Norfolk Vanguard Offshore Wind Farm

Chapter 32

Offshore Cumulative and Transboundary Impacts

Environmental Statement

Volume 1

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Environmental Impact Assessment
Environmental Statement

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For and on behalf of Norfolk Vanguard Limited

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Glossary

ADR	Air Defence Radar
AEZ	Archaeological Exclusion Zones
CAA	Civil Aviation Authority
Cefas	Centre for Environment, Fisheries and Aquaculture Science
CIA	Cumulative Impact Assessment
CNS	Communication, Navigation and Surveillance
COWRIE	Collaborative Offshore Wind Research into the Environment
DCO	Development Consent Order
DEPONS	Disturbance Effects of Noise on the Harbour Porpoise Population in the North Sea
EEA	European Economic Area
EIA	Environmental Impact assessment
EMF	Electromagnetic Fields
EPP	Evidence Plan Process
ES	Environmental Statement
ETG	Expert Topic Groups
EU	European Union
FIR	Flight Information Region
HMR	Helicopter Main Route
HRA	Habitat Regulations Assessment
HVDC	High Voltage Direct Current
iPCoD	Interim Population Consequences of Disturbance
IFR	Instrument Flight Rules
MCA	Maritime and Coastguard Agency
MCZ	Marine Conservation Zone
MOD	Ministry of Defence
MS	Member State
NATS	National Air Traffic Service
NPS	National Policy Statement
NRA	Navigational Risk Assessment
NSIP	Nationally Significant Infrastructure Project
OWF	Offshore Wind Farm
PEIR	Preliminary Environmental Information Report
PSR	Primary Surveillance Radar
SAC	Special Area of Conservation
SCI	Site of Conservation Importance
SNCB	Statutory Nature Conservation Body
SNSOWF	Southern North Sea Offshore Wind Forum
SPA	Special Protection Area
SSC	Suspended Sediment Concentration
TTS	Temporary Threshold Shift
TWT	The Wildlife Trust
UNECE	United Nations Economic Commission for Europe
UXO	Unexploded Ordnance
ZEA	Zonal Environmental Appraisal

Terminology

Cumulative Impacts	These may occur as a result of the project in conjunction with other existing or planned projects within the study area for each receptor.
Offshore accommodation platform	A fixed structure (if required) providing accommodation for offshore personnel. An accommodation vessel may be used instead.
Offshore cable corridor	The corridor of seabed from the Norfolk Vanguard OWF sites to the landfall site within which the offshore export cables would be located.
Offshore electrical platform	A fixed structure located within the wind farm area, containing electrical equipment to aggregate the power from the wind turbine generators and convert it into a more suitable form for export to shore.
Offshore export cables	The cables which transmit electricity from the offshore electrical platform to the landfall.
The Applicant	Norfolk Vanguard Limited.
The OWF sites	The two distinct offshore wind farm areas, Norfolk Vanguard East and Norfolk Vanguard West.
The project	Norfolk Vanguard Offshore Wind Farm, including the onshore and offshore infrastructure.

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32 OFFSHORE CUMULATIVE AND TRANSBOUNDARY IMPACTS

32.1 Introduction

1. This chapter of the Environmental Statement (ES) provides a summary of the Cumulative Impact Assessment (CIA) and transboundary impact assessment for the offshore topics of the proposed Norfolk Vanguard Offshore Wind Farm (herein 'the project'). Whilst each technical assessment chapter within the ES (offshore chapters 8 to 18) provides its own CIA section in relation to that topic, including transboundary impacts where applicable, the purpose of this chapter is to present a complete overview of potential cumulative impacts of the project.

2. This chapter describes the requirement for CIA and transboundary impact assessment, the guidance for completing CIA in relation to Nationally Significant Infrastructure Projects (NSIP), and the consultation undertaken to inform the approach that Norfolk Vanguard Limited has adopted.

3. Note that an in-combination assessment has been completed as part of the Habitats Regulations Assessment (HRA) process. In-combination assessment is required for HRA and is the equivalent to the Environmental Impact Assessment (EIA) CIA, therefore there are elements of the approach to CIA that are mirrored by the in-combination HRA process, in particular the method used to identify other plans, projects and activities that are taken forward in each assessment. The Information to Support HRA Report (document 5.3) is submitted with the DCO application and that document should be consulted for further information relevant to the assessment of effects on European Sites.

4. This chapters draws information from and should be read in conjunction with:

- Chapter 8 Marine Geology, Oceanography and Physical Processes;
- Chapter 9 Marine Water and Sediment Quality;
- Chapter 10 Benthic and Intertidal Ecology;
- Chapter 11 Fish and Shellfish Ecology;
- Chapter 12 Marine Mammals;
- Chapter 13 Offshore Ornithology;
- Chapter 14 Commercial Fisheries;
- Chapter 15 Shipping and Navigation;
- Chapter 16 Aviation and Radar;
- Chapter 17 Offshore and Intertidal Archaeology and Cultural Heritage;
- Chapter 18 Infrastructure and Other Users; and
- Information to Support the HRA Report (document 5.3).

32.2 Legislation, Guidance and Policy

5. There are numerous pieces of legislation, guidance and policy applicable to CIA and transboundary impacts. The following sections provide detail on key pieces of international and UK legislation, policy and guidance which are relevant to this chapter.

32.2.1 Legislation

6. Norfolk Vanguard is subject to EIA under European Union (EU) EIA Directive 85/337/EEC (as amended). The EIA Directive was transposed into English law for Nationally Significant Infrastructure Projects (NSIPs) by the Infrastructure Planning (Environmental Impact Assessment) Regulations 2009 (the EIA Regulations). In 2011, the original EIA Directive and amendments were translated into EIA Directive 2011/92/EU.

7. Directive 2014/52/EU amending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment was published in the European Union's Official Journal in April 2014. The requirements of Directive 2014/52/EU have been formally implemented in England insofar as relevant to NSIPs in the form of a revised set of regulations entitled 'The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017' (the EIA Regulations 2017).

8. Under Article 3(2) of the Directive, transposed by Regulation 37, the EIA Regulations 2017, where an ES is submitted or where a scoping opinion has been sought before 16 May 2017, the project can benefit from transitional provisions to continue under the provisions of the EIA Regulations 2009. However, in order to ensure the EIA is maintained at high quality and in accordance with best practice, Norfolk Vanguard Limited has given consideration to, and sought to apply, the new Directive within this ES.

9. Schedule 4 paragraph 5 of the 2017 EIA Regulations (abridged below) states the need for:

"A description of the likely significant effects of the development on the environment resulting from, inter alia:

(e) the cumulation of effects with other existing and/or approved projects, taking into account any existing environmental problems relating to areas of particular environmental importance likely to be affected or the use of natural resources

The description of the likely significant effects on the factors specified in regulation 4(2) should cover the direct effects and any indirect, secondary, cumulative,

transboundary, short-term, medium-term and long-term, permanent and temporary, positive and negative effects of the development."

10. In line with this requirement, a description of likely significant cumulative and transboundary effects is provided in each technical chapter of the ES and summarised in this chapter.

11. The United Nations Economic Commission for Europe (UNECE) Convention on Environmental Impact Assessment in a Transboundary Context (referred to as the Espoo Convention) requires that assessments are extended across borders between Parties of the Convention when a planned activity may cause significant adverse transboundary impacts.

12. Regulation 32 of the EIA regulations sets out procedures to address issues associated with a development that might have a significant impact on the environment in another European Member State. The procedures involve providing information to the Member State and for the Planning Inspectorate to enter into consultation with that State regarding the significant impacts of the development and the associated mitigation measures. Further advice on transboundary issues, in particular with regard to timing, process and consultation is given in the Planning Inspectorate (2015a) Advice Note 12.

32.2.2 Guidance

32.2.2.1 Cumulative Impact Assessment guidance

13. Guidance that is applicable to a specific assessment is identified in the relevant chapters (Chapters 8 – 18).

14. Of relevance to CIA in general, and which has been used to guide the approach taken, are the Guidelines for the Assessment of Indirect and Cumulative Impacts as well as Impact Interactions (European Commission 1999) and RenewableUK (2013) Cumulative Impact Assessment Guidelines, guiding principles for cumulative impacts assessments in offshore wind farms.

15. Also of relevance to the general approach taken is Advice Note Nine, published by the Planning Inspectorate (2012). This Advice Note addresses the use of the 'Rochdale Envelope' approach under the Planning Act 2008 (as amended by the Localism Act 2011). Advice Note 17 (Planning Inspectorate, 2015b) also provides guidance on plans and projects that should be considered in the CIA.

32.2.2.1.1 The Planning Inspectorate Advice Note Nine

16. The Planning Inspectorate's Advice Note Nine (the Planning Inspectorate, 2012) recognises that, at the time of submitting an application, offshore wind developers

may not know the precise nature and arrangement of infrastructure that make up the proposed development. This is due to a number of factors such as the evolution of technology, the need for flexibility in key commercial project decisions and the need for further detailed surveys (especially geotechnical surveys) which are required before a final design and layout can be determined. It is therefore important that a design envelope is used to provide flexibility to a developer. Where necessary, a range of parameters for each aspect of the project has been defined and subsequently, the worst case scenario associated with each parameter and dependent on the receptor has been used in each impact assessment. This provides confidence that the EIA process is robustly considering the likely impact of the project, whilst also allowing the project to be optimised and refined at the time of construction, noting that this may be several years after the DCO application is made. The project design envelope therefore provides the maximum extent of the consent sought. The detailed design of the project can then be developed, refined and procured within this consented envelope prior to construction.

17. The advice note highlights the importance of identifying and assessing the potential for cumulative impacts against the baseline position (which would include built and operational development) in order to ensure a robust application of the Rochdale Envelope.

18. In line with the advice note, this ES considers the potential for cumulative impacts to arise in the context of the flexibility being sought as part of the consent application. This chapter provides a summary of the assessment that has been undertaken.

32.2.2.1.2 The Planning Inspectorate Advice Note 12

19. Advice Note Twelve: Transboundary Impacts and Process (The Planning Inspectorate, 2018) sets out the procedures for consultation in association with an application for a Development Consent Order (DCO) to the Planning Inspectorate, where such development may have significant transboundary impacts. The Advice Note sets out the roles of the Planning Inspectorate, UK Government departments and developers. Developers are advised to identify the possible significant transboundary effects or alternatively, state why they consider that there would not be any significant effects on another European Economic Area (EEA) State.

32.2.2.1.3 The Planning Inspectorate Advice Note 17

20. Advice Note Seventeen: Cumulative Effects Assessment (The Planning Inspectorate, 2015) outlines the following staged process for the consistent assessment of cumulative impacts:

- Stage 1: Establish the project's zone of influence and identify a long list of other developments within this zone;
- Stage 2: Identify shortlist of other developments by applying inclusion/exclusion criteria to the Stage 1 list for CIA;
- Stage 3: Information Gathering regarding the shortlisted 'other development' to inform the CIA; and
- Stage 4: Assessment.

32.2.3 Policy

21. CIA has been undertaken with specific reference to the relevant National Policy Statements (NPS). These are the principal decision making documents for NSIP, and those relevant to Norfolk Vanguard are:

- Overarching NPS for Energy (EN-1) (Department of Energy and Climate Change (DECC) 2011a); and
- NPS for Renewable Energy Infrastructure (EN-3) (DECC 2011b).

22. The specific requirements of the NPS in relation to CIA and the transboundary impact assessment are summarised in Table 32.1 and includes where in the ES they are addressed.

Table 32.1 NPS assessment requirements for CIA and transboundary impact assessment

NPS Requirement	NPS reference	ES reference
EN-1 – Overarching NPS for Energy		
Information should be provided on how the effects of the applicant's proposal would combine and interact with the effects of other development (including projects for which consent has been sought or granted, as well as those already in existence).	EN-1, paragraph 4.2.5	This is assessed in all chapters as applicable.
Any assessment on aviation or other defence interests should also assess the cumulative effects of the project with other relevant projects in relation to aviation and defence.	EN-1, paragraph 4.19.12	Chapter 16 Aviation and Radar
Paragraphs 5.4.10 to 5.4.13 of EN-1 informs that if the proposed development could have an effect on civil and military aviation then the assessment should: • Consult the Ministry of Defence (MoD), the Civil Aviation Authority (CAA) and NATS and any aerodrome – licensed or otherwise – likely to be affected by the proposed development in preparing an assessment of the proposal on aviation or other defence interests; • Any assessment of aviation or other defence interests should include potential impacts of the project upon the operation of Communication, Navigation and Surveillance (CNS) infrastructure, flight patterns (both civil and military), other defence assets and aerodrome operational procedures.	NPS EN-1 Paragraph 5.4.10 to 5.4.13	Chapter 16 Aviation and Radar

NPS Requirement	NPS reference	ES reference
• Assess the cumulative effects of the project with other relevant projects in relation to aviation and defence.		
EN-3 – NPS for Renewable Energy Infrastructure		
Cumulative effects of the development with other relevant proposed, consented and operational wind farms will be considered.	EN-3, paragraph 2.6.169	All Chapters
Where cumulative effects are predicted as a result of multiple export cable routes in the intertidal zone, it may be appropriate for applicants of various schemes to work together to ensure that the number of cable crossings are minimised and installation and decommissioning phases are coordinated in order to reasonably minimise potential disturbance.	EN-3, paragraph 2.6.89	There will be no impact on the intertidal zone due to the use of long HDD as embedded mitigation
Where cumulative effects are predicted as a result of multiple cable routes in the subtidal zone, it may be appropriate for applicants of various schemes to work together to ensure that the number of cable crossings are minimised and installation and decommissioning phases are coordinated in order to reasonably minimise potential disturbance.	EN-3, paragraph 2.6.119	Chapter 10 Benthic and Intertidal Ecology
In some circumstances, transboundary issues may be a consideration as fishermen from other countries may fish in waters within which offshore windfarms are sited.	EN-3, paragraph 2.6.124	Chapter 14 Commercial Fisheries
The assessment of the effects on marine mammals should include the duration of the potentially disturbing activity including cumulative effects with other plans or projects.	EN-3, paragraph 2.6.92	Chapter 14 Marine Mammals
The navigation risk assessment will necessitate cumulative risks associated with the development and other developments (including other wind farms) in the same area of sea.	EN-3, paragraph 2.6.164	Chapter 15 Shipping and Navigation

32.3 Consultation

23. Consultation is an important driver of the EIA and ES, and is an ongoing process throughout the lifecycle of the project, from the initial stages through to consent and post-consent. To date, consultation regarding the approach to CIA and transboundary impacts has been conducted through a number of Expert Topic Groups (ETG) through an overarching Norfolk Vanguard Evidence Plan Process (EPP), the Scoping Report (Royal HaskoningDHV, 2016) and the Preliminary Environmental Information Report (PEIR) (Norfolk Vanguard Limited, 2017). Full details of the project consultation process are presented within Chapter 7 Technical Consultation and the Consultation Report (document 5.1), which has been submitted as part of the DCO application.

24. A summary of the consultation carried out at key stages throughout the project is detailed within relevant chapter assessments and focusses on key issues defined in each assessment. Consultation specifically on the CIA has been set out in Appendix 33.1; consultation on transboundary impacts is shown in Table 32.2.

25. Under the Espoo Convention (1991), where a development is likely to cause 'significant adverse transboundary impact', relevant EEA Member States should be notified as early as possible, giving them the opportunity to participate in relevant EIA procedures. The Planning Inspectorate provided transboundary notification to EEA States regarding Norfolk Vanguard on the 16th February 2017. Five EEA States confirmed that they wish to participate in the procedure for examining the application: Denmark, Netherlands, Germany, France and Belgium. In addition to this pre-application consultation, statutory transboundary consultation will be undertaken by the Planning Inspectorate in accordance with Regulation 32 of the EIA Regulations, if and when it accepts Norfolk Vanguard Limited's application for a DCO.

Table 32.2 Summary of consultation in relation to transboundary impact assessment

Consultee	Date /Document	Comment	Response / where addressed in the ES
Chapter 8 Marine Geology Oceanography and Physical Processes			
Cefas	EPP Meeting 16th February 2017	Discussion of transboundary impacts	Transboundary impacts have been scoped out. Tidal ellipses show that all movement is in a north south direction so will not be across the international boundary.
Chapter 13 Offshore Ornithology			
Natural England	PEIR 11th December 2017	Transboundary Impacts: We note that no transboundary impacts have been considered in the PEIR – is this because these have been screened out? If this is the case, then justification should be provided on the reasons for this.	Transboundary impacts have been considered in relation to designated sites in the Information to Support HRA report (document 5.3).
Ministry of Infrastructure and Water Management Netherlands	PEIR 11th December 2017	Chapter 13 on offshore ornithology has a clear structure, with a good description on used methodology. Some remarks though: • Conclusions on cumulative impacts are less clear and structured: worst case estimates of collisions/displacement are given followed by a (qualitative) reasoning that actual impacts will be lower. • Attention could also be paid to possible mitigating measures to reduce the impacts, disregard if this is a significant effect or not. We also note that the impact of wind parks in the Netherlands, Belgium and Germany are not taken into consideration. For bird populations which have the Southern North	The cumulative impact assessment sections have been revised and updated as necessary. Mitigation has been considered where appropriate. Transboundary impacts have been considered in section 13.9 in Chapter 13 Offshore Ornithology.

Consultee	Date /Document	Comment	Response / where addressed in the ES
		Sea as habitat, an international cumulative approach would be required. Within the international cooperation of North Sea countries as a follow-up of the Political declaration on Energy Cooperation (also signed by the UK) such an approach is looked into and developed further.	
Chapter 14 Commercial Fisheries			
French Transboundary (Ministry for the Environment, France)	October 2017 Consultation on PEIR	There is a clear impact on professional sea fishing, especially for Dutch and Belgium fishers. Even though, the impact on French professional fishers is very limited, we have to take into account the potential impact of the movement of foreign ships in the French fishing area. This concern is due to the rising presence of windfarm projects in the North Sea.	Consideration has been given to the potential impacts of the project on all fishing fleets active in areas relevant to Norfolk Vanguard, including the French fleet (section 14.6.5 of Chapter 14 Commercial Fisheries). The potential impact of loss of fishing grounds and subsequent potential for displacement has been assessed for the project alone and cumulatively with other projects (section 14.7.4.7 and section 14.8 in Chapter 14 Commercial Fisheries).
French Transboundary (Ministry for the Environment, France)	October 2017 Consultation on PEIR	A public enquiry has been organised from November 6 2016 to December 16 2016 from the city of Bray-Dunes (Department du Nord) to the city of Etaples (Department du Pas-de-Calais). The purpose of this consultation was to understand and to provide an analysis of the potential impacts of the windfarm projects about: marine environment, activities in relation to sea fishing and marine navigation. Following the public consultation the commission of inquiry has considered that the environmental impact on French coasts and marine environment remain low in view of the distance between British windfarm projects and French coasts.	Noted.
French Transboundary (Ministry for the Environment,	October 2017 Consultation on PEIR	In regard to the location of the project the potential environmental impact could be very limited due to the distance between the Norfolk Vanguard project and the French coastline. However considering the	Noted. Consideration has been given in this assessment to the potential for the project to result in cumulative impacts on

Consultee	Date /Document	Comment	Response / where addressed in the ES
France)		potential impact of the rising presence of windfarm projects this new project will have to take account of the cumulative impacts generated by all the activities in the affected area (potential impacts in terms of pollution produced over time by heavy metals). Specific measures will have to be taken to preserve the environmental sphere. It seems helpful to provide a global study about the environment impacts of the windfarm projects who have already been allowed. This research could help to understand the global assessment of the windfarm projects in the North Sea.	commercial fisheries in conjunction with other projects, both in UK and non-UK waters (section 14.8 in Chapter 14 Commercial Fisheries.). The undertaking of a global study on the environmental impacts of windfarm projects already operational is outside of the scope of this ES. Where relevant, however, lessons learned and knowledge from the experience of operational projects has been taken account of in this chapter (section 14.7 of Chapter 14 Commercial Fisheries).
Ministry of Infrastructure and Water Management Netherlands	October 2017 Consultation on PEIR	I am happy to note that you comply with the arrangements for East Anglia as commented by Rijkswaterstaat (distance between shipping route and wind park) with reference in Appendix 15.1 section 17.3.2 to the IMO advice.	Noted.
Chapter 15 Shipping and Navigation			
Trinity House	Scoping Opinion November 2016	Any possible national trans-boundary issues should be assessed, through consultation with the Dutch authorities.	Consultation was undertaken with the Dutch Authorities through Rijkswaterstaat (Ministry of Infrastructure and the Environment), as shown in this table. Transboundary issues are discussed in section 15.9 of Chapter 15 Shipping and Navigation.
Chamber of Shipping	8 May 2017 Minutes from consultation meeting with CoS.	Transboundary issues should be considered and the Dutch authorities/stakeholders consulted.	Section 15.9 of Chapter 15 Shipping and Navigation. includes consideration for Transboundary issues. The Dutch authorities have been consulted with, as summarised in this table.
BP Shipping	15 May 2017	Transboundary issues should be considered	Section 15.8 of Chapter 15

Consultee	Date /Document	Comment	Response / where addressed in the ES
	Minutes from consultation meeting with BP.	and the Dutch authorities and relevant Dutch stakeholders should be consulted.	Shipping and Navigation. includes consideration of cumulative impact and notes Transboundary elements. The Dutch authorities have been consulted with, as summarised in this table.
Chapter 17 Offshore Archaeology and Cultural Heritage			
Historic England via The Planning Inspectorate (Secretary of State)	November 2016 / Scoping Opinion	The specific reference to cultural heritage associated with wrecks (vessel or aircraft) of non-British, European nationality provides a very limited consideration of this factor which must be developed with a sound methodological approach to determine the nature and substance of any transboundary impacts as relevant to this proposed project.	Transboundary impacts are discussed in section 17.9 of Chapter 17 Offshore Archaeology and Cultural Heritage.
Historic England / Norfolk County Council Historic Environment Service	February 2017, EPP ETG Offshore Archaeology Meeting Log	Transboundary impact scenarios to consider: • International wrecks and aircraft consideration. • Transboundary sensitivities in conjunction with local community groups and interests. • Cumulative effects of changes to physical processes have the potential to impact archaeology across extended sea areas. • - Potential to affect larger-scale archaeological features such as palaeolandscapes/ historic seascapes across boundaries. Represents a valid way to proceed and sound methodological approach.	Transboundary impacts are discussed in section 17.9 Chapter 17 Offshore Archaeology and Cultural Heritage.
Historic England	February 2017, Response to Offshore Archaeology Method Statement	Have the relevant potential cumulative impacts been identified? If not, please provide details We note that Vattenfall is also developing the Norfolk Boreas offshore wind farm (OWF) and that at this stage Norfolk Boreas will use the same offshore cable corridor and landfall location as both Norfolk Vanguard turbine array areas. We also welcome the statement regarding other OWF developments off East Anglia and we look forward to receiving from you how the Cumulative Impact Assessment (CIA) and	Cumulative impact assessment presented in section 17.8 of Chapter 17 Offshore Archaeology and Cultural Heritage. Transboundary impacts are discussed in section 17.9 of Chapter 17 Offshore Archaeology and Cultural Heritage.

Consultee	Date /Document	Comment	Response / where addressed in the ES
		how any identifiable transboundary impacts will be assessed as relevant to the historic environment and landscape/seascape factors.	
Historic England	11/12/2017 PEIR Response (Chapter 17. Offshore and Intertidal Archaeology and Cultural Heritage)	We welcome the attention given in Section 17.9 (Transboundary Impacts) of the PEIR to cultural heritage associated with wrecks (vessel or aircraft) of non-British, European or international identity as well as the attention given to research directed at submerged prehistoric landscapes and how recent projects have promoted pan-European collaboration. In particular we see that attention is given to possible positive effects associated with expanding knowledge and understanding. Furthermore, paragraph 177 references other European maritime policy measures and it would therefore seem appropriate to add reference to published Marine Plan policy effective in the UK that may support gain in knowledge and understanding for effective decision making.	Noted, reference is made to the East Inshore and Offshore Marine plans in Table 17.2 in Chapter 17 Offshore Archaeology and Cultural Heritage.

32.3.1 Southern North Sea Offshore Wind Forum

26. Recognising the importance of developing a consistent framework for the assessment of cumulative and transboundary impacts across other relevant offshore wind farm projects, Norfolk Vanguard Limited (through its parent company Vattenfall Wind Power Ltd.) has also engaged and consulted with the developers of the other wind farms in the southern North Sea (referred to as the Southern North Sea Offshore Wind Forum (SNSOWF)).

32.4 Assessment Methodology

27. This section sets out Norfolk Vanguard Limited's approach to the assessment of cumulative and transboundary impacts for offshore elements of Norfolk Vanguard.

32.4.1 Cumulative Impact Assessment

28. The scope of the CIA (in terms of relevant issues and projects) has been established with consultees (including through the EPP (section 32.3) and liaison with other developers) as the EIA has progressed, this is also detailed in Chapter 6 EIA Methodology and in each offshore technical chapter (chapters 8-18). Norfolk Vanguard Limited has taken advice and guidance (section 32.2.2) from various sources to inform the CIA. The CIA also draws from findings of earlier studies

undertaken to inform the East Anglia Zonal Environmental Appraisal (ZEA) (EAOW, 2012a) which considered cumulative impacts arising from the development of the whole former zone.

29. In addition, Norfolk Vanguard Limited has considered experience from other projects located within the former East Anglia Zone through work undertaken for East Anglia ONE (EAOW, 2012b) and East Anglia THREE (EATL, 2015); the wider Southern North Sea; and other UK projects.

30. The Planning Inspectorate Advice Note Nine and its complementary guidance in Advice Note 17 provides guidance on plans and projects that should be considered in the CIA based on a tiered approach with decreasing levels of likely available detail:

- Projects that are under construction;
- Permitted applications, not yet implemented;
- Submitted applications not yet determined;
- Projects on the Planning Inspectorate's Programme of Projects;
- Development identified in relevant Development Plans, with weight being given as they move closer to adoption and recognising that much information on any relevant proposals will be limited; and
- Sites identified in other policy documents as development reasonably likely to come forward.

31. Where it is helpful to do so 'Tiers' of these other projects' development statuses have been defined, as well as the availability of information to be used within the CIA. This approach is based on the three tier system proposed in the Planning Inspectorate's Advice Note 17. In some offshore chapters, a more refined tiering system based on the guidance issued by JNCC and Natural England in September 2013 is employed and involves six tiers presented below:

- Tier 1: built and operational projects;
- Tier 2: projects under construction plus Tier 1 projects;
- Tier 3: projects that have been consented (but construction has not yet commenced) plus Tiers 1 and 2;
- Tier 4: projects that have an application submitted to the appropriate regulatory body that have not yet been determined, plus Tiers 1-3;
- Tier 5: projects that the regulatory body are expecting to be submitted for determination (e.g. projects listed under the Planning Inspectorate programme of projects), plus Tiers 1-4; and
- Tier 6: projects that have been identified in relevant strategic plans or programmes plus Tiers 1-5.

32. In accordance with Advice Note Seventeen, an initial long list of projects with the potential to interact with Norfolk Vanguard has been identified, based on the potential mechanism of interaction. Where it is helpful to do so, the tiered approach may be adopted, based on the availability of information for each project to enable further assessment.

33. Only projects which are reasonably well described and sufficiently advanced to provide information on which to base a meaningful and robust assessment have been included in the CIA.

34. Projects which are sufficiently implemented during the site characterisation for the project are considered as part of the baseline for the EIA.

35. Vattenfall Wind Power Ltd. (VWPL) submitted the request for a Scoping Opinion for Norfolk Boreas, the sister project to Norfolk Vanguard on 9th May 2017; therefore, this project is a material consideration in the CIA for Norfolk Vanguard.

36. Offshore cumulative impacts may arise from interactions with the following activities and industries:

- Other offshore wind farms;
- Aggregate extraction and dredging;
- Licensed disposal sites;
- Sub-sea cables and pipelines;
- Potential port/harbour development; and
- Oil and gas activities.

37. In line with the RenewableUK Cumulative Impact Assessment Guidelines for offshore wind farms (RenewableUK, 2013), the cumulative assessment of other North Sea Round 3 developments has taken an approach that attempts to incorporate an appropriate level of pragmatism. This is demonstrated in the confidence levels applied to various developments, particularly those that are known but currently lack detailed project application documentation, such as those projects at the scoping stage only. These projects have been considered for CIA only in those chapters where it is considered that the Scoping Reports contain sufficient detail with which to undertake a meaningful assessment. Due to the lack of specific information in the public domain about these projects, and how and when (or if) they will be built, it is not always possible to undertake a meaningful CIA for these projects and therefore in some chapters they are not considered in the CIA.

38. This issue also arises with projects which are further developed. For example, in the case of the Hornsea Project Three Offshore Wind Farm (OWF), which is being promoted by Orsted, this project has been included in the CIA as Tier 5

development, following the suggested approach in JNCC and Natural England (2013). The application for development consent was submitted in May 2018 and therefore the pre-application stage is running almost concurrently with Norfolk Vanguard. At the time of writing it has not always been the case for each topic that the data necessary for Norfolk Vanguard to undertake a meaningful CIA taking into account Hornsea Project Three OWF (and vice versa) has been publicly available (only that typically presented in the PEIR for the project). However, Norfolk Vanguard Limited and Orsted are in regular dialogue and will continue to work closely together, and with statutory consultees, to ensure the CIA is as robust as possible. If necessary, Norfolk Vanguard Limited will update the CIA within its Environmental Statement during examination to take into account any new data which has been made available following the submission of the Hornsea Project Three OWF application to the Secretary of State. This approach complies with the relevant EIA Regulations and is consistent with that taken for other applications, where relevant environmental information has become available after the point of application submission.

39. Table 32.1 in Appendix 32.1 details the full list of plans or projects included in the CIA which has been developed as part of on-going consultation with technical consultees.

32.4.2 Transboundary Impact Assessment

40. As discussed in section 32.3, the Planning Inspectorate invited transboundary stakeholders to notify the Planning Inspectorate if they wished to be consulted on the proposed development. Denmark, Netherlands, Germany, France and Belgium stated that they wished to participate in the EIA procedure. The Norwegian Environment Agency consider the location of Norfolk Vanguard to be too far away from their area of interest and so did not wish to participate, however the Norwegian Environment Agency requested to be kept informed of the results of offshore ornithological studies in relation to the geographical use of the area by migrating seabirds.

41. Potential transboundary impacts have been approached in a similar way to other cumulative impacts, with a clear audit trail provided to demonstrate why projects have been included or excluded. In accordance with the advice detailed above, relevant EEA member states have been consulted through targeted consultation including meetings with transboundary commercial fishermen and statutory consultees; and through the consultation on the EIA.

32.5 Cumulative Impact Assessment Summary

42. The sections below summaries the cumulative impacts identified for each offshore chapter in the ES. The tables below provide the impact, a rationale of how

cumulative impacts could occur and a CIA. All mitigation measures and further detail around the CIA are included in each relevant technical chapter.

32.5.1 Marine Geology, Oceanography and Physical Processes

43. Table 32.3 provides a summary of the CIA outcomes for marine geology, oceanography and physical processes. All plans and projects with the potential for cumulative impacts identified for marine geology oceanography and physical processes are presented in Appendix 33.1.

Table 32.3 Potential cumulative impacts identified for marine geology, oceanography and physical processes

Potential Impact	Rationale for Cumulative Impact	Cumulative Impact Significance
Construction		
Changes in Suspended Sediment Concentrations due to Seabed Preparation and drill arisings associated with foundations	Where construction windows could overlap for projects adjacent to Norfolk Vanguard i.e. Norfolk Boreas and East Anglia THREE there is potential for cumulative impact.	**Negligible**
Changes in Seabed Level due to Seabed Preparation and drill arisings associated with foundations	Where construction windows could overlap for projects adjacent to Norfolk Vanguard i.e. Norfolk Boreas and East Anglia THREE there is potential for cumulative impact.	**Negligible**
Changes in Suspended Sediment Concentrations during Offshore Export Cable Installation	Norfolk Vanguard and Norfolk Boreas share an offshore cable corridor and therefore there is potential for cumulative impacts. Consideration is also given to Marine Aggregate Dredging	**Negligible**
Changes in Seabed Level and interruptions to bed load due to Offshore Export Cable Installation	Norfolk Vanguard and Norfolk Boreas share an offshore cable corridor and therefore there is potential for cumulative impacts. Consideration is also given to Marine Aggregate Dredging	**Negligible**
Changes in Suspended Sediment Concentrations during Array and Interconnector Cable Installation	Where construction windows could overlap for projects adjacent to Norfolk Vanguard i.e. Norfolk Boreas and East Anglia THREE there is potential for cumulative impact.	**Negligible**
Changes in Seabed Level due to Array and Interconnector Cable Installation	Where construction windows could overlap for projects adjacent to Norfolk Vanguard i.e. Norfolk Boreas and East Anglia THREE there is potential for cumulative impact.	**Negligible**
Operation		
Changes to the Tidal Regime due to	Additive changes to the tidal regime of Norfolk	**Negligible**

Potential Impact	Rationale for Cumulative Impact	Cumulative Impact Significance
the Presence of Wind Turbine Structures	Vanguard, Norfolk Boreas and East Anglia THREE due to their proximity.	
Changes to the Wave Regime due to the Presence of Wind Turbine Structures	Additive changes to the wave regime of Norfolk Vanguard, Norfolk Boreas and East Anglia THREE due to their proximity.	**Negligible**
Decommissioning		
The detail and scope of the decommissioning works will be determined by the relevant legislation and guidance at the time of decommissioning and agreed with the regulator. A decommissioning plan will be provided. As such, cumulative impacts during the decommissioning stage are assumed to be the same as those identified during the construction stage.		

32.5.2 Marine Water and Sediment Quality

44. Table 32.4 provides a summary of the CIA outcomes for marine water and sediment quality. All plans and projects with the potential for cumulative impacts identified for marine water and sediment quality are presented in Appendix 33.1

Table 32.4 Potential cumulative impacts identified for marine water and sediment quality

Potential Impact	Rationale for Cumulative Impact	Cumulative Impact Significance
Construction		
Deterioration in water quality due to increased suspended sediment concentrations during installation of foundations	The worst case scenario in relation to water quality effects would be for all wind farm projects identified in Appendix 33.1 to be constructed at the same time since this would provide the greatest opportunity for interaction of any sediment plumes during construction.	**Minor Adverse**
Deterioration in water quality due to increased suspended sediment concentrations due to drill arisings for installation of piled foundations		
Deterioration in water quality due to increased suspended sediment concentrations during installation of the offshore export cable	The worst case scenario is that some interaction could potentially occur between dredging plumes and plumes from Norfolk Vanguard cable installation, making the spatial extent of the combined plume slightly greater than for the plumes originating from the offshore cable installation only.	**Minor adverse**
Deterioration in water due to increased suspended sediment concentrations during array and interconnector cable installation.		

Potential Impact	Rationale for Cumulative Impact	Cumulative Impact Significance
Deterioration in water and bathing water quality due to works at the offshore export cable landfall		
Deterioration in water quality due to re-suspension of sediment bound contaminants	As described above.	**Negligible**
Operation		
There are no operational effects anticipated on marine sediment and water quality as embedded mitigation will remove the risk of any effects occurring		
Decommissioning		
The detail and scope of the decommissioning works will be determined by the relevant legislation and guidance at the time of decommissioning and agreed with the regulator. A decommissioning plan will be provided. As such, cumulative impacts during the decommissioning stage are assumed to be the same as those identified during the construction stage.		

32.5.3 Benthic and Intertidal Ecology

45. Table 32.5 provides a summary of the CIA outcomes for benthic and intertidal ecology. All plans and projects with the potential for cumulative impacts identified for benthic and intertidal ecology are presented in Appendix 33.1.

Table 32.5 Potential cumulative impacts identified for benthic and intertidal ecology

Potential Impact	Rationale for Cumulative Impact	Cumulative Impact Significance
Construction		
Temporary habitat loss/ disturbance associated with the OWF sites	Additive habitat loss/disturbance across the region.	**Negligible**
Temporary habitat loss/disturbance associated with offshore cable corridor	Additive habitat loss/disturbance of Norfolk Boreas sharing the same offshore cable corridor as Norfolk Vanguard.	**Negligible**
Temporary increases in suspended sediment concentrations and associated sediment deposition in the OWF sites	Norfolk Boreas and East Anglia THREE are 1km and 0km from NV East, respectively. There is therefore potential for cumulative impacts associated with suspended sediments and deposition towards the perimeter of each wind farm if construction is undertaken at the same time.	**Negligible**

Potential Impact	Rationale for Cumulative Impact	Cumulative Impact Significance
Temporary increases in suspended sediment concentrations and associated sediment deposition in the offshore cable corridor	Consideration is given to cumulative impacts of suspended sediment from Norfolk Boreas, sharing the same offshore cable corridor, as well as impacts from aggregate dredging.	**Negligible**
Operation		
Long term loss of seabed habitat in the OWF sites	Additive habitat loss/disturbance across the region	**Negligible**
Long term loss of seabed habitat in the offshore cable corridor	Additive habitat loss/disturbance of Norfolk Boreas sharing the same offshore cable corridor as Norfolk Vanguard	**Minor adverse**
Temporary seabed disturbances from maintenance operations in the OWF sites	Additive habitat loss/disturbance across the region	**Negligible**
Temporary seabed disturbances from maintenance operations in the offshore cable corridor	Additive habitat loss/disturbance of Norfolk Boreas sharing the same offshore cable corridor as Norfolk Vanguard	**Negligible**
Decommissioning		
The detail and scope of the decommissioning works will be determined by the relevant legislation and guidance at the time of decommissioning and agreed with the regulator. A decommissioning plan will be provided. As such, cumulative impacts during the decommissioning stage are assumed to be the same as those identified during the construction stage.		

32.5.4 Fish and Shellfish Ecology

46. Table 32.5 provides a summary of the CIA outcomes for fish and shellfish ecology. All plans and projects with the potential for cumulative impacts identified for fish and shellfish ecology are presented in Appendix 33.1.

Table 32.6 Potential cumulative impacts identified for fish and shellfish ecology

Potential Impact	Cumulative Impact	Rationale
Construction		
Physical disturbance and temporary habitat loss	Considering the wide overall extent of the distribution of the fish and shellfish species of concern (including the extent of spawning and nursery grounds for relevant species) and taking account of the fact that additive impacts would only occur where construction schedules of the projects included for	**Negligible**

Potential Impact	Cumulative Impact	Rationale
	assessment significantly overlap, fish and shellfish receptors are considered to be of low sensitivity.	
Increase in Suspended Sediment Concentration (SSCs) and sediment re-deposition	There may be potential for cumulative increased SSCs and sediment re-deposition impacts to occur on the fish and shellfish receptors relevant to the area of Norfolk Vanguards associated with other projects, provided their construction schedules coincide.	**Negligible**
Underwater noise associated with pile driving during construction	The potential cumulative impact would be the result of either spatial or temporal effects resulting from concurrent or sequential piling at different offshore wind farms, or a combination of both. Of particular concern in this regard is the potential for cumulative behavioural impacts to occur on species which use the area for spawning, however consideration has also been given to other fish species.	**Minor adverse**
Noise from other construction activities	Potential disturbance to fish and shellfish species associated with construction activities other than piling (i.e. vessel transit and cable laying) would occur over very small areas (i.e. tens to few hundred meters).	**Negligible**
Noise from UXO clearance	The detonation of unexploded Ordnance (UXO) associated with other offshore wind farm developments, would also result in injury and disturbance to fish species in the vicinity of the detonation. Physical injury / trauma would occur in close proximity to the detonation with Temporary Threshold Shift (TTS) and behavioural effects occurring at greater distance.	**Minor adverse**
Operation		
Permanent loss of seabed habitat	There is potential for the introduction of infrastructure associated with Norfolk Vanguard together with that associated with other wind farm projects, to result in cumulative impacts on fish and shellfish species, in terms of loss of seabed habitat.	**Minor adverse**

Potential Impact	Cumulative Impact	Rationale
Introduction of hard substrate	Hard substrates introduced as part of the Project together with that introduced as a result of other wind farm projects could result in cumulative impacts on fish and shellfish species in terms of changes to the species assemblage.	**Negligible**
Operation noise	During the operational phase there may be potential for operational noise from Norfolk Vanguard to add cumulatively to operational noise from other offshore wind farm projects.	**Negligible**
EMFs	EMFs associated with cables at Norfolk Vanguard and other offshore wind farm projects could result in a cumulative impact on sensitive fish and shellfish species (particularly elasmobranchs).	**Minor adverse**
Decommissioning		
The detail and scope of the decommissioning works will be determined by the relevant legislation and guidance at the time of decommissioning and agreed with the regulator. A decommissioning plan will be provided. As such, cumulative impacts during the decommissioning stage are assumed to be the same as those identified during the construction stage.		

32.5.5 Marine Mammals

47. Table 32.7 provides a summary of the CIA outcomes for marine mammals. The CIA considered the three types of impact (underwater noise, indirect impacts and direct interaction) from all stages of any plan or project where there is the potential to overlap with Norfolk Vanguard. Each type of potential cumulative impact has been assessed, where relevant, for harbour porpoise, grey seal and harbour seal.

48. Appendix 12.3 details the plans and projects which were considered for the Marine Mammal CIA.

Table 32.7 Potential cumulative impacts identified for marine mammals

Potential Impact	Rationale for Cumulative Impact	Cumulative Impact Significance	
Construction			
Underwater noise during piling	Additive impacts would only occur where construction schedules of the projects included for assessment significantly overlap	Harbour porpoise	**Minor adverse**
		Grey Seal	**Minor adverse**

Potential Impact	Rationale for Cumulative Impact	Cumulative Impact Significance	
		Harbour seal	**Negligible**
Underwater noise for all other noise sources	Behavioural impacts resulting from underwater noise during other construction activities, for example, seabed preparation, rock dumping and cable installation. Additive impacts would only occur where construction schedules of the projects included for assessment significantly overlap	Harbour porpoise	**Minor adverse**
		Grey Seal	**Minor adverse**
		Harbour seal	**Minor adverse**
Changes to prey availability	Additive habitat loss/disturbance across the region may change prey availability.	Harbour porpoise	**Minor adverse**
		Grey Seal	**Minor adverse**
		Harbour seal	**Negligible**
Collision risk – vessels and tidal devices	During the construction of Norfolk Vanguard there will be an increase in vessel traffic. And therefore, a potential increase in collision risk. However marine mammals in the Norfolk Vanguard area would be habituated to the presence of vessels and would be able to detect and avoid vessels	Harbour porpoise	**Negligible to Minor adverse**
		Grey Seal	**Negligible to Minor adverse**
		Harbour seal	**Negligible to Minor adverse**
Decommissioning			
The detail and scope of the decommissioning works will be determined by the relevant legislation and guidance at the time of decommissioning and agreed with the regulator. A decommissioning plan will be provided. As such, cumulative impacts during the decommissioning stage are assumed to be the same as those identified during the construction stage.			

32.5.6 Offshore Ornithology

49. A cumulative assessment of operation displacement risk was undertaken for Red-throated diver, Gannet, Auks, Puffin, Razorbill and Guillemot and a cumulative assessment of collision risk was undertaken for Gannet, Kittiwake, Lesser black-backed gull and Great black-backed gall. Detail on the assessment for each species can be found in Chapter 13 Offshore Ornithology. Table 32.1 provides a summary of the CIA outcomes for offshore ornithology. Appendix 33.1 details the plans and projects which were considered for the offshore ornithology CIA.

Table 32.8 Potential cumulative impacts identified for offshore ornithology

Potential Impact	Rationale for Cumulative Impact	Cumulative Impact Significance	
Construction			
No cumulative impacts identified during the construction stage.			
Operation			
Disturbance and displacement	There is a sufficient likelihood of a cumulative impact to justify a detailed, quantitative cumulative impact assessment	Red-throated diver	**Minor adverse**
		Gannet	**Negligible**
		Puffin	**Negligible to minor adverse**
		Razorbill	**Minor adverse**
		Guillemot	**Minor adverse**
Collision risk	There is a sufficient likelihood of a cumulative impact to justify a detailed, quantitative cumulative impact assessment.	Gannet	**Minor adverse**
		Kittiwake	**Minor adverse**
		Lesser black-backed gull	**Minor adverse**
		Great black-backed gull	**Minor adverse**
Decommissioning			
The likelihood that there would be a cumulative impact on disturbance and displacement and through effects on habitats and prey species is low because the contribution from the proposed project is small and it is dependent on a temporal and spatial co-incidence of disturbance / displacement from other plans or proposed projects.			

32.5.7 Commercial Fisheries

50. Table 32.9 provides a summary of the CIA outcomes for commercial fisheries. All plans and projects with the potential for cumulative impacts identified for commercial fisheries are presented in Appendix 33.1.

Table 32.9 Potential cumulative impacts identified for commercial fisheries

Potential Impact	Rationale for Cumulative Impact	Cumulative Impact Significance	
Construction, Operation and Decommissioning			
Adverse effects on commercially exploited Fish and Shellfish Populations	There is the potential for Norfolk Vanguard to have adverse impacts on commercially exploited fish and shellfish as a result of cumulative impacts with other projects. This could in turn indirectly affect the productivity of the fisheries that target them.	All commercial fishing vessels	**Minor adverse**
Loss or Restricted Access to Traditional Fishing Grounds	The potential cumulative impact of Norfolk Vanguard with other projects, activities and conservation measures on commercial fisheries is assessed by individual fleet. In respect of other offshore wind farm projects, it is taken that fishing will be able to resume in operational offshore wind farms with the exception of projects in countries where fishing within them is prohibited	Dutch Beam Trawling	**Minor adverse**
		Dutch Sein Netting	**Minor adverse**
		Dutch demersal otter and mid water trawling	**Negligible**
		Dutch nets, purse seines, traps and dredges	**Minor adverse**
		Belgian Beam Trawling	**Minor adverse**
		Belgian Demersal Otter Trawling	**Negligible**
		Belgian Seine Netting	**Negligible**
		UK Beam Trawling (Anglo-Dutch)	**Minor adverse**
		UK Beam Trawling (South-west ports)	**Negligible**
		UK Demersal Otter Trawling	**Negligible**
		UK Local Static Gears	**Minor adverse**
		French demersal and pelagic trawls	**Minor adverse**
		Danish sandeel industrial trawlers and midwater trawlers	**Negligible**

Potential Impact	Rationale for Cumulative Impact	Cumulative Impact Significance	
		German fishing vessels	**Negligible**
Safety Issues for Fishing Vessels	It is assumed that the same obligations in respect of safety issues will apply to other projects/activities		
Increased Steaming Times to Fishing Grounds	The implementation of advisory safety zones at Norfolk Vanguard and other projects could result in some short term increases in steaming distances and times, and therefore higher operational costs for fishing vessels	All fishing fleets	**Negligible**
Obstacles on the seabed	It is assumed that the same obligations in respect of seabed obstacles will apply to other projects/activities		
Interference with Fishing Activities	There could be potential for construction and operation and maintenance activities at Norfolk Vanguard and other projects, particularly other offshore wind farms, to result in interference with fishing activities as a result of increased construction/operation vessel transits.	Local static gear vessels	**Minor adverse**
		Towed gear vessels	**Minor adverse**
Displacement of Fishing Activity into Other Areas	Considering the construction phase in other projects and other activities, there would also be limited potential for displacement to result in increased levels of competition between local inshore static gear vessels. It is assumed that if required adequate mitigation such as that proposed for the project would be applied by other projects/activities to minimise loss of fishing grounds and prevent potential conflicts between static gear vessels. Similarly, as described for assessment of displacement during construction for the project alone, considering the construction phase in other projects and other activities, there would also be little potential for cumulative displacement to result in conflicts between towed and static gear vessels	Local static gear vessels	**Minor adverse**
		Towed gear vessels	**Negligible to Minor adverse**

32.5.8 Shipping and Navigation

51. Table 32.10 provides a summary of the CIA outcomes for shipping and navigation. All plans and projects with the potential for cumulative impacts identified for shipping and navigation are presented in Appendix 33.1.

52. Shipping and navigation impacts have been assessed using the International Maritime Organization Formal Safety Assessment (FSA) (IMO, 2002) process, as required by the MCA. The approach is broadly similar to that used for the wider EIA (see Chapter 6 EIA Methodology), however impact significance is categorised under the FSA approach as "no impact"; "broadly acceptable"; "tolerable (with or without mitigation)" or "unacceptable". Further information on the methodology for assessing shipping and navigation impacts is provided in section 15.4.1 of Chapter 15. Cumulative impacts associated with Norfolk Vanguard have been assessed as tolerable with mitigation, as shown in Table 32.10.

Table 32.10 Potential cumulative impacts identified for shipping and navigation

Potential Impact	Rationale for Cumulative Impact	Cumulative Impact Significance
Construction, Operation and Decommissioning		
Vessel routeing and / or displacement	This was raised as a key point to be considered during consultation.	**Tolerable with mitigation**
Increased vessel to vessel collision risk	This was raised as a key point to be considered during consultation.	**Tolerable with mitigation**
Increased vessel to structure allision risk	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)	**Tolerable with mitigation**
Diminishing emergency response resources	Increase in activity cumulatively within the southern North Sea area.	**Tolerable with mitigation**

32.5.9 Aviation and Radar

53. In assessing the significance of impacts on aviation operations, the aviation industry is highly regulated and subject to numerous mandatory standards, checks and safety requirements. The sensitivity and magnitude of the impact on operations can only be identified by the appropriate aviation organisation conforming to the Risk Classification Scheme used to quantify and qualify the severity and likelihood of a hazard occurring. The Risk Classification Scheme is a fundamental element of an aviation organisation's Safety Management System (SMS), which must be acceptable to, and approved by, the UK Civil Aviation Authority (CAA) or the Military Aviation Authority (MAA), as appropriate. As such, for the purposes of the Aviation and Radar

assessment, no detailed grading has been made of the magnitude of the impact or sensitivity of the receptor on the basis that any potential reduction in aviation safety cannot be tolerated. Instead, definitions of basic significance have been identified.

54. Table 32.11 provides a summary of the CIA outcomes for aviation and radar. All plans and projects with the potential for cumulative impacts identified for aviation and radar are presented in Appendix 33.1.

Table 32.11 Potential cumulative impacts identified for aviation and radar

Potential Impact	Rationale for Cumulative Impact	Cumulative Impact Significance
Operation		
Creation of an aviation obstacle	Aircraft captains have the responsibility for the safety of their aircraft and are required to avoid any obstacle by legislated minimum distances. There would be no cumulative effects from the establishment of the proposed project.	**Not significant**
Wind turbines causing permanent interference on civil and military radar	The proposed project is approximately 66 to 91 km, from existing offshore wind farm developments located in the southern North Sea. Other developments are at a sufficient distance in ATS terms that they would not create cumulative impacts on aviation operations in the area of Norfolk Vanguard. With respect to onshore wind farm sites, these would all be of a sufficient distance from the proposed project that there would be no cumulative effects on aviation operations that arise from any combined adverse impacts. Adjacent offshore wind farms have the potential to create a cumulative effect on radar systems similarly impacted by the development of Norfolk Vanguard. Norfolk Boreas is being developed by the same applicant as Norfolk Vanguard and it is anticipated that mitigation for Norfolk Vanguard will be equally suitable for the effects Norfolk Boreas will create to identified radar systems. Similarly, it is assumed that operational wind farms and those proposed will mitigate their effects on aviation radar; therefore, any potential for a cumulative effect will be removed once mitigation is in place for current and future wind farms.	**Not significant**

32.5.10 Offshore and Intertidal Archaeology and Cultural Heritage

55. The cumulative impact assessment includes known consented and planned projects within 100km of Norfolk Vanguard, while developments beyond 100km are scoped

out for the purposes of direct impacts. The COWRIE guidance (Oxford Archaeology, 2008) states that establishing a geographical boundary for cumulative impact assessment needs to be considered on a case-by-case basis. A 100km boundary has been selected for this project in order to facilitate a clear understanding of the types of projects in the 'region' that may affect not only the heritage assets themselves but also their settings and the perceptual values associated with the historic seascape character.

56. The cumulative impact assessment for marine physical processes is set out in section 8.8 of Chapter 8 Marine Geology, Oceanography and Physical processes. The assessment in Table 32.12 takes account of the results of this assessment in identifying the potential for indirect cumulative impact to heritage assets from the effect of marine physical processes and from sediment plumes and deposition. All plans and projects with the potential for cumulative impacts identified for aviation and radar are presented in Appendix 33.1.

Table 32.12 Potential cumulative impacts identified for offshore archaeology and cultural heritage

Potential Impact	Rationale for Cumulative Impact	Cumulative Impact Significance
Construction,		
Direct impact to known heritage assets	Direct cumulative impacts to known heritage assets are unlikely to occur due to the avoidance of known archaeological sites and features identified through EIA for each of the constructed and planned projects as part of the consenting process.	**No impact**
Direct impact to potential heritage assets	Although the effect of unavoidable impacts will be mitigated by agreed measures as part of the consenting process for each of the constructed and planned projects, the impacts will still have occurred and permanent damage or destruction will have taken place. The assessment of cumulative impacts, therefore, needs to consider the effect of multiple unavoidable impacts from multiple projects upon the archaeological resource.	**Minor adverse** (plus positive benefit from accumulation of data)
Indirect impact to heritage assets from changes to physical processes	Across the region, cumulative impacts to the setting of heritage assets and historic seascape character will occur as a result of the construction of multiple projects.	**No impact**
Operation		
Direct impact to potential	There is potential for multiple unavoidable	**No impact**

Potential Impact	Rationale for Cumulative Impact	Cumulative Impact Significance
heritage assets	impacts associated with operations and maintenance activities (e.g. cable repairs and vessel anchors/jack up legs) during the operation phases of multiple projects.	
Impacts to the setting of heritage assets and historic seascape character	Within 100km of Norfolk Vanguard (and across the southern North Sea as a whole), cumulative impacts to the setting of heritage assets and historic seascape character will occur. Whether this is considered adverse/beneficial depends upon individual perceptions of a seascape associated with offshore renewables as a negative or positive change.	
Decommissioning		
Impacts to the setting of heritage assets and historic seascape character	Within 100km of Norfolk Vanguard (and across the southern North Sea as a whole), cumulative impacts to the setting of heritage assets and historic seascape character will occur. Whether this is considered adverse/beneficial depends upon individual perceptions of a seascape associated with offshore renewables as a negative or positive change.	

32.5.11 Infrastructure and Other Users

57. In accordance with the Scoping Report (Royal HaskoningDHV, 2016) and scoping opinion (the Planning Inspectorate, 2016), cumulative impacts have been scoped out of the EIA.

32.6 Transboundary Impact Assessment Summary

58. This section presents a summary of the potential impacts on transboundary receptors for each topic within the ES. Where transboundary impacts are scoped out, this is also noted.

32.6.1 Marine Geology, Oceanography and Physical Processes

59. Transboundary impacts have been assessed through consideration of the extent of influence of changes or effects and their potential to impact upon marine geology, oceanography and physical processes receptor groups that are located within other European Union (EU) member states.

60. Transboundary impacts were considered in the Scoping Report for this topic and it was concluded that “transboundary impacts are unlikely to occur or are unlikely to be significant.” (Royal HaskoningDHV, 2016). This statement is supported by the assessments that have been completed for the East Anglia ZEA (ABPmer, 2012), the ES of East Anglia THREE (EATL, 2015), and the ES of East Anglia ONE (EAOW, 2012b), as well as this document. Therefore, transboundary impacts are scoped out.

32.6.2 Marine Water and Sediment Quality

61. The localised nature of the potential impacts on the benthos means that significant transboundary impacts are unlikely. In accordance with the Scoping Report (Royal HaskoningDHV, 2016), transboundary impacts have been scoped out of the EIA for this topic.

32.6.3 Benthic and Intertidal Ecology

62. The localised nature of the potential impacts on the benthos means that significant transboundary impacts are unlikely. In accordance with the Scoping Report (Royal HaskoningDHV, 2016), transboundary impacts have been scoped out of the EIA for this topic.

32.6.4 Fish and Shellfish Ecology

63. The distribution of fish and shellfish species is independent of national geographical boundaries. The impact assessment has therefore been undertaken taking account of the distribution of fish stocks and populations irrespective of political limits. As a result, it is considered that a specific assessment of transboundary effects is unnecessary. This approach is consistent with those taken for other projects in the region (e.g. East Anglia ONE and East Anglia THREE).

32.6.5 Marine Mammals

64. The potential for transboundary impacts has been addressed by considering the reference populations and potential linkages to non-UK sites as identified through telemetry studies.

65. The assessment of the effect on the integrity of the transboundary European sites as a result of impacts on the designated marine mammal populations has been undertaken and presented in the Information to Support HRA Report (document 5.3).

66. The highly mobile nature of marine mammal species considered in this assessment means that there are potential transboundary impacts for each receptor. These transboundary impacts are already considered in the assessment, as the impacts for all species have been based on the relevant Management Units and reference populations.

67. For harbour porpoise the extent of the reference population considered within the HRA Report includes UK, Dutch, German, French, Belgian, Danish and Swedish waters. For harbour seal the extent of the reference population includes UK, Dutch,

German, Belgian and French waters. For grey seal the extent of the reference population includes UK, Dutch, German, Belgian, Danish and French waters.

32.6.6 Offshore Ornithology

68. Consultation with other EU Member States (MS) surrounding the North Sea basin resulted in one response that raised a potential concern over transboundary impacts on ornithology receptors. This was the response from Rijkswaterstaat (RWS) in the Netherlands, which noted that non-UK wind farms in the southern North Sea had not been included in the cumulative assessment. This response also noted that this would require an international cumulative approach, which has not been developed to date. Furthermore, owing to the different approaches to impact assessment adopted by each MS it is not currently clear how this could be undertaken quantitatively.

69. With regards to the potential for transboundary cumulative impacts, there is potential for collisions and displacement at wind farms outside UK territorial waters. However, the operational offshore wind farms in Belgium, the Netherlands and Germany are comparatively small (in combination these projects are of a similar size to no more than one to two of the more recent UK wind farms, such as East Anglia ONE). Since the spatial scale and hence seabird populations sizes for a transboundary assessment would be much larger than that assessed, and the scale of wind farm development would be relatively much smaller, the inclusion of non-UK wind farms is considered very unlikely to alter the conclusions of the existing cumulative assessment.

32.6.7 Commercial Fisheries

70. The impact assessment provided within Chapter 14 takes account of the potential impacts of Norfolk Vanguard on international fleets which are known to operate in the study area. As a result, the assessment of potential transboundary impacts is integrated within the impact assessment carried out throughout Chapter 14 Commercial Fisheries.

71. Table 14.31 in Chapter 14 Commercial Fisheries provides a summary of the transboundary impacts for commercial fisheries.

32.6.8 Shipping and Navigation

72. Assessment of vessel routeing has identified that there is 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 and cumulative assessments of Chapter 15 Shipping and Navigation.

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

32.6.9 Aviation and Radar

74. Other EU member states that could be impacted by the proposed project are detailed in Table 32.13.

Table 32.13 List of other EU Member States retained in the transboundary impact assessment in relation to the topic

EU member state	Commentary
Netherlands	Norfolk Vanguard would be located adjacent to and abutting the London / Amsterdam Flight Information Region (FIR). Helicopter Main Route (HMR) KZ50 which is located in the Amsterdam FIR is a continuation of HMRs originating in the London FIR in UK airspace (HMRs 447 and 450) which cross the Norfolk Vanguard OWF sites.

75. The strategies applied to mitigate any impact to UK Helicopter Main Routes (HMR)s should be equally effective in the Netherlands, as aviation operations are regulated by international criteria. Consultation with helicopter operators based in the UK, Netherlands and Belgium has been completed with no concerns expressed by helicopter operators or the Air Traffic Services provider of an impact to operations on HMRs; the impact has therefore been assessed to be of **no significance**.

76. During consultation for the East Anglia Zone which is considered relevant for Norfolk Vanguard due to its proximity, both the Dutch Ministerie Van Defensie and Luchtverkeersleiding Nederland (LVNL) considered that there would be no effect to their radar or infrastructure, whilst Inspectie Leefomgeving en Transport (ILT) requested that any aviation lighting requirement should be in accordance with UK requirements. Both Netherlands Air Traffic Control (LVNL) and the Dutch Air Force (Dutch Ministerie Van Defensie) have confirmed that there will be no impact to their

operations created by Norfolk Vanguard. The transboundary impact with regard to charting, lighting and marking of wind turbines and radar operations is considered to be limited and to be **not significant**.

77. Table 32.14 provides a summary of the potential transboundary impacts identified for aviation and radar.

Table 32.14 Potential transboundary impacts identified for aviation and radar

Potential Impact	Receptor	Significance	Mitigation	Residual Impact
Impacts to aircraft operators using HMR KZ50	Helicopters using HMR which transit the proposed project	Not Significant	N/A	**Not significant**
Impacts on Dutch PSR	LVNL Ministerie Van Defensie	Not significant	N/A	**Not significant**

32.6.10 Offshore and Intertidal Archaeology and Cultural Heritage

78. Transboundary impacts stemming from changes to marine physical processes have been scoped out (see Chapter 8 Marine Geology, Oceanography and Physical Processes). Tidal ellipses show that all movement is in a north south direction and so will not cross the international boundary.

79. Transboundary archaeological impacts may occur if wrecks or aircraft of non-British, European nationality are subject to impact from development. Such wrecks may fall within the jurisdiction of another country, and may include, for example, foreign warships lost in UK waters. As the implementation AEZs will prevent direct impacts to known archaeological receptors, transboundary impacts to known wrecks and aircraft are not expected to occur. Table 32.15 provides a summary of the transboundary impacts for offshore and intertidal archaeology.

Table 32.15 Potential transboundary impacts identified for offshore and intertidal archaeology and cultural heritage

Potential Impact	Receptor	Value/Sensitivity	Magnitude	Significance	Mitigation	Residual Impact
Direct impact to known heritage assets	Wrecks or aircraft of non-British origin	High	High	Major adverse	Avoidance	**No impact**
Direct impact to potential	Wrecks or aircraft of non-British	High	High	Major adverse	Further assessment/ reporting	**Minor adverse**

Potential Impact	Receptor	Value/Sensitivity	Magnitude	Significance	Mitigation	Residual Impact
heritage assets	origin				protocol/ consideration of legal status in country of origin	
	Prehistoric, maritime and aviation archaeological resource (across national boundaries)	Medium to High	High	Major adverse	Further assessment/ reporting protocol	**Minor adverse** (plus positive benefit from accumulation of data)
Indirect impact to heritage assets from changes to physical processes	Tidal ellipses show that all movement is in a north south direction so will not cross the international boundary and transboundary impacts will not occur.					

32.6.11 Infrastructure and Other Users

80. In accordance with the Scoping Report (Royal HaskoningDHV, 2016) and agreed by the SoS in the Scoping Opinion, transboundary impacts have been scoped out of the EIA.

32.7 Summary

81. This chapter of the provided a summary of the CIA and transboundary impact assessment for the offshore topics of the project. Full details of the CIA for each offshore topic are presented in the relevant offshore chapters 8 to 18.

32.8 References

ABPmer. (2012a). East Anglia Offshore Wind Zonal Environmental Appraisal Report. Appendix G – Physical Processes Baseline and References.
Department of Energy and Climate Change (DECC) (2011a). *Overarching National Policy Statement for Energy (EN-1).* London: The Stationery Office.
Department of Energy and Climate Change (DECC) (2011b). *National Policy Statement for Renewable Energy Infrastructure (EN-3).* London: The Stationery Office.
Department of Energy and Climate Change (DECC) (2011c). *National Policy Statement for Electricity Networks Infrastructure (EN-5).* London: The Stationery Office.
East Anglia Offshore Wind (EAOW) (2012a) East Anglia Offshore Wind Zonal Environmental Appraisal Report March 2012
East Anglia Offshore Wind (2012b). East Anglia Offshore Wind Zonal Environmental Appraisal Report
East Anglia THREE Limited (2015). East Anglia THREE Offshore Wind Farm Environmental Statement.
European Commission. 1999. Guidelines for the Assessment of Indirect and Cumulative Impacts as well as Impact Interactions. Available at: http://ec.europa.eu/environment/eia/eia-studies-and-reports/guidel.pdf. Accessed 15/05/2018
HM Government (2011). Marine Policy Statement. Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69322/pb3654-marine-policy-statement-110316.pdf
IMO. (2002) *Guidelines for Formal Safety Assessment (FSA) for Use in the IMO Rule Making Process*, London: IMO.
JNCC and Natural England (2013). 'Suggested Tiers for Cumulative Impact Assessment'.
Norfolk Vanguard Limited (2017) Norfolk Vanguard Limited Preliminary Environmental Information Report.
OSPAR Commission (2008). Assessment of the environmental impact of offshore wind-farms
Oxford Archaeology commissioned by COWRIE (2008) Guidance for Assessment of Cumulative Impacts on the Historic Environment from Offshore Renewable Energy.
The Planning Inspectorate (2012). Advice Note Nine: Using the Rochdale Envelope.
The Planning Inspectorate (2015) Advice Note Seventeen: Cumulative effects assessment relevant to nationally significant infrastructure projects
The Planning Inspectorate. (2016). Scoping Opinion Proposed Norfolk Vanguard Offshore Wind Farm.
The Planning Inspectorate (2018) Advice Note Twelve: Development with significant transboundary impacts consultation
RenewableUK (2013) Cumulative impact assessment guidelines, guiding principles for cumulative impacts assessments in offshore wind farms.
Royal HaskoningDHV (2016). Norfolk Vanguard Offshore Wind Farm Environmental Impact Assessment Scoping Report