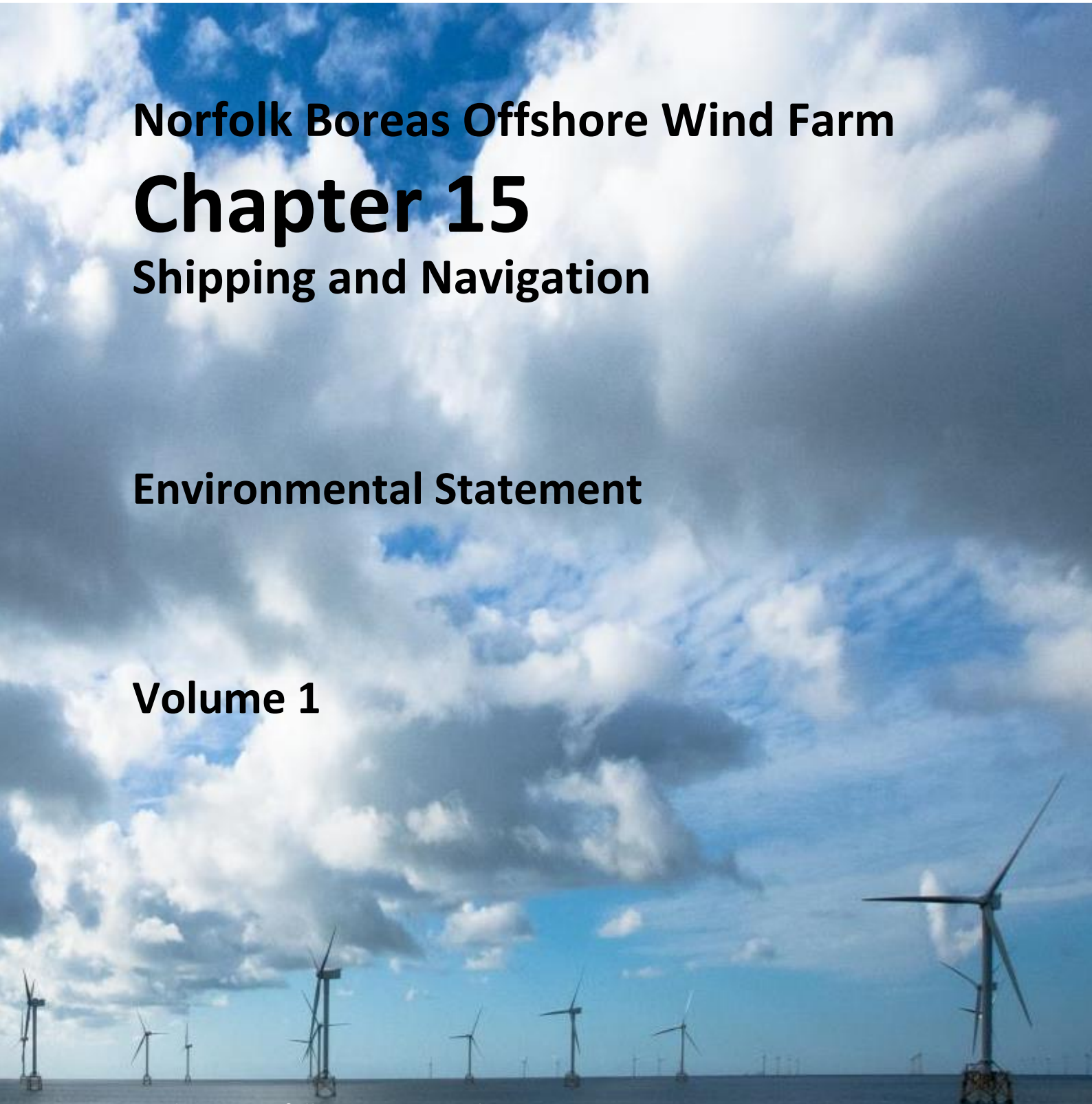
Norfolk Boreas Offshore Wind Farm

Chapter 15

Shipping and Navigation

Environmental Statement

Volume 1



Applicant: Norfolk Boreas Limited
Document Reference: 6.1.15
Pursuant to APFP Regulation: 5(2)(a)

Date: June 2019
Revision: Version 1
Author: Anatec Limited

Photo: Ormonde Offshore Wind Farm

Date	Issue No.	Remarks / Reason for Issue	Author	Checked	Approved
20/02/2019	01D	Norfolk Boreas Limited review	Anatec	JL/DT	JL
05/03/2019	02D	Norfolk Boreas Limited Review	Anatec	JL/DT	JL
11/04/2019	01F	Norfolk Boreas Limited review	Anatec	DT	JL

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Glossary of Acronyms

AIS	Automatic Identification System
ALARP	As Low As Reasonably Practicable
AtoNs	Aids to Navigation
BEIS	Department for Business, Energy and Industrial Strategy
BMAPA	British Marine Aggregate Producers Association
CA	Cruising Association
CIA	Cumulative Impact Assessment
COLREGS	International Convention for the Prevention of Collision at Sea
CoS	Chamber of Shipping
DCO	Development Consent Order
DML	Deemed Marine Licence
DSC	Digital Selective Calling
DWR	Deep Water Route
EEA	European Economic Area
EIA	Environmental Impact Assessment
ERCoP	Emergency Response Co-operation Plan
ES	Environmental Statement
EU	European Union
FSA	Formal Safety Assessment
HSE	Health and Safety Executive
IALA	International Association of Marine Aids to Navigation and Lighthouse Authorities
IHO	International Hydrographic Organisation
IMO	International Maritime Organization
ITF	International Transport Forum
km	Kilometre
m	Metre
MAIB	Marine Accident Investigation Branch
MCA	Maritime and Coastguard Agency
MEHRA	Marine Environmental High Risk Area
Met Mast	Meteorological Mast
MGN	Marine Guidance Note
MHWS	Mean High Water Springs
MMO	Marine Management Organisation
MW	Megawatt
nm	Nautical Mile
NPS	National Policy Statement
NRA	Navigation Risk Assessment
NtM	Notice to Mariners
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

RAM	Restricted in Ability to Manoeuvre
RNLI	Royal National Life Institution
RYA	Royal Yachting Association
SAR	Search and Rescue
SNSOWF	Southern North Sea Offshore Wind Forum
SOLAS	Safety of Life at Sea
SPS	Significant Peripheral Structure
TH	Trinity House
TSS	Traffic Separation Scheme
UK	United Kingdom
UKCS	United Kingdom Continental Shelf
UKHO	United Kingdom Hydrographic Office
VHF	Very High Frequency

Glossary of Terminology

Abaft the Beam	A relative bearing of greater than 90 degrees from the bow.
Abeam	A relative bearing at right angle to a vessel keel, the central structural basis of the hull.
As Low As Reasonably Practicable (ALARP)	The principle that the residual risk shall be reduced as far as reasonably practicable.
Allision	Contact between a moving and stationary object.
Array cables	Cables which link wind turbine to wind turbine, and wind turbine to offshore electrical platforms.
Automatic Identification System (AIS)	Automatic Identification System. A system by which vessels automatically broadcast their identity, key statistics e.g. length, brief navigation details e.g. location, destination, speed and current status e.g. survey. Most commercial vessels and European Union (EU) fishing vessels over 15 m are required to have AIS.
Baseline	The assessment of risk based on current shipping densities and traffic types as well as the marine environment.
Bow	Front of a vessel
Collision	The act or process of colliding (crashing) between two moving objects.
Design Rules	A set of rules defining how the layout will be designed post consent. The Rules have been agreed with the Maritime and Coastguard Agency (MCA) and Trinity House (TH) to ensure safe navigation of third party surface vessels and Search and Rescue (SAR) helicopters and surface vessels.
Formal Safety Assessment (FSA)	A structured and systematic process for assessing the risks and costs (if applicable) associated with shipping activity.
Future Case	The assessment of risk based on the predicted growth in future shipping densities and traffic types as well as foreseeable changes in the marine environment.
Interconnector cables	Offshore cables which link offshore electrical platforms within the Norfolk Boreas site.
Landfall	Where the offshore cables come ashore at Happisburgh South
Lee	Area where land or the shoreline provides shelter from adverse weather conditions such as strong winds or tidal conditions.
Marine Environmental High Risk Area (MEHRA)	Areas in United Kingdom (UK) coastal waters where ships' masters are advised of the need to exercise more caution than usual i.e. crossing areas of high

	environmental sensitivity where there is a risk of pollution from commercial shipping.
Marine Guidance Note (MGN)	A system of guidance notes issued by the MCA which provide significant advice relating to the improvement of the safety of shipping and of life at sea, and to prevent or minimise pollution from shipping.
Navigation Risk Assessment (NRA)	A document which assesses the overall impact to shipping and navigation of a proposed Offshore Renewable Energy Installation (OREI) based upon formal risk assessment.
Norfolk Boreas site	The Norfolk Boreas wind farm boundary. Located offshore, this will contain all the wind farm array.
Norfolk Vanguard	Norfolk Vanguard offshore wind farm, sister project of Norfolk Boreas.
Not Under Command	Under Part A of the International Regulations for Preventing Collisions at Sea (COLREGs), the term "vessel not under command" means a vessel which through some exceptional circumstance is unable to manoeuvre as required by these Rules and is therefore unable to keep out of the way of another vessel.
Offshore cable corridor	The corridor of seabed from the Norfolk Boreas site to the landfall site within which the offshore export cables will be located.
Offshore electrical platform	A fixed structure located within the Norfolk Boreas site, containing electrical equipment to aggregate the power from the wind turbines and convert it into a suitable form for export to shore.
Offshore export cables	The cables which transmit power from the offshore electrical platform to the landfall.
Offshore Renewable Energy Installation (OREI)	OREIs as defined by Guidance on UK Navigational Practice, Safety and Emergency Response Issues, MGN 543. For the purpose of this report and in keeping with the consistency of the EIA, OREI can mean offshore turbines and the associated electrical infrastructures such as offshore High Voltage Alternating Current (HVAC) transformer substations, offshore High Voltage Direct Current (HVDC) converter substations, offshore service platform and offshore HVAC booster stations.
Offshore Service Platform	A platform to house workers offshore and/or provide helicopter refuelling facilities. An accommodation vessel may be used as an alternative for housing workers.
Pitch	The up and down rotation of a vessel about its transverse axis.
Offshore project area	The area including the Norfolk Boreas site, project interconnector cable search area and offshore cable corridor.
Project interconnector cable	Offshore cables which would link either turbines or an offshore electrical platform in the Norfolk Boreas site with an offshore electrical platform in one of the Norfolk Vanguard sites.
Project interconnector search area	The area within which the project interconnector cable would be installed.
Radar	Radio Detection And Ranging – an object-detection system which uses radio waves to determine the range, altitude, direction, or speed of objects.
Regular Operator	A commercial vessel operator whose vessel(s) are observed to transit through a particular region on a regular basis.
Roll	The tilting rotation of a vessel about its longitudinal axis.
Safety Zone	A marine zone demarcated for the purposes of safety around a possibly hazardous installation or works/ construction area under the Energy Act 2004.
Significant Peripheral Structure (SPS)	A peripheral structure (usually a wind turbine) either at a corner or other significant point of an array.
Stern	Rear of a vessel
The project	Norfolk Boreas Wind Farm including the onshore and offshore infrastructure.

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15 SHIPPING AND NAVIGATION

15.1 Introduction

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

2. This chapter has been prepared by Anatec Limited 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 (IMO) Formal Safety Assessment (FSA) (2002) to assess risks associated with the development of Norfolk Boreas within the Navigation Risk Assessment (NRA) (Appendix 15.1). The NRA is the supporting technical document which scopes out impacts that are not significant for the Environmental Statement (ES), and contains the background technical analysis undertaken to inform the Environmental Impact Assessment (EIA) therein. The results of the NRA are summarised in this chapter.

4. Vattenfall Wind Power Limited (VWPL) (the parent company of Norfolk Boreas Limited) is also developing Norfolk Vanguard, a 'sister project' to Norfolk Boreas. Norfolk Vanguard's development schedule is approximately one year ahead of Norfolk Boreas and as such the Development Consent Order (DCO) application was submitted in June 2018.

5. Norfolk Vanguard may undertake some enabling works for Norfolk Boreas, but these are only relevant to the assessment of impacts onshore. This assessment does however include interconnector cables between the Norfolk Boreas and Norfolk Vanguard projects (herein, 'the project interconnector'). If Norfolk Vanguard does not proceed then the project interconnector would not be required.

15.2 Legislation, Guidance and Policy

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

7. 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 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 15.3 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 TH for United Kingdom (UK) wind farms), relevant industry bodies and representatives of recreational users	2.6.154	Section 15.3 summarises consultation undertaken with the organisations stated. Consultation with the MMO is ongoing at an overarching 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 NRA (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.

8. 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	Paragraph in NPS EN-3	Where Addressed in ES
Consent shall not be granted to the construction or extension of offshore wind farm (OWF) 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, however it is noted that the

Summary of NPS EN-3 Policy	Paragraph in NPS EN-3	Where Addressed in ES
		primary assessment concern of the NRA (Appendix 15.1) is navigational safety.
Negative impacts on less strategically important shipping routes should be reduced to As Low as Reasonably Practicable (ALARP).	2.6.163	Section 15.6 includes an analysis of all shipping and main routes in the vicinity of the proposed project, with associated impacts assessed in section 15.7.
A detailed Search and Rescue (SAR) Response Assessment should be undertaken prior to the commencement of construction.	2.6.164	Section 10 of the NRA (Appendix 15.1) outlines emergency response resources relative to the proposed project and sections 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.

9. The primary guidance considered for this chapter is the Marine Guidance Note (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, 2015).

10. Other guidance considered within this chapter and the NRA (Appendix 15.1) is listed below:

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

15.3 Consultation

11. As part of the EIA process, extensive consultation with key marine stakeholders relevant to shipping and navigation has been undertaken. This includes individual meetings with statutory stakeholders, liaison with regular operators, Hazard Consultations undertaken in a group setting to inform the Hazard Log, responses received under Section 42 of the Planning Act 2008 in response to the Preliminary Environmental Information Report (PEIR), responses received as part of a targeted consultation on a change in offshore order limits and consideration of outputs of the Scoping process.

12. During the course of the Norfolk Boreas EIA new information and guidance has been incorporated as appropriate. However, it was necessary to have a cut-off point prior to the DCO submission to allow the assessment to be completed, after which new guidance or information would not be considered. This cut-off point was taken to be the 20th March which coincided with Deadline 5 of the Norfolk Vanguard Examination.

13. At the time of writing the Norfolk Vanguard project is under examination. Given the similarities between Norfolk Vanguard and Norfolk Boreas in terms of design, location and timing, many of the issues examined for Norfolk Vanguard are also relevant to the Norfolk Boreas project. Therefore, relevant matters considered under the examination process for Norfolk Vanguard have been given regard within the assessment for Norfolk Boreas where possible. In order that the programmed submission of the Norfolk Boreas DCO has not been impacted it has been necessary to also use the cut-off point of the 20th March after which information provided at the Vanguard examination has not been included in this assessment unless it could be done without impacting the programme for submission.

14. A summary of the key consultation output is presented in Table 15.3. A full list of consultation undertaken and responses received is available within the NRA (Appendix 15.1).

Table 15.3 Consultation Output Summary

Consultee	Document & Date	Comment	Response / where addressed in the ES
Secretary of State	Scoping Opinion June 2017	The EIA should consider a worst case scenario in its navigation assessment. The EIA should set out how such a worst case scenario has been determined.	The worst case scenario assessed is detailed in section 15.7.3.
		If the Davy platform is still in place upon undertaking of the EIA, it should still be considered cumulatively, even if it is planned to be decommissioned prior to construction. This includes cumulative effects of the decommissioning process.	The scenario in which the Davy platform is not decommissioned prior to the construction of Norfolk Boreas is included within the impact assessment (section 15.7).
		The EIA should provide justification for the rise in traffic of 10% assumed in the future case modelling.	Cases of 10% and 20% have been assessed within the NRA in line with the scenarios assessed for Norfolk Vanguard (Anatec, 2017) at the request of the Chamber of Shipping (CoS). The 10% value has been assumed to ensure comparison with other North Sea development assessments and is considered to be a realistic future case scenario.
		Exposed cables could create a snagging risk to vessel anchors, and this should be assessed within the EIA.	This risk has been assessed for all project phases within this chapter (sections 15.7.5.9, 15.7.6.9 and 15.7.7.9.3).
		The EIA should clearly identify whether or not an effect is considered to be significant, as per the EIA Regulations 2009.	The EIA undertaken within this chapter uses an FSA approach as required under the MCA methodology (MCA, 2015). Impacts are assessed as either broadly acceptable (not significant in EIA terms), tolerable (not significant in EIA terms), or unacceptable (significant in EIA terms). This is stated within the conclusion of each impact assessed.
MMO	Scoping Opinion June 2017	Non-renewable developments such as aggregate dredging and port and harbour developments should be considered within the Cumulative Impact Assessment (CIA).	Marine aggregate dredging and port / harbour developments have been considered as part of the baseline (section 15.6).
MCA	Scoping Opinion June 2017	The EIA Should include assessment of the following impacts for both commercial and recreational vessels:	Impact screening is undertaken within the NRA (Appendix 15.1, see section 27.2), including for each of the

Consultee	Document & Date	Comment	Response / where addressed in the ES
		• Collision; • Navigational safety; • Visual intrusion and noise; • Risk management and emergency response; • Marking and lighting; • Information to mariners; • Effect on small craft navigational and communication equipment; • Risk to drifting recreational craft in adverse weather or tidal conditions; and • Squeeze of small craft into the routes of larger commercial vessels.	impacts listed by the MCA. Those impacts screened in have been assessed within section 15.7 of this chapter.
		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 OREI. This NRA should be accompanied by a detailed MGN 543 Checklist.	The NRA forms the technical appendix to this chapter (Appendix 15.1). A completed MGN 543 checklist is available in Appendix 15.2.
		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.	Norfolk Boreas Limited would ensure the hydrographic surveys are compliant with IHO Order 1a and MCA requirements.
		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 are required e.g. rock bags, concrete mattresses, the MCA would be willing to accept a 5% reduction in surrounding depths referenced to Chart Datum.	Norfolk Boreas Limited would undertake an assessment of cable burial / protection post consent as per section 15.7.1 (embedded mitigation). This would include consideration of under keel clearance issues.
		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	Impacts on marine radar have been assessed within the NRA (Appendix 15.1).

Consultee	Document & Date	Comment	Response / where addressed in the ES
		into consideration previous reports on the subject available on the MCA website.	
		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.	Vessel displacement and adverse weather routeing are assessed within section 15.7 of this chapter.
		Particular consideration will need to be given to the implications of the site size and location on SAR resources and Emergency Response Co-operation Plans (ERCoP). Attention should be paid to the level of radar surveillance, Automatic Identification System (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.	The layout would be agreed with the MCA (with consideration as to the Design Rules) and MMO post consent. The mechanism securing this would be via the Deemed Marine Licence (DML) which would form part of the Development Consent Order (DCO). This would include consideration of SAR and emergency response.
Norfolk County Council	Scoping Opinion June 2017	The CIA should include consideration of operational, consented or proposed wind farms of the Norfolk Coast. All impacts should be considered for commercial vessels, fishing vessels, and recreational vessels. It should be ensured that there will not be any demonstrable negative impact on Norfolk's ports as a consequence of the proposed OWFs and any potential change in shipping and navigational routes.	The CIA considers all projects listed in section 15.8. Ports are considered within the NRA (Appendix 15.1), and impacts were subsequently screened out on the basis of proximity. Impacts have been assessed for commercial, fishing, and recreational vessels.
		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.	Mitigation measures considered embedded are listed in section 15.7.1.
TH	Scoping Opinion June 2017	The NRA should include: • Comprehensive vessel traffic analysis in accordance with	Marine traffic analysis has been undertaken as part of the NRA (Appendix 15.1), with a summary

Consultee	Document & Date	Comment	Response / where addressed in the ES
		MGN 543; and • Cumulative effects on shipping routes.	provided in section 15.6 of this chapter. Cumulative effects on routeing are assessed in detail within the NRA (Appendix 15.1) and in section 15.8 of this chapter.
		Proposed layouts should comply with MGN 543. Any structures located outside of the array (e.g., Offshore Substation Platforms) will require additional risk assessment.	Compliance with MGN 543 is considered as embedded mitigation (section 15.7.1). The layout would be agreed with the MCA (with consideration as to the Design Rules) (via the MMO) post consent.
		Wind farm structures should be marked in line with IALA O-139 requirements, and additional Aids to Navigation (AtoNs) (e.g., buoyage) may be necessary.	Lighting and marking would be in line with IALA O-139, and would be agreed with TH post consent (including buoyage).
		All lighting and marking is required to be agreed with TH. All AtoNs must meet the internationally recognised availability and reporting standards.	Lighting and marking requirements would be agreed with TH post consent. AtoNs would be designed to meet the required availability standards.
		A buffer zone between the wind farm and the Deep Water Route (DWR) to the west should be fully considered.	Buffer zones would be implemented in line with those agreed for Norfolk Vanguard and East Anglia THREE to ensure a continuous and consistent separation between structures and the DWRs.
		National trans-boundary issues should be assessed, through consultation with the Dutch authorities.	The Dutch authority (Rijkswaterstaat) has been consulted with in regards to cumulative effects on vessel routeing.
		A decommissioning plan, which includes a scenario where on decommissioning and on 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 or no longer considered a danger to navigation, the continuing cost of which would need to be met by the developer / operator.	A decommissioning plan would be agreed post consent. Decommissioning impacts are assessed in section 15.7.7.
		Marking of the export cables and the	An assessment of cable burial and

Consultee	Document & Date	Comment	Response / where addressed in the ES
		associated installation vessels should be considered. 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.	protection would be undertaken post consent, as per the embedded mitigation listed in section 15.7.1.
MCA and TH	Kick Off Meeting May 2018	The MCA queried whether non AIS traffic has been accounted for.	The data sources used to inform the baseline assessment within the NRA (Appendix 15.1) are detailed in Table 15.8. This includes visual and radar data. It was agreed that the summer 2017 and winter 2018 survey data would inform the PEIR. This ES chapter has now been updated with a summer 2018 survey.
		MCA noted that lighting and marking (including aviation lighting) will need to be considered in line with lighting and marking approved for Norfolk Vanguard.	Lighting and marking design would be undertaken post consent, as per the embedded mitigation listed in section 15.7.1. Lighting and marking would be designed to be sympathetic to that agreed for Norfolk Vanguard.
		TH stated any issues relating to alignment with platforms (oil or gas) will need to be assessed. Oil and gas decommissioning activities will need to be assessed cumulatively where information is publicly available.	The layout would be agreed with the MCA post consent (with consideration as to the Design Rules) via agreement with the MMO which would be secured in the DML.
		MCA stated if the Meteorological Mast (Met Mast) is still present when other structures are installed, it will need to be accounted for within layout discussions surrounding lines of orientation.	The layout would be agreed with the MCA post consent (with consideration as to the Design Rules) via agreement with the MMO which would be secured in the DML.
		Should the export cables interfere with existing buoys, TH must be consulted prior to installation to ensure both navigational and commercial concerns are addressed.	No buoys were identified within the offshore cable corridor (see section 8.3 of the NRA, Appendix 15.1). However TH would be consulted if any works were to interfere with existing buoyage.
Rijkswaterstaat	Consultation telephone meeting May 2018	Queried if consultation responses from Rijkswaterstaat issued for other projects would be considered for Norfolk Boreas (notably for East Anglia THREE).	Consultation outputs of other projects have been considered (notably East Anglia THREE and Norfolk Vanguard). However any points considered as requiring addressing specifically should be

Consultee	Document & Date	Comment	Response / where addressed in the ES
			highlighted in the S42 response to the PEIR.
		Cumulative routeing within the Dutch sector and within the vicinity of Norfolk Boreas was discussed.	The output of this consultation has been incorporated into the cumulative routeing assessment undertaken in the NRA (section 19.3).
BP Shipping, CoS and RYA	Hazard Workshop May 2018	CoS raised concerns over small vessels being displaced into the DWRs which were originally intended for larger, deep draughted vessels.	Smaller vessels may choose to transit through the wind farms. Future case routeing has been assessed in the NRA (Appendix 15.1) and section 15.7 of this chapter.
		CoS stated the IMO routeing measures should be included within the cumulative case.	All routeing assessment (pre wind farm, post wind farm, and cumulative) has taken account of the IMO routeing measures.
		BP Shipping content with one nautical mile spacing between DWR and bordering wind farms but stated their biggest concern was a vessel breaking down.	The potential for a vessel to break down and subsequently drift into a wind turbine is assessed in section 15.7. The supporting modelling process is provided in the NRA (Appendix 15.1).
		RYA expressed concern over reduction of coastal water depths through external cable protection.	Any cable protection would comply with MGN 543.
Cruising Association (CA) and Scotline		CA noted concern over potential fishing vessel and recreational vessel encounters (which the wind farm may increase).	Encounters within the marine traffic survey have been identified and analysed within the NRA (Appendix 15.1).
		Scotline raised concern over the impact of Norfolk Boreas on Scotline routes from Inverness to the continent and from Rochester, north-east bound.	Future case routeing has been assessed in the NRA (Appendix 15.1) and the impact on commercial vessels assessed in section 15.7 of this chapter.
		Scotline raised concern over adverse weather routeing due to the preference to transit the UK coast southbound before transiting the sea area where Norfolk Boreas, Norfolk Vanguard and EA3 are proposed.	Vessel displacement and adverse weather routeing are assessed within section 15.7 of this chapter.
		Scotline raised concern over vessel breakdown within the vicinity of a wind farm.	Collision and allision modelling is assessed within the NRA (Appendix 15.1), including drifting risks.
		Scotline stated that if smaller vessels are displaced into the DWR, the larger vessels lack of manoeuvrability would	Collision impacts are assessed in section 15.7.

Consultee	Document & Date	Comment	Response / where addressed in the ES
		be a concern.	
		CA stated concerns over cumulative effects.	Cumulative impacts are assessed within section 15.8 of this Chapter.
		CA stated concern over wind farm vessels causing congestion within port approaches.	Marine coordination would be in place as per the embedded mitigation listed in section 15.7.1.
		CA noted that consistency of appearance within a wind farm is of importance to recreational users.	Lighting and marking would be agreed with the MCA and TH post consent. The layout would be agreed with the MCA post consent (with consideration as to the Design Rules) via agreement with the MMO.
		CA stated a preference for a south-west / north-east line of orientation. Scotline indicated a north-west / south-east orientation would be preferable.	The layout would be agreed with the MCA post consent (with consideration as to the Design Rules) via agreement with the MMO.
		CA stated that under keel clearance would be an issue in areas where depths are currently less than 10m.	Norfolk Boreas would undertake an assessment of cable burial / protection post consent as per section 15.7.1 (embedded mitigation). This would include consideration of under keel clearance issues. Norfolk Boreas would also comply with MGN 543.
DFDS Seaways	April 2018 Regular Operator Consultation	Norfolk Boreas would impact DFDS' Newcastle (UK) to Amsterdam (Ijmuiden, Netherlands) route. Impact will increase fuel bills, time and emissions.	Vessel displacement and adverse weather routeing are assessed within section 15.7 of this chapter.
Scotline		Norfolk Boreas and Norfolk Vanguard will impact their trading. Any deviations will have a cost impact, especially if vessels do not arrive in time for the tide. Scotline's adverse weather routeing will also be adversely affected.	Vessel displacement and adverse weather routeing are assessed within section 15.7 of this chapter.
		The exclusion zones [sic] of Norfolk Boreas will displace more vessels into the DWRs increasing collision risk.	Displacement and collision risk impacts are assessed within section 15.7 of this chapter.
		Expressed concern over the cumulative impact of multiple OWFs within the North Sea.	Cumulative impacts are assessed within section 15.8 of this Chapter.
Scotline	Response to draft Hazard	Queried FSA terminology, particularly the definitions of the significance	The FSA process (including terminology) is described in section

Consultee	Document & Date	Comment	Response / where addressed in the ES
	Log July 2017	rankings.	15.4.
		Raised concerns over time / financial costs arising from deviations around wind farm. Concerns also raised over displacement of traffic leading to a navigation or pollution incident.	Impacts associated with vessel deviation and displacement are assessed in section 15.7.
MCA	PEIR Response December 2019	The development area carries a significant amount of through traffic. Attention therefore needs to be paid to routeing, particularly in heavy weather to ensure safe passage without significant large scale deviations.	The majority of traffic in the area utilises the nearby DWRs, with traffic through the Norfolk Boreas site itself being less frequent. Displacement and adverse weather routeing are assessed within section 15.7 of this chapter, noting that vessels within the existing routeing measures will not be displaced.
		Possible cumulative and in combination effects on routes should be considered taking into account Norfolk Vanguard East, Norfolk Vanguard West, East Anglia 3 and other Southern North Sea operations.	Cumulative impacts are assessed in section 15.8 of this chapter.
		Turbine layout design will require MCA approval prior to construction to minimise risk to surface vessels, including rescue boats and SAR aircraft. Structures must be aligned in straight rows and columns, including any platforms with a minimum of two lines orientation. Any additional navigation safety and / or SAR requirements as per MGN 543 Annex 5 (v2) will be agreed at the approval stage.	The layout and any additional navigational safety and / or SAR requirements would be agreed with the MCA post consent in line with the Design Rules.
		An approved ERCoP is required prior to construction. The ERCoP is an active operational document and must remain current during all stages of the project. A SAR checklist will be discussed post consent.	An ERCoP would be produced post consent and agreed with the MCA as per section 15.7.1. The SAR checklist process will be discussed and agreed with the MCA post consent.
		Supports safety zones during construction, maintenance and decommissioning phases. Should be noted that operational safety zones may have maximum 50m radius from individual turbines. Justification and evidence for 50m operational safety zone would be required.	A safety zone application would be produced and agreed with the MCA post consent, noting that the application for safety zones is assumed as embedded mitigation in section 15.7.1. This may include provision for operational safety zones around manned platforms.

Consultee	Document & Date	Comment	Response / where addressed in the ES
		Information on potential mooring arrangements for floating turbines should be included in the ES. This includes possible anchor and line spread, monitoring, recovery of turbines and third party verification. Recent MCA and HSE guidance should be referenced.	Floating tension leg platforms are no longer being considered therefore no response is required.
		MCA would like to see continuous construction which is progressive across the wind farm with no opportunity for two separate areas to be constructed with a gap in the middle.	Norfolk Boreas Limited considers that the effects of disparate construction sites are mitigated, notably through the use of aids to navigation during the entire construction phase. Embedded mitigation is listed in section 15.7.1.
MMO	PEIR Response December 2019	A cable burial risk assessment is proposed pre-construction. The cable burial risk assessment also needs to be conducted post construction and updated regularly to provide understanding of burial and mitigate risks to other sea users. Risk assessment should include mitigation that will be required. This should be presented within the ES. Further information required on how changes in burial depths over time are addressed in the EIA, and how risks are to be communicated to fishermen and other sea users.	Norfolk Boreas Limited would undertake an assessment of cable burial / protection post consent as per section 15.7.1 (embedded mitigation). Further details, including risk mitigation and promulgation of information are summarised in section 26.3 of the NRA (Appendix 15.1).
		If during construction, any unused cables are to be cut and clumped at the point of intersection with the windfarm cables, requests clarification on how the impact on other sea users will be assessed and mitigated to avoid navigational risk.	Norfolk Boreas Limited would undertake an assessment of cable burial / protection post consent as per section 15.7.1 (embedded mitigation), where the approach to disused cables would also be detailed.
		Notes that Vattenfall has stated that cable protection is to be kept to a minimum which is welcomed. However, the MMO expects that contingency for unexpected exposures / unburied cables will be built into the assessments.	Norfolk Boreas Limited would undertake an assessment of cable burial / protection post consent as per section 15.7.1 (embedded mitigation). Protection would be periodically monitored to identify any areas of exposure or ineffective protection as per section 26.3 of the NRA (Appendix 15.1).
TH	PEIR Response	Contents of letter noted. Look forward to working with Norfolk Boreas	Noted.

Consultee	Document & Date	Comment	Response / where addressed in the ES
	December 2019	Limited up to and throughout the application process.	
Rijkswaterstaat	PEIR Response December 2019	Of the 40+ potential impacts on shipping and navigation, only 12 have been assessed as 'Tolerable' of which 4 Tolerable with mitigation'. The other potential impacts are assessed as 'Broadly acceptable' or 'no impact'. This seems a mild result, certainly if cumulative effects are considered. Could you elaborate on this issue and especially on the following two issues?	The impact assessment has been undertaken using the IMO FSA, as per MCA requirements and in line with the shipping and navigation assessments that have been undertaken for similar UK developments. Under the relevant MCA guidance this approach is primarily concerned with ensuring mariner safety, considering consequence (safety) and the frequency of the effect into account to determine overall impact significance. Further details are provided in section 15.4 of the ES. The rankings for the Norfolk Boreas ES are considered justified on the basis that impact significance has been based on the likely frequency at which any given consequence will occur (as assessed within this comprehensive NRA).
		Could you explain why a collision of a commercial vessel with third party vessels or a structure would only have MINOR consequences (slight injury, minor damage, tier 1 pollution assistance, minor business safety)? Experts in The Netherlands have pointed out more severe consequence due to the exchange of a lot of energy. Even in the case when a large ship drifts into an OWF. But of course real data on this subject sparse.	The assessment considers both frequency and consequence of each impact, with consideration of both most likely and realistic worst cases considered within the hazard log, produced as part of the NRA process (Appendix 15.1 to the ES), which ultimately feeds into the impact assessment. In this case, the minor consequence ranking was attached to the assessed frequency at which a collision with such consequences was estimated to occur (at most reasonable probable), based on the findings of the NRA (Appendix 15.1 to the ES). A collision resulting in more severe consequences (which is acknowledged as a feasible outcome) would be assessed as being of a lesser frequency than a collision with minor consequences, leading to the same overall significance (at most tolerable with mitigation).
		Deviation of routeing due to adverse	The remote frequency assessed refers

Consultee	Document & Date	Comment	Response / where addressed in the ES
		weather – for commercial vessels the frequency is considered to be remote 1 in 10 to 100 years) but according to our information this should be 'frequent'(yearly)	to the frequency at which an incident of restricted adverse weather routeing would be likely to result in moderate safety consequences. It is agreed that Norfolk Boreas will impact upon adverse weather routeing on a more frequent basis (as per Section 18.4 of the NRA (Appendix 15.1 to the ES)), however the significant majority of such cases were assessed as being likely to be of a lower consequence i.e. time increases rather than safety effects. Therefore, had a higher frequency been considered, the overall significance would not have changed (tolerable with mitigation).
		It is stated that DFDS IJmuiden – Newcastle is the busiest route required to deviate, however minor and that's a fair assessment. But it can also be said that with minor adjustments to the OWF ('topping off'), this deviation can be avoided and collision will further decrease. Is this something Vattenfall would consider?	This was raised previously during a consultation call between Rijkswaterstaat and Vattenfall on the 8th May 2018. At this application stage of the project it cannot be confirmed how much of the site will be built out, however Vattenfall will consider consultation responses on the subject during the layout approval process which will be undertaken with the MCA and Trinity House (TH). No concerns were raised during consultation with regular operators regarding the northern boundary of the Norfolk Boreas site (including from the operator of the route that intersects the Northern tip). Cumulative assessment also shows any deviation to be manageable when considered with the identified projects that could include cumulative impacts. It is noted that as per Environmental Impact Assessment regulations it is only reasonable that Vattenfall consider cumulative projects which are reasonably foreseeable.
		The Dutch government has indeed planned a corridor in the scheduled OWF 'IJmuiden Ver' coinciding with the routing IJmuiden Newcastle.	As per EIA regulations any assessment of cumulative impacts is based on projects or other activities that are active or reasonably foreseeable. Given that a detailed design of the proposed navigation corridor is not

Consultee	Document & Date	Comment	Response / where addressed in the ES
			publicly available we are not able to make an assessment.
		It is stated that there is likely to be a collective increase in emergency response requirements due to increased incident rates, more personnel and more vessels. You refer to self-help capability, which should also be considered within the project specific impacts. Could you elaborate on this issue? What does that mean? What kind of measures will be taken?	Self-help refers to any vessel, personnel, facility or resource associated with Norfolk Boreas that could be used in an emergency situation. A full list of the available resources cannot be provided at this stage of the project, however comprehensive details would be provided in the Emergency Response Cooperation Plan (ERCoP) which would be produced post consent in consultation with the MCA. Indicatively, this will include construction/maintenance vessels and crew, lifesaving equipment on board the vessels and wind farm structures, and any further relevant onshore facilities.
		Why is it relevant to note the majority of fishing vessels are Dutch beam trawlers?	The NRA and ES follow the guidance contained within MGN 543 which requires the assessment to detail break downs of vessels types within the study area. It is typical to note type and nationality of fishing vessels given that this provides additional detail on the nature of transits and movements.
MCA	Project update consultation meeting January 2019	Content that the worst case (200 turbines) has already been modelled and modelling would not need to be redone for the 180 turbine layout.	Noted.
		MCA noted that although not within their remit, consideration should be given to operational helicopter access if platforms are included within the array.	Operational helicopter access would be in line with CAP 437guidance.
		Noted that they would also like export cable route data to be brought up to date and in line with the summer 2018 data.	Analysis of the summer 2018 data within the offshore cable corridor study area has been carried out in section 13 of the NRA (Appendix 15.1) and is summarised in section 15.6 of this ES.
TH		No concerns marking sample layouts shown and indicated that lighting was likely to initially be done on a project in isolation basis with lights removed	Noted.

Consultee	Document & Date	Comment	Response / where addressed in the ES
		(turned) off as required when other projects were built or decommissioned.	
MCA and TH		Content that the floating foundation had been removed and that tetra base foundations were now a consideration. As under keel clearance would be a minimum of 10m, MCA and TH raised no concerns over this.	Noted.
		No concerns with the increased interconnector search area of the HVDC options noting that worst case has already been considered.	Noted.
		No concerns with accommodation platforms becoming accommodation and / or refuelling platforms.	Noted. It is highlighted that the accommodation / and or refuelling platform is now referred to as the offshore service platform.
		Content with the design rules being noted within the DCO as long as the condition still allowed for final sign off.	Noted.
		The Design Rules were discussed as an ongoing matter.	Noted. Further discussion will be undertaken with the MCA and TH.
CA	Offshore order limits change report February 2019	The Cruising Association has no further comment to make on Norfolk Boreas beyond that made previously on the original PEIR and wish you well with the project.	No response required, further detail on the offshore order limits change consultation are provided in the consultation report (document reference 5.1).
Trinity House	Offshore order limits change report March 2019	I can confirm that Trinity House have no objections to the revised order limits and have no further comments to make at this stage.	No response required, further detail on the offshore order limits change consultation are provided in the consultation report (document reference 5.1).
MCA	Offshore order limits change report March 2019	We note from the non-statutory consultation report that the seabed within the gap was not assessed as part of the preliminary environmental information as presented in the PEIR, and that the 'assessment' will be updated to include the gap. Although it has not been subject to any site specific surveys, the area is covered by existing data sets including the shipping and navigation data sets. Section 3.5 further states that the EIA will use data collected from within the	Further detail on the offshore order limits change consultation are provided in the consultation report (document reference 5.1). As per Section 15.7.3, the applicant considers that the worst case scenario from a shipping and navigation perspective has been assessed.

Consultee	Document & Date	Comment	Response / where addressed in the ES
		buffer to update the assessment. On the understanding that new additional area has been assessed in line with all the requirements of MGN 543 and its annexes, including the relevant traffic surveys, and that the NRA and EIA Shipping and Navigation Chapter are updated to reflect the additional area, then the MCA does not have any concern with regards to proposed change. The MCA would therefore like reassurance that the application NRA and Shipping and Navigation chapter are a true reflection of the worst case scenario.	
Trinity House and MCA	Design rule consultation April 2019	Meetings to finalise wording of the Design Rules.	Final wording of the Design Rules as agreed with MCA and TH is given in section 15.7.1.

15.4 Assessment Methodology

15.4.1 Impact Assessment Methodology

15. Shipping and navigation impacts have been assessed using the FSA process, as required under the MCA methodology (MCA, 2015). 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).

16. Identified impacts and their initial significance rankings were provided to the relevant shipping and navigation stakeholders in the form of a Hazard Log (Appendix 15.5), 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.

17. As described within section 15.1 Norfolk Vanguard may undertake some enabling works for Norfolk Boreas, but these are only relevant to the assessment of impacts onshore (see Appendix 5.1 of Chapter 5 Project Description for detail). However a project interconnector may be required between the Norfolk Boreas and Norfolk Vanguard projects. If Norfolk Vanguard does not proceed then the project interconnector would not be required.

18. The presence of the project interconnector would not have any perceptible influence on the residual impacts on shipping and navigation receptors. However, for completeness, the project interconnector search area baseline environment has been established in section 15.6; and where relevant the project interconnector has been referenced in section 15.7and considered for assessment of impacts under the worst case scenario.

15.4.1.1 Frequency of Occurrence

19. The definitions assumed within the FSA for 'Frequency of Occurrence' are presented in Table 15.4. The frequency of each impact is determined via the output of modelling results (where modelling pertinent to that impact has been undertaken), and consultation output (primarily the Hazard Log).

Table 15.4 FSA Frequency of Occurrence Definitions

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 Severity of Consequence

20. The definitions assumed within the FSA for 'Severity of Consequence are presented in Table 15.5. As part of the Hazard Log consequence to shipping and navigation receptors relevant to business (i.e., financial concerns) were considered, however it should be noted that the FSA is primarily concerned with navigational safety.

Table 15.5 FSA Severity of Consequence Definitions

Rank	Consequence	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).

Rank	Consequence	Definition
		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 Significance

21. Once 'frequency of occurrence' and 'severity of consequence' (see sections 15.4.1.1 and 0 respectively) are assigned to an impact, the significance of the impact is determined as either 'Broadly Acceptable', 'Tolerable', or 'Unacceptable' via the risk matrix presented in Table 15.6, assuming embedded mitigation is in place as per section 15.7.1.

22. The definitions of the significance rankings are presented in Table 15.7. Impacts determined to be 'Unacceptable' are considered significant in EIA terms, with those of lesser significance not considered significant in EIA terms. Where identified as necessary, additional mitigation would be identified to ensure residual impacts are ALARP.

Table 15.6 Impact Significance Matrix

Frequency						
	Frequent	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 Significance Ranking Definitions

	No Perceptible Impact	No perceptible impact on shipping and navigation receptors.
	Broadly Acceptable	Risk ALARP with no additional mitigations or monitoring required above embedded mitigations.
	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. Impacts considered Unacceptable are considered Significant in EIA terms.

15.4.2 Cumulative Impact Assessment

23. Each identified impact has been assessed for the potential for cumulative impact by considering other offshore developments (renewable, oil or gas) as per the Cumulative Impact Assessment (CIA) long list presented in section 15.8, and as per Chapter 6 EIA Methodology. Other third party operations have also been considered, however it is noted that impacts associated with ongoing activities, such as marine aggregate dredging, fishing, and recreational activity, are considered baseline.

24. 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 the NRA (Appendix 15.1).

25. As raised during consultation, the key cumulative impact to be assessed 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

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

27. Impacts to vessel routeing are considered cumulatively, noting that consultation has been undertaken with Rijkswaterstaat with regards to routeing within the Dutch sector, as per Table 15.3.

15.5 Scope

15.5.1 Study Area

28. The majority of assessment within this Chapter and the NRA has been undertaken within a ten nautical mile (nm) buffer of the Norfolk Boreas site (the 'Offshore Wind Farm (OWF) Site Study Area') as presented in Figure 15.1. This is considered a wide enough extent to cover all relevant passing traffic (notably the key nearby routeing measures) while still remaining site specific to Norfolk Boreas.

29. A 5nm buffer of the offshore cable corridor has been used to assess marine traffic and relevant navigational features to the offshore export cables (the 'offshore cable corridor study area'), as shown in Figure 15.1. The offshore cable corridor study area was initially defined to include the most up to date iteration of the project interconnector search area available at the time. However, since the analysis was first undertaken at the PEIR stage, the project interconnector search area has been refined to include a portion of the gap between the project interconnector search area and the Norfolk Boreas site. This new section is therefore not included within the offshore cable corridor study area. However, the limited spatial extent of the change means there is negligible impact on the assessment undertaken at the PEIR stage. Regardless, the OWF site study area described above does capture the affected area.

15.5.2 Data Sources

30. The data sources used to inform the baseline assessment within the NRA (Appendix 15.1) and within this chapter are listed in Table 15.8.

Table 15.8 Data Sources

Data	Year	Coverage	Confidence	Notes
14 days of summer marine traffic survey data collected within Norfolk Boreas (AIS, visual and radar) collected from a dedicated survey vessel as per MGN 543.	2018 (summer)	10nm study area around Norfolk Boreas site	High	Data collected by a dedicated survey vessel with supplementary AIS recorded from the Met Mast used to ensure comprehensive coverage. Survey undertaken in August 2018. Used to refresh and validate findings of the summer 2017 marine traffic assessment.
14 days of winter marine traffic survey data collected within Norfolk Boreas (AIS, visual and radar)	2018 (winter)	10nm study area around Norfolk Boreas site	Moderate	Data collected by a dedicated survey vessel with supplementary AIS recorded from onshore receivers used to ensure maximum coverage.

Data	Year	Coverage	Confidence	Notes
collected from a dedicated survey vessel as per MGN 543.				Survey undertaken in February 2018. Used for both submission of PEIR and initial NRA as well as this ES.
23 days of marine traffic survey data collected within Norfolk Boreas (AIS, visual and radar) collected a dedicated survey vessel as per MGN 543.	2017 (summer)	10nm study area around Norfolk Boreas site	High	Data collected by a dedicated survey vessel, with supplementary AIS recorded from the Met Mast and onshore receivers used to ensure comprehensive coverage. Survey undertaken in July and August 2017. Full data set used to inform modelling process during PEIR stage. 14 days August 2017 used for marine traffic analysis within PEIR and NRA.
14 days of marine traffic survey data (AIS only)	2018 (summer)	5nm study area around offshore cable corridor (including project interconnector search area)	Moderate	Data collected from shore-based receivers, Met Mast, and survey vessel (stationed at the Norfolk Boreas site). Data set was AIS only. Covers same August 2018 period as Norfolk Boreas site survey. Used to refresh and validate findings of the summer 2017 marine traffic assessment.
14 days of marine traffic survey data (AIS only)	2018 (winter)	5nm study area around offshore cable corridor (including project interconnector search area)	Moderate	Data collected from shore-based receivers, Met Mast, and survey vessel (stationed at the Norfolk Boreas site). Data set was AIS only. Covers same February 2018 period as Norfolk Boreas site survey.
Marine traffic survey data (AIS only)	2017	5nm study area around offshore cable corridor (including project interconnector search area)	Moderate	Data collected from shore-based receivers, Met Mast, and survey vessel (stationed at the Norfolk Boreas site). Data set was AIS only. Covers same August 2017 period as Norfolk Boreas site survey.
Anatec ShipRoutes database	2018	10nm study area around Norfolk	High	Data developed by Anatec (2018a) to assist in identifying

Data	Year	Coverage	Confidence	Notes
		Boreas		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 Norfolk Boreas and 5nm study area around 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 Norfolk Boreas and 5nm study area around offshore cable corridor	Moderate	Data covers all incidents responded to by the RNLI excluding cases of a hoax or false alarm.
United Kingdom Hydrographic Office (UKHO) Admiralty charts	2018	Southern North Sea	High	Used to identify navigational features and tidal data - 1503, 1504, 1631, and 1632 were the key charts considered.
Admiralty Sailing Directions – North Sea (West) Pilot NP54	2016	Southern North Sea	High	Used to identify relevant navigational features and marine conditions, including visibility.
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 indication of approximate offshore cruising routes used by recreational users, and coastal recreational density.
Wave Height Data collected from within Norfolk Vanguard East	2013	Norfolk Projects	Moderate	Archive data used to estimate sea state conditions of the area. Data Validated against Anatec's in house data.
Wind data collected from local Met Mast	2013 to 2016	Norfolk Projects	High	Wind data collected from within Norfolk Boreas to estimate wind direction probabilities in the area. Validated against Anatec's in-house data.
Strategic Overview of SAR in the UK and Northern Ireland	2017	UK Continental Shelf (UKCS)	High	Identification of SAR assessments within the UKCS
British Marine Aggregate Producers	2017	Southern North Sea	Medium	Regular transit routes used by

Data	Year	Coverage	Confidence	Notes
Association (BMAPA) dredging transit routes				marine aggregate dredgers.
Fishing sighting surveillance data	2005 to 2009	10nm study area around Norfolk Boreas	Low	Sightings data collected by the MMO via patrol vessels / aircraft. Used for validation purposes only.
Fishing satellite surveillance data	2009	10nm study area around Norfolk Boreas	Moderate	Surveillance data collected via satellite. Used for validation purposes only.

31. It is noted that as per MGN 543, marine traffic data used for an NRA within a consent application must be within 24 months of the application submission date to the Planning Inspectorate. Given the project timeline, the 2017 summer survey data (AIS, radar, and visual observations from the *Fugro Pioneer*) used to inform the PEIR is not compliant with this requirement (noting that in all other aspects it is compliant with MGN 543). Therefore, as detailed in Table 15.8, an additional summer survey has been undertaken, which has been used to validate the marine traffic assessment within the NRA, with the results summarised in this ES. This approach has been agreed with the MCA as stated in Table 15.3.

32. To ensure a succinct assessment within this chapter, only the analysis of the two 2018 marine traffic surveys has been presented in the baseline section (15.6). However, a full assessment of the summer 2017 survey data is available in the NRA (Appendix 15.1).

15.5.3 Assumptions and Limitations

33. 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

34. 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.

35. The following limitations associated with the available marine traffic survey data are acknowledged, and should be considered when viewing the findings of the marine traffic survey baseline:

- During the vessel based 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;
- AIS data collected from the Met Mast was not available for the winter period at the time of writing for the PEIR, and coverage of the OWF site study area was therefore not comprehensive (noting that coverage of the Norfolk Boreas site itself was suitable; 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).

36. It is noted that while the winter 2018 data has not been supplemented with additional Met Mast data, the data is considered fit for the purpose of this ES. Modelling inputs have been calibrated using the comprehensive summer 2017 data and validated against Anatec's ShipRoutes database (Anatec, 2018a) and the summer 2018 survey to ensure any coverage issues associated with the winter 2018 data do not have undue influence. This ES has analysed the summer 2018 data in order to validate the outcomes of the summer 2017 data assessment and the modelling outputs. Some changes were observed, as discussed in the NRA (Appendix 15.1). However none of these changes were deemed as affecting the assessment already undertaken at the PEIR stage (see section 27.3 of the Appendix 15.1 for further details).

15.5.3.2 MAIB Incident Data

37. 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 RNLI Incident Data

38. The RNLI data includes all incidents to which the RNLI responded (excluding hoaxes or false alarms). Any incident to which an RNLI resource was not mobilised is therefore not accounted for.

15.5.3.4 UKHO Admiralty Charts

39. 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. Data taken from charts includes navigational features and tidal stream information.

15.5.3.5 MetOcean Data

40. The data used to establish MetOcean conditions within the vicinity of the Norfolk Boreas site is detailed below. Further details of MetOcean conditions are available in Chapter 8 Marine Geology, Oceanography and Physical processes.

15.5.3.5.1 Wind Data

41. Wind data collected from the local Met Mast between 2013 and 2016 was used to estimate wind direction probabilities of the area. It has been assumed that this data is indicative of the general area, noting that the probabilities have been used to assess the likelihood that vessels in the area would drift towards the Norfolk Boreas site. This data has been validated against Anatec's in-house data, as shown in the NRA (Appendix 15.1).

15.5.3.5.2 Wave Data

42. Wave data collected from within Norfolk Vanguard East has been used to assess sea state probabilities within the area. It has been assumed that this data is indicative of conditions within the general area including Norfolk Boreas. This data has been validated against Anatec's in-house data, as shown in the NRA (Appendix 15.1).

15.5.3.5.3 Visibility

43. 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, Netherlands. Based on the available data, the UK North Sea average was assumed to be representative of the project area.

15.6 Existing Environment

44. This section details the navigational feature and marine traffic baseline, as established using the data sources listed in Table 15.8.

45. An overview of the main navigational features identified within the study areas is presented in Figure 15.2. The marine traffic data considered is shown plotted by vessel type in Figure 15.3 (summer) and Figure 15.4 (winter).

15.6.1 Navigational Features

46. The key navigational features in the area are the IMO adopted routeing measures. The DR1 Lightbuoy Deep Water Route (DWR) is positioned west of Norfolk Boreas, with a separation distance of approximately one nautical mile. This DWR connects to the Off Botney Ground Traffic Separation Scheme (TSS) around 10nm to the north. The Off Brown TSS is to the east, and is positioned (at its closest) approximately 3.4nm from the Norfolk Boreas site. This TSS links to the West Friesland DWR, which adjoins the DR1 Lightbuoy DWR approximately 30nm to the south of the Norfolk Boreas site.

47. There are no charted anchorages in the vicinity of the Norfolk Boreas site. However, it is noted that the Pilot Book (UKHO, 2016) states that vessels may anchor coastally within The Would between Bacton and Winterton Ness which is near the landfall.

48. There are no Ministry of Defence Practice and Exercise Areas intersecting the OWF site study area or the offshore cable corridor.

49. There is one gas platform (normally unmanned) within the Norfolk Boreas site, associated with the Davy Field. The platforms associated with the Sean Field are positioned north of the Norfolk Boreas site, with the closest being 1.4nm from the boundary.

50. The landfall is located approximately 4nm from 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.

51. There are no marine aggregate dredging areas intersecting the Norfolk Boreas site or offshore cable corridor. The two closest aggregate dredging areas are both production areas located approximately 3.14nm south of the offshore cable corridor. British Marine Aggregate Producers Association (BMAPA) dredging transit routes indicate that the majority of dredging transit in the area is coastal, however routes associated with mainland Europe do cross the Norfolk Boreas site.

52. There were no Marine Environmental High Risk Areas (MEHRAs) identified on the coast of the offshore export cable corridor study area, with the nearest being in excess of 40nm to the south.

53. Other offshore wind farm developments within the area are shown in Figure 15.2. This includes planned projects, however only constructing or operational wind farms are considered baseline. The closest such project is East Anglia ONE located approximately 30nm to the south, which is currently under construction. Of note is Hornsea Project One located approximately 45nm to the north-west, which is currently under construction. All projects shown regardless of phase have been considered cumulatively as per section 15.8.

15.6.2 Marine Traffic

54. The following marine traffic analysis is based on the summer and winter 2018 surveys. Detailed analysis of the summer 2017 analysis is available in the NRA (Appendix 15.1).

15.6.3 Commercial Vessels

15.6.3.1 Norfolk Boreas Site

55. An average of 79 unique vessels per day passed within the OWF site study area during the summer 2018 survey period (with 17 per day intersecting the Norfolk Boreas site), compared to an average of 36 per day during winter 2018 (with five per day intersecting the Norfolk Boreas site).

56. The majority of traffic recorded during both surveys was from commercial vessels (cargo and tankers), largely due to the presence of the IMO adopted routeing measures, however commercial vessels were also recorded within the Norfolk Boreas site. Of particular note is the DFDS (commercial ferry operator) operated route between Newcastle (UK) and Amsterdam (Ijmuiden, Netherlands), which crosses a very small section of the north-east corner of the Norfolk Boreas site. This is visible in Figure 15.3 and 15.4 which present the results of the 2018 summer survey and the 2018 winter survey, respectively.

57. Main vessel routes within the OWF site study area have been identified, as shown in Figure 15.5, with details of each route are then presented in Table 15.9. The terminus points included in Table 15.9 represent the most common destinations transmitted via AIS by vessels on a given route, and it should therefore be noted that vessels using a route may not be associated with either terminus listed.

58. The busiest routes were observed to be those utilising the IMO Routeing measures.

Table 15.9 Main Route Details

Route	Terminus Ports	Vessels per Day	Intersects Site?	Description
1	TSS West Friesland – Rotterdam (Netherlands)	17	No	Southbound traffic associated with the West Friesland TSS.
2	Rotterdam (Netherlands) – TSS West Friesland	16	No	Northbound traffic associated with the West Friesland TSS.
3	TSS Off Botney – Rotterdam (Netherlands)	6	No	Southbound traffic associated with the Off Botney TSS.
4	Rotterdam (Netherlands) – TSS Off Botney	6	No	Northbound traffic associated with the Off Botney TSS.
5	Newcastle, UK / Amsterdam (Ijmuiden, Netherlands)	1-2	Yes	DFDS operated Newcastle / Amsterdam cruise ferry route.
6	Rotterdam (Netherlands) / Forth	1	No	Cargo and tanker route between

Route	Terminus Ports	Vessels per Day	Intersects Site?	Description
	Ports (UK)			Scottish ports and Rotterdam.
7	Rotterdam (Netherlands) / Tees (UK)	1	No	Route between Rotterdam and Tees, traffic comprised mainly of cargo vessels. Limited tanker and oil and gas vessels.
8	TSS Off Botney / Thames Ports (UK)	< 1	No	Cargo tanker route associated with the Off Botney TSS.
9	Ijmuiden (Netherlands) / Humber (UK)	< 1	No	Cargo vessel route between Ijmuiden and Humber ports.
10	Tees (UK) / Rotterdam (Netherlands)	< 1	No	Cargo and tanker route between Tees and Rotterdam.
11	Humber (UK) / Cuxhaven(Denmark)	< 1	No	Cargo traffic between Humber ports and Cuxhaven. Includes DFDS operated Immingham / Cuxhaven RoRo ferry route.
12	Forth Ports (UK) / Rotterdam (Netherlands)	< 1	Yes	Low use route, cargo traffic.
13	Great Yarmouth or Lowestoft (UK) / Thames Field	< 1	No	Oil and gas traffic to the Thames field.
14	Rochester (UK) / TSS West Friesland	< 1	Yes	Cargo and tanker traffic from Rochester.
15	Den Helder (Netherlands) / Sean Field	< 1	Yes	Oil and gas traffic to the Sean field.
16	Great Yarmouth or Lowestoft (UK) / Esbjerg (Denmark)	< 1	Yes	Low use cargo / tanker traffic route.
17	The Wash (UK) / Cuxhaven (Denmark)	< 1	Yes	Low use cargo / tanker traffic route.

59. No transit route(s) to the Davy Platform located within the Norfolk Boreas site were identified within the 2018 winter marine traffic survey data. Anatec's ShipRoutes (Anatec, 2018a) also indicated vessel numbers visiting the platform were limited (the platform is normally unmanned). However, the 2018 summer marine traffic survey data recorded a number of oil and gas support vessels operating within the Davy Field. The potential for increased vessel presence should the platform be decommissioned has been assessed qualitatively within the impact assessment (section 15.7).

60. Other oil and gas activity was recorded at the Sean Field, Wissey Field, K13-A (Noordwinning) and Corvette Field during summer 2018. This is an increase in oil and gas vessel activity compared to winter 2018 when oil and gas vessels were recorded only at the Sean Field.

15.6.3.2 Offshore Cable Corridor

61. An average of 106 unique vessels was recorded within the offshore cable corridor study area per day during the summer 2018 period, falling to 93 per day during winter 2018. Of these, 92 unique vessels per day intersected the offshore cable corridor itself during summer, as did 84 during the winter period. The majority of this traffic comprised commercial vessels on coastal routes, however it is noted that the DR1 lightbuoy DWR (and hence the traffic utilising it) also intersected the offshore cable corridor study area. Figure 15.6 presents the combined marine traffic data recorded during the summer and winter 2018 surveys.

15.6.3.3 Project Interconnector Search Area

62. Approximately 24 unique vessels per day intersected the project interconnector search area during the summer 2018 survey, falling to 15 during the winter 2018 period. The majority of this traffic was from commercial vessels utilizing the DR1 Lightbuoy DWR and during summer 2018 also included oil and gas vessels working at the Wissey Field.

15.6.4 Recreational Vessels

63. The tracks recorded from recreational vessels during the summer 2018 marine traffic surveys are presented in Figure 15.7. It should be noted that there were no recreational vessels recorded during the winter 2018 survey. The RYA Coastal Atlas (RYA, 2016) is then presented in Figure 15.8.

15.6.4.1 Norfolk Boreas Site

64. Less than one recreational vessel per day was recorded during the summer 2018 survey, with no vessels recorded during winter.

65. Consultation indicated that recreational vessels on passage from the UK to Scandinavia may transit the area, however given the distance from the coast the traffic will be spread, and is therefore considered light.

66. The RYA Coastal Atlas (RYA, 2016) indicated an offshore cruising route approximately 25nm south of the Norfolk Boreas site. It is noted that historic RYA cruising route data (RYA, 2009) indicate routes associated with Ijmuiden (Netherlands) cross the Norfolk Boreas site.

15.6.4.2 Offshore Cable Corridor

67. There were approximately three recreational vessels per day recorded within the offshore cable corridor during summer 2018, with the majority of recreational activity observed to be coastal. This correlated well with the RYA Coastal Atlas (RYA, 2016), which also showed the densest areas as being largely coastal. Only one vessel was recorded within the offshore cable corridor during the entire winter survey; however it should be noted that the offshore cable corridor surveys are AIS only, and therefore recreational traffic may be underrepresented.

15.6.4.3 Project Interconnector Search Area

68. There were no recreational vessels observed to intersect the project interconnector search area during the summer or winter survey periods.

15.6.5 Commercial Fishing Vessels

69. Commercial fishing vessels tracks recorded during the summer and winter 2018 marine traffic surveys are presented in Figure 15.9. Data within the offshore cable corridor study area is AIS only. Further details of commercial fishing are provided in Chapter 14 Commercial Fisheries.

15.6.5.1 Norfolk Boreas Site

70. Based on the marine traffic surveys, an estimated 12 fishing vessels per day were recorded within the OWF site study area during summer 2018, falling to one in winter. The majority of the activity during both survey periods was observed to be from Dutch beam trawlers. This included active fishing (as opposed to vessels in transit) within the Norfolk Boreas site itself.

71. The findings of the 2018 survey data correlated well with the longer term sightings and satellite data, in that both the additional data sets showed the majority of fishing vessels within the OWF site study area to be Dutch beam trawlers.

15.6.5.2 Offshore Cable Corridor

72. Fishing vessel numbers within the offshore cable study area averaged approximately seven per day during the summer 2018 survey period, falling to two per day during winter 2018. Numbers within the offshore cable corridor itself were estimated at four a day during summer and one per day in winter.

73. Coastal vessels were observed to be in transit rather than engaged in fishing, with active fishing observed to occur further offshore from beam and demersal trawlers, including within the offshore cable corridor.

15.6.5.3 Project Interconnector Search Area

74. An average of three fishing vessels per day was recorded within the project interconnector search area during summer 2018. Activity was less in winter 2018,

with only three vessels intersecting the project interconnector search area during the entire survey period.

75. This included limited levels of active fishing (as opposed to vessels in transit) from demersal and beam trawlers, however the majority of active fishing was recorded north of the project interconnector search area.

15.6.6 Anchoring Vessels

15.6.6.1 Norfolk Boreas Site

76. Two vessels were deemed to be at anchor within the OWF site study area during the summer 2018 marine traffic survey while no vessels were recorded during the winter survey. The two vessels were not at anchor within the Norfolk Boreas site, with the nearest being located 2.4nm to the south of the site. It is noted that tankers were also observed to be 'waiting for orders / berths' in the area prior to transit to their next destination. These manoeuvres were undertaken outwith the routeing measures, but did intersect the Norfolk Boreas site. From analysis of the AIS tracks it was clear the associated vessels did not anchor.

15.6.6.2 Offshore Cable Corridor

77. During the summer 2018 survey, three vessels were recorded at anchor within the offshore cable corridor study area. These were a buoy laying vessel (anchored within 200m of the offshore cable corridor), a tanker (anchored 2nm from the offshore cable corridor) and a cargo vessel (anchored 1.5nm south from the offshore cable corridor).

78. One marine aggregate dredger was also recorded at anchor approximately 170m to the south of the offshore cable corridor during the winter 2018 survey, located approximately 3.5nm from the coast.

79. It is noted that anchoring activity from tugs was recorded coastally within the offshore cable corridor study area during the summer 2017 survey period. However additional research has indicated that this activity may have been in relation to a salvage operation following a collision in July. Therefore, this is considered temporary, noting that activity was not reflected in the winter survey, the summer 2018 survey, or the Norfolk Vanguard marine traffic surveys (Anatec, 2017). Further details of this operation are provided in the NRA (Appendix 15.1).

80. As the offshore cable corridor surveys are AIS only, non-AIS vessel anchoring is not accounted for, and as per section 15.6.1, the Pilot Book (UKHO, 2016) states that anchorage can be obtained coastally within The Would between Bacton and Winterton Ness which is near the landfall. The position of this area is indicated in Figure 15.2.

15.6.6.3 Project Interconnector Search Area

81. No anchoring activity was recorded within the project interconnector search area.

15.6.7 Anticipated Trends in Baseline Conditions

82. The baseline assessment has established that the majority of traffic in the area is comprised of commercial vessels utilising the IMO routeing measures. Future commercial traffic levels are dependent on market conditions, and fluctuations are therefore difficult to predict, however the current accepted trend is that vessel size will increase, while overall vessel numbers will decrease, as per a study undertaken by the International Transport Forum (ITF) at the Organisation for Economic Cooperation and Development (OECD) on the impact of 'Mega Ships' (OECD / ITF, 2015).

83. Despite oil and gas traffic increasing between summer 2017 and summer 2018, traffic levels are expected to decrease, given that Southern North Sea decommissioning is ongoing. This may be offset by increases in wind farm associated traffic, noting that both renewables and oil and gas traffic in the area was typically mobilised from Great Yarmouth or Lowestoft during the summer 2017 survey. Based on port calling data (DfT, 2017) assessed within the NRA (section 8.5), vessel callings to Great Yarmouth decreased between 2012 and 2015, before rising to above 2012 levels in 2016. This may be due to increased wind farm vessel traffic, or traffic associated with North Sea decommissioning.

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

15.7 Potential Impacts

15.7.1 Embedded Mitigation

85. The impact assessment has been undertaken assuming the embedded mitigation relevant to shipping and navigation listed below would be in place:

- Application for 'rolling' 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;
- Risk assessment of cable burial and protection 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. Further details are provided in section 26.3 of the NRA (Appendix 15.1);
- Compliance with the Design Rules (as agreed with the MCA and TH) which provide a framework for post consent layout approval (see section 15.7.1.1);

- 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 Norfolk Boreas site complying with IALA Recommendations O-139 (IALA, 2013), to be finalised in consultation with TH and the MCA;
- Final layout design to ensure no outlying or extreme peripheral turbines;
- Final layout would require alignment with the edge of the DWR. This would be considered with Norfolk Vanguard Limited to ensure any consistency required by regulators is addressed;
- Final foundations designs to be risk assessed post consent to ensure they do not impact on vessels transiting internally within the array;
- Information relevant to the proposed project to be promulgated via Notice to Mariners (NtMs) and other appropriate media;
- Floating foundations no longer under consideration, noting these were the worst case foundation from an under keel clearance perspective;
- Marine traffic coordination;
- Compliance with 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;
- Wind turbines to be constructed in accordance with MGN 543 (MCA, 2016) where applicable;
- Use of guard vessel during the deployment of safety zones, and during any other key construction periods where identified by risk assessment; and
- Wind turbines to have at least 22m clearance above Mean High Water Spring (MHWS) as per RYA (2015) position paper and MGN 543 (MCA, 2016).

15.7.1.1 Design Rules

86. As part of the embedded mitigation for the project, VWPL will comply with the Design Rules which have been agreed with the MCA and TH and will provide a framework for post consent layout approval. The Design Rules are detailed in Table 15.10.

Table 15.10 Design Rules

Rule Number	Design Rule	Reasoning
1	A minimum spacing of 720m shall be maintained between the centre points of all structures	To assist internal surface navigation
2	SAR Access Lanes of 500m width shall be maintained in at least one direction within the array, with a safety justification to support, as per MGN 543jsutification would set out reasoning why a single line of orientation is considered sufficient and safe for SAR surface and air navigation. In the case of wind turbines this distance is measured from the blade tips that are transverse to the SAR lane.	To facilitate SAR asset access
3	The position of Structures, so far as is practicable, shall be arranged in straight lines (to a tolerance of between 50 and 100m either side of the centre line of an internal row for micro siting or wind energy capture; as rule 2 a safety justification will be provided) in an easily understandable pattern. Spacing between these straight lines is referred to as SAR Access Lanes.	To facilitate SAR asset access and assist internal surface navigation; whilst accounting for micro siting, turbines foundation size and energy capture.
4	As far as practicable, the position of all periphery structures around a windfarm area will be arranged in straight lines (to a tolerance of 50m either side of the centre line of the row) in an easily understandable pattern. Where routeing measures exist (e.g. the DWR), periphery structures must be aligned with it. There should be no outliers, or surface infrastructure isolated on the periphery. Should Norfolk Boreas be within 1nm (in line with design rule 6) and 3nm (based on maximum SPS spacing) of an existing offshore windfarm site (consented, constructed or layout agreed) then the peripheral turbine edge facing that site shall be reviewed with Trinity House and MCA to confirm required compliance with design rule 4 (peripheral alignment).	To facilitate safe navigation for marine traffic navigating within routeing measures
5	Where SAR Access Lanes are more than 10nm, a Helicopter Refuge Area perpendicular to the SAR Access Lanes shall be included within the layout design. The Helicopter Refuge Area shall be at least 1nm (tip to tip) in width and allow access across the array.	To facilitate SAR asset access
6	Where an array is proposed to border another array with different alignment and/or spacing a minimum spacing of 1nm (blade tip to blade tip) must be maintained between the two arrays.	To facilitate SAR asset access and to assist internal surface navigation

15.7.2 Monitoring

87. Details of the intended monitoring plans relevant to Shipping and Navigation which would be undertaken for Norfolk Boreas are set out in section 28 of the NRA (Appendix 15.1). In summary, the following monitoring would be undertaken:

- Marine traffic monitoring during construction as per the Marine Traffic Monitoring Strategy (as per the DML);
- Monitoring of cable protection as per the DML; and
- Hydrographic surveys (as per MGN 543 (MCA, 2016)).

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

15.7.3 Worst Case

89. The layout of wind turbines and other associated platforms would be defined and agreed with the MCA post consent (with consideration as to the Design Rules). For shipping and navigation receptors the worst case is considered the largest number of wind turbines covering the widest possible area within the Norfolk Boreas site. For the purpose of the ES, and the NRA (Appendix 15.1) an indicative layout has been assessed which meets these parameters and would assess the impact of maximum displacement and largest allision risk. Any alternative configurations would then lie within the parameters of the assessed worst-case scenario.

90. It is noted that following the Section 42 consultation, the Project Design Envelope used within this ES 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 10 Megawatt (MW) (meaning the maximum number of wind turbines possible is now 180 whereas for PEIR it was 200). However, given that the worst case scenario for shipping and navigation is the maximum number of structures over the greatest development area, the modelling (based on 200 wind turbines) is considered to represent worst case results and any alternative configurations (or reduced wind turbine numbers) would return lower results. Therefore any impacts assessed would be equal to or less than the residual ranking. Full details of the modelling parameters considered are presented in the NRA (Appendix 15.1).

91. Indicative programmes for the phased construction approaches under consideration (including the worst case considered within this chapter) are provided in Chapter 5 Project Description.

92. Within the project design envelope, several different sizes of wind turbine are being considered in the range of 10MW to 20MW. In order to achieve the maximum 1,800MW export capacity, there would be between 90 (of the largest wind turbines under consideration) and 180 (of the smallest wind turbines).

93. In addition, up to two offshore electrical platforms, one offshore service platform, and the additional subsea cabling (export cables, array cables, interconnector cables (linking the two Norfolk Boreas offshore electrical platforms and the project interconnector) are considered as part of the worst case scenario.

94. The worst case scenarios with regard to shipping and navigation are presented by each impact assessed in Table 15.11. 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 15.11 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.	**Norfolk Boreas site construction area and duration** • Up to two phases of construction (non-consecutive); and • Buoyed construction area deployed around the maximum extent of the Norfolk Boreas site including 500m construction safety zones and 50m pre commissioning safety zones. **Array, interconnector, project interconnector and offshore export cable installation** • Maximum export cable length of approximately 500 kilometres (km) (four cables of 125km each, including 25km within Norfolk Boreas site); • Maximum length of array cables, up to 600km; • Up to three interconnector cables linking the offshore electrical platforms, up to 90km (30km in total length each); or • Up to three project interconnector cables linking Norfolk Boreas with Norfolk Vanguard, up to 180km total length (3 cables of 60km each in length), cables laid in two trenches each of 60km; and • Minimum safe passing distances around cable installation vessels.
Effects on adverse weather routeing	Largest extent of buoyed construction area and areas of consecutive cable installation over longest construction period.	**Norfolk Boreas site construction area and duration** • Up to two phases of construction (non-consecutive); and • Buoyed construction area deployed around the maximum extent of the Norfolk Boreas site including 500m construction safety zones and 50m pre commissioning safety zones. **Array, interconnector, project interconnector and offshore export cable installation** • Maximum export cable length of approximately 500km (four cables of 125km each, including 25km within Norfolk Boreas site); • Maximum length of array cables, up to 600km; • Up to three interconnector cables linking the offshore electrical platforms, approximately 90km (30km in total length each); • Up to three project interconnector cables linking Norfolk Boreas with Norfolk Vanguard, up to 180km total length (3

Impact	Parameter	Notes
		cables of 60km each in length), cables laid in two trenches each of 60km; 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.	**Norfolk Boreas site construction area and duration** • Up to two phases of construction (non-consecutive); and • Buoyed construction area deployed around the maximum extent of the Norfolk Boreas site including 500m construction safety zones and 50m pre commissioning safety zones. **Array, interconnector, project interconnector and offshore export cable installation** • Maximum export cable length of approximately 500km (four cables of 125km each, including 25km within Norfolk Boreas site); • Maximum length of array cables, up to 600km; • Up to three interconnector cables linking the offshore electrical platforms, approximately 90km (30km in total length each); • Up to three project interconnector cables linking Norfolk Boreas with Norfolk Vanguard, up to 180km total length (3 cables of 60km each in length), cables laid in two trenches each of 60km; and • Minimum safe passing distances around cable installation vessels. **Number of vessels and personnel** • Up to 57 vessels engaged at any given time; • One helicopter trip to site per week; and • Up to 1,180 vessel movements (return trip to port).
Increased vessel to structure allision risk	Maximum number and position of pre commissioned structures over the longest construction period.	**Norfolk Boreas site construction area and duration** • Up to two phases of construction (non-consecutive); • Buoyed construction area deployed around the maximum extent of the construction works, including 500m construction safety zones and 50m pre commissioning safety zones; • Up to 180 pre commissioned wind turbines on quadropod jacket platforms (foundation with largest surface area at sea level); • Up to two offshore electrical platforms;

Impact	Parameter	Notes
		• One offshore service platform; and • Up to two Lidar buoys, two wave buoys, and two Met Masts.
Anchor interaction and snagging	Maximum number and position of pre commissioned structures and pre-installed cables over the longest construction period.	**Norfolk Boreas site construction area and duration** • Up to two phases of construction (non-consecutive); • Buoyed construction area deployed around the maximum extent of the construction works, including 500m construction safety zones and 50m pre commissioning safety zones; • Up to 180 pre commissioned wind turbines on quadropod jacket platforms (foundation with largest surface area at sea level); • Up to two offshore electrical platforms; • One offshore service platform; and • Up to two Lidar buoys, two wave buoys, and two Met Masts. **Array, interconnector, project interconnector and offshore export cable installation** • Maximum export cable length of approximately 500km (four cables of 125km each, including 25km within Norfolk Boreas site); • Maximum length of array cables, up to 600km; • Up to three interconnector cables linking the offshore electrical platforms, approximately 90km (30km in total length each); and • Up to three project interconnector cables linking Norfolk Boreas with Norfolk Vanguard, up to 180km total length (3 cables of 60km each in length), cables laid in two trenches each of 60km.
Effects on emergency response resources	Maximum number and personnel on site over the longest construction period.	**Number of vessels and personnel** • Up to 113 vessels engaged on the project; • One helicopter trip to site per week; and • Up to 1,180 vessel movements (return trip to port).
Operation		
Effects on vessel routeing and / or displacement	Largest operational area over longest operational life.	**Norfolk Boreas site and operational life** • Maximum turbine deployment (up to 180) covering maximum sea area over a 30 year operational life; • Minimum clearance above sea level of 22m MHWS; • Minimum turbine spacing of 720m (based on minimum separation of 4 rotor

Impact	Parameter	Notes
		diameters of 180m for 10MW turbine) ; • Up to two Lidar buoys, two wave buoys, and two Met Masts (not modelled); • Up to two offshore electrical platforms; • One offshore service platform; and • Maintenance safety zones of up to 500m. **Foundation** • Quadropod jacket platforms (foundation with largest surface area at sea level).
Effects on adverse weather routeing	Largest operational area over longest operational life causing maximum displacement of vessels and activities.	**Norfolk Boreas site and operational life** • Maximum turbine deployment (up to 180) covering maximum sea area over a 30 year operational life;; • Minimum clearance above sea level of 22m MHWS; • Minimum turbine spacing of 720m; • Up to two Lidar buoys, two wave buoys, and two Met Masts (not modelled); • Up to two offshore electrical platforms; • One offshore service platform; and • Maintenance safety zones of up to 500m. **Foundation** • Quadropod jacket platforms (foundation with largest surface area at sea level).
Increased vessel to vessel collision risk	Largest operational area over longest operational life causing maximum displacement of vessels and activities.	**Norfolk Boreas site and operational life** • Maximum turbine deployment (up to 180) covering maximum sea area over a 30 year operational life; • Minimum clearance above sea level of 22m MHWS; • Minimum turbine spacing of 720m; • Up to two Lidar buoys, two wave buoys, and two Met Masts (not modelled); • Up to two offshore electrical platforms; • One offshore service platform; and • Maintenance safety zones of up to 500m. **Foundation** • Quadropod jacket platforms (foundation with largest surface area at sea level).
Increased vessel to structure allision risk	Maximum number of structures presenting the greatest surface area for allision risk over the longest operational period.	**Norfolk Boreas site and operational life** • Maximum turbine deployment (up to 180) covering maximum sea area over a 30 year operational life; • Minimum clearance above sea level of 22m MHWS; • Minimum turbine spacing of 720m; • Up to two Lidar buoys, two wave buoys, and two Met Masts (not modelled); • Up to two offshore electrical platforms; • One offshore service platform; and • Maintenance safety zones of up to 500m. **Foundation**

Impact	Parameter	Notes
		• Quadropod jacket platforms (foundation with largest surface area at sea level).
Anchor interaction and snagging	Maximum number of cables presenting the greatest risk of anchoring snagging.	**Array, interconnector, project interconnector and offshore export cables** • Maximum export cable length of approximately 500km (four cables of 125km each, including 25km within Norfolk Boreas site); • Maximum length of array cables, up to 600km; • Up to three interconnector cables linking the offshore electrical platforms, approximately 90km (30km in total length each); and • Up to three project interconnector cables linking Norfolk Boreas with Norfolk Vanguard, up to 180km total length (3 cables of 60km each in length), cables laid in two trenches each of 60km.
Effects on 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 site per week; • Up to 445 movements per year; and • Operation & Maintenance 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.	**Decommissioning area and duration** • Estimated decommissioning duration of one year; and • Buoyed decommissioning area encompassing the array infrastructure. **Array, interconnector, project interconnector and offshore export cable decommissioning** • Buried cables cut and left in-situ; • Cable protection left in-situ; and • Scour protection left in-situ.
Effects on adverse weather routeing	Largest extent of buoyed decommissioning area.	**Decommissioning area and duration** • Estimated decommissioning duration of one year; and • Buoyed decommissioning area encompassing the array infrastructure. **Array, interconnector, project interconnector and offshore export cable decommissioning** • Buried cables cut and left in-situ; • Cable protection left in-situ; and • Scour protection left in-situ.

Impact	Parameter	Notes
Increased vessel to vessel collision risk	Largest extent of buoyed decommissioning area.	**Decommissioning area and duration** • Estimated decommissioning duration of one year; and • Buoyed decommissioning area encompassing the array infrastructure. **Array, interconnector, or project interconnector and offshore export cable decommissioning** • Buried cables cut and left in-situ; • Cable protection left in-situ; and • Scour protection left in-situ.
Increased vessel to structure allision risk	Maximum number and position of decommissioning structures.	**Decommissioning area and duration** • Estimated decommissioning duration of one year; and • Buoyed decommissioning area encompassing the array infrastructure.
Anchor interaction and snagging	Maximum number and position of decommissioning structures and cables.	**Decommissioning area and duration** • Estimated decommissioning duration of one year; and • Buoyed decommissioning area encompassing the array infrastructure. **Array, interconnector or project interconnector and offshore export cable decommissioning** • Buried cables cut and left in-situ; • Cable protection left in-situ; and • Scour protection left in-situ.
Effects on emergency response resources	Maximum number and personnel on site.	**Decommissioning area and duration** • Estimated decommissioning duration of one year; and • Buoyed decommissioning area encompassing the array infrastructure. **Number of vessels and personnel** • Maximum number of decommissioning vessels on site; and • Maximum number of personnel on site.
Cumulative		
Cumulative effects on deviation (including adverse weather routeing)	Maximum number of OWF developments within the southern North Sea.	Worst case assumption for the project plus UK and Dutch wind farms.
Cumulative effects on allision	Maximum number of OWF developments (and maximum number of structures) within the southern North Sea.	Worst case assumption for the project plus UK and Dutch wind farms.
Cumulative effects on emergency response	Maximum number of OWF developments within the southern North Sea; with significant construction overlap.	Worst case assumption for the project plus UK and Dutch wind farms.

15.7.4 Assessment Confidence

15.7.4.1 Commercial Vessels

95. Impacts to commercial vessels have been assessed primarily based on the outputs of the marine traffic data surveys, the findings of which are considered comprehensive given the carriage requirements for AIS on commercial vessels. Furthermore, routeing has been validated against Anatec's long term ShipRoutes database (Anatec, 2018a). Impacts to commercial vessels are therefore assessed with high confidence.

15.7.4.2 Recreational Vessels

96. The recreational activity baseline was established using the findings of the marine traffic survey data, the RYA Coastal Atlas (RYA, 2016) and consultation output. Data confidence is high within the OWF site study area given that non-AIS vessels were recorded via radar, and consultation indicated the likely periods of peak recreational traffic on a seasonal basis.

97. Non-AIS vessels were not accounted for within the offshore cable corridor marine traffic assessment. However given that the RYA Coastal Atlas (RYA, 2016) has also fed into the assessment, recreational impacts within the offshore cable corridor are assessed with medium confidence.

15.7.4.3 Commercial Fishing Vessels in Transit

98. The marine traffic surveys were used as the primary assessment tool for establishing the fishing vessel baseline, with longer term surveillance data used for validation purposes. Non-AIS fishing vessels (less than 15m in length) were recorded via radar within the OWF site study area, and the surveillance data correlated well with the overall findings. Data confidence is therefore high within the OWF site study area with further data being collated within 2018 surveys.

99. As non-AIS vessels were not accounted for within the offshore cable corridor marine traffic assessment, fishing vessels of less than 15m in length may be underrepresented in the assessment. Impacts within the offshore cable corridor are therefore assessed with medium confidence, taking the validation data into consideration.

15.7.4.4 Emergency Response Resources

100. Emergency response resources have been identified using the UK SAR framework (UKSAR, 2017) which includes location and types of emergency response providers within the UKCS. This has also been supplemented by data from the RNLI which provides locations of RNLI bases and resource types. Given the fixed nature of this data the level of confidence in the type of resource the UK can provide is considered high.

15.7.5 Potential Impacts during Construction

15.7.5.1 Vessel Displacement – Norfolk Boreas Site

101. The physical presence of pre commissioned structures and associated works could have an effect on vessel routeing within the area and displacement of activities within the Norfolk Boreas site.

15.7.5.1.1 Commercial Vessels

102. Baseline commercial vessel routeing has been established using marine traffic survey data collected during summer 2017 and winter 2018, with Anatec's ShipRoute database (Anatec, 2018a) and the summer 2018 data used to validate the findings. A total of 17 routes were identified, as shown in Table 15.9.

103. Of these 17 routes, seven are considered likely to be displaced by the buoyed construction area implemented at the Norfolk Boreas site during construction, which will be defined by TH post consent. Given that the buoyed construction area would be deployed under TH authority and guidance it is assumed it would be designed to minimise impact to the existing DWR traffic. It should be noted that the buoyed construction area would not exclude vessel entry (vessel entry would only be restricted into safety zones around structures), however consultation and experience has indicated that commercial vessels will generally avoid transiting through wind farms under construction.

104. The buoyed construction area may also displace routes to oil and gas platforms, notably the Sean and Davy platforms. The Davy platform is expected to be decommissioned prior to the construction of Norfolk Boreas. However should the construction of Norfolk Boreas and the decommissioning of the Davy field overlap, there could be disruption to either however this would not expected to impact on third party vessels and any potential displacement. Liaison is ongoing between the Davy platform operators and Norfolk Boreas Ltd.

105. Vessels to the Sean platforms would be able to pass north of the buoyed construction area with only a minor deviation.

106. Ongoing activities would be promulgated through NtMs, Kingfisher Information Service – Offshore Renewable & Cable Awareness 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.

107. When considering navigational safety risk, not commercial impacts, the severity of consequence is considered to be **minor** for the Norfolk Boreas site 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.

108. 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.

109. 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.

15.7.5.1.2 Recreational Vessels

110. Recreational vessel (classed as 2.5 to 24m length) movements were very low during the marine traffic surveys, and 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**).

15.7.5.1.3 Commercial Fishing Vessels (in transit)

111. Based on the marine traffic surveys, an average of six fishing vessels per day were recorded during summer 2018 within the Norfolk Boreas site, and one in winter 2018. The majority of these vessels were Dutch beam trawlers.

112. Chapter 14 Commercial Fisheries considers displacement of commercial fishing activity. From a navigational safety perspective, fishing vessels will be able to transit through the buoyed construction area during construction using the embedded mitigation of promulgation of information to note areas of current construction activity. Given the smaller size of fishing vessels transiting through the area (compared to commercial vessels) 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.

113. The severity of consequence from the Norfolk Boreas site 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 Vessel Displacement – Offshore Cable Corridor

114. Cable installation vessels may displace traffic within the offshore cable corridor, 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)

and the location of the installation will be temporary no displacement impact has been identified (noting COLREGS (IMO, 1972) as an embedded mitigation which deals with navigational situations involving RAM vessels) (**no impact**).

15.7.5.3 Restriction of Adverse Weather Routeing – Norfolk Boreas Site

115. The buoyed construction area may restrict routeing options to vessels during periods of adverse weather. Consultation has indicated that during periods of adverse weather, vessels prefer to transit near shore on a coastal route (generally in the lee of any adverse weather conditions) before crossing the southern North Sea (to minimise impacts of weather by keeping it forward or abaft of their beam rather than directly onto the bow, stern or abeam) within the vicinity of Norfolk Boreas where the transit across is at its shortest.

15.7.5.3.1 Commercial Vessels

116. Commercial vessels passing further south of their typical routes during periods of adverse weather may be required to deviate further to avoid the Norfolk Boreas site. Actual deviations would depend on the severity and direction of the weather conditions. It is assumed that both forecast adverse conditions and the presence of the Norfolk Boreas site would be taken into account by a vessel when passage planning to ensure safe passage and minimal deviations.

117. Severity of consequence is considered **moderate** given the potential for a vessel not being able to safely mitigate the effects of the adverse weather during a crossing resulting in significant rolling and / or pitching resulting in injury to persons or damage to cargo. The frequency of occurrence is considered to be **remote**. The impact is therefore assessed as **tolerable**, and not significant in EIA terms.

15.7.5.3.2 Recreational Vessels

118. Recreational transits this far offshore would not be expected if adverse conditions were forecast. Users that far offshore would be expected to be experienced, and would prioritise seeking shelter should such conditions be forecast. In the event that a recreational vessel was in the vicinity of Norfolk Boreas in adverse conditions it is likely to pass south of the Norfolk Boreas site, given that transit through the array may not be safe in unfavourable conditions, particularly if construction vessels were present.

119. Recreational activity was low during summer 2018, and no activity was recorded during winter 2018 (when adverse conditions would be expected). Frequency of occurrence is considered to be **negligible**, with severity of consequence assessed as **moderate** given the potential for damage to the vessel and / or injury to persons. The impact is therefore assessed as **broadly acceptable**, and not significant in EIA terms.

15.7.5.3.3 Fishing Vessels

120. Similarly to recreational vessels, fishing vessels should take any adverse conditions into account when passage planning, and would prioritise seeking shelter should such conditions be forecast. Entry into the buoyed construction area during adverse weather conditions may not be preferable, particularly if construction vessels were present.

121. Frequency of occurrence is considered to be **extremely unlikely**, with severity of consequence assessed as **moderate** given the potential for damage to the vessel and / or injury to persons. The impact is therefore assessed as **broadly acceptable**, and not significant in EIA terms.

15.7.5.4 Restriction of Adverse Weather Routeing – Offshore Cable Corridor

122. Given that the offshore cable corridor will create a negligible (and temporary) 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 adverse weather routeing (**no impact**).

15.7.5.5 Increased Vessel to Vessel Collision Risk – Norfolk Boreas Site

123. The physical presence of pre commissioned structures and associated works could result in the displacement of vessels and activities from within the Norfolk Boreas site leading to an increase in vessel encounters and hence vessel to vessel collision risk.

15.7.5.5.1 Commercial Vessels

124. For the construction phase this impact can be separated into two impacts, increased encounters and collision risk between a third party vessel and a Norfolk Boreas construction vessel, and increased encounters and collision risk between third party vessels.

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

125. 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 there will be up to 113 vessels engaged on the project. The majority of these vessels would remain within the buoyed construction area, with RAM vessels also likely to be within the confines of a safety zone around a structure.

126. Should the decommissioning works associated with the Davy platform located within the Norfolk Boreas site overlap with the construction phase, liaison would be

required with the operators to ensure vessel movements and areas / durations of the works were promulgated. However it is noted that the Davy platform is anticipated to be decommissioned prior to the commencement of construction.

127. All construction vessel movements would be managed by a Marine Coordinator who would ensure that construction traffic does not interact with third party vessels. Other embedded mitigation would also be in place to manage construction vessel activity including:

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

128. When considering experience at other constructing wind farms it is identified that third party vessels do consider NtMs 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 commercial 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

129. As noted in section 15.7.5.1, there is expected to be some level of displacement associated with the construction of the project, notably from within the buoyed construction area. The densest routes (i.e., the routes on the IMO routeing measures) would not be deviated and the majority of routes which would require deviation are transited by at most one vessel per day. The busiest route likely to require deviation is the DFDS operated Newcastle-Ijmuiden ferry route (1-2 transits per day), which intersects the northern extent of the Norfolk Boreas site, however only a minor deviation to the north is expected.

130. 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 IMO Conventions including COLREGs (IMO, 1972) and SOLAS (IMO, 1974);
- MGN 372 (MCA, 2008); and

- Promulgation of Information (including to regular operators, notably DFDS).

131. The frequency of occurrence is considered to be **reasonably probable**, with severity consequences determined to be **minor**, noting that the most likely consequences are increased encounters rather than collision. The impact is therefore expected to be **tolerable** with mitigation including the management of construction traffic. This impact is therefore not significant under EIA terms.

15.7.5.5.2 Recreational Vessels

132. Based on the marine traffic analysis, less than one recreational vessel per day was recorded within the Norfolk Boreas site during summer 2018, with no recreational traffic recorded during winter.

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

133. 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

134. 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 areas of the Norfolk Boreas site where construction work is ongoing. 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 are likely to stay outwith areas used by construction vessels.

135. This is considered especially likely for Norfolk Boreas given the distance from shore (73km or 40nm), in that any recreational user at such a distance offshore is likely to be experienced, and would be aware of the risks associated with RAM vessels (noting that vessels would be free to transit the buoyed construction area assuming safety zones were avoided). Regardless, a guard vessel(s) or other on-site vessel may make contact with any vessel approaching the buoyed construction area to ensure they are aware of the ongoing works, safety zones, and structures.

136. Therefore, 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**).

15.7.5.5.3 Fishing Vessels in Transit

137. Based on the marine traffic survey data output, an average of 12 fishing vessels were recorded within the OWF site study area during summer 2018, compared to one in winter 2018. While fishing vessels would be free to enter the buoyed construction area (assuming safety zones are avoided), it is considered likely based on experience of other wind farm developments that the active construction work, and hence the construction vessels, will be avoided. Similarly, given the limited geographical area within which the array cable installation vessels will operate, and the temporary nature of their work, no collision risks associated with the cable installation vessels are perceived. There is therefore not anticipated to be any perceptible collision impact between fishing vessels and construction associated vessels (**no impact**).

15.7.5.6 Increased Vessel to Vessel Collision Risk – Offshore Cable Corridor

15.7.5.6.1 Commercial Vessels

138. 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.

139. 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.

15.7.5.6.2 Recreational Vessels

140. There are no perceptible impacts associated with the installation of the offshore export cable on recreational vessels (**no impact**).

15.7.5.6.3 Commercial Fishing Vessels in Transit

141. There are no perceptible impacts associated with the installation of the offshore export cable on fishing vessels in transit (**no impact**).

15.7.5.7 Vessel to structure allision risk – Norfolk Boreas Site

142. The physical presence of pre commissioned structures would create a vessel to structure allision risk for a vessel navigating within or near the Norfolk Boreas site.

15.7.5.7.1 Commercial Vessels

143. 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 (which will be agreed with TH post consent) may not yet have been implemented.

144. It is assumed that through effective promulgation of information (notably to identified regular operators of the area), the majority of passing commercial vessels would be aware of the ongoing construction, and would passage plan in advance to avoid the active work. Additional promulgation of information regarding safety zones would also be undertaken as part of the corresponding application process, which would provide additional awareness of the development. The temporary lighting and marking in place during construction would also provide an indication to passing vessels of the allision hazard, and guard vessels would be deployed where required to protect sensitive areas of construction.

145. Should the decommissioning works associated with the Davy platform located within the Norfolk Boreas site overlap with the construction phase, liaison would be required with the operators to ensure the associated vessels were aware of the ongoing works, potential for partially completed structures and safety zones. However it is noted that the Davy platform is anticipated to be decommissioned prior to the commencement of construction.

146. It is considered extremely unlikely that a commercial vessel would approach ongoing construction operations, and any allision scenario is therefore likely to be due to human error or machinery failure.

147. 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.

148. Phased project layouts are not available at this stage but the final layout would be agreed in advance with the MMO (in conjunction with the MCA and TH (with consideration as to the Design Rules in Table 15.10)) as per the Development Consent Order requirements.

149. Severity of consequence is considered to be **minor** given the embedded mitigation in place, and the frequency of occurrence 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

150. 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 Norfolk Boreas 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 unintentionally. 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.

151. The severity of consequence from the Norfolk Boreas site is considered to be **minor** given the low energy and low speed of any allision incident (based on the size of recreational vessels), 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.

15.7.5.7.3 Fishing Vessels in Transit

152. Fishing vessels are likely to avoid the areas of active construction within the buoyed construction area, however they may still choose to transit through areas clear of construction activity. As with recreational craft, the promulgation of information would ensure that fisherman are well informed of the Norfolk Boreas site. There would 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.

153. 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 is considered to be **moderate**, and the frequency of occurrence is considered to be **extremely unlikely**, due to embedded mitigation measures in place. The impact has therefore been classed as **broadly acceptable** which is not significant under EIA terms.

15.7.5.8 Vessel to Structure Allision Risk – Offshore Cable Corridor

154. Given that there are no surface structures associated with the offshore export cable corridor, 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 (**no impact**).

15.7.5.9 Anchor interaction and snagging risk – Norfolk Boreas Site

155. The presence of subsea cables (array) could create an increased snagging risk for vessels navigating within the Norfolk Boreas site.

15.7.5.9.1 Commercial Vessels

156. Two vessels were identified as anchoring within the OWF site study area during the summer 2018 marine traffic survey data while no vessels were recorded during winter 2018. Neither of these vessels was recorded at anchor within the Norfolk Boreas site. Due to the distance of the site offshore, it is likely these vessels were anchored while they awaited orders.

157. 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, based on statistical evidence, are also considered unlikely. Further details on anchoring and vessel breakdown are provided within the NRA (Appendix 15.1).

158. 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 levels of anchoring the frequency of any potential interaction is considered to be very low.

159. A commercial vessel anchor is unlikely to snag on a cable (based on its length overall and therefore its anchor size), with the most likely consequence being damage to the cable.

160. The frequency of occurrence is considered to be **remote**, with severity of consequence is considered to be **minor**. The impact is therefore determined to be **broadly acceptable**, and not significant under EIA terms.

15.7.5.9.2 Recreational Vessels

161. Recreational vessels (and their anchors) are typically much smaller than commercial vessels. Interaction with subsea cables 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 recreational users this far offshore would be expected to be experienced.

162. The sea area within the Norfolk Boreas site is of a depth greater than 20m and small recreational vessels are considered unlikely to attempt to anchor in such depths.

163. However, given that the cables would be protected and charted, an incident of anchor interaction is considered an unlikely event, noting that recreational vessel anchor penetration depths would typically be much more limited than larger commercial vessels.

164. Frequency of occurrence is therefore considered to be **negligible**, with consequence assessed as **negligible**. The impact is determined to be **broadly acceptable**, and not significant under EIA terms.

15.7.5.9.3 Fishing Vessels in transit

165. In addition to potential for anchor snagging, fishing vessels may also snag their gear on the cables; this is impact is assessed specifically within Chapter 14 Commercial Fisheries.

166. As with recreational vessels, fishing vessels are typically small when compared to commercial vessels but are likely to have larger anchors than recreational vessels. Fishing vessels are considered most likely to anchor coastally in sheltered waters, and the highest risk area is therefore within the coastal areas of the offshore cable corridor rather than within the Norfolk Boreas site.

167. Frequency of occurrence is therefore considered to be **remote** for the Norfolk Boreas site, with severity of consequence assessed as **minor**. The impact is determined to be **broadly acceptable**, and not significant under EIA terms.

15.7.5.10 Anchor Interaction and Snagging Risk – Offshore Cable Corridor

168. The offshore export cables could create an increased snagging risk for vessels navigating within the offshore cable corridor and the project interconnector search area.

15.7.5.10.1 Commercial Vessels

169. Commercial anchoring activity was considered low within the offshore cable corridor study area (which includes the project interconnector search area) based on the findings of the baseline assessment.

170. 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.

171. 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 has therefore been classed as **broadly acceptable** and not significant under EIA terms.

15.7.5.10.2 Recreational Vessels

172. No recreational anchoring activity was recorded within the marine traffic surveys, however it should be considered that as the marine traffic assessment of the offshore cable corridor was AIS only, levels of recreational anchoring may be underestimated. Recreational anchoring is considered much more likely within coastal areas, based on water depths and the shelter provided near the coast. For this reason there is not considered to be snagging risk associated with the project interconnector.

173. The greatest risk is therefore likely to be in the vicinity of the shore line, however the cable would be buried and / or protected where it is installed, and it is currently anticipated that Horizontal Directional Drilling will be utilised approximately 700 to 1,000m from shore providing protection to the most vulnerable area (i.e., where water depths are shallowest) The cables would also be charted, which should be taken into consideration by a vessel prior to anchoring.

174. The severity of consequence from the offshore cable corridor is therefore 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.

15.7.5.10.3 Commercial Fishing Vessels in Transit

175. Given that no anchoring activity was recorded from fishing vessels within the offshore cable corridor study area (which includes the project interconnector search area), fishing anchoring levels are considered to be a low frequency event. It should be noted that the offshore cable corridor traffic surveys were AIS only, and fishing vessels of less than 15m are therefore not necessarily accounted for. Such vessels would be expected to anchor coastally in sheltered waters (based on their size), rather than within the offshore cable corridor itself. Additionally, the fishing grounds of smaller vessels are likely to be coastal, and it is therefore unlikely that such vessels would need to transit further offshore (i.e., within the offshore cable corridor). Further details on fishing grounds are provided in Chapter 14 Commercial Fisheries.

176. 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. Impacts associated with commercial fishing gear are assessed in Chapter 14 Commercial Fisheries.

15.7.5.11 Effects on Emergency Response Resources – Norfolk Boreas Site

177. The increased vessel and personnel presence on site during construction may raise incident rates within the area, which may impact upon emergency response resources, including pollution response.

178. Under national and international law the operators of Norfolk Boreas would be required to comply with existing emergency response requirements, as detailed in the NRA (Appendix 15.1), 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 Emergency Response Co-operation Plan (ERCoP) would be given to what resources are required to provide a level of response that would ensure that response time and resources are not impacted.

179. Embedded mitigation includes compliance with MGN 543 and the development of an ERCoP. Norfolk Boreas Limited 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 'SAR and emergency response matters'.

180. For emergency response, Norfolk Boreas 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 Boreas would also generally increase facilities in the area for all third party users; noting requirements under SOLAS (IMO, 1974) to render assistance to persons in distress. This may offset any increase in incident rates.

181. On this basis frequency of occurrence is assessed to be **remote**. Severity of consequence is assessed to be **moderate** given the potential for multiple or (single serious) injuries and Tier 2 pollution incidents requiring assistance. The impact is therefore determined to be **tolerable**, which is not significant in EIA terms.

15.7.5.12 Effects on Emergency Response Resources – Offshore Cable Corridor

182. 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**).

15.7.6 Potential Impacts during Operation

15.7.6.1.1 Vessel Displacement – Norfolk Boreas Site

183. The physical presence of the structures within the Norfolk Boreas site could result in effects on vessel routeing and displacement of activities within the OWF Site Study Area.

15.7.6.1.2 Commercial Vessels

184. The worst case scenario for the project assumes that all 180 turbines, two offshore electrical platforms, and one offshore service platform would be operational within the Norfolk Boreas site, causing maximal displacement.

185. Following the principals set out in MGN 543 (MCA, 2016), a total of 17 main routes were identified within the OWF site study area. The majority of traffic in the area was observed to be utilising routes within the existing IMO routeing measures, and will therefore not be required to deviate (though some vessels within the routeing measures may choose to pass further from the routeing measure boundaries once the structures are present).

186. Of the 17 routes identified, seven are anticipated to notably deviate as a result of the wind farm structures; deviation around the Boreas Site has been considered as a worst case given that it would result in the largest increase in distance. Consultation undertaken for Norfolk Boreas has indicated that smaller commercial vessels may choose to transit through the Norfolk Boreas site if spacing allowed for safe navigation; however, this was only considered likely to occur if other wind farm developments are built (notably Norfolk Vanguard and East Anglia THREE), and so such a scenario has primarily been considered cumulatively. A full list of the other wind farms considered for cumulative assessment is provided in Table 15.13, in section 15.8).

187. Commercial vessels that avoided the buoyed area during the construction phase are likely to have already developed new routes which continue to avoid the Norfolk Boreas site post commissioning. Oil and gas vessels associated with the Sean platforms may choose to transit through the Norfolk Boreas site during operation given their size, however the deviation required to avoid the structures altogether is considered minor. Given that the Davy platform is expected to be decommissioned

prior to commencement of construction, it is considered extremely unlikely there will be any associated activity by the operational phase of Norfolk Boreas.

188. The increase in route distances for vessels displaced by the project would be minimised by embedded mitigation including promulgation of information (such as NtMs) and charting which would enable vessels to effectively passage plan in advance of passing the Norfolk Boreas site.

189. The severity of consequence 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.

15.7.6.1.3 Recreational Vessels

190. Limited recreational vessel activity was recorded within the Norfolk Boreas site during summer, and consultation has indicated vessels between the UK and Scandinavia will transit on north-east / south-west passage through the area. No offshore route indicators within the RYA Coastal Atlas (RYA, 2016) relevant to the Norfolk Boreas site were observed, however it is noted that archive RYA data (RYA, 2009) shows offshore cruising routes do intersect the site boundaries.

191. The minimum spacing between turbines would be 720m and the site would comply with the Design Rules as per Table 15.10. Assuming at least one line of orientation is maintained this should allow (based on consultation feedback) adequate sea room for recreational craft to navigate through the Norfolk Boreas site. Recreational users are likely to take due consideration for the weather conditions and passage plan accordingly to ensure safe transits, and it is assumed that in winter periods limited recreational activity would be present within the Norfolk Boreas site given the distance offshore.

192. 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 including use of the Design Rules post consent (see Table 15.10), navigation within the array or displacement of recreational vessels from the proposed project has no perceptible effects and is not significant under EIA terms (**no impact**).

15.7.6.1.4 Fishing Vessels

193. As with the equivalent construction impact, Chapter 14 Commercial Fisheries considers the impacts of the displacement of fishing activity. From a navigational safety perspective, fishing vessels would be able to transit through the Norfolk

Boreas site during operation (noting that temporary 500m safety zones may be implemented around major maintenance work).

194. Given the size of fishing vessels (on average approximately 42m length within the marine traffic survey data) navigating within the area, the ability to transit through is expected to be higher than that of commercial vessels and 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 720m which should allow adequate sea room for fishing vessels to navigate through the Norfolk Boreas site, again noting that it is assumed that a minimum of one line of orientation would be maintained (in accordance with Rule number 2 of the Design Rules (see Table 15.10) agreed post consent).

195. Severity of consequence 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 Vessel Displacement – Offshore Cable Corridor

196. There will be no permanent displacement associated with the offshore cable corridor during the operational phase, noting that there may be spatially limited and temporary displacement during any periods of cable monitoring or maintenance. However, the temporary displacement associated with these tasks would not be of sufficient magnitude to result in any perceptible impact. Therefore vessel displacement in the offshore cable corridor has been assessed to have **no impact**.

15.7.6.3 Restriction of Adverse Weather Routeing – Norfolk Boreas Site

197. The Norfolk Boreas site may restrict routeing options to vessels during periods of adverse weather. Consultation has indicated that during periods of adverse weather, vessels prefer to transit near shore on a coastal route (generally in the lee of any adverse weather conditions) before crossing the southern North Sea (to minimise impacts of weather by keeping it forward or abaft of their beam rather than directly onto the bow, stern or abeam) within the vicinity of Norfolk Boreas where the transit across is at its shortest.

15.7.6.3.1 Commercial Vessels

198. During operation, it is considered likely that commercial vessels would continue to avoid the Norfolk Boreas site. Consultation has indicated that smaller commercial vessels may transit through if turbine spacing allowed for safe navigation; however, this is considered unlikely in adverse weather.

199. During adverse weather it is considered likely that vessels would pass south of the Norfolk Boreas site, however actual deviations would depend on the severity of the weather conditions. It is assumed that both forecast adverse conditions and the presence of the Norfolk Boreas site would be taken into account by a vessel when passage planning to ensure safe passage and minimal deviations. It is also noted that by the operational phase, operators will have identified optimal adverse weather routes that take the Norfolk Boreas site into account.

200. Severity of consequence is considered **moderate** given the potential for a vessel not being able to safely mitigate the effects of the adverse weather during a crossing resulting in significant rolling and / or pitching resulting in injury to persons or damage to cargo. The frequency of occurrence is considered to be **remote**. The impact is therefore assessed as **tolerable**, and not significant in EIA terms.

15.7.6.3.2 Recreational Vessels

201. Recreational transits this far offshore would not be expected if adverse conditions were forecast. Users that far offshore would be expected to be experienced, and would prioritise seeking shelter should such conditions be forecast. In the event that a recreational vessel was in the vicinity of the Norfolk Boreas site in adverse conditions it is likely to pass south of the structures, given that transit through the array may not be safe in unfavourable conditions.

202. Recreational activity was low during summer, and no activity was recorded during winter (when adverse conditions would be expected). Frequency of occurrence is considered to be **negligible** given that recreational vessels will not within the Norfolk Boreas site during adverse weather conditions (assuming embedded mitigation of effective passage planning), with severity of consequence assessed as **moderate** given the potential for injury or damage to the vessel. The impact is therefore assessed as **broadly acceptable**, and not significant in EIA terms.

15.7.6.3.3 Fishing Vessels

203. Similar to recreational vessels, fishing vessels should take any adverse conditions into account when passage planning, and would prioritise seeking shelter should such conditions be forecast. There would be no restrictions to site entry during normal operations, however entry may not be preferable in adverse conditions.

204. Frequency of occurrence is considered to be **extremely unlikely**, with severity of consequence assessed as **moderate** given the potential for injury or damage to the vessel. The impact is therefore assessed as **broadly acceptable**, and not significant in EIA terms.

15.7.6.4 Restriction of Adverse Weather Routeing – Offshore Cable Corridor

205. Given that the offshore cable corridor will create a negligible deviation during the operational phase (an anticipated safe passing distance around RAM maintenance vessels), any impact on vessels is not considered to have a perceptible effect with regards to adverse weather routeing (**no impact**).

15.7.6.5 Increased Vessel to Vessel Collision Risk – Norfolk Boreas Site

206. Given that the physical presence of the structures could displace traffic (see section 15.7.6.1.1), encounter rates between vessels may increase, leading to a rise in collision rates.

15.7.6.5.1 Commercial Vessels

207. As part of the assessment of the impact of the project on vessel to vessel collision risk within the NRA, the following scenarios have been considered:

- Pre wind farm routeing – base case traffic levels;
- Post wind farm routeing – base case traffic levels;
- Post wind farm routeing – 10% traffic growth; and
- Post wind farm routeing – 20% traffic growth.

208. The case of a 20% increase in traffic was requested by the CoS during the Norfolk Vanguard consultation process, and this was therefore included in the modelling of vessel to vessel collision risk for Norfolk Boreas.

Increased Encounters and Collision Risk between Third Party Vessels

209. The baseline established from the marine traffic survey data showed the significant commercial routes in the area were those in the routeing measures. A key concern raised during consultation was the potential for smaller vessels currently intersecting the Norfolk Boreas site to be displaced into the routeing measures, leading to increased encounters with larger vessels. Further assessment of traffic levels within the routeing measures is available in section 16 of the NRA (Appendix 15.1).

210. It is noted that vessels may choose to pass north or south of the Norfolk Boreas site rather than use the DWRs. This may lead to increases in vessel density at the wind farm periphery, resulting in increased vessel encounters, and hence collision rate.

211. It was estimated that a vessel would be involved in a collision once every 18.9 years based on the pre wind farm routeing (at base case traffic levels). Assuming likely deviations, the post wind farm risk rose by 1% to once every 18.7 years. Further details are provided in the NRA, including the results of the traffic increase simulations.

212. 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 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.

Encounters and Collision Risk between Third Party Vessels and Operation and Maintenance Vessels

213. It is estimated that there will be 445 vessel movements (round trips to port) per year during the operation and maintenance phase. These vessels are likely to operate from Great Yarmouth or Lowestoft and would 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.

214. During major maintenance, RAM vessels may be required to work at the structures. Such vessels pose a particular collision risk to passing traffic given their lack of manoeuvrability, however safety zones would be implemented around any structure where such work is being undertaken, and details of the works would be promulgated in advance including through NtMs.

215. Severity of consequence is considered to be **minor**, and frequency of occurrence is considered **remote** taking into consideration the embedded mitigation in place. The impact is therefore assessed as **broadly acceptable** and not significant in EIA terms.

15.7.6.5.2 Recreational Vessels

216. The turbine spacing (minimum of 720m) and compliance with the Design Rules (see Table 15.10) post consent is considered to provide suitable room for safe navigation for smaller recreational vessels to safely transit through the Norfolk Boreas site during the operation and maintenance phase should they choose to. It is considered likely that such vessels would use this option rather than utilise the routeing measures given the risk of encounters with larger vessels.

217. 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**).

15.7.6.5.3 Fishing Vessels

218. As with recreational vessels, it is considered that there is suitable spacing for fishing vessels to safely transit through the Norfolk Boreas site if they choose to due to a minimum spacing of 720m and compliance with the Design Rules (see Table 15.10) post consent.

219. As this chapter is concerned with navigational safety impacts only, there are not expected to be any perceptible effects associated with the project during operation (**no impact**). Impacts on Commercial Fisheries are assessed fully within Chapter 14.

15.7.6.6 Increased Vessel to Vessel Collision Risk – Offshore Cable Corridor

220. Given that the offshore export cables would be buried, there is no associated displacement and therefore no collision risk impact identified (**no impact**), noting the potential for negligible displacement from RAM vessels during periods of maintenance or monitoring. This assumes that any under keel clearance issues are assessed as part of the assessment of cable burial / protection (embedded mitigation) that would be undertaken post consent.

15.7.6.7 Vessel to Structure Allision Risk

221. The physical presence of structures would create a vessel to structure allision risk for a vessel navigating within the Norfolk Boreas site.

15.7.6.7.1 Commercial Vessels

222. During the operation and maintenance phase, the structures within the Norfolk Boreas site 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 considered likely that commercial vessels would not enter the Norfolk Boreas site and the majority of allision risk is therefore anticipated to be from vessels outside of the array. Consultation for Norfolk Boreas has indicated that smaller commercial vessels may choose to transit through wind farms if spacing was considered to allow safe passage, however this scenario has only been considered cumulatively given that it is expected vessels would pass north or south of Norfolk Boreas if it was built in isolation.

223. Modelling was undertaken for both vessel allision risk under way and allision risk associated with vessels NUC (assuming vessels will not enter the array). The full results can be found in section 20 of the NRA (Appendix 15.1). In summary, a powered allision was estimated to occur once every 4,000 years, whereas a drifting (NUC) allision was estimated to occur once every 10,900 years (this assumes base case traffic levels and post wind farm routeing).

224. Should a commercial vessel allide with a structure within the Norfolk Boreas site, 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 structure, particularly if the impact was under power.

225. Evidence at other wind farm projects shows that vessels are able to navigate safely and effectively in close proximity to a wind farm[1]. Embedded mitigations are well tested and include consideration for wind turbine array layout. Notably:

- The avoidance of extreme peripheral turbines;
- Lighting and marking in agreement with TH and the MCA;
- Regular shapes and edges to aid effective navigational marking; and
- A minimum of one line of orientation (preferred by recreational consultees).

226. It is also noted that increased minimum spacing in round three wind farm projects (compared to round one and two projects) allows increased room to manoeuvre and thus improved navigational safety.

227. Compliance with COLREGS (IMO, 1972) would 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.

228. It is also noted that any layouts would require final signoff by the MMO in consultation with the MCA and TH (with consideration to the Design Rules as per Table 15.10).

229. The severity of consequence 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, guard vessels, and safety zones. This impact has therefore been classed as **broadly acceptable** and not significant under EIA terms.

15.7.6.7.2 Recreational Vessels

230. There is the potential for a recreational vessel to allide with a structure within the Norfolk Boreas site during the operation and maintenance phase. Recreational vessels may choose to transit through the Norfolk Boreas site on a regular basis, and allision from a vessel intending to be within the array is therefore considered a possibility. It is not considered likely that a recreational vessel would transit through the Norfolk Boreas site at high speed, and at this distance from shore, recreational users will tend to be better equipped and more experienced.

[1] AIS data has been assessed at numerous wind farms (such as Thanet and Humber Gateway) by Anatec Limited

231. 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. Compliance with the Design Rules (see Table 15.10) post consent would also reduce the risk of a recreational vessel alliding with a structure within the Norfolk Boreas site.

232. Under keel allision 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 foundation types under consideration are expected to achieve this. However, if this unable to be achieved then Norfolk Boreas Limited would look at alternative mitigation including surface piercing markers showing the extent of the underwater structure or external warning signage.

233. Should a recreational vessel allide with a structure within the Norfolk Boreas site, 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 given a typical recreational vessel's size and stability.

234. The severity of consequence 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.

15.7.6.7.3 Fishing Vessels

235. There is the potential for a fishing vessel to allide with a structure within the Norfolk Boreas site during the operation and maintenance phase. As with recreational vessels, fishing vessels may choose to transit through the array during the operation and maintenance phase, and it is considered likely that this would be preferable to utilising the routeing measures. There is also potential for an allision to occur whilst engaged in fishing activity (i.e., with gear deployed) and although gear snagging is considered in Commercial Fisheries Chapter 14, the NRA and this chapter has only assessed the impact of waterline allisions.

236. It was estimated that a fishing vessel would allide with a wind farm structure once every 4.6 years (worst case and assuming no mitigating action is taken). This value is based on the assumption that levels of fishing activity within the Norfolk Boreas site will remain consistent with the baseline activity. It should also be considered that 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 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. Further details are provided in the NRA (section 21.2.3).

237. 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).

238. Allision consequences for fishing vessels are more similar to recreational vessels than for commercial vessels (i.e., increased potential for loss of stability, 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.

239. Severity of consequence is considered to be **moderate** given the potential for damage, with frequency of occurrence determined to be **remote** (noting minor allisions with no notable consequence may be more frequent). The impact has therefore been classed as **tolerable** noting compliance with the Design Rules post consent (see Table 15.10) and that further mitigation (depending upon the foundation type selected) may be required to ensure risk remains ALARP and not significant under EIA terms.

15.7.6.8 Vessel to Structure Allision Risk – Offshore Cable Corridor

240. 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 given that there are no surface structures within the offshore cable corridor (**no impact**).

15.7.6.9 Anchor Interaction and Snagging Risk – Norfolk Boreas Site

241. The physical presence of cables could create an increased snagging risk for vessels navigating within the Norfolk Boreas site.

15.7.6.9.1 Commercial Vessels

242. Two vessels were identified as being at anchor during the summer 2018 marine traffic survey, however neither were within the Norfolk Boreas site. There were no vessels identified as being at anchor during the winter 2018 survey.

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

marked on Admiralty charts, and the proximity of the vessel to the charted position should be taken into consideration prior to the deployment of anchor.

244. It is considered very unlikely a commercial vessel would anchor within an array, and given baseline anchoring levels within the OWF site study area are low, a commercial vessel dragging anchor into the array is also considered unlikely.

245. The severity of consequence 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.

15.7.6.9.2 Recreational Vessels

246. Recreational vessel anchors would typically be much smaller than those of commercial vessels. An interaction between a recreational vessel anchor and a subsea cable may therefore have more serious implications, in that a snagging may occur. This could lead to loss of stability of the vessel, which may result in capsize.

247. It is considered unlikely that a recreational vessel would anchor within the Norfolk Boreas site based on the distance offshore and the water depths. Snagging risk associated with the cables would be managed via marking on Admiralty charts, and the proximity of the vessel to the charted position should be taken into consideration prior to the deployment of anchor.

248. The severity of consequence 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.

15.7.6.9.3 Commercial Fishing Vessels in Transit

249. 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; this is considered separately within Chapter 14 Commercial Fisheries.

250. As with recreational vessels, given typical fishing vessel anchor sizes a cable interaction may lead to snagging, and hence capsize. However, cable burial and protection requirements would be assessed post consent.

251. The cables would be marked on Admiralty charts, and the proximity of the vessel to the charted position should be taken into consideration prior to the deployment of anchor. Regardless, anchoring is considered to be a low frequency event within the Norfolk Boreas site given that no fishing anchoring activity was recorded within the marine traffic surveys.

252. The severity of consequence is considered to be **minor** and the frequency is considered to be **extremely unlikely** given the very low frequency of anchoring. The impact has therefore been classed as **broadly acceptable** which is not significant under EIA terms.

15.7.6.10 Anchor Interaction and Snagging Risk – Offshore Cable Corridor

253. The physical presence of the offshore export cables could create an increased snagging risk for vessels navigating within the offshore cable corridor and project interconnector search area.

15.7.6.10.1 Commercial Vessels

254. Levels of anchoring activity were considered low within the offshore cable corridor study area (which includes the project interconnector search area) based on the findings of the marine traffic assessment.

255. Where possible the cables would be buried and where protection is required, a cable risk assessment would be carried out to understand risks in relation to anchoring, emergency anchoring or under keel clearance. Additionally, the cables would be marked on Admiralty charts, and should therefore be taken into consideration prior to an anchor being deployed.

256. 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.

257. The severity of consequence for the offshore cable corridor 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.

15.7.6.10.2 Recreational Vessels

258. No recreational anchoring was recorded within the offshore cable corridor study area; however it should be considered that the data assessed was AIS only, and non-AIS recreational anchoring is therefore not accounted for. Recreational anchoring is most likely to occur coastally in sheltered waters and shallow water depths, and it is noted that the Pilot Book (UKHO, 2016) states that vessels may anchor coastally within The Would between Bacton and Winterton Ness which is near the landfall. For this reason, there is not considered to be a snagging risk associated with the project interconnector.

259. An assessment of cable burial and protection would be undertaken post consent to ensure the cable is buried or externally protected as necessary. This would include assessment of areas where under keel clearance may be an issue (i.e., shallower

waters). Additionally, the cables would be marked on Admiralty charts, and should therefore be taken into consideration prior to an anchor being deployed.

260. The frequency of occurrence is considered to be **remote**, with severity of consequence assessed as **minor**. This impact has therefore been classed as **broadly acceptable** which is not significant under EIA terms.

15.7.6.10.3 Commercial Fishing Vessels in Transit

261. Given that no anchoring activity was recorded from fishing vessels within the offshore cable corridor study area (which includes the project interconnector search area), fishing anchoring levels are considered to be a low frequency event. It should be noted that the offshore cable corridor traffic surveys were AIS only, and fishing vessels of less than 15m are therefore not necessarily accounted for. Such vessels would be expected to anchor coastally in sheltered waters (based on their size), rather than within the offshore cable corridor itself. Additionally, the fishing grounds of smaller vessels are likely to be coastal, and it is therefore unlikely that such vessels would need to transit further offshore (i.e., within the offshore cable corridor). Further details on fishing grounds are provided in Chapter 14 Commercial Fisheries.

262. An assessment of cable burial and protection would be undertaken post consent to ensure the cable is buried or externally protected as necessary. This would include assessment of areas where under keel clearance may be an issue (i.e., shallower waters). Additionally, the cables would be marked on Admiralty charts, and should therefore be taken into consideration prior to an anchor being deployed.

263. 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.

15.7.6.11 Effects on Emergency Response Resources – Norfolk Boreas Site

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

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

266. Due to the reduction in activity on site during the operational phase and compliance with the Design Rules (specifically with reference to SAR helicopter access as per Table 15.10), 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.

15.7.6.12 Effects on Emergency Response Resources – Offshore Cable Corridor

267. 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**).

15.7.7 Potential Impacts during Decommissioning

15.7.7.1 Vessel Displacement – Norfolk Boreas Site

268. The physical presence of decommissioning structures and the associated works could have an effect on vessel routeing and displacement of activities from within the Norfolk Boreas site.

15.7.7.1.1 Commercial Vessels

269. Baseline commercial vessel routeing has been established using marine traffic survey data collected during 2017 and 2018, with Anatec's ShipRoute database (Anatec, 2018) and the summer 2018 survey data used to validate the findings. A total of 17 routes were identified, as shown in Table 15.9.

270. The decommissioning works would be contained within a buoyed decommissioning area around the Norfolk Boreas site, and it is considered likely that commercial vessels will continue using the deviated routes established during the construction and operational phases. Once decommissioning is complete, these vessels would be free to transit the area again if they chose to (noting that structures would be removed to seabed level).

271. 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 Norfolk Boreas site. However, as discussed above, it is considered likely that commercial vessels would still avoid the buoyed decommissioning are while decommissioning was underway.

272. Given that details of the decommissioning works would be promulgated in advance including through NtMs, mariners should be able to passage plan as necessary to take the works into account where necessary.

273. Noting that the main purpose of the NRA is to assess navigational safety risk, the severity of consequence is considered to be **minor** 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** and not significant under EIA terms.

15.7.7.1.2 Recreational Vessels

274. Given the low recreational vessel numbers established in the baseline, 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 during decommissioning has no perceptible effects and is not significant under EIA terms (**no impact**).

15.7.7.1.3 Fishing Vessels in transit

275. Chapter 14 Commercial Fisheries considers displacement of commercial fishing activity. 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.

276. The severity of consequence 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.

15.7.7.2 Vessel Displacement – Offshore Cable Corridor

277. Given that cables would be cut and left in-situ, the associated surface vessel activity will only be present for a short period of time, and limited to a small area geographically. No perceptible displacement impact has therefore been identified (**no impact**).

15.7.7.3 Restriction of Adverse Weather Routeing – Norfolk Boreas Site

15.7.7.3.1 Commercial Vessels

278. Commercial vessels are likely to avoid the buoyed construction area during decommissioning. Consultation has indicated that smaller commercial vessels may transit through the Norfolk Boreas site if turbine spacing allowed for safe navigation, however this is considered unlikely in adverse weather, particularly if decommissioning vessels were present.

279. During adverse weather it is considered likely that vessels would continue to pass south of the Norfolk Boreas site (as they are anticipated to do during construction and operation), however actual deviations would depend on the severity of the weather conditions. It is assumed that both forecast adverse conditions and the presence of the Norfolk Boreas site would be taken into account by a vessel when passage planning to ensure safe passage and minimal deviations. Operators are considered likely to have identified optimal adverse weather routes that take the Norfolk Boreas site into account by this stage.

280. Once decommissioning is complete vessels may revert to pre wind farm adverse weather routes given that the foundations would be removed to seabed level.

281. As with the construction phase severity of consequence is considered **moderate** given the potential for injury or damage to cargo, with frequency of occurrence considered to be **remote**. The impact is therefore assessed as **tolerable**, and not significant in EIA terms.

15.7.7.3.2 Recreational Vessels

282. Recreational transits this far offshore (i.e., near the buoyed decommissioning area) would not be expected if adverse conditions were forecast. Users that far offshore would be expected to be experienced, and would prioritise seeking shelter should such conditions be forecast. In the event that a recreational vessel was in the vicinity of the buoyed decommissioning area in adverse conditions it is likely to pass south of the Norfolk Boreas site, given that transit through the array may not be safe in unfavourable conditions.

283. Recreational activity was low during summer, and no activity was recorded during winter (when adverse conditions would be expected). Frequency of occurrence is considered to be **negligible** as with the construction phase, with severity of consequence assessed as **moderate** given the potential for injury and damage to the vessel. The impact is therefore assessed as **broadly acceptable**, and not significant in EIA terms.

15.7.7.3.3 Fishing Vessels

284. Similarly to recreational vessels, fishing vessels should take any adverse conditions into account when passage planning, and would prioritise seeking shelter should such conditions be forecast. Entry into the buoyed decommissioning area during adverse weather conditions may not be preferable, particularly if decommissioning vessels were present.

285. Based on baseline fishing levels, frequency of occurrence is considered to be **extremely unlikely**, with severity of consequence assessed as **moderate** given the potential for injury and damage to the vessel. The impact is therefore assessed as **broadly acceptable**, and not significant in EIA terms.

15.7.7.4 Restriction of Adverse Weather Routeing – Offshore Cable Corridor

286. Given that cables would be cut and left in-situ, the associated surface vessel activity will only be present for a short period of time, and limited to a small area geographically. Therefore no perceptible impact on adverse weather routeing has been identified (**no impact**).

15.7.7.5 Increased Vessel to Vessel Collision Risk – Norfolk Boreas Site

287. The physical presence of decommissioning structures and associated works could result in the displacement of vessels and activities within the Norfolk Boreas site, leading to increased encounters and vessel to vessel collision risk.

15.7.7.5.1 Commercial Vessels

288. During decommissioning, there would be an increased vessel presence within the Norfolk Boreas site (from vessels associated with the decommissioning), which may cause vessel displacement. However, as commercial vessels are unlikely to be transiting through the Norfolk Boreas site 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).

289. Should fishing or recreational vessels be displaced from the Norfolk Boreas site during decommissioning there may be an increase in encounters with commercial vessels. However as fishing vessels and recreational vessels would be free to transit areas of the Norfolk Boreas site where work was not active (i.e., where there were no safety zones), no significant collision rate rise is anticipated.

290. The severity of consequence 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.

15.7.7.5.2 Recreational Vessels

291. 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 Norfolk Boreas site during the operation and maintenance phase. However, it is anticipated that recreational vessels will continue to transit areas of the buoyed decommissioning area where decommissioning is not underway.

292. There are not expected to be any effects associated with recreational craft encountering or colliding with decommissioning or other third party vessels (given they are likely to transit through the wind farm in areas where work is not active) and therefore this impact is considered not significant under EIA terms (**no impact**).

15.7.7.5.3 Fishing Vessels in transit

293. 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 Norfolk Boreas site during the operation and maintenance phase, for either transit or fishing purposes.

294. Fishing vessels would still be free to transit the wind farm through areas where decommissioning was not underway, and it considered likely that this would be preferable to deviation, particularly into the routeing measures.

295. Commercial fishing impacts are considered in Chapter 14 Commercial Fisheries. As the NRA considers only fishing vessels transiting there are not expected to be any perceptible effects associated with collision during decommissioning (**no impact**).

15.7.7.6 Increased Vessel to Vessel Collision Risk – Offshore Cable Corridor

296. Given that cables would be cut and left in-situ, the associated surface vessel activity will only be present for a short period of time, and limited to a small area geographically. Therefore no perceptible displacement impact (and hence increased collision risk) has been identified (**no impact**).

15.7.7.7 Vessel to Structure Allision Risk – Norfolk Boreas Site

297. The physical presence of decommissioning structures would create a vessel to structure allision risk for a vessel navigating within or near the Norfolk Boreas site.

15.7.7.7.1 Commercial Vessels

298. Given that it is likely that commercial vessels will continue to avoid the Norfolk Boreas site during decommissioning and noting the presence of the buoyed decommissioning area (to be defined in agreement with TH), allision risks are considered to be similar to that during construction and operation. It is noted that operational lighting and marking may no longer be active, however other mitigation would be in place to manage this, including safety zones and the buoyed decommissioning area.

299. It is anticipated that foundations would be removed above seabed level, and there are therefore no allision risks once decommissioning is completed.

300. The severity of consequence 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** and not significant in EIA terms.

15.7.7.7.2 Recreational Vessels

301. Recreational vessels are likely to continue to transit the Norfolk Boreas site during decommissioning, by avoiding areas of active work (as denoted by decommissioning vessels and safety zones). The distance offshore (73km or 40nm) suggests that any recreational users within the Norfolk Boreas site would be experienced, and would therefore navigate the array with care.

302. It is noted that operational lighting and marking may no longer be active on partially decommissioned structures, however other mitigation would be in place to manage this, including safety zones and the buoyed decommissioning area.

303. It is anticipated that foundations would be removed above seabed level, and there are therefore no allision risks once decommissioning is completed.

304. The severity of consequence is considered to be **minor** given the anticipated 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.

15.7.7.7.3 Fishing Vessels in transit

305. Fishing vessels are likely to continue to transit the Norfolk Boreas site during decommissioning, by avoiding areas of active work (as denoted by decommissioning vessels and safety zones). This is considered preferable to using the routeing measures given the potential for encounters with larger vessels.

306. It is noted that operational lighting and marking may no longer be active on partially decommissioned structures, however other mitigation would be in place to manage this, including safety zones and the buoyed decommissioning area.

307. It is anticipated that foundations would be removed above seabed level, and there are therefore no allision risks once decommissioning is completed.

308. The severity of consequence is considered to be **moderate** and the frequency of effect is considered to be **extremely unlikely**. Following consideration of embedded mitigation the risk is considered to be **broadly acceptable** and is not significant under EIA terms.

15.7.7.8 Vessel to Structure Allision Risk – Offshore Cable Corridor

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

15.7.7.9 Anchor Interaction and Snagging Risk

310. The physical presence of cables could create an increased snagging risk for vessels navigating within the Norfolk Boreas site.

15.7.7.9.1 Commercial Vessels

311. It is considered extremely unlikely that a commercial vessel would anchor within the Norfolk Boreas site 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 cables is considered to be an unlikely event.

312. The severity of consequence is considered to be **minor** and the frequency of occurrence is considered to be **extremely unlikely**. The impact has therefore been classed as **broadly acceptable** which is not significant under EIA terms.

15.7.7.9.2 Recreational Vessels

313. It is considered unlikely that a recreational vessel would anchor within the Norfolk Boreas site given the distance it is located offshore (73km or 40nm at closest point to land). It is also noted that a recreational user that far offshore would be expected to be experienced, and should therefore be aware of the cables and the decommissioning activity in the event of a requirement to drop anchor.

314. However, given that the cables would be charted and noting that recreational anchoring would be expected to occur coastally in sheltered water. The frequency of occurrence is therefore considered to be **extremely unlikely**, with severity of

consequence considered as **minor**. This impact has therefore been classed as **broadly acceptable** which is not significant under EIA terms.

15.7.7.9.3 Fishing Vessels in transit

315. Given that cables would be cut and left in-situ, an interaction risk with a fishing vessel anchor exists. It should also be noted that cable protection would no longer be monitored or maintained. However it is considered unlikely that a fishing vessel would anchor within the Norfolk Boreas site given the distance offshore, and it is noted that no anchoring activity from fishing vessels was recorded during the marine traffic surveys.

316. Due to the size of a typical fishing vessel, should an anchor snagging occur, loss of stability with the potential for capsize is a risk, albeit a remote one. However, the more likely outcome is loss of the anchor (either deliberately to free the vessel, or accidently during attempts to do so). Loss or damage of fishing gear during active fishing is assessed in Chapter 14 Commercial Fisheries). Any damage to the cables at this stage would be non-consequential.

317. The severity of consequence 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 instead of anchoring offshore they will proceed to anchor near shore. The impact has therefore been classed as **broadly acceptable** which is not significant under EIA terms.

15.7.7.10 Anchor Interaction and Snagging – Offshore Cable Corridor

15.7.7.10.1 Commercial Vessels

318. Cables would be cut and left in-situ, and an interaction risk with a commercial vessel anchor therefore exists. However baseline commercial vessel anchoring levels were established as being low within the offshore cable corridor study area (including the project interconnector search area), and it is noted that any damage to the abandoned cables would be non-consequential. Cables would continue to be charted which should be taken into consideration by commercial vessels prior to anchoring.

319. 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.

15.7.7.10.2 Recreational Vessels

320. Cables would be cut and left in-situ, and an interaction risk with a recreational vessel anchor therefore exists. No recreational anchoring was recorded during the marine traffic surveys, however it should be considered that the offshore cable corridor assessment was AIS only, and non-AIS vessels may therefore be underrepresented. Such vessels would be expected to anchor coastally in sheltered waters rather than within the offshore cable corridor or project interconnector search area.

321. Cable protection would no longer be monitored or maintained, however the charted presence of the abandoned cables should still be taken into consideration prior to the decision to drop anchor.

322. 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.

15.7.7.10.3 Commercial Fishing Vessels in Transit

323. No anchoring activity was recorded from fishing vessels during the marine traffic surveys. However it should be considered that the offshore cable corridor assessment was AIS only, and non-AIS vessels (i.e., fishing vessels less than 15m) may therefore be underrepresented. Such vessels would be expected to anchor coastally in sheltered waters rather than within the offshore cable corridor or project interconnector search area based on their size. Additionally, the fishing grounds of smaller vessels are likely to be coastal, and it is therefore unlikely that such vessels would need to transit further offshore (i.e., within the offshore cable corridor). Further details on fishing grounds are provided in Chapter 14 Commercial Fisheries.

324. Cable protection would no longer be monitored or maintained, however the charted presence of the abandoned cables should still be taken into consideration prior to the decision to drop anchor.

325. 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.

15.7.7.11 Effects on Emergency Response Resources – Norfolk Boreas Site

326. 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, given the increased levels of vessels and personnel on site.

327. 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 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.

15.7.7.12 Effects on Emergency Response Resources – Offshore Cable Corridor

328. 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 Impacts

329. 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 15.13. Then those impacts which have an effect have been assessed and ranked as per the FSA process detailed in section 15.4.

Table 15.12 Potential Cumulative Impacts

Impact	Potential for cumulative impact	Data confidence	Rationale
Construction			
Vessel Displacement	Yes	Medium	This was raised as a key point to be considered during consultation.
Restriction of Adverse Weather Routes	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	No	Medium	Snagging risk during anchoring operations is localised to the

Impact	Potential for cumulative impact	Data confidence	Rationale
and snagging risk			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.
Effects on emergency response resources	Yes	Low	Increase in activity cumulatively within the southern North Sea area must be considered.
Operation and Maintenance			
Vessel Displacement	Yes	Medium	This was raised as a key point to be considered during consultation.
Restriction of Adverse Weather Routes	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.
Effects on emergency response resources	Yes	Low	Increase in activity cumulatively within the southern North Sea area must be considered.
Decommissioning			
Vessel Displacement	Yes	Medium	This was raised as a key point to be considered during consultation.
Restriction of Adverse Weather	Yes	Medium	This was raised as a key point to be considered during

Impact	Potential for cumulative impact	Data confidence	Rationale
Routes			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.
Effects on emergency response resources	Yes	Low	Increase in activity cumulatively within the southern North Sea area must be considered.

330. Cumulative project screening has been undertaken, the details of which are provided in the NRA (Appendix 15.1). The list of projects carried through to the CIA are listed in Table 15.13. It is noted that fully commissioned wind farms are considered baseline and are not listed.

Table 15.13 Summary of Projects considered for the CIA in Relation to the Shipping and Navigation (see Appendix 15.1 for full discussion)

Project	Status	Distance from Norfolk Boreas site (nm)	Rationale
UK Wind Farms			
East Anglia ONE North	Concept / Early Planning	28	Within 100nm of Norfolk Boreas site.
East Anglia TWO		39	
Thanet Extension		93	
Hornsea Project Three	Consent Application Submitted	29	
Norfolk Vanguard		0.53	
Doggerbank Creyke Beck A	Consented	93	
Doggerbank Teesside B		100	

Project	Status	Distance from Norfolk Boreas site (nm)	Rationale
East Anglia THREE		8	
Triton Knoll		66	
Hornsea Project Two	Pre-Construction (Consented)	55	
Hornsea Project Four	Pre-Planning Application	Site boundary not available	
East Anglia ONE	Under Construction	33	
Hornsea Project One	Under Construction	46	
EU Wind Farms			
Hollandse Kust Noord Holland I and II (Tender 2019)	Concept / Early Planning	40	Within 100nm of Norfolk Boreas site.
Hollandse Kust Zuid Holland III and IV - (Tender 2018)		52	
Poseidon P60 - Mermaid		70	
Windpark Fryslân	Consent Application Submitted	77	
Borssele Site 3 and 4	Consented	70	
Borssele Site V		70	
Hollandse Kust Zuid Holland I and II - Chinook (Tender 2017)		48	
Mermaid		68	
Northwester 2		70	
Seastar		73	
Borssele 1 and 2	Pre-Construction	72	
Norther		78	
Hollandse Kust West	Tender 2020 / 2021	26	
Ten noorden van de Waddeneilanden	Tender 2022	90	
Ijmuiden Ver	Tender 2024	10	
Rentel	Under Construction	76	

15.8.1 Vessel Displacement and Collision Risk – Cumulative

331. As shipping and navigational receptors can be cumulatively impacted by a number of offshore developments and installations (including offshore wind farm projects), the spatial extent within which projects have been considered cumulatively (in terms of vessel routeing) has been extended to 100nm from the Norfolk Boreas site. The routes passing through the OWF site study area have been assessed, and only the following projects have a notable effect on cumulative routeing:

- East Anglia THREE (consented);
- East Anglia ONE (under construction);
- East Anglia TWO (scoped);
- East Anglia ONE North (scoped);
- Hornsea Project One (under construction);
- Hornsea Project Two (consented);
- Hornsea Project Three (pre-consent); and
- Norfolk Vanguard (pre-consent).

332. 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 is currently being updated by VWPL (Anatec, 2018b), and has been considered when predicting likely cumulative deviations of the routes within the OWF site study area. A summary of this work is provided in section 19.3 of the NRA (Appendix 15.1).

333. The majority of traffic within the area is transiting within IMO Routeing Measures which have been left clear of any surface development and therefore vessel routes within them remain undeviated. There will be minor deviations within the DR1 Lightbuoy DWR during cable (export and project interconnector) installation from the associated vessel activity, however any deviations will be small and temporary. It is noted that an increase in traffic within the routeing measures may be observed depending upon future traffic trends, and on vessel deviations due to the cumulative developments within the southern North Sea.

334. There are a number of developments located to the west of the project including Triton Knoll (consented), Dudgeon (under construction), Race Bank (commissioned) 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 smaller development area 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.

335. It is noted that Hornsea Project Four may have some effect on routes passing within the OWF site study area on a cumulative basis, however an up to date site boundary is not available at the time of writing.

336. The Ijmuiden Ver development zone to the east may cause cumulative deviation to routes between the UK and mainland Europe, notably the DFDS operated Newcastle to Amsterdam (Ijmuiden) ferry route (Route 5 in Figure 15.5). It is likely that this route will shift north of Norfolk Boreas, however it is noted that the Dutch regulators are considering spatial solutions within the Ijmuiden Ver development zone to ensure safe routeing options remain available for vessels transiting within the Dutch sector. At the time of writing, consultation was ongoing.

337. Consultation for Norfolk Boreas has indicated that smaller commercial vessels may choose to transit through wind farms if turbine spacing allowed, however it is noted that this differs from experience and consultation for other wind farms. The projected increased levels of wind farm infrastructure within the southern North Sea is likely to be behind this change. The final Norfolk Boreas layout would be agreed with the MCA post consent, with due consideration given to the Design Rules (see Table 15.10), alignment with nearby projects, or alternate spatial solutions (e.g., buffer zones between projects).

338. No impacts have been identified on cumulative displacement of transiting fishing and recreational activity and hence collision risk. This is due to the assumption that recreational and fishing vessels will mostly transit within the wind turbine arrays to avoid the majority of displaced commercial traffic. Vessels related to the construction, operation and maintenance or decommissioning of any of the cumulative projects would be managed by the Marine Coordinators.

339. Given baseline collision rates are already high in the area, a collision when considered cumulatively is considered a **reasonably probable** event, with severity of consequence assessed as **moderate**, given that deviations would be greater than for Norfolk Boreas considered in isolation. The impact is therefore determined to be **tolerable**, and not significant under EIA terms.

15.8.2 Restriction of Adverse Weather Routeing - Cumulative

340. Concerns over restriction of adverse weather routeing were raised during the Regular Operator consultation undertaken for Norfolk Boreas, as operator preference is to cross the North Sea at its shortest point during unfavourable conditions. On a cumulative basis, the addition of Norfolk Vanguard and East Anglia THREE in particular would mean larger deviations would be needed for vessels

requiring to pass south of the wind farms in adverse weather than if the project is considered in isolation.

341. Consultation for Norfolk Boreas has indicated that smaller commercial vessels may choose to transit through wind farms if turbine spacing allowed, however this is considered an unlikely choice in periods of adverse weather.

342. A high level assessment of longer term data recorded during 2017 and Anatec's ShipRoutes database (Anatec, 2018a) indicates that this is a **reasonably probable** event. Severity of consequence is considered **moderate**, given that safe headings are likely to be obtained south of the Norfolk Vanguard and East Anglia THREE projects, however significant deviations from the usual routeing may be required. The impact is therefore **tolerable**, and not significant in EIA terms.

15.8.3 Vessel to Structure Allision Risk - Cumulative

343. Following assessment of the cumulative routeing it has been identified that the development of Norfolk Boreas, Norfolk Vanguard, 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. The Hornsea projects to the north-west should also be considered noting they may increase traffic into the IMO routeing measures and raise allision risk further. As discussed site boundary information is not currently available for Hornsea Project Four. Cumulative allision is considered to affect vessels transiting within the area including recreational and fishing vessels.

344. In order to facilitate vessel transits within the routeing measures (notably the DR1 DWR, given the associated traffic will be within a proposed (by Norfolk Vanguard) navigation corridor for some of its extent), wind turbines adjacent to the proposed navigational corridor must be aligned in a straight line; for Norfolk Boreas this is only on its western boundary. Lighting and marking of boundary's adjacent to the proposed navigational corridor require consideration alongside lighting of other projects in line with TH guidance to ensure that it aids vessel navigation within the Norfolk Boreas 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.

345. 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 AtoNs in a high density development of turbines. The mariner would use lights on Significant Peripheral Structures (SPS) (similar to entering a port) to navigate with, including fixing their position. Following agreement on the final layout post consent (with consideration

as to the Design Rules as per Table 15.10), Norfolk Boreas Limited (for the project and other cumulative sites) would identify AtoNs, in consultation with TH, which are most appropriate within the DWR.

346. Concern was raised during consultation over the probability of a vessel breaking down within the DR1 DWR given that turbines would be present on either side from the Norfolk projects and East Anglia THREE. Emergency anchoring (dependent on the vessel's speed) could be used to prevent allision with a structure, and is considered likely to be the best course of action in such a scenario, given that 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.

347. 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 would be able to provide emergency support (noting potential downtime during periods of adverse weather). Project vessels would comply with SOLAS (IMO, 1974) requirements to render aid to vessels in distress.

348. Consultation for Norfolk Boreas has indicated smaller commercial vessels may choose to transit through the Norfolk Boreas site if other surrounding projects are also built. This would only be considered a viable option to the vessels if spacing was such that safe navigation was possible.

349. Given that fishing vessels and recreational vessels would also be free to enter into the various arrays, allision risk is considered to be in line with that assessed for the project in isolation.

350. 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.

15.8.4 Effects on Emergency Response Resources - Cumulative

351. 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, given that incident rates may rise based on increased personnel and vessels working at the various sites. 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.

352. 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

353. Transboundary impacts relate to impacts that may occur from an activity within one European Economic Area (EEA) state on the environment or interests of another.

354. 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 15.6) and cumulative assessments (section 15.8).

355. It was identified that transboundary impacts 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 (noting that regular routes to the Netherlands and Germany were identified in the marine traffic survey data). 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 cumulative vessel routeing were considered tolerable as per Section 15.8.1.

356. It is considered that there are no additional transboundary impacts beyond those included in the cumulative assessment, noting that as per Table 15.13, transboundary projects were considered.

357. All European Union (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. Given that Dutch sector wind farms will have a notable cumulative effect when considered with Norfolk Boreas, consultation with Rijkswaterstaat has been undertaken on vessel routeing and will be ongoing.

15.10 Inter-relationships

358. 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 Table 15.14 highlights any additional interrelationships with their localised activities.

Table 15.14 Shipping and Navigation inter-relationships

Topic and description	Related Chapter	Where addressed in this Chapter
Changes to wave and tidal currents	Chapter 8 Marine Geology, Oceanography and Physical Processes	Effects of wave and tidal currents are considered within the NRA (Appendix 15.1).
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 15.7.
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 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 15.7.
Impacts on oil and gas infrastructure	Chapter 18 Infrastructure and Other Users	Impacts on the navigational safety of oil and gas vessels visiting nearby platforms are considered within section 15.7.

15.11 Interactions

359. 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 interactions into account and for the impact assessments are considered conservative and robust.

360. For clarity the areas of interaction between impacts are presented in Table 15.15. There is considered to be distinction between phases (construction, operation, and decommissioning) in terms of interactions between impacts.

Table 15.15 Interaction between impacts

Potential interaction between impacts						
Construction, Operation, and Decommissioning Phases						
	Vessel Displacement	**Restriction of Adverse Weather Routeing**	**Increased Collision Risk**	**Increased Allision Risk**	**Anchor Snagging**	**Effects on Emergency Response**
Vessel Displacement	-	Yes	Yes	Yes	No	No
Restriction of Adverse Weather Routeing	Yes	-	Yes	Yes	No	Yes
Increased Collision Risk	Yes	Yes	-	Yes	No	Yes
Increased Allision Risk	Yes	Yes	Yes	-	No	Yes
Anchor Snagging	No	No	No	No	-	No
Effects on Emergency Response	No	Yes	Yes	Yes	No	-

15.12 Summary

361. A summary of the impact assessment is presented in Table 15.16.

Table 15.16 Potential Impacts Identified for Shipping and Navigation

Potential Impact	Receptor	Frequency of Occurrence	Severity of Consequence	Significance	Mitigation	Residual Impact
Construction						
Vessel Displacement – Norfolk Boreas Site	Commercial Vessels	Reasonably Probable	Minor	**Tolerable**	n/a	**Tolerable**
	Recreational Vessels	--	--	**No impact**	n/a	**No impact**
	Fishing Vessels	Remote	Negligible	**Broadly Acceptable**	n/a	**Broadly Acceptable**
Vessel Displacement – Offshore Cable Corridor	Commercial Vessels	--	--	**No impact**	n/a	**No impact**
	Recreational Vessels	--	--	**No impact**	n/a	**No impact**
	Fishing Vessels	--	--	**No impact**	n/a	**No impact**
Restriction of Adverse Weather Routeing – Norfolk Boreas Site	Commercial Vessels	Remote	Moderate	**Tolerable**	n/a	**Tolerable**
	Recreational Vessels	Negligible	Moderate	**Broadly Acceptable**	n/a	**Broadly Acceptable**
	Fishing Vessels	Extremely Unlikely	Moderate	**Broadly Acceptable**	n/a	**Broadly Acceptable**
Restriction of Adverse Weather Routeing – Offshore Cable Corridor	Commercial Vessels	--	--	**No impact**	n/a	**No impact**
	Recreational Vessels	--	--	**No impact**	n/a	**No impact**
	Fishing Vessels	--	--	**No impact**	n/a	**No impact**
Increased Vessel to Vessel Collision Risk – Norfolk Boreas Site	Commercial Vessels	Reasonably Probable	Minor	**Tolerable**	Management of construction traffic.	**Tolerable with mitigation**
	Recreational Vessels	--	--	**No impact**	n/a	**No impact**

Potential Impact	Receptor	Frequency of Occurrence	Severity of Consequence	Significance	Mitigation	Residual Impact
	Fishing Vessels	--	--	**No impact**	n/a	**No impact**
Increased Vessel to Vessel Collision Risk – Offshore Cable Corridor	Commercial Vessels	Remote	Minor	**Broadly Acceptable**	n/a	**Broadly Acceptable**
	Recreational Vessels	--	--	**No impact**	n/a	**No impact**
	Fishing Vessels	--	--	**No impact**	n/a	**No impact**
Vessel to Structure Allision Risk – Norfolk Boreas Site	Commercial Vessels	Extremely Unlikely	Minor	**Broadly Acceptable**	n/a	**Broadly Acceptable**
	Recreational Vessels	Negligible	Minor	**Broadly Acceptable**	n/a	**Broadly Acceptable**
	Fishing Vessels	Extremely Unlikely	Moderate	**Broadly Acceptable**	n/a	**Broadly Acceptable**
Vessel to Structure Allision Risk – Offshore Cable Corridor	Commercial Vessels	--	--	**No impact**	n/a	**No impact**
	Recreational Vessels	--	--	**No impact**	n/a	**No impact**
	Fishing Vessels	--	--	**No impact**	n/a	**No impact**
Anchor Interaction and Snagging Risk – Norfolk Boreas Site	Commercial Vessels	Remote	Minor	**Broadly Acceptable**	n/a	**Broadly Acceptable**
	Recreational Vessels	Negligible	Negligible	**Broadly Acceptable**	n/a	**Broadly Acceptable**
	Fishing Vessels	Remote	Minor	**Broadly Acceptable**	n/a	**Broadly Acceptable**
Anchor Interaction and Snagging Risk – Offshore	Commercial Vessels	Remote	Minor	**Broadly Acceptable**	n/a	**Broadly Acceptable**

Potential Impact	Receptor	Frequency of Occurrence	Severity of Consequence	Significance	Mitigation	Residual Impact
Cable Corridor	Recreational Vessels	Extremely Unlikely	Negligible	**Broadly Acceptable**	n/a	**Broadly Acceptable**
	Fishing Vessels	Remote	Minor	**Broadly Acceptable**	n/a	**Broadly Acceptable**
Effects on Emergency Response Resources – Norfolk Boreas Site	Emergency Response Resources	Remote	Moderate	**Tolerable**	n/a	**Tolerable**
Effects on Emergency Response Resources – Offshore Cable Corridor	Emergency Response Resources	--	--	**No impact**	n/a	**No impact**
Operation						
Vessel Displacement – Norfolk Boreas Site	Commercial Vessels	Reasonably Probable	Minor	**Tolerable**	n/a	**Tolerable**
	Recreational Vessels	--	--	**No impact**	n/a	**No impact**
	Fishing Vessels	Remote	Negligible	**Broadly Acceptable**	n/a	**Broadly Acceptable**
Vessel Displacement – Offshore Cable Corridor	Commercial Vessels	--	--	**No impact**	n/a	**No impact**
	Recreational Vessels	--	--	**No impact**	n/a	**No impact**
	Fishing Vessels	--	--	**No impact**	n/a	**No impact**
Restriction of Adverse Weather Routeing – Norfolk Boreas Site	Commercial Vessels	Remote	Moderate	**Tolerable**	n/a	**Tolerable**
	Recreational Vessels	Negligible	Moderate	**Broadly Acceptable**	n/a	**Broadly Acceptable**
	Fishing Vessels	Extremely Unlikely	Moderate	**Broadly Acceptable**	n/a	**Broadly Acceptable**

Potential Impact	Receptor	Frequency of Occurrence	Severity of Consequence	Significance	Mitigation	Residual Impact
Restriction of Adverse Weather Routeing – Offshore Cable Corridor	Commercial Vessels	--	--	**No impact**	n/a	**No impact**
	Recreational Vessels	--	--	**No impact**	n/a	**No impact**
	Fishing Vessels	--	--	**No impact**	n/a	**No impact**
Increased Vessel to Vessel Collision Risk – Norfolk Boreas Site	Commercial Vessels	Remote	Minor	**Broadly Acceptable**	n/a	**Broadly Acceptable**
	Recreational Vessels	--	--	**No impact**	n/a	**No impact**
	Fishing Vessels	--	--	**No impact**	n/a	**No impact**
Increased Vessel to Vessel Collision Risk – Offshore Cable Corridor	Commercial Vessels	--	--	**No impact**	n/a	**No impact**
	Recreational Vessels	--	--	**No impact**	n/a	**No impact**
	Fishing Vessels	--	--	**No impact**	n/a	**No impact**
Vessel to Structure Allision Risk – Norfolk Boreas Site	Commercial Vessels	Remote	Minor	**Broadly Acceptable**	n/a	**Broadly Acceptable**
	Recreational Vessels	Extremely Unlikely	Moderate	**Broadly Acceptable**	n/a	**Broadly Acceptable**
	Fishing Vessels	Remote	Moderate	**Tolerable**	Further mitigation may be required depending upon foundation type selected.	**Tolerable with mitigation**
Vessel to Structure Allision Risk – Offshore Cable Corridor	Commercial Vessels	--	--	**No impact**	n/a	**No impact**
	Recreational Vessels	--	--	**No impact**	n/a	**No impact**

Potential Impact	Receptor	Frequency of Occurrence	Severity of Consequence	Significance	Mitigation	Residual Impact
	Fishing Vessels	--	--	**No impact**	n/a	**No impact**
Anchor Interaction and Snagging Risk – Norfolk Boreas Site	Commercial Vessels	Extremely Unlikely	Negligible	**Broadly Acceptable**	n/a	**Broadly Acceptable**
	Recreational Vessels	Negligible	Negligible	**Broadly Acceptable**	n/a	**Broadly Acceptable**
	Fishing Vessels	Extremely Unlikely	Minor	**Broadly Acceptable**	n/a	**Broadly Acceptable**
Anchor Interaction and Snagging Risk – Offshore Cable Corridor	Commercial Vessels	Remote	Minor	**Broadly Acceptable**	n/a	**Broadly Acceptable**
	Recreational Vessels	Remote	Minor	**Broadly Acceptable**	n/a	**Broadly Acceptable**
	Fishing Vessels	Remote	Minor	**Broadly Acceptable**	n/a	**Broadly Acceptable**
Effects on Emergency Response Resources – Norfolk Boreas Site	Emergency Response Resources	Extremely Unlikely	Minor	**Broadly Acceptable**	n/a	**Broadly Acceptable**
Effects on Emergency Response Resources – Norfolk Boreas Site	Emergency Response Resources	--	--	**No impact**	n/a	**No impact**
Decommissioning						
Vessel Displacement – Norfolk Boreas Site	Commercial Vessels	Reasonably Probable	Minor	**Tolerable**	n/a	**Tolerable**
	Recreational Vessels	--	--	**No impact**	n/a	**No impact**
	Fishing Vessels	Remote	Negligible	**Broadly Acceptable**	n/a	**Broadly Acceptable**

Potential Impact	Receptor	Frequency of Occurrence	Severity of Consequence	Significance	Mitigation	Residual Impact
Vessel Displacement – Offshore Cable Corridor	Commercial Vessels	--	--	**No impact**	n/a	**No impact**
	Recreational Vessels	--	--	**No impact**	n/a	**No impact**
	Fishing Vessels	--	--	**No impact**	n/a	**No impact**
Restriction of Adverse Weather Routeing – Norfolk Boreas Site	Commercial Vessels	Remote	Moderate	**Tolerable**	n/a	**Tolerable**
	Recreational Vessels	Negligible	Moderate	**Broadly Acceptable**	n/a	**Broadly Acceptable**
	Fishing Vessels	Extremely Unlikely	Moderate	**Broadly Acceptable**	n/a	**Broadly Acceptable**
Restriction of Adverse Weather Routeing – Offshore Cable Corridor	Commercial Vessels	--	--	**No impact**	n/a	**No impact**
	Recreational Vessels	--	--	**No impact**	n/a	**No impact**
	Fishing Vessels	--	--	**No impact**	n/a	**No impact**
Increased Vessel to Vessel Collision Risk – Norfolk Boreas Site	Commercial Vessels	Reasonably Probable	Minor	**Tolerable**	Management of decommissioning traffic	**Tolerable with mitigation**
	Recreational Vessels	--	--	**No impact**	n/a	**No impact**
	Fishing Vessels	--	--	**No impact**	n/a	**No impact**
Increased Vessel to Vessel Collision Risk – Offshore Cable Corridor	Commercial Vessels	--	--	**No impact**	n/a	**No impact**
	Recreational Vessels	--	--	**No impact**	n/a	**No impact**
	Fishing Vessels	--	--	**No impact**	n/a	**No impact**
Vessel to Structure Allision	Commercial Vessels	Extremely Unlikely	Minor	**Broadly**	n/a	**Broadly Acceptable**

Potential Impact	Receptor	Frequency of Occurrence	Severity of Consequence	Significance	Mitigation	Residual Impact
Risk – Norfolk Boreas Site				**Acceptable**		
	Recreational Vessels	Negligible	Minor	**Broadly Acceptable**	n/a	**Broadly Acceptable**
	Fishing Vessels	Extremely Unlikely	Moderate	**Broadly Acceptable**	n/a	**Broadly Acceptable**
Vessel to Structure Allision Risk – Offshore Cable Corridor	Commercial Vessels	--	--	**No impact**	n/a	**No impact**
	Recreational Vessels	--	--	**No impact**	n/a	**No impact**
	Fishing Vessels	--	--	**No impact**	n/a	**No impact**
Anchor Interaction and Snagging Risk – Norfolk Boreas Site	Commercial Vessels	Extremely Unlikely	Minor	**Broadly Acceptable**	n/a	**Broadly Acceptable**
	Recreational Vessels	Extremely Unlikely	Minor	**Broadly Acceptable**	n/a	**Broadly Acceptable**
	Fishing Vessels	Remote	Minor	**Broadly Acceptable**	n/a	**Broadly Acceptable**
Anchor Interaction and Snagging Risk – Offshore Cable Corridor	Commercial Vessels	Remote	Minor	**Broadly Acceptable**	n/a	**Broadly Acceptable**
	Recreational Vessels	Extremely Unlikely	Negligible	**Broadly Acceptable**	n/a	**Broadly Acceptable**
	Fishing Vessels	Remote	Minor	**Broadly Acceptable**	n/a	**Broadly Acceptable**
Effects on Emergency Response Resources – Norfolk Boreas Site	Emergency Response Resources	Remote	Moderate	**Tolerable**	n/a	**Tolerable**
Effects on Emergency	Emergency	--	--	**No impact**	n/a	**No impact**

Potential Impact	Receptor	Frequency of Occurrence	Severity of Consequence	Significance	Mitigation	Residual Impact
Response Resources – Offshore Cable Corridor	Response Resources					
Cumulative						
Vessel Displacement and Increased Collision Risk	All users	Reasonably Probable	Moderate	**Tolerable**	Management of wind farm associated traffic	**Tolerable with mitigation**
Restriction of Adverse Weather Routeing	All users	Reasonably Probable	Moderate	**Tolerable**	n/a	**Tolerable**
Vessel to Structure Allision Risk	All users	Reasonably Probable	Moderate	**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**
Effects on Emergency Response Resources	All users	Reasonably Probable	Moderate	**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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