Sea. However, it is likely that each individual development would require its own self-help capability and therefore should be considered within the project specific impacts as per section 15.7. Potentially there may be some overlap in resources but this would be considered at a commercial and local level between project developers. Therefore, the severity of consequence is considered to be moderate and the frequency of effect is considered to be reasonably probable. Therefore, the impact has been classed as **tolerable** which is not significant under EIA terms**,** noting that each project defines and develops its own ERCoP and self-help capability**.**

15.9 Transboundary Impacts

302. Transboundary impacts relate to impacts that may occur from an activity within one EEA state on the environment or interests of another.

303. Assessment of vessel routeing has identified that there was potential for significant transboundary effects with regard to shipping and navigation from the project upon

the interests of other EEA states; however due to the international nature of shipping and navigation this has been considered within the baseline (section 15.7) and cumulative assessments (section 15.8).

304. It was identified that transboundary issues could arise from the project having an effect upon commercial shipping routes transiting between the UK and other EEA ports. This could also include impacts upon international ports, shipping routes and / or routes affected by other international offshore renewable energy developments. The potentially affected areas include ports within the southern North Sea. The development of the project could affect routes operating between the UK and ports located in the Netherlands, Denmark, Belgium and Germany. The results of the vessel deviation assessments in the NRA identified some deviations for routes; however, the deviations identified were found to have no perceptible impacts (no impact) on ports following consideration of the cumulative routeing scenarios. It is noted that the project is located centrally within the southern North Sea and that levels of displacement for vessel routeing were considered **broadly acceptable**.

305. All EU member states are consulted as part of the formal phases of consultation. Dialogue with these authorities will continue to take place throughout the development of the project in relation to transboundary impacts.

306. Rijkswaterstaat (see section 15.2) did respond to consultation noting general advice with regards to development. This has been considered, however existing guidance given by the MCA on the distance from routeing measures has been adhered to as a priority in order to ensure consistency and alignment with other projects.

15.10 Inter-relationships

307. The following section identifies potential inter-relationships associated with shipping and navigation and other identified effects associated with the development of the proposed project. It should be noted that shipping and navigation as a receptor contains a number of marine activities that are both transient in the form of a navigating vessel as well as localised in terms of their activity, e.g. fishing vessels on transit and fishing vessels engaged in fishing. This chapter has already considered these receptors in their navigational or transient state and the following table highlights any additional interrelationships with their localised activities.

Table 15.13 Chapter topic inter-relationships

Topic and description	Related Chapter	Where addressed in this Chapter	Rationale
Changes to wave and tidal currents	Chapter 8 Marine Geology, Oceanography and Physical Processes	Effects of wave and tidal currents are considered within Appendix 15.1.	There are not expected to be any additional effects associated with inter-relationships and impacts on wave and tidal currents associated with the project.
Increased collision risk for fishing vessels engaged in fishing activity	Chapter 14 Commercial Fisheries	Impacts on the navigational safety of fishing vessels are considered in section 15.6.	All navigational safety impacts are considered ALARP. Allision and collision risk modelling has not differentiated between vessels engaged in or not engaged in fishing activity.
Increased snagging risk for fishing vessels engaged in fishing activity	Chapter 14 Commercial Fisheries	Navigational safety impacts for vessels on transit have already been considered within this chapter.	Impacts on gear snagging (which could affect their navigational status) have been considered within Chapter 14 Commercial Fisheries.
Impacts on aggregate dredging activities	Chapter 18 Infrastructure and Other Users	Impacts on the navigational safety of marine aggregate dredgers are considered within commercial vessels impacts in section 15.6.	All navigational safety impacts are considered ALARP; marine aggregate dredging sites are not within close proximity to the OWF sites.

15.11 Interactions

308. The impacts identified and assessed in this chapter have the potential to interact with each other, which could give rise to synergistic impacts as a result of that interaction. The worst case impacts assessed within the chapter take these potential interactions into account, and therefore the impact assessments are considered conservative and robust.

309. For clarity, the potential areas of interaction which may arise between impacts are presented in Table 15.14.

Table 15.14 Interaction between impacts

Potential interaction between impacts Construction, Operation, and Decommissioning Phases	Vessel Displacement	Increased Collision Risk	Increased Allision Risk	Anchor Snagging	Diminishing Emergency Response
Vessel Displacement	-	Yes	Yes	No	No

Potential interaction between impacts Construction, Operation, and Decommissioning Phases					
	Vessel Displacement	**Increased Collision Risk**	**Increased Allision Risk**	**Anchor Snagging**	**Diminishing Emergency Response**
Increased Collision Risk	Yes	-	Yes	No	Yes
Increased Allision Risk	Yes	Yes	-	No	Yes
Anchor Snagging	No	No	No	-	No
Diminishing Emergency Response	No	Yes	Yes	No	-

15.12 Summary

310. Following a review of the baseline environment, an NRA (Appendix 15.1) has been undertaken for the project including the OWF sites and the offshore cable corridor. The NRA includes the required FSA to meet MCA guidance (MCA, 2015 and 2016) for all phases of the project, as well as an assessment of cumulative effects. The NRA has then informed the preliminary environmental impact review presented in this chapter.

311. A summary of the findings of the preliminary environmental impact review which relate to shipping and navigation are presented in Table 15.15 below; the table includes residual impacts following consideration of embedded mitigation measures required for the project and the offshore cable corridor to be within ALARP parameters.

15.12.1 Construction Phase

312. For the construction phase no impacts were found to have an unacceptable level of risk associated with the development of the project. There are three impacts which have a tolerable effect on shipping and navigation. These are summarised below. All other impacts are broadly acceptable or have no impact.

313. Effects on vessel routeing and / or displacement associated with OWF sites, interconnector and array cables have a tolerable level of impact on commercial vessels. This is due to the frequency at which a commercial vessel would likely be deviated due to the presence of buoyed construction area; however, consequences of these deviations would be minor with no navigational safety impacts associated. This therefore means that the impact is tolerable and does not require additional mitigation (to manage safety) aside for that already agreed to as embedded mitigation such as promulgation of information which allows mariners to effectively passage plan to minimise impacts.

314. Given the increase in commercial vessel deviations there is also a potential for increased vessel to vessel collision when considered alongside the location of the DR1 Lightbuoy DWR and the expected level of construction vessels associated with the project. This impact is considered tolerable with mitigation, with management of construction traffic (including the creation of construction vessel routeing and entry/exit points into the OWF sites) and as part of the marine coordination process to ensure that the risk is ALARP.

315. The impact of diminishing emergency response resources is considered to be moderate due to the potential for moderate damage to vessels, multiple or single

serious injuries and Tier 2 pollution incidents which require assistance. There are not expected to be any perceptible impacts associated with the offshore cable corridor.

316. Mitigation of this impact includes effective emergency response planning and self-help capabilities including compliance with MGN 543, development of an ERCoP; and a gap analysis to identify resources which may be required.

15.12.2 Operation and Maintenance Phase

317. For the operation and maintenance phase there were no impacts considered to have unacceptable risks associated with the development of the project. Two impacts were identified to have tolerable levels of effect including, as with the construction phase, commercial vessel deviations. These deviations were frequent but of low consequence and therefore require no additional mitigation to bring them within ALARP parameters.

318. Allision risk with fishing vessels was also identified as a tolerable impact due to the potential for large tensioned leg floating platforms to be used within the OWF sites which when considered against the potential for commercial fishing vessels to transit within the wind turbine array requires further consideration of foundation design post consent to ensure it does not impact on allision and under keel clearance. This will be secured as part of the layout sign off process (with MMO and in conjunction with MCA) and cable burial risk assessments included as part of the DCO. This will ensure this impact remains in tolerable parameters.

319. It is noted that during the operation and maintenance phase vessel numbers (and personnel numbers) working on the project will be lower than during the construction or decommissioning phases, thus reducing the vessel to vessel collision risk but also diminishing emergency response resources.

15.12.3 Decommissioning Phase

320. For the decommissioning phase the assessment of effects was similar to the construction phase with no unacceptable impacts and identical tolerable impacts (three) that would be mitigated in the same way to ALARP parameters.

321. It is noted that the worst case scenario assumes the offshore export cable(s) would be left in situ reducing the number of vessels on site but requiring future case monitoring to ensure that cable remain buried and/or protected.

15.12.4 Cumulative Impacts

322. All cumulative impacts are tolerable and so the impacts do not require further mitigation to reduce risk to ALARP levels. Vessel deviation and displacement, and any

subsequent vessel to vessel collision risk would require additional mitigation of traffic management (at a project level) to ensure that cumulative project development does not adversely affect a vessel's safe passage through the southern North Sea area.

323. Cumulative allision risk is only associated with projects within the former East Anglia Zone, notably Norfolk Vanguard, Norfolk Boreas, East Anglia One, East Anglia Two, East Anglia Three and East Anglia One North and can be mitigated with further consideration of cumulative lighting, consideration of MGN 543 with regard to directly adjacent wind farm boundaries, and straight line edges of projects bordering the DR1 Lightbuoy DWR.

324. As with diminishing emergency response resources being impacted by the project in isolation, cumulative developments may also have an impact and should again be mitigated by each project effectively managing its own ERPs and self-help capability.

325. The transboundary impacts, relating to impacts that may occur from an activity within one EEA state on the environment or interests of another, have been assessed in regard to shipping and navigation.

326. It was identified that transboundary issues could arise from the project having an effect upon commercial shipping routes transiting between the UK and other EEA ports. However, given the minor deviations expected and the distance of the project from the UK or mainland Europe coastline there are not expected to be any perceptible impacts.

15.12.5 Inter-Relationships

327. Inter-related effects associated with shipping and navigation have been identified in this chapter and are provided in Table 15.13. Impacts on shipping and navigation are primarily associated with placing infrastructure within a previously open sea area resulting in potential route deviations which have been assessed within this chapter.

Table 15.15 Potential impacts identified for shipping and navigation

Potential Impact	Receptor	Severity of Consequence	Frequency	Significance	Additional Mitigation	Residual Impact
Construction						
Effects on vessel routeing and / or displacement – OWF sites including	Commercial vessels	Minor	Reasonably probable	Tolerable	N/A	**Tolerable**
	Recreational vessels	No perceptible effect	No perceptible effect	No perceptible effect	N/A	**No perceptible effect**

Potential Impact	Receptor	Severity of Consequence	Frequency	Significance	Additional Mitigation	Residual Impact
interconnector and array cables	Fishing vessels in transit	Negligible	Remote	Broadly acceptable	N/A	**Broadly acceptable**
Effects on vessel routeing and / or displacement – offshore cable corridor	Commercial vessels, recreational vessels and fishing vessels in transit	No perceptible effect	No perceptible effect	No perceptible effect	N/A	**No perceptible effect**
Increased vessel to vessel collision risk – OWF sites including interconnector and array cables	Commercial vessels	Minor	Reasonably probable	Tolerable	Management of construction traffic.	**Tolerable with mitigation**
	Recreational vessels and fishing vessels in transit	No perceptible effect	No perceptible effect	No perceptible effect	N/A	**No perceptible effect**
Increased vessel to vessel collision risk – offshore cable corridor	Commercial vessels	Minor	Remote	Broadly acceptable	N/A	**Broadly acceptable**
	Recreational vessels and fishing vessels in transit	No perceptible effect	No perceptible effect	No perceptible effect	N/A	**No perceptible effect**
Increased vessel to structure allision risk – OWF sites including interconnector and array cables	Commercial vessels	Minor	Extremely unlikely	Broadly acceptable	N/A	**Broadly acceptable**
	Recreational vessels	Minor	Negligible	Broadly acceptable	N/A	**Broadly acceptable**
	Fishing vessels in transit	Moderate	Extremely unlikely	Broadly acceptable	N/A	**Broadly acceptable**
Increased vessel to structure allision risk – offshore cable corridor	Commercial vessels, recreational vessels and fishing vessels transit	No impact	No impact	No impact	N/A	**No impact**
Anchor interaction and snagging risk – OWF sites	Commercial vessels and fishing vessels in	Minor	Remote	Broadly acceptable	N/A	**Broadly acceptable**

Potential Impact	Receptor	Severity of Consequence	Frequency	Significance	Additional Mitigation	Residual Impact
including interconnector and array cables	transit					
	Recreational vessels	Negligible	Negligible	Broadly acceptable	N/A	**Broadly acceptable**
Anchor interaction and snagging risk – offshore cable corridor	Commercial vessels and fishing vessels in transit	Minor	Remote	Broadly acceptable	N/A	**Broadly acceptable**
	Recreational vessels	Negligible	Extremely unlikely	Broadly acceptable	N/A	**Broadly acceptable**
Diminishing emergency response resources – OWF sites including interconnector and array cables	All sea users	Moderate	Remote	Tolerable	Effective emergency response planning and self-help capabilities including compliance with MGN 543, development of an ERCoP; and a gap analysis to identify resources which may be required.	**Tolerable with mitigation**
Diminishing emergency response resources – offshore cable corridor	All sea users	No perceptible effect	No perceptible effect	No perceptible effect	N/A	**No perceptible effect**
Operation and maintenance						
Effects on vessel routeing and / or displacement – OWF sites including interconnector and array cables	Commercial vessels	Minor	Reasonably probable	Tolerable	N/A	**Tolerable**
	Recreational vessels	No perceptible effect	No perceptible effect	No perceptible effect	N/A	**No perceptible effect**
	Fishing vessels in transit	Negligible	Remote	Broadly acceptable	N/A	**Broadly acceptable**

Potential Impact	Receptor	Severity of Consequence	Frequency	Significance	Additional Mitigation	Residual Impact
Effects on vessel routeing and / or displacement – offshore cable corridor	Commercial vessels, recreational vessels and fishing vessels transit	No impact	No impact	No impact	N/A	**No impact**
Increased vessel to vessel collision risk – OWF sites including interconnector and array cables	Commercial vessels	Minor	Remote	Broadly acceptable	N/A	**Broadly acceptable**
	Recreational vessels and fishing vessels in transit	No perceptible effect	No perceptible effect	No perceptible effect	N/A	**No perceptible effect**
Increased vessel to vessel collision risk – offshore cable corridor	Commercial vessels, recreational vessels and fishing vessels in transit	No impact	No impact	No impact	N/A	**No impact**
Increased vessel to structure allision risk – OWF sites including interconnector and array cables	Commercial vessels	Minor	Remote	Broadly acceptable	N/A	**Broadly acceptable**
	Recreational vessels	Moderate	Extremely unlikely	Broadly acceptable	N/A	**Broadly acceptable**
	Fishing vessels in transit	Moderate	Remote	Tolerable	Further mitigation may be required depending upon foundation type selected.	**Tolerable**
Increased vessel to structure allision risk – offshore cable corridor	Commercial vessels, recreational vessels and fishing vessels transit	No impact	No impact	No impact	N/A	**No impact**
Anchor interaction and snagging risk – OWF sites	Commercial vessels	Negligible	Extremely unlikely	Broadly acceptable	N/A	**Broadly acceptable**
	Recreational vessels	Negligible	Negligible	Broadly acceptable	N/A	**Broadly acceptable**

Potential Impact	Receptor	Severity of Consequence	Frequency	Significance	Additional Mitigation	Residual Impact
including interconnector and array cables	Fishing vessels in transit	Minor	Extremely unlikely	Broadly acceptable	N/A	**Broadly acceptable**
Anchor interaction and snagging risk – offshore cable corridor	Commercial vessels and fishing vessels in transit	Minor	Remote	Broadly acceptable	N/A	**Broadly acceptable**
	Recreational vessels	Negligible	Extremely unlikely	Broadly acceptable	N/A	**Broadly acceptable**
Diminishing emergency response resources – OWF sites including interconnector and array cables	All sea users	Minor	Extremely unlikely	Broadly acceptable	N/A	**Broadly acceptable**
Diminishing emergency response resources – offshore cable corridor	All sea users	No impact	No impact	No impact	N/A	**No impact**
Decommissioning						
Effects on vessel routeing and / or displacement – OWF sites including interconnector and array cables	Commercial vessels	Minor	Reasonably probable	Tolerable	N/A	**Tolerable**
	Recreational vessels	No perceptible effect	No perceptible effect	No perceptible effect	N/A	**No perceptible effect**
	Fishing vessels in transit	Negligible	Remote	Broadly acceptable	N/A	**Broadly acceptable**
Effects on vessel routeing and / or displacement – offshore cable corridor	Commercial vessels, recreational vessels and fishing vessels transit	No perceptible effect	No perceptible effect	No perceptible effect	N/A	**No perceptible effect**
Increased vessel to vessel collision risk – OWF sites	Commercial vessels	Minor	Reasonably probable	Tolerable	Management of construction traffic	**Tolerable with mitigation**

Potential Impact	Receptor	Severity of Consequence	Frequency	Significance	Additional Mitigation	Residual Impact
including interconnector and array cables					including the use of control measures for construction traffic such as entry/exit points.	
	Recreational vessels and fishing vessels in transit	No perceptible effect	No perceptible effect	No perceptible effect	N/A	**No perceptible effect**
Increased vessel to vessel collision risk – offshore cable corridor	Commercial vessels, recreational vessels and fishing vessels in transit	No impact	No impact	No impact	N/A	**No impact**
Increased vessel to structure allision risk – OWF sites including interconnector and array cables	Commercial vessels	Minor	Extremely unlikely	Broadly acceptable	N/A	**Broadly acceptable**
	Recreational vessels	Minor	Negligible	Broadly acceptable	N/A	**Broadly acceptable**
	Fishing vessels in transit	Moderate	Extremely unlikely	Broadly acceptable	N/A	**Broadly acceptable**
Increased vessel to structure allision risk – offshore cable corridor	Commercial vessels, recreational vessels and fishing vessels transit	No impact	No impact	No impact	N/A	**No impact**
Anchor interaction and snagging risk – OWF site including interconnector and array cables	Commercial vessels and fishing vessels in transit	Minor	Extremely unlikely	Broadly acceptable	N/A	**Broadly acceptable**
	Recreational vessels	Negligible	Negligible	Broadly acceptable	N/A	**Broadly acceptable**
Anchor interaction and snagging risk – offshore cable corridor	Commercial vessels and fishing vessels in transit	Minor	Remote	Broadly acceptable	N/A	**Broadly acceptable**

Potential Impact	Receptor	Severity of Consequence	Frequency	Significance	Additional Mitigation	Residual Impact
	Recreational vessels	Negligible	Extremely unlikely	Broadly acceptable	N/A	**Broadly acceptable**
Diminishing emergency response resources – OWF sites including interconnector and array cables	All sea users	Moderate	Remote	Tolerable	Effective emergency response planning and self-help capabilities	**Tolerable with mitigation**
Diminishing emergency response resources – offshore cable corridor	All sea users	No perceptible effect	No perceptible effect	No perceptible effect	N/A	**No perceptible effect**
Cumulative						
Effects on deviation and vessel and vessel collision risk associated with cumulative projects within the southern North Sea	Commercial vessels, recreational vessels and fishing vessels in transit	Moderate	Reasonably probable	Tolerable	Management of construction traffic	**Tolerable with mitigation**
Effects on vessel to structure allision risk associated with cumulative projects within the southern North Sea	Commercial vessels, recreational vessels and fishing vessels in transit	Moderate	Reasonably probable	Tolerable	Consideration of cumulative lighting, consideration of MGN 543 with regard to directly adjacent wind farm boundaries and straight line edges of projects bordering the DR1 Lightbuoy DWR.	**Tolerable with mitigation**

Potential Impact	Receptor	Severity of Consequence	Frequency	Significance	Additional Mitigation	Residual Impact
Diminishing emergency response resources due to cumulative projects within the southern North Sea	Commercial vessels, recreational vessels and fishing vessels in transit	Moderate	Reasonably probable	Tolerable	Effective emergency response planning and self-help capabilities	**Tolerable with mitigation**
Transboundary						
Effects on deviation causing transboundary impacts at mainland European ports.	Commercial vessel routeing.	No perceptible effect	No perceptible effect	No perceptible effect	N/A	**No perceptible effect**

15.13 References

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