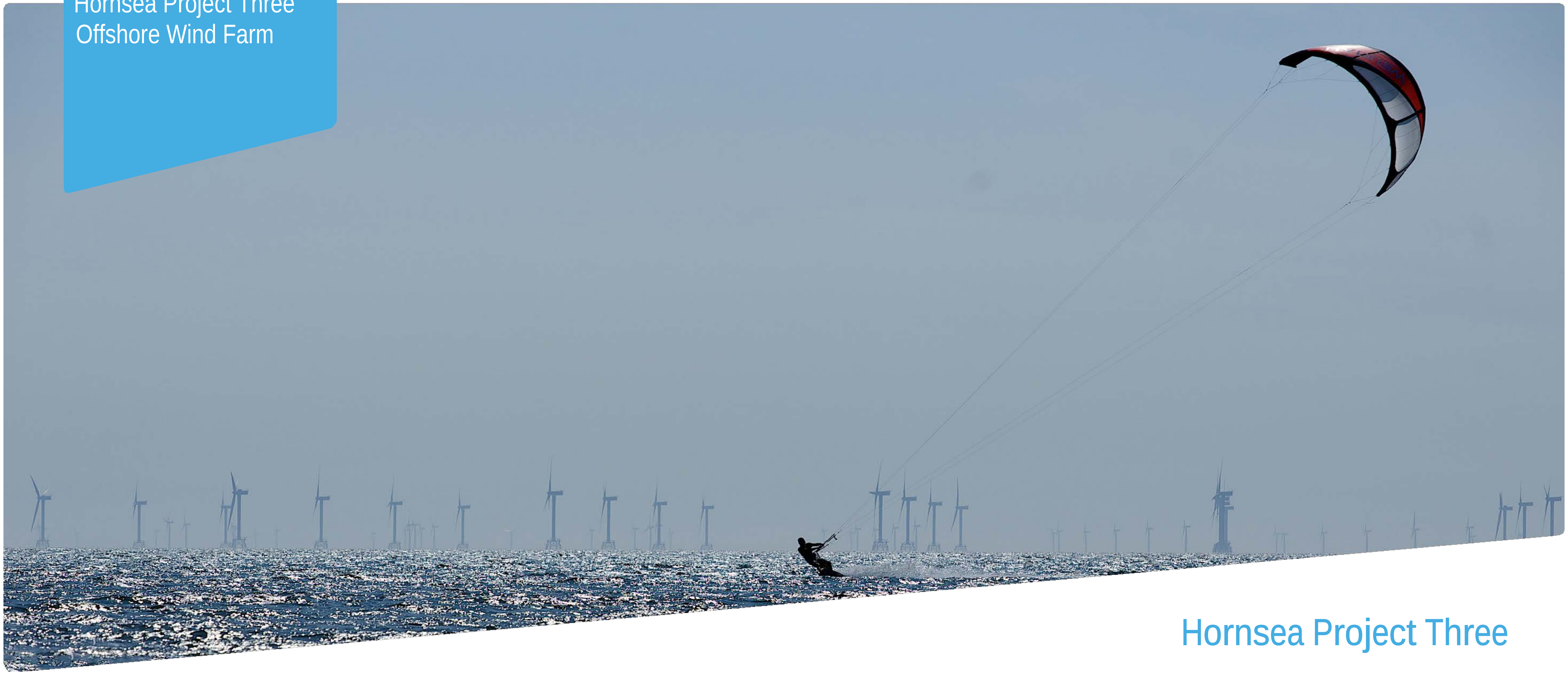
Hornsea Project Three
Offshore Wind Farm



Hornsea Project Three

Offshore Wind Farm

Preliminary Environmental Information Report: Chapter 5 – Offshore Ornithology

Date: July 2017

Hornsea 3
Offshore Wind Farm

DONG energy

Environmental Impact Assessment

Preliminary Environmental Information Report

Volume 2

Chapter 5 – Offshore Ornithology

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Front cover picture: Kite surfer near one of DONG Energy's UK offshore wind farms © DONG Energy Hornsea Project Three (UK) Ltd., 2016.

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Glossary

Term	Definition
Bathymetry	The measurement of water depth in oceans, seas and lakes
Birds Directive	European Parliament and Council Directive 2009/147/EC on the conservation of wild birds – a key legislative measure for the protection of birds in the European Union
Former Hornsea Zone	The Hornsea Zone was one of nine offshore wind generation zones around the UK coast identified by The Crown Estate (TCE) during its third round of offshore wind licensing. In March 2016, the Hornsea Zone Development Agreement was terminated and project specific agreements, Agreement for Leases (AfLs), were agreed with The Crown Estate for Hornsea Project One, Hornsea Project Two, Hornsea Project Three and Hornsea Project Four. The Hornsea Zone has therefore been dissolved and is referred to throughout the Hornsea Project Three Scoping Report as the former Hornsea Zone.
Hornsea Project One	The first offshore wind farm project within the former Hornsea Zone. It has a maximum capacity of 1.2 gigawatts (GW) or 1,200 MW and includes all necessary offshore and onshore infrastructure required to connect to the existing National Grid substation located at North Killingholme, North Lincolnshire. Referred to as Hornsea Project One throughout the PEIR.
Hornsea Project Three offshore wind farm	The third offshore wind farm project within the former Hornsea Zone. It has a maximum capacity of 2.4 GW (2,400 MW) and includes offshore and onshore infrastructure to connect to the existing National Grid substation located at Norwich Main, Norfolk. Referred to as Hornsea Three throughout the PEIR.
Hornsea Project Two	The second offshore wind farm project within the former Hornsea Zone. It has a maximum capacity of 1.8 GW (1,800 MW) and includes offshore and onshore infrastructure to connect to the existing National Grid substation located at North Killingholme, North Lincolnshire. Referred to as Hornsea Project Two throughout the PEIR.
Mean High Water Spring (MHWS)	The height of mean high water during spring tides in a year.
Statutory Nature Conservation Bodies	Comprised of JNCC, Natural Resources Wales, Department of Agriculture, Environment and Rural Affairs/Northern Ireland Environment Agency, Natural England and Scottish Natural Heritage these agencies provide advice in relation to nature conservation to government

Acronyms

Unit	Description
ASL	Above Sea Level
BDMPS	Biologically Defined Minimum Population Scale
CV	Coefficient of Variation
DCO	Development Consent Order
DECC	Department for Energy and Climate Change
EIA	Environmental Impact Assessment
EU	European Union
EWG	Expert Working Group
FAME	Future of the Atlantic Marine Environment
GPS	Global Positioning System
HRA	Habitats Regulations Assessment
HVAC	High Voltage Alternating Current
IPC	Infrastructure Planning Commission
JNCC	Joint Nature Conservation Committee
MHWS	Mean High Water Spring
MMO	Marine Management Organisation
PCH	Potential Collision Height
PEIR	Preliminary Environmental Information Report
PINS	Planning Inspectorate
pSPA	Potential Special Protection Area
RIAA	Report to Inform Appropriate Assessment
RSPB	Royal Society for the Protection of Birds
SD	Standard Deviation
SMP	Seabird Monitoring Programme
SNCB	Statutory Nature Conservation Body
SPA	Special Protection Area
SOSS	Strategic Ornithological Support Services

Unit	Description
SOSS MAT	Strategic Ornithological Support Services (SOSS) Migration Assessment Tool (MAT)
SSSI	Site of Special Scientific Interest
STAR	Seabird Tracking and Research
UK	United Kingdom
VOR	Valued Ornithological Receptor
WTG	Wind Turbine Generator

Units

Unit	Description
km	Kilometre (distance)
m	Metre (length)
kJ	Kilojoules (energy)
MW	Megawatt (power)

5. Offshore Ornithology

5.1 Introduction

5.1.1.1 This chapter of the Preliminary Environmental Information Report (PEIR) presents the findings to date of the Environmental Impact Assessment (EIA) for the potential impacts of the Hornsea Project Three offshore wind farm (hereafter referred to as Hornsea Three) on offshore ornithology. Specifically, this chapter considers the potential impact of Hornsea Three seaward of Mean High Water Springs (MHWS) during its construction, operation and maintenance, and decommissioning phases. The potential impact of Hornsea Three landward of MHWS are considered in Volume 3, chapter 3: Terrestrial Ecology.

5.1.1.2 This chapter describes the existing environment with regard to offshore ornithological interest within Hornsea Three and the former Hornsea Zone (see section 5.7) and in the context of the wider region of the North Sea. Section 5.7 characterises the distribution, abundance and behaviour of ornithological species known to occur, or which have been recorded within Hornsea Three, the former Hornsea Zone and wider region through site-specific digital video aerial surveys and desk-based research. The subsequent initial assessment (section 5.11) presents the potential impacts of construction; operation and maintenance, and decommissioning of Hornsea Three on the ornithological assemblage present, and in particular on identified species of conservation concern.

5.1.1.3 At the time of the preparation of this chapter of the PEIR, the baseline characterisation survey programme that will inform the EIA was still on-going. In consequence, the preliminary and emerging nature of the baseline characterisation survey data that informed this chapter of the PEIR has only enabled the latter to present a preliminary and incomplete assessment (section 5.11).

5.1.1.4 This chapter summarises information contained within the Baseline Characterisation Report included at volume 5, annex 5.1: Baseline Characterisation Report.

5.2 Purpose of this chapter

5.2.1.1 The primary purpose of the Environmental Statement is to support the Development Consent Order (DCO) application for Hornsea Three under the Planning Act 2008 (the 2008 Act). This PEIR constitutes the Preliminary Environmental Information for Hornsea Three and sets out the findings of the EIA to date to support pre-application consultation activities required under the 2008 Act. The EIA will be finalised following completion of pre-application consultation and the Environmental Statement will accompany the application to the Secretary of State for Development Consent.

5.2.1.2 The PEIR will form the basis for Phase 2 Consultation which will commence on 27 July and conclude on 20 September 2017. At this point, comments received on the PEIR will be reviewed and incorporated (where appropriate) into the Environmental Statement, which will be submitted in support of the application for Development Consent scheduled for the second quarter of 2018.

5.2.1.3 In particular, this PEIR chapter:

- Presents the existing environmental baseline established from desk studies, and consultation;
- Presents the potential environmental effects on offshore ornithology arising from Hornsea Three, based on the information gathered and the analysis and assessments undertaken to date;
- Identifies any assumptions and limitations encountered in compiling the environmental information; and
- Highlights any necessary monitoring and/or mitigation measures which could prevent, minimise, reduce or offset the possible environmental effects identified in the EIA process.

5.2.1.4 The PEIR chapter only summarises information contained within:

- The Baseline Characterisation Report included at volume 5, annex 5.1: Baseline Characterisation Report;
- Analysis of displacement impacts on seabirds included at volume 5, annex 5.2: Analysis of displacement impacts on seabirds; and
- Collision Risk Modelling Report included at volume 5, annex 5.3: Collision Risk Modelling Report.

5.2.1.5 Three key potential impacts on offshore ornithology during the construction, operation and maintenance, and decommissioning of Hornsea Three have been identified:

- The potential for Hornsea Three to adversely affect qualifying ornithological features of nearby designated sites (Special Protection Areas (SPAs), proposed Special Protection Areas (pSPAs), Sites of Special Scientific Interest (SSSIs) and Ramsar sites);
- The potential for Hornsea Three to adversely affect seabirds of highest conservation concern, listed on Annex I of the Birds Directive and/or Schedule 1 of the Wildlife and Countryside Act 1981 (as amended); and
- The potential for Hornsea Three to adversely affect other species in internationally, nationally, or regionally important numbers, overwinter, during migration, or whilst commuting locally between foraging and breeding grounds.

5.2.1.6 Based on reviews of other offshore wind farms and their potential impacts on birds, (e.g. Drewitt and Langston (2006); Dierschke *et al.*, (2006); Langston (2010); and Wade *et al.*, (2016)), for each of the above, direct adverse impacts may arise through loss of foraging habitat, disturbance, displacement, pollution, collision with turbines or barrier effects (when a bird's avoidance of wind turbines results in an increase in energy use to circumvent the turbine area (Goodale and Divoll, 2009). Indirect impacts may arise due to effects upon the distribution and abundance of prey species.

5.3 Study area

5.3.1.1 For the purposes of the Hornsea Three offshore ornithology EIA, four study areas are defined:

- The former Hornsea Zone plus 10 km buffer (the former Hornsea Zone offshore ornithology study area);
- The Hornsea Three array area plus 4 km buffer. Surveys undertaken across the former Hornsea Zone have overlapped spatially with the proposed Hornsea Three array area. The extent of buffer is defined from Natural England and JNCC recommending for assessment of displacement, a buffer of up to 4 km for the most sensitive species (divers and sea ducks; Natural England and JNCC, 2017) (the Hornsea Three offshore ornithology study area);
- The Hornsea Three offshore cable corridor plus 2 km buffer, – all areas of the Hornsea Three offshore cable corridor and landfall area that are seaward of MHWS (the Hornsea Three offshore cable corridor) plus a 2 km buffer. The 2 km buffer is considered sufficiently precautionary when assessing offshore ornithology receptors given they are considered most at risk during export cable installation and to operations that are expected to be highly localised e.g. cable laying vessels which are moving slowly during cable installation; and
- The North Sea – this is the regional offshore ornithology study area and coincides with the northern and southern North Sea (see Figure 1.1, volume 5, annex 5.1: Baseline Characterisation Report) as defined by the regional seas identified by JNCC for implementing UK nature conservation strategy (JNCC, 2004). This North Sea offshore ornithology study area provides a wider context for the site-specific data and is the area covered by the desktop review including consideration of species specific foraging ranges, migration routes and wintering areas.

5.3.1.2 The first three study areas listed above i.e. the former Hornsea Zone plus 10 km buffer, The Hornsea Three offshore ornithology study area and The Hornsea Three offshore cable corridor, were identified for the purposes for defining the baseline environment and undertaking the Hornsea Three alone assessment. The North Sea offshore ornithology study area represents the maximum extent of the area within which the cumulative effects assessment (CEA) is conducted, with the boundary used that area dependent on the particular impact as well as each species' population distribution and behaviour (e.g. foraging range).

5.3.1.3 Figure 5.1 presents the Hornsea Three array area and offshore cable corridor, as well as their associated buffers which comprise the study areas.

5.3.1.4 Further details on the Hornsea Three and former Hornsea Zone offshore ornithology study areas and the surveys carried out are presented in volume 5, annex 5.1: Baseline Characterisation Report.

5.4 Planning policy context

5.4.1.1 Planning policy on offshore renewable energy Nationally Significant Infrastructure Projects (NSIPs), specifically in relation to offshore ornithology, is contained in the Overarching National Policy Statement (NPS) for Energy (EN-1; DECC, 2011a) and the NPS for Renewable Energy Infrastructure (EN-3, DECC, 2011b).

5.4.1.2 NPS EN-3 includes guidance on what matters are to be considered in the assessment. These are summarised in Table 5.1 below.

Table 5.1: Summary of NPS EN-3 provisions relevant to this chapter.

Summary of [NPS EN-3] provision	How and where considered in the PEIR
Biodiversity	
Applicants should assess the effects on the offshore ecology and biodiversity for all stages of the lifespan of the proposed offshore wind farm (paragraph 2.6.64 of NPS EN-3).	Construction, operation and decommissioning phases of Hornsea Three are assessed (paragraph 5.11.1.1 *et seq.*, paragraph 5.11.2.1 *et seq.* and paragraph 5.11.3.1 *et seq.*).
Consultation on the assessment methodologies should be undertaken at early stages with the statutory consultees as appropriate (paragraph 2.6.65 of NPS EN-3).	Consultation on the assessment methodologies with relevant statutory and non-statutory stakeholders has been carried out from the early stages of Hornsea Three (paragraph 5.6.1.2,). An Expert Working Group (EWG) has been established since March 2016 and the survey methods, scope, collision risk modelling and displacement have been wholly or largely agreed to the extent set out in below.
Any relevant data that has been collected as part of post-construction ecological monitoring from existing, operational offshore wind farms should be referred to where appropriate (paragraph 2.6.66 of NPS EN-3).	Relevant data collected as part of post-construction monitoring from other offshore wind farm developments has informed the assessment of Hornsea Three (paragraphs 5.6.5.8 *et seq.*).
Applicants should assess the potential for the scheme to have both positive and negative effects on marine ecology and biodiversity (paragraph 2.6.67 of NPS EN-3).	Both the positive and negative effects have been assessed for Hornsea Three (section 5.11).
Offshore ornithology	
Offshore wind farms have the potential to impact on birds through: – collisions with rotating blades; – direct habitat loss; – disturbance from construction activities such as the movement of construction/ decommissioning vessels and piling; – displacement during the operational phase, resulting in loss of foraging/ roosting area; and – impacts on bird flight lines (i.e. barrier effect) and associated increased energy use by birds for commuting flights between roosting and foraging areas (paragraph 2.6.101 of NPS EN-3).	The Hornsea Three assessment has considered all impacts during each phase of development on key ornithological species in the vicinity of the development (paragraph 5.8.1.1 *et seq.*, Table 5.8) i.e. the former Hornsea Zone plus 10 km buffer, The Hornsea Three offshore ornithology study area and The Hornsea Three offshore cable corridor.
The scope, effort and methods required for ornithological surveys should have been discussed with the relevant statutory advisor (paragraph 2.6.102 of NPS EN-3).	The Hornsea Three application process has included full consultation with statutory advisors (the Joint Nature Conservation Committee (JNCC) and Natural England) on ornithological survey methods and scope (paragraphs 5.6.1.1 *et seq.*, .
Relevant data from operational offshore wind farms should be referred to in the applicant's assessment (paragraph 2.6.103 of NPS EN-3).	Hornsea Three has consider relevant information on offshore birds in relation to published studies on operational offshore wind farms as part of the Environmental Impact Assessment process (paragraphs 5.6.5.8 *et seq.*).
It may be appropriate for assessment to include collision risk modelling for certain species of birds. Where necessary, the assessments carried out by applicants should assess collision risk using survey data collected from the site at the pre-application EIA stage. The Secretary of State will want to be satisfied that the collision risk assessment has been conducted to a satisfactory standard having had regard to the advice from the relevant statutory advisor (paragraph 2.6.104 of NPS EN-3).	Hornsea Three will conduct collision risk modelling primarily utilising data obtained from baseline surveys of the Hornsea Three offshore ornithology study area (paragraph 5.6.6.1 *et seq.*and paragraph 5.11.2.94 *et seq.*).
Applicants are expected to adhere to requirements in respect of FEPA licence requirements (now Marine Licence). A FEPA licence may be deemed to be given by a provision in a development consent given by the Secretary of State (paragraph 2.6.105 of NPS EN-3).	Hornsea Three will consider the need to protect the environment and human health, and to prevent interference with legitimate uses of the sea, as required by a Marine Licence. In relation to ornithological interests, this is considered in the Mitigation Table 5.15 as well as determination of a worst-case impact in Table 5.8, and subsequent impact assessments.

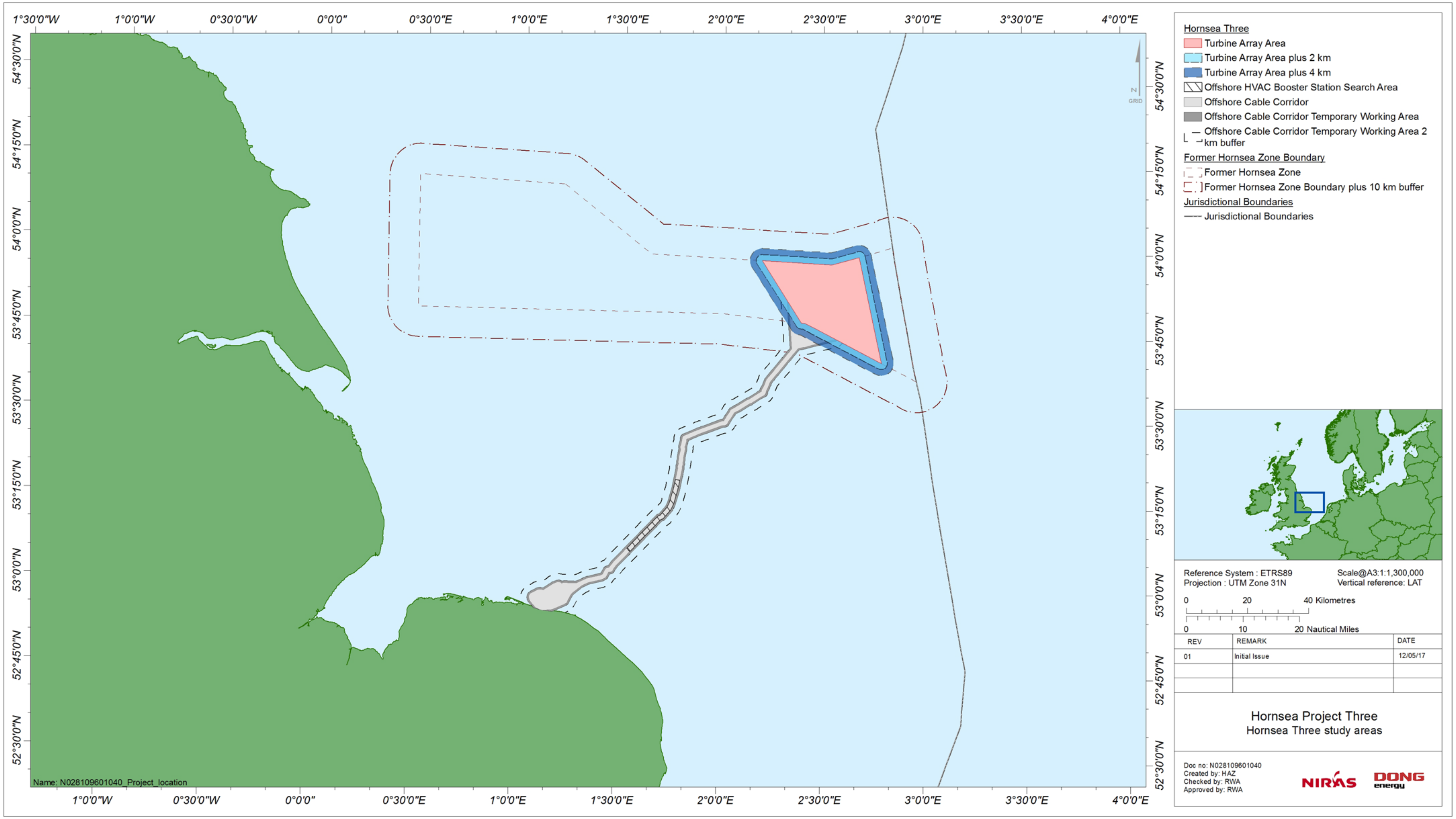

Figure 5.1: Hornsea Three array area and export cable route and associated buffer areas

5.4.1.3 NPS EN-3 also highlights a number of factors relating to the determination of an application and in relation to mitigation. These are summarised in Table 5.2 below.

Table 5.2: Summary of NPS EN-3 policy on decision making relevant to this chapter.

Summary of NPS EN-3 policy on decision making (and mitigation)	How and where considered in the PEIR
Biodiversity	
The Secretary of State should consider the effects of a proposal on marine ecology and biodiversity taking into account all relevant information made available to it (paragraph 2.6.68 of NPS EN-3).	The effect of the proposal on biodiversity will be described and considered as part of the Hornsea Three assessment process.
The designation of an area as Natura 2000 site does not necessarily restrict the construction or operation of offshore wind farms in or near that area (paragraph 2.6.69 of NPS EN-3).	Natura 2000 sites will be considered during the Hornsea Three assessment process (section 5.7.1).
Mitigation may be possible in the form of careful design of the development itself and the construction techniques employed (paragraph 2.6.70 of NPS EN-3).	Mitigation will be considered during the Hornsea Three assessment (Table 5.15). It should be noted that as part of the project design process, a number of designed-in measures have been proposed to reduce the potential for impacts (section 5.10).
Ecological monitoring is likely to be appropriate during the construction and operational phases to identify the actual impact so that, where appropriate, adverse effects can then be mitigated and to enable further useful information to be published relevant to future projects (paragraph 2.6.71 of NPS EN-3).	Future monitoring will be considered within the Hornsea Three assessment.
Ornithology	
In addition to Section 5.3 of NPS EN-1 the offshore wind-specific biodiversity considerations set out in paragraphs 2.6.58 to 2.6.71 should inform Secretary of State decision-making (paragraph 2.6.106 of NPS EN-3).	The effect of the proposal on offshore ornithology will be described and considered as part of the Hornsea Three assessment process.
Aviation and navigation lighting should be minimised to avoid attracting birds, taking into account impacts on safety (paragraph 2.6.107 of NPS EN-3).	Lighting effects on birds will be considered within the Hornsea Three assessment process (see paragraphs 5.11.2.211 to 5.11.2.224)
Subject to other constraints, wind turbines should be laid out within a site, in a way that minimises collision risk, where the collision risk assessment shows there is a significant risk of collision (paragraph 2.6.108 of NPS EN-3).	Mitigation relating to turbine layout and birds will be considered within the Hornsea Three assessment process (see Table 5.15). It should be noted that as part of the project design process, a number of designed-in measures have been proposed to reduce the potential for collision mortality (section 5.10). Hornsea Three has committed to a significantly increased lower blade tip height than previous planning applications for offshore wind farms in the UK, in an effort to mitigate impacts of collision risk.
Construction vessels associated with offshore wind farms should, where practicable and compatible with operational requirements and navigational safety, avoid rafting seabirds during sensitive periods (paragraph 2.6.109 of NPS EN-3).	Mitigation measures for offshore ornithological interests will be considered within the Hornsea Three assessment process (Table 5.15).
The exact timing of peak migration events is inherently uncertain. Therefore, shutting down turbines within migration routes during estimated peak migration periods is unlikely to offer suitable mitigation (paragraph 2.6.110 of NPS EN-3).	Mitigation measures for offshore ornithological interests will be considered within the Hornsea Three assessment process (Table 5.15).

5.4.2 Legislation and guidance

5.4.2.1 The key international conventions promoting the conservation of birds are the Convention on Wetlands of International Importance especially as Waterfowl Habitat (the 'Ramsar Convention'), the Convention on the Conservation of Migratory Species of Wild Animals (the 'Bonn Convention') and the Convention on the Conservation of European Wildlife and Natural Habitats (the 'Bern Convention').

5.4.2.2 The Ramsar Convention allows contracting parties to the convention to designate suitable wetlands within their own territory for inclusion in the 'List of Wetlands of International Importance' (the List). Contracting parties are required to incorporate into their planning the conservation of the areas included in the List. In addition, the Ramsar Convention states that "where a Contracting Party in its urgent national interest, deletes or restricts the boundaries of a wetland included in the List, it should as far as possible compensate for any loss of wetland resources, and in particular it should create additional nature reserves for waterfowl and for the protection, either in the same area or elsewhere, of an adequate portion of the original habitat."

5.4.2.3 The Bonn Convention provides for contracting parties to work together to conserve migratory species and their habitats by providing strict protection for endangered migratory species (listed in Appendix I of the Convention), by concluding multilateral agreements for the conservation and management of migratory species which require or would benefit from international cooperation (listed in Appendix II), and by undertaking cooperative research activities.

5.4.2.4 The Bern Convention aims to ensure conservation and protection of wild plant and animal species and their natural habitats (listed in Appendices I and II of the Convention). It also aims to increase cooperation between contracting parties and regulate the exploitation of those species (including migratory species) listed in Appendix III.

5.4.2.5 Within the European Union, the key legislative measures providing for the protection of birds are Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds (the 'Birds Directive') and Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (the 'Habitats Directive').

5.4.2.6 The Birds Directive aims to maintain the populations of wild bird species across their natural range and allows for the designation of SPAs for rare and vulnerable species listed in Annex I of the Directive and regularly occurring migratory birds.

5.4.2.7 The Habitats Directive promotes the maintenance of biodiversity by requiring Member States to maintain or restore natural habitats and wild species listed in the Annexes to the Directive and by introducing protection for habitats and species of European importance. The Habitats Directive contributes to a coherent European ecological network of protected sites by designating Special Areas of Conservation (SACs) for habitats listed on Annex I and for species listed on Annex II of the Directive.

5.4.2.8 Together, SACs and SPAs create a Europe-wide network of designated sites known as Natura 2000.

5.4.2.9 The Habitats Directive and Birds Directives have been transposed into UK legislation through the Conservation of Habitats and Species Regulations 2010 (as amended) (the 'Habitats Regulations') and the Offshore Marine Conservation (Natural Habitats, &c.) Regulations 2007 (as amended) (the 'Offshore Habitats Regulations'). These Regulations allow for the designation of SACs and SPAs and set out a mechanism for the protection of those sites.

5.4.2.10 Birds are further protected in the UK under the Wildlife and Countryside Act 1981 (as amended) which provides protection for wild birds by making it an offence to kill, injure, or take any wild bird or take, damage or destroy the nest or eggs of a wild bird. The Act also provides for the designation of SSSIs which are sites designated by Natural England as areas of land of special interest by reason of any of their flora, fauna, or geological or physiographical features.

5.4.2.11 Further advice in relation specifically to the Hornsea Three development has been sought through consultation with the statutory authorities and from the PINS Secretary of State's scoping opinion (Table 5.3).

5.4.2.12 No regional or local policies or guidance have been identified that are relevant to this assessment.

5.5 Consultation

5.5.1.1 A summary of the key issues raised during consultation specific to offshore ornithology is outlined below, together with how these issues have been considered in the production of this PEIR.

5.5.2 Hornsea Project One and Hornsea Project Two consultation

5.5.2.1 Hornsea Three has similarities, both in terms of the nature of the development and its location, to Hornsea Project One and Hornsea Project Two. The matters relevant to Hornsea Three, which were raised by consultees during the pre-application and examination phases of Hornsea Project One and Hornsea Project Two, on offshore ornithology, are set out in volume 4, annex 1.1:Hornsea Project One and Hornsea Project Two Consultation of Relevant to Hornsea Three.

5.5.3 Hornsea Three consultation

5.5.3.1 Table 5.3 below summarises the issues raised relevant to offshore ornithology, which have been identified during consultation activities undertaken to date. Table 5.3 also indicates either how these issues have been addressed within this PEIR or how the Applicant has had regard to them.

5.5.4 Evidence Plan

5.5.4.1 The Evidence Plan process has been set out in the Hornsea Project Three Offshore Wind Farm – Draft Evidence Plan (DONG Energy, 2017), the purpose of which is to agree the information Hornsea Three needs to supply to PINS, as part of a DCO application for Hornsea Three. The Draft Evidence Plan seeks to ensure compliance with the Habitat Regulations Assessment (HRA).

5.5.4.2 As part of the Evidence Plan process, the Offshore Ornithology Expert Working Group (EWG) was established with representatives from the key regulatory bodies and their advisors and statutory nature conservation bodies, including the MMO, Natural England and RSPB. Between April 2016 and publication of this PEIR, a number of EWG meetings were held that included discussion of key issues with regard to the offshore ornithology elements of Hornsea Three, including characterisation of the baseline environment and the impacts to be considered within the impact assessment. The identification of key issues was informed by consultation on Hornsea Project One and Project Two, where appropriate. Matters raised during EWG meetings have been included in Table 5.3 below.

Table 5.3: Summary of key consultation issues raised during consultation activities undertaken for Hornsea Three relevant to offshore ornithology

Date	Consultee and type of response	Issues raised	Response to issue raised and/or where considered in this chapter
November 2016	PINS/ Natural England (Hornsea Three Scoping Opinion, 25/11/2016)	Impact scoped in/out Indirect permanent habitat loss/disturbance has been scoped out from the operational/maintenance phase. The Secretary of State/Natural England does not agree that this can be concluded, as the presence of subsurface structures as well as changes in wind patterns that may result in changes in current patterns in the area could result in changes in prey availability and distribution during the operational phase of the development. Indirect impacts may cause disturbance to prey (e.g. fish) species from important bird feeding areas or changes to prey availability due to changes to physical processes and habitat as a result of the presence of operational infrastructure. Secretary of State/Natural England does not agree with the Applicant's proposal to scope out "Accidental Pollution" and "Disturbance from Lighting" as potential impacts on ornithological receptors	The impact of indirect effects such as changes in habitat or prey availability has been assessed for the operational/maintenance phase (see paragraph 5.11.2.83 *et seq.*). Accidental pollution and disturbance from lighting has been assessed (see Section 5.11).
November 2016	Natural England (Hornsea Three Scoping Opinion, 25/11/2016)	Baseline Surveys Natural England recommends that the Applicant reviews the following additional publications that are not referenced in the scoping report when producing the Environmental Statement (noting that this is not an exhaustive list). It will be important that the level of uncertainty/confidence associated with each data source and assessment should be discussed/quantified based on the nature of evidence used and how this evidence was used to determine impact significance. It is important that there is detailed presentation of the uncertainty associated with any quantitative estimates to establish confidence in conclusions drawn. The Applicant will need to ensure that that their survey methodologies are appropriate and enable collection of data (or use of existing data) that will enable quantification of the variability and uncertainty in key data parameters e.g. densities of birds in the project area, flight height behaviour, connectivity with protected sites.	The additional publications noted have been considered. The level of uncertainty/confidence associated with each data source has be discussed. The survey methodologies have been discussed with the Expert Working Group (EWG) through the Evidence Plan process and supplemented by existing data, have been agreed as appropriate to enable the characterisation of the baseline environment. The EWG have agreed that monthly aerial surveys from April 2016 – September 2017, considering the timescales of the Project, is the most appropriate approach to providing enough site specific data to characterise the baseline environment. The suitability of existing ornithological data from across the Hornsea zone to inform the EIA, specifically regarding the array site, is being examined by means of a meta-analysis and to be reviewed by the EWG.
		Appropriate spatial scales Natural England notes that alternative spatial scales may be relevant for some species and aspects of the ornithology assessment. The appropriate spatial scale will depend on the ornithological receptor species being considered as well as the time of year when the impact is predicted. Natural England would welcome further discussion with the Applicant regarding the appropriate spatial scale for each species and season.	The approach to defining Biological Defined Minimum Population Scale (BDMPS) has been agreed with Expert Working Group (EWG), see section 1.2.5 of annex 5.1: Baseline Characterisation Report.
		Breeding seasons Furness *et al.* (2015) define breeding seasons for UK birds based on an assessment of median return data to colonies in the UK, but the months presented in the table as the breeding season months for each species do not match the ones in Furness *et al.* (2015). We advise that the breeding season months as defined by the median return date for UK colonies from Furness *et al.* (2015) should be the starting point. For some species there will then be an overlap between months defined as breeding season and some of the non-breeding season months. Further, for individual colonies of interest there may be colony specific data on occupancy in the breeding season that will be relevant to the assessment and should be considered. We would welcome further discussion regarding the most appropriate approach to defining breeding seasons as part of the Evidence Plan process.	Impact on bird populations from effects individuals may sustain as a consequence of Hornsea Three has be assessed in relation to relevant biological seasons and the appropriate reference populations as derived from Furness (2015) refined with existing data from the former Hornsea Zone and expert opinion. The issue is currently under ongoing discussion within the Evidence Plan.

Date	Consultee and type of response	Issues raised	Response to issue raised and/or where considered in this chapter
		Foraging ranges We note that the values in Thaxter *et al.* (2012) should not be viewed as the only source of available information. Assessments should always be based upon the best and most up to date evidence available. Thus, in some situations, it may be justified to consider screening in SPAs beyond published mean maximum foraging range of the qualifying features. For example, new tracking data may suggest that previous maximum ranges for a species were underestimated; thus, it may be appropriate to derive new maximum and mean maximum ranges.	It has been agreed with the Expert Working Group (EWG) that where there is specific SPA data this has be used over Thaxter *et al.*, (2012) and any additional data supplied will be reviewed and considered. Otherwise Thaxter *et al.*, (2012) is deemed appropriate.
		Wildfowl and waders There is no mention here of other bird species such as wildfowl and waders which also have the potential to be found within the Horsea Three array area during migration periods and which may have connectivity with a number of more distant UK SPAs	Potential impacts on wildfowl and waders has been assessed, along with other migratory species, see paragraphs 5.11.2.190 *et seq.*
		Connectivity with the Hornsea Three Project “Statutory designated sites of bird conservation importance within proximity of Hornsea Three with cited features of relevance to offshore ornithology” is unclear as it omits some of the features of the SPAs listed that do have potential connectivity with the Hornsea Three site (e.g. guillemot and razorbill at Flamborough and Filey Coast pSPA), and also omits a range of SPA and Ramsar sites that have designated features with potential connectivity with Hornsea Three, in particular outside of the breeding season. It would be clearer if the table set out more general principles that will be applied to scope in designated sites and features, rather than listing sites and species at this stage.	Full logic for the screening of SPAs and establishment of connectivity was outlined within the HRA Screening Report. The approach is based upon the application of mean-maximum foraging ranges as reported by Thaxter *et al*. (2012). In some cases more specific information is available from GPS/satellite tracking studies, such as, for example, the FAME/STAR initiatives for kittiwake and gannet colonies associated with the FFC pSPA.
		Disturbance/displacement impacts We are unclear about why the disturbance/displacement impacts associated with construction only details information about the inter-tidal areas and only mentions little tern specifically. This is confusing and does not seem to be complete. There is the potential for disturbance/displacement in the offshore project and cable route areas and also in the near-shore and coastal areas along the offshore cable route and not just specifically the cable landfall site. This includes construction activities associated with installation of export cables and infrastructure as well as increased vessel activity from construction activities. There is the potential for connectivity between these components of the project and a number of species including in near shore areas, common scoter, red-throated diver, common tern, Sandwich tern and little tern (i.e. not just little tern).	The approach to assessment of displacement has been agreed with stakeholders. The assessment has covered the Hornsea Three array area and the Hornsea Three offshore cable corridor (see section 5.6.5 and paragraphs 5.11.2.3 *et seq.*).

Date	Consultee and type of response	Issues raised	Response to issue raised and/or where considered in this chapter
		Collision Risk Modelling The Applicant states "Whether use is made of the latest version of the model that takes better account of the uncertainty around collision risk prediction (Madsen, 2015) is to be agreed with the relevant SNCBs". Natural England's view is that it is important to reflect the variability and uncertainty around the various input parameters used for collision risk assessment. This includes variability around densities of birds at the project site, flight heights, flight speeds, avoidance rates and turbine rotor speed. Band (2012) recommends that uncertainty around these need to be reflected in the outputs, but the model does not provide a mechanism to statistically model the combined effects of uncertainty across a range of input parameters. A recent update to the Band (2012) model by Masden (2015) has included a simulation approach that allows the incorporation of variability and uncertainty in the collision modelling outputs, producing average collision estimates with associated confidence intervals. Natural England considers that being able to quantify the uncertainty and variability around the collision estimates is important therefore we recommend that the Applicant considers using Masden (2015) to calculate the risk of collision for seabirds present in the project area. As this is a newer version of the Band model, Natural England would welcome further discussions with the Applicant regarding the appropriate data and input parameters to use with the collision risk model.	It was agreed with stakeholders that the Masden (2015) update wouldbe used where possible. Where it would not be appropriate to use Masden (2015), the Band (2012) model was to be utilised with both the basic and extended versions presented. However, it has recently come to light through advice from Natural England (EWG 29th March 2017) that further evaluation of the Masden (2015) variant of the collision risk model is required. As a result, Masden (2015) has not been used to calculate collision risk estimates for the PEI stage of Hornsea Three. Pending this review and any subsequent modification, the use of Masden (2015) will be considered as part of the final EIA for Hornsea Three. See paragraph 5.6.6.2.
10 March 2016	Offshore ornithology Expert Working Group (EWG) meeting	Introduction to the Evidence Plan: Aims, principles and approach. Identification of key issues and discussion around baseline data collection requirements and methodology.	The following agreements were made: • Agreement on the scope of the Ornithology EWG. • Inception of the meta-analysis of existing former Hornsea Zone data (paragraph 5.6.4.6 *et seq.*). • Agreement that aerial surveys would be the preferred survey methodology (paragraph 5.6.4.1).
13 April 2016	Offshore ornithology Expert Working Group (EWG) meeting	Discussion around the aerial survey methodology and meta-analysis scope of works	Agreement to updates within the meta-analysis scope of works (see paragraphs 5.6.4.6 *et seq.*) and the proposed aerial survey methodology (paragraph 5.6.4.1).
27 July 2016	Offshore ornithology Expert Working Group (EWG) meeting	Introduction to the export cable scoping corridor and potential landfall locations.	Agreement that no further intertidal surveys are required and the intertidal assessment will be incorporated into the offshore ornithology and onshore ecology as required. Agreement on the designated conservation sites, the potential impacts, and key assessment issues relevant to the Hornsea Three offshore cable corridor see section 5.5.
21 November 2016	Offshore ornithology Expert Working Group (EWG) meeting	Discussion around the Scoping Report and HRA Screening Report, and further discussions over Hornsea Three offshore cable corridor boundary and aerial surveys.	Agreement that 18 months of survey data would be included within the assessment, including two breeding seasons. Further detail is provided in the minutes of the EWG as appended to the Draft Evidence Plan (DONG Energy 2017). Data only up to February 2017 has been included within PEIR, see section 5.5. Agreement on the apportioning approach for gannet and fulmar, while puffin and kittiwake remained under discussion.

Date	Consultee and type of response	Issues raised	Response to issue raised and/or where considered in this chapter
29 March 2017	Offshore ornithology Expert Working Group (EWG) meeting	Discussion around EIA Scoping responses, HRA Screening response, baseline data collection and key assessment methodologies.	Agreement on impacts to be included within the assessment as outlined in section 5.8. Agreement on use of Masden (2015) within the collision risk modelling where applicable, see paragraph 5.6.6.2. Agreement that 18 months of aerial surveys will be completed, covering two breeding seasons, with the meta-analysis providing additional information for the characterisation of the non-breeding season. Agreement on approach to defining BDMPS, see section 1.2.5 of annex 5.1: Baseline Characterisation Report. Agreement as to the approach used to establish connectivity between an SPA breeding colony and Hornsea Three array area for fulmar and gannet , see annex 5.1: Baseline Characterisation Report.. Agreement on approach to assessing operational displacement and mortality rates following SNCB guidance, see paragraph 5.6.5.3 *et seq.*. Agreement that a range of avoidance rates will be presented, see paragraph 5.6.6.11 *et seq.*. Agreement on a tier approach to the cumulative assessment, as outlined in paragraph 5.12.1.2 *et seq.*.

5.6 Methodology to inform the baseline

5.6.1 Evidence-based Approach

5.6.1.1 Advice in relation to Hornsea Three specifically has been sought through consultation with the statutory consultees through the Evidence Plan process. The Evidence Plan process has been set out in Evidence Plan (DONG Energy 2017), the purpose of which is to agree the information Hornsea Three needs to supply to the PINS, as part of a DCO application for Hornsea Three. This includes agreeing as to the methodology to inform the baseline. The Evidence Plan seeks to ensure compliance with the EIA and Habitat Regulations Assessment (HRA).

5.6.1.2 As part of the Evidence Plan process, an Offshore Ornithology EWG was established with representatives from the key regulatory bodies, statutory nature conservation bodies (SNCBs) and non-statutory parties, including the MMO, Natural England and The Royal Society for the Protection of Birds (RSPB). A number of meetings have been held in order to discuss and agree key elements of the offshore ornithology EIA. Meetings with key stakeholders commenced in March 2016 and have continued throughout 2016 and into 2017.

5.6.1.3 The approach proposed by Hornsea Three for the purposes of characterising the offshore ornithology within the four offshore ornithology study areas defined in paragraph 5.3.1.1 was an evidence based approach to the EIA, which includes utilising existing data and information from sufficiently similar or analogous studies to inform the baseline understanding and/or impact assessments for a new proposed development. The Hornsea Three array area is located within the former Hornsea Zone, for which extensive data and knowledge regarding offshore ornithology is already available. This data/knowledge has been acquired through zonal studies and from the surveys and characterisations undertaken for Hornsea Project One and Hornsea Project Two. The suitability of existing ornithological data from across the former Hornsea zone to inform the EIA, specifically regarding the array site, is being examined by means of a meta-analysis and to be reviewed by the EWG (further detailed in a section below).

5.6.1.4 The baseline characterisation of the Hornsea Three offshore ornithology study area within this PEIR has also drawn upon the site-specific surveys that have also been undertaken (further detailed in a section below). The survey methodologies have been discussed with the Expert Working Group (EWG) through the Evidence Plan process and supplemented by existing data, have been agreed as appropriate to enable the characterisation of the baseline environment. The EWG have agreed that monthly aerial surveys from April 2016 – September 2017, considering the timescales of the Project, is the most appropriate approach to providing enough site specific data to characterise the baseline environment.

5.6.1.5 The Hornsea Three offshore cable corridor is unique to Hornsea Three. As such, the existing data and knowledge of the baseline environment along the Hornsea Three offshore cable corridor for Hornsea Project One and Hornsea Project Two is relevant only in part to the Hornsea Three offshore cable corridor and the evidence-based approach described above cannot be applied. Therefore the baseline characterisation of the Hornsea Three offshore cable corridor within this PEIR has primarily drawn upon the desktop information from third-party surveys, including surveys targeting areas within and in close proximity to areas designated for nature conservation, and primarily Lawson *et al.* (2015). An initial desk based appraisal and site walkover in July 2016 at the Hornsea Three landfall area established the Hornsea Three offshore cable corridor landfall being of minimal importance for intertidal birds (DONG Energy 2016). The EWG have agreed that no further intertidal surveys are required and the intertidal assessment will be incorporated into the offshore ornithology and onshore ecology as required.

5.6.2 Desktop study

5.6.2.1 A literature review was undertaken to provide information on the ornithological interest of the former Hornsea Zone and its importance in a regional, national and international context. This review included general seabird ecology, migration behaviour, population sizes and conservation status, particularly on the east coast of Britain, the southern North Sea, and Britain as a whole. Information sources used are summarised in Table 5.4.

5.6.3 Designated sites

5.6.3.1 All designated sites that could be affected by the construction, operation and maintenance, and decommissioning of Hornsea Three for offshore ornithology, were identified using the three step process described below:

- Step 1: All designated sites of international, national and local importance were identified using a number of sources;
- Step 2: Information was compiled on the relevant qualifying features for each of these sites including foraging range and non-breeding season distribution; and
- Step 3: Using the above information and expert judgement, sites were included for further consideration if e.g. the site would be directly affected by Hornsea Three. In this instance, 'Direct' means where the Hornsea Three array area or Hornsea Three offshore cable corridor is within or passes through the boundary of a designated site. Note that both direct and indirect effects have been considered in the assessment as and where appropriate.

Table 5.4: Summary of key desktop reports.

Title	Source	Year	Author
A review of assessment methodologies for offshore wind farms	British Trust for Ornithology	2009	Maclean *et al,*
British Trust for Ornithology (BTO) online profiles of birds occurring in Britain and Ireland, BirdFacts	British Trust for Ornithology	2016	Robinson
Seabird foraging ranges as a preliminary tool for identifying candidate Marine Protected Areas	British Trust for Ornithology	2012	Thaxter *et al.*
Data from aerial surveys carried out between 2004 and 2008 collated in reports produced by the Department of Energy and Climate Change (DECC, formerly BERR) and the Department for Trade and Industry (DTI)	DTI, 2006; BERR, 2007; DECC, 2009b	Multiple	-
Atlas of seabird distribution in northwest European waters	JNCC	1995	Stone *et al.*
JNCC Online SPA standard data forms for Natura 2000 sites	http://jncc.defra.gov.uk/page-1400	Multiple	
Biologically appropriate, species-specific, geographically non-breeding season population estimates for seabirds	Natural England	2015	Furness
An analysis of the numbers and distribution of seabirds within the British Fishery Limit aimed at identifying areas that qualify as possible marine SPAs	JNCC	2010	Kober *et al.*
The Migration Atlas	British Trust for Ornithology	2002	Wernham *et al.*
Population estimates of birds in Great Britain and the UK	British Birds journal	2013	Musgrove *et al.*
Wetland Bird Survey (WeBS) Annual Reports and Report Online interface	Wetland Bird Survey partnership	Multiple	Multiple
Assessing the risk of offshore wind farm development to migratory birds designated as features of UK SPAs	Strategic Ornithological Support Services	2012	Wright *et al.*
Existing offshore wind farm Environmental Statements and Monitoring Reports	Multiple	Multiple	Multiple
Survey data relating to the former Hornsea Zone, including Hornsea Project One and Hornsea Project Two boat based surveys	Smart Wind	2010-2013	
Reports, guidance and advice notes	Scoping Response from Natural England	Multiple	Multiple

5.6.3.2 There may be the potential for impacts on ornithological features of sites located further afield, where qualifying features of these sites forage and/or migrate through the Hornsea Three array area and/or Hornsea Three offshore cable corridor. These features include:

- Breeding birds;
- Migratory seabirds; and
- Waterbirds (waders and wildfowl).

5.6.3.3 During the breeding season foraging birds may travel some distance from their breeding colonies. The information available on the distances that breeding birds will forage depends on the species. Thaxter *et al.* (2012) provide data on recorded foraging ranges for a wide range of species, including the mean and maximum distances travelled. Typically the mean-maximum range (i.e. the mean average of the maximum foraging trips recorded and therefore a precautionary approach) has been used as a criterion for establishing whether there is likely to be connectivity (and hence risk of an impact) between an SPA breeding colony and a proposed wind farm array area. In some cases more specific information is available from GPS/satellite tracking studies, such as, for example, the FAME/STAR initiatives for kittiwake and gannet colonies associated with the Flamborough and Filey Coast (FFC) pSPA.

5.6.3.4 For the identification of SPAs relevant to Hornsea Three, mean-maximum foraging ranges as reported by Thaxter *et al.* (2012) have been used to determine potential connectivity with Hornsea Three, unless specific relevant tracking data are available (where the latter is deemed to have priority).

5.6.3.5 During the non-breeding period, birds from colonies further afield may also be present within Hornsea Three, although there is uncertainty regarding how many individuals from each of the colonies will be affected by Hornsea Three. Details of how potential impacts are apportioned across colonies from within the region are given in the supporting documents associated with the Report to Inform the Habitats Regulations Assessment for Hornsea Three.

5.6.4 Site specific surveys

Site-specific aerial surveys

5.6.4.1 For Hornsea Three, digital aerial surveys have also been undertaken monthly since April 2016. These aerial surveys covered the Hornsea Three offshore ornithology study area. A strip-transect method was employed with transects arranged approximately perpendicular to depth contours and 2.5 km apart. Further information on the aerial digital survey methodology and how data are processed are described in Sections 1.2.1 and 1.2.2 of Annex 5.1: Baseline Characterisation Report, respectively. The aerial survey programme for Hornsea Three is not yet complete with only data from April 2016 to February 2017 currently incorporated into the assessments in this PEI chapter.

5.6.4.2 Data collected during aerial surveys were analysed by trained reviewers. The abundance of each species observed during surveys was estimated separately using a design-based strip transect analysis with variance and confidence intervals ("CI") derived using a bootstrapping methodology. A more detailed explanation of the data processing approach and calculation of abundance metrics is provided in Section 1.2.3 of Annex 5.1: Baseline Characterisation Report.

5.6.4.3 It was agreed through the offshore ornithology EWG that surveys of the Hornsea Three offshore cable corridor are not required (draft RIAA, Annex 2).

Former Hornsea Zone Boat-based surveys

5.6.4.4 A series of monthly boat-based surveys of seabirds across the former Hornsea Zone commenced in March 2010 and were completed in February 2013, encompassing three breeding, migratory and winter periods.

5.6.4.5 JNCC was consulted in January 2010, on the proposed survey methodology for ornithology surveys across the former Hornsea Zone. This methodology was formally approved, as part of the PINS planning process, in the Scoping Opinions for Hornsea Project One (IPC, 2010) and Hornsea Project Two (The Planning Inspectorate, 2012). Full details of these surveys and the methodology employed are included in the Hornsea Project Two Ornithology Technical Report Part 1, Section 2 (see PINS Document Reference 7.5.5.1 available from https://infrastructure.planninginspectorate.gov.uk).

Meta-analysis of baseline ornithological data sets

5.6.4.6 As part of the preparation of data for use in an Environmental Impact Assessment ("EIA") for Hornsea Three, a detailed analysis of the boat-based and digital aerial data has been conducted in order to understand the inherent variability in the boat-based survey data and how this affects the compatibility of these historical boat-based data with digital aerial data.

5.6.4.7 This analysis will attempt seeks to produce the following outputs:

- Calculate seasonal density estimates for the Hornsea Three area (plus relevant buffers) for key species and seasons;
- Identify the seasonal and annual variability in population density for key species for each analysis area;
- Investigate suitable co-variates (such as sea temperature, bathymetry, distance from shore, chlorophyll a) that might explain observed variability in densities and flight heights; and
- Undertake detailed analysis including statistical analysis and, where possible, predictive modelling.

5.6.4.8 The production of these outputs should allow for the following analyses to be conducted which in turn will inform discussions in relation to Hornsea Three:

- Identify the extent of boat-based ornithological records across the Hornsea Three area;
- Characterise uncertainty in population estimates and density distribution;
- Compare population estimates for 10 key species for Hornsea Three with those derived for the Hornsea Project One and Hornsea Project Two sites;
- Analyse the variability in patterns of observed flight heights across the former Hornsea Zone by season and year;
- Compare results of the boat-based and aerial surveys;
- Discuss implications of the above for collision risk modelling and displacement analysis; and
- Reference other potential sources of information for the population estimates and density distributions.

5.6.4.9 The results of the meta-analysis are not yet available for incorporation into the Hornsea Three PEI however, it is expected that these will be presented to and discussed with the Expert Working Group (EWG) and will be incorporated into the final application.

5.6.5 Displacement analysis

5.6.5.1 The presence of wind turbines has the potential to directly disturb and displace birds from within and around Hornsea Three. This indirect habitat loss would reduce the area available for feeding, loafing and moulting for seabird species that may occur at Hornsea Three.

5.6.5.2 Seabird species vary in their reactions to the presence of operational infrastructure (e.g. wind turbines, substations and met mast) and to the maintenance activities that are associated with it (particularly ship and helicopter traffic). Wade *et al.* (2016) present a scoring system for such disturbance factors, which is used widely in offshore wind farm EIAs.

5.6.5.3 Annex 5.2: Analysis of displacement impacts on seabirds presents information to inform the assessments presented in this chapter relating to the significance of displacement impacts. These analyses have been informed by recent guidance published jointly by the UK Statutory Nature Conservation Bodies (SNCBs) (JNCC *et al.*, 2017).

5.6.5.4 The following species were identified for inclusion in the displacement assessment:

- Fulmar;
- Gannet;
- Guillemot;
- Razorbill; and
- Puffin.

5.6.5.5 The full process applied to identify species that may be impacted by displacement effects is documented in the Baseline Characterisation Report (Annex 5.1: Offshore Ornithology Baseline Characterisation Report).

5.6.5.6 It is recognised that for many species, limited information is available to predict the magnitude of displacement or, should it occur, its resultant effects on populations. For most species there has been little evidence of total or near-total displacement from constructed offshore wind farms (e.g. Krijgsveld *et al.*, 2011). For some species, such as auks, the reported levels of displacement have been variable.

5.6.5.7 Following recently published joint SNCB interim guidance JNCC *et al.* (2017), displacement impacts for each relevant species are presented using a wide range of potential displacement and mortality rates. These have been presented as separate matrix tables, one for each of the seasons being assessed as applicable (e.g. 'breeding', 'post-breeding', 'non-breeding' and 'pre-breeding') in Annex 5.2: Analysis of displacement impacts on seabirds. The matrices and assessments presented in this chapter take into consideration three species-specific factors: (i) intensity of displacement within a given area (i.e. what proportion of the population is displaced); (ii) spatial extent – to what distance from turbines any individuals within the population will be displaced; and (iii) seasonality – what magnitude of impact there will be within a population (taken as percentage mortality), based on the species' particular sensitivity during a particular stage in the life cycle.

5.6.5.8 The predicted intensity of displacement for each species is based on available published evidence (e.g. Krijgsveld *et al.*, 2011; Vanermen *et al.*, 2013) and published reviews of species vulnerability to the effect (e.g. Wade *et al.* 2016).

5.6.5.9 Although concentrating on birds in flight, the study of the operational Egmond aan Zee wind farm by Krijgsveld *et al.* (2011) represents one of the most in-depth studies to date on determining the effect of the presence of operational turbines on birds. Based on radar and panorama scans, macro-avoidance rates (i.e. birds avoiding the wind farm as a whole) were assessed for the majority of species groups present, and this behaviour is likely to be indicative of displacement risks. Gulls were the main species present, and although in the cases of auks and divers too few observations were available to obtain a reliable macro-avoidance rate, from flight paths it was evident that their avoidance behaviour was similar to that of gannets and scoters, rather than that of gulls.

5.6.5.10 Construction period records from the Lincs offshore wind farm showed that at least 769 birds (198 observations) including large gulls, kittiwake and terns used turbine bases and monopiles to rest on. On several occasions gulls were clearly associated with the jack-up barge, the guard vessels and with the Resolution construction vessel while piling was in progress (RPS, 2012). Similarly, Vanermen *et al.* (2013) in their study of Belgian offshore wind farms, birds (mainly gulls) were attracted to physical structures e.g. turbines, as roost locations and did not show any signs of displacement. Construction disturbance to these species is therefore considered likely to be minimal.

5.6.5.11 Based on evidence in the literature such as that in the preceding discussion (e.g. Krijgsveld *et al.*, 2011; RPS, 2012; Vanermen *et al.*, 2013), it is considered that the species with low vulnerability to disturbance/ displacement impacts or with a relatively low macro avoidance rate (skuas, gulls and terns) can be screened out of further assessment from all phases of the project.

5.6.5.12 For those species selected for displacement analysis, although a range of values are presented within each matrix table (0-100%); a single level of displacement is selected within the table to take forward for the purposes of assessment. This level is species-specific and considered suitably conservative and representative of available evidence where available.

5.6.5.13 With regards to those species screened into this assessment, Krijgsveld et al . (2011) identifies fulmar as a lower sensitivity species with a displacement rate of 28%, and gannet and auks as higher sensitivity species with displacement rates of 64% and 68% respectively. For razorbill further information on displacement is presented in Walls *et al* . (2013) which presents information from monitoring at Robin Rigg Offshore Wind Farm. This suggests a displacement rate of 30% for auk species and on a precautionary basis, incorporating the information from Krijgsveld *et al* . (2011) and Walls *et al* . (2013), 40% is used for the assessment of displacement for razorbill at Hornsea Three (Table 5.5). For fulmar and gannet, precautionary displacement rates of 30% and 70% are used, respectively (Table 5.5). Cook *et al.* (2014) provides additional evidence for gannet displacement rates stating a macro-avoidance of 64%.

5.6.5.14 In addition to the proportion of birds displaced within a particular area, a second aspect to consider is the spatial distribution of birds. JNCC *et al.* (2017) interim guidance recommends that for the species of highest sensitivity (divers and sea ducks), the site plus 4 km buffer should be used when assessing displacement, whereas a 2 km buffer should be used for all other species. In both cases JNCC *et al.* (2017) recommended that no gradient of impact of displacement level should be applied to the buffer zone, as there is not sufficient evidence to underpin any such gradient application on a species-by-species basis. This is a precautionary approach that doesn't represent the reality of some degree of gradient with respect to how close individual birds will approach a source of disturbance influenced by e.g. past exposure to the event (habituation), need to feed chicks and ability to forage as successfully elsewhere.

5.6.5.15 Buffers taken forward to impact assessment for Hornsea Three are the wind farm plus a 2 km buffer for all species, with no gradient of impact of displacement level applied to the buffer zone. Species deemed particularly sensitive to displacement, such as divers and seaduck did not qualify as Valued Ornithological Receptors (VORs) in this assessment for Hornsea Three array area on being absent (e.g. common scoter) or recorded in very small numbers (e.g. red-throated diver) by site-specific aerial surveys (Annex 5.1: Baseline Characterisation Report). Where red-throated diver and common scoter did qualify as Valued Ornithological Receptors (VORs) in this assessment for Hornsea Three, namely the Hornsea Three Export Cable Route, Hornsea Three offshore cable corridor is still considered to be an equally valid approach to apply when considering disturbance / displacement due to low densities of birds and nature of the potential impacts.

5.6.5.16 In order to assess the displacement effect, the seasonal mean peak population of birds recorded within Hornsea Three offshore cable corridor is considered sufficiently precautionary for the realistic worst-case in line with guidance (JNCC *et al.*, 2017).

5.6.5.17 The potential impact of displacement will vary depending on the season. Breeding seabirds are 'central place foragers', with the need to optimise their time spent away from the nest and energy expended in foraging. The range at which they can forage away from the nest site becomes constrained by distance from their nesting site, unlike birds that are not actively breeding, irrespective of season, that can forage more widely. Consequently, any displacement during the breeding season of breeding adults from foraging areas is predicted to have a greater magnitude of impact than at other times as birds may struggle to meet their energy requirements.

5.6.5.18 There are no directly applicable studies of the effects of displacement on mortality of seabirds. It is however reasonable to consider as overly precautionary, the assumption of 100% of displaced birds will die. It follows that the density of birds within areas to which birds are displaced will increase as a result of the relocation of the displaced birds to where others may already be occupying. There is the possibility that there will be additional mortality experienced by these birds due to increased resource competition and that this "additional mortality" will be a function of density, i.e. the mortality rate increases as density increases.

5.6.5.19 There is little or no evidence on what the extent of the impact magnitude may be, although a typical ceiling of 10% is often applied by advisers. Based on expert judgement on the sensitivity of each receptor, for the purposes of the assessment precautionary mortality rates of between 2 and 10% are applied in the breeding season to displaced species taken forward to impact assessment (Table 5.5) These rates are comparable to those previously used in offshore wind farms e.g. Hornsea Project Two. The mortality rate varies between species, with actual assigned values dependent on that species' known behaviour (e.g. habitat and foraging flexibility). These rates are considered suitably precautionary for EIA requirements, although the matrices presented show rates of up to 100% for both displacement and mortality as recommended in interim guidance JNCC *et al.*, 2017).

5.6.5.20 During the 'non-breeding' periods (i.e. defined here as all seasons outside of breeding), seabirds are generally less constrained to restricted foraging ranges, with those what where breeding adults, free from providing food for young or breeding partners, and are more capable of relocating to other areas. The vast majority of individuals are therefore highly likely to find alternative foraging habitat if displaced. However, for the purposes of this assessment it is considered that in the non-breeding season, significantly lower proportion of birds will be exposed to sufficient stress to suffer mortality individuals are not constrained by central place foraging from a colony and have a greater degree of flexibility in utilising different resources. Therefore a mortality rate of 1% of displaced birds has been adopted and is considered suitably precautionary (Table 5.5).

5.6.5.21 'Post-breeding' seabirds leave their colonies and disperse. For most species this period is little or no different from the 'non-breeding' period. However, razorbill, for example, leaving their colonies accompanied by chicks are constrained to some extent, by both the adults and young being flightless and therefore unable to travel large distances rapidly in search for food. Displaced birds away from suitable foraging areas may be at higher risk of increased mortality than birds during the 'non-breeding period'. Other post-breeding seabirds can, however, move further afield than breeding adults and therefore the potential effects from displacement are expected to be lower. Furthermore, the possible impacts from displacement are more transitory as the majority of birds are dispersing through the area. For the purposes of the assessment a 2% mortality rate for auks displaced in the post-breeding period is applied (Table 5.5), which reflects the lower restrictions than during the breeding season, but the slightly increased potential for mortality on razorbill due to the ongoing care required for young, as well as any stress incurred during the moult period when foraging range is more limited.

Table 5.5: Assessment criteria for displacement effects for the area Hornsea Three array area plus a 2 km buffer

Species	Season of relevance	Months	Displacement rate (%)	Mortality rate (%)
Fulmar	Breeding	Apr – Aug	30	2
	Post-breeding	Sep-Oct	30	1
	Non-breeding	Dec	30	1
	Pre-breeding	Jan – Mar	30	1
Gannet	Breeding	Apr – Aug	70	2
	Post-breeding	Sep – Nov	70	1
	Pre-breeding	Dec- Mar	70	1
Puffin	Breeding	Apr – Jul	40	10
	Non-breeding	Aug – Mar	40	1
Razorbill	Breeding	Apr – Jul	40	10
	Post-breeding	Sep – Oct	40	2
	Non-breeding	Nov – Dec	40	1
	Pre-breeding	Jan – Mar	40	2
Guillemot	Breeding	Mar – Jul	30	10
	Non-breeding	Aug – Feb	30	1

5.6.6 Collision Risk Modelling

5.6.6.1 Collision Risk Modelling (CRM) was undertaken to quantify the potential risk of additional mortality through collisions with operational turbines above the current baseline for each species. The most frequently used collision risk model in the UK is commonly referred to as 'the Band model'. This model was originally devised in 1995 and has since been subject to a number of iterations, most recently to facilitate application in the offshore environment (Band, 2011) and to allow for the use of flight height distribution data and to include a methodology for considering birds on migration (Band, 2012).

5.6.6.2 Masden (2015) presents an update to the Band (2012) which further develops the application of the Band model using a simulation modelling approach to incorporate variability and uncertainty. The update provides for an improved understanding of uncertainty by randomly sampling parameter values from distributions for each parameter, deriving average collision risk estimates with associated measures of variability. However, it has recently come to light through advice from Natural England that further evaluation of the Masden (2015) variant of the collision risk model is required. As a result, Masden (2015) has not been used to calculate collision risk estimates for the PEI stage of Hornsea Three. Pending this review and any subsequent modification, the use of Masden (2015) will be considered as part of the final EIA for Hornsea Three.

5.6.6.3 The Band (2012) model incorporates two approaches to calculating the risk of collision referred to as the 'Basic' and 'Extended' versions of the model. A key difference between these versions is the extent to which they account for the flight height patterns of seabirds (Band 2012). The distribution of seabird flights across the sea is generally skewed towards lower altitudes. As stated by Band (2012) there are three consequences of a skewed flight height distribution:

- "the proportion of birds flying at risk height decreases as the height of the rotor is increased;
- more birds miss the rotor, where flights lie close to the bottom of the circle presented by the rotor; and
- the collision risk, for birds passing through the lower parts of a rotor, is less than the average collision risk for the whole rotor."

5.6.6.4 The Basic model assumes a uniform distribution of flights across the rotor with a consistent risk of collision across the whole rotor swept area. The Extended model of Band (2012) takes into account the distribution of birds in addition to the differential risk across the rotor swept area. It should be noted that the use of the basic model is precautionary as it does not take into account the variability in risk of collision that occurs across a rotor swept area, with the risk of collision decreasing as the distance from the hub of the turbine increases. If this were to be taken into account (as when using Option 3) it is likely that collision risk estimates would be lower as the vertical distribution of birds flying across water is skewed towards lower heights (i.e. those associated with a lower risk of collision within a rotor swept area).

5.6.6.5 The aerial survey programme for Hornsea Three is not yet complete with only data from April 2016 to February 2017 currently incorporated into the collision risk modelling supporting the assessments in this PEI chapter. As such, the baseline characterisation for the site is only partially complete serving as an interim measure to inform the PEI and will be updated for the final Environmental Statement chapter following the completion of aerial surveys at Hornsea Three. For the purposes of this preliminary assessment, it is considered that model predictions provide an approximate indication of the likely risk. The use of an incomplete data set has implications for the calculation of the proportion of birds at rotor height at Hornsea Three not least a limited flight height dataset. Therefore at this stage only Options 2 and 3 of the Band (2012) CRM, which use generic flight height information (from Johnston *et al.*, 2014) have been used to calculate collision risk estimates.

5.6.6.6 Collision risk modelling is undertaken for three species groups that occur at Hornsea Three:

- Regularly occurring seabirds;
- Migratory seabirds; and
- Migratory waterbirds.

5.6.6.7 A brief description of the methodology applied for each of these groups is provided in the following sections with full methodologies provided in Annex 5.3: Collision Risk Modelling.

5.6.6.8 The maximum design scenario for collision risk in this modelling process is taken to be the development scenario comprising the maximum number of turbines - 342 with parameters as defined in volume 1, chapter 3: Project Description. The parameters for this scenario are presented in Annex 5.3: Collision Risk Modelling. The collision risk modelling assumed a wind turbine hub-height of 127.47 m (above LAT) will be used at Hornsea Three. This provides for a lower tip height clearance of 34.97 m LAT reducing the potential collision risk impacts on birds. The lower tip height clearance is consistent with the consented value at Hornsea Project Two.

Regularly occurring seabirds

5.6.6.9 Collision risk modelling was conducted for four regularly occurring seabird species at Hornsea Three with these species selected using the criteria applied in Annex 5.1 Baseline Characterisation Report:

- Gannet;
- Kittiwake;
- Lesser black-backed gull; and
- Great black-backed gull.

5.6.6.10 Collision risk modelling for these species has been conducted using both the Band (2012) CRM and the updated Masden (2015) CRM, as agreed with the Expert Working Group (EWG). Bird biometric parameters and densities from Hornsea Three for each of these species is presented in Annex 5.3: Collision Risk Modelling.

5.6.6.11 The avoidance rates applied for each species are also presented in Annex 5.3: Collision Risk Modelling. The rates applied are taken from Cook *et al.* (2014) which presents avoidance rates for all four species included in the modelling for Hornsea Three. Cook *et al.* (2014) recommended avoidance rates for use with the Basic model for all four species and with the Extended model for lesser black-backed gull and great black-backed gull. Cook *et al.* (2014) were unable to recommend an avoidance rate for use in the Extended model for gannet and kittiwake and as such a default 98% avoidance rate is applied in the modelling conducted for Hornsea Three.

5.6.6.12 In a joint response, UK SNCBs supported the recommended avoidance rates of Cook *et al.* (2014) with the exception of kittiwake (JNCC *et al.*, 2014). The SNCBs did not agree with the application of avoidance rates calculated for the 'small gull' category used in Cook *et al.* (2014) to kittiwake and recommended that the avoidance rate calculated for the 'all gull' category should be applied instead. Collision risk modelling for Hornsea Three is therefore conducted using the avoidance rates presented in Table 5.6 taking into account the recommendations in Cook *et al.* (2014) and JNCC *et al.* (2014).

Table 5.6: Avoidance rates applied in collision risk modelling for regularly occurring seabirds at Hornsea Three

Band (2012) model	Gannet	Kittiwake	Lesser black-backed gull	Great black-backed gull
Basic	98.9 (±0.2)	98.9 (±0.2) 99.2 (±0.2)	99.5 (±0.1)	99.5 (±0.1)
Extended	98.0	98.0	98.9 (±0.2)	98.9 (±0.2)

5.6.6.13 Outputs from the collision risk modelling undertaken for the four regularly occurring seabird species are presented in Annex 5.3: Collision Risk Modelling.

5.6.6.14 Ongoing research is currently investigating the avoidance behaviour of seabirds at offshore wind farms (the Offshore Renewables Joint Industry Programme), with any information that becomes available during the programme for Hornsea Three to be incorporated into the generic empirical evidence base for avoidance rates, if considered appropriate.

Migratory seabirds

5.6.6.15 Collision risk modelling has been conducted for five migratory seabird species with potential connectivity with Hornsea Three with these species selected by applying the criteria in Annex 5.1: Baseline Characterisation Report:

- Arctic skua;
- Great skua;
- Little gull;
- Common tern; and
- Arctic tern.

5.6.6.16 Unlike the modelling approach used for collision risk modelling for regularly occurring seabird species at Hornsea Three, density data collected during site-specific surveys is deemed to be unsuitable to estimate the impact of collision for migratory seabird species. This is due to the snapshot nature of site-specific surveys and consequential limitations in recording sporadic movements of migratory species. Therefore the collision risk modelling approach used for migratory seabirds incorporates species-specific information relating to population estimates and migratory behaviour. A generic 'migratory front' is then defined which is then used to calculate the number of birds that have the potential to interact with Hornsea Three during spring and autumn migration. A detailed methodology is provided in Appendix C of Annex 5.3: Collision Risk Modelling alongside the calculation of interacting populations and the peak migratory months used for modelling.

5.6.6.17 Collision risk modelling for migratory seabirds has been undertaken using the Band (2012) CRM. As the modelling approach used for migratory seabird species uses population estimates, the update to the Band (2012) CRM presented by Masden (2015), which requires density data, cannot be used.

5.6.6.18 Bird biometric parameters for each of the species selected for modelling is presented in Appendix C of Annex 5.3: Collision Risk Modelling. With the exception of little gull, there is limited published evidence relating to avoidance rates to be applied for migratory species as such for Arctic skua, great skua, common tern and Arctic tern, collision risk estimates calculated using a 98% avoidance rate are used in the assessment of LSE.

5.6.6.19 Cook *et al.* (2014) derived avoidance rates for small gull spp. and gull spp., two groups which included data relating to the avoidance behaviour of little gull. Avoidance rates of 99.2% and 98.9% were derived for the small gull spp. and gull spp. respectively. As such, avoidance rates of 98%, 98.9%, 99.2% and 99.5% will be used in the collision risk modelling for little gull, with a 99.2% avoidance rate considered to be the most relevant for assessment purposes as a small gull spp, and subset of gull spp..

5.6.6.20 The results of the collision risk modelling conducted for migratory seabird species are presented in Appendix C of Annex 5.3: Collision Risk Modelling.

Migratory waterbirds

5.6.6.21 Migratory waterbirds move across offshore areas in large numbers predominantly over short temporal periods. These movements are poorly recorded by traditional boat-based or aerial surveys used to define the baseline environment for Environmental Impact Assessments of offshore wind farms. As such, the modelling approach described by Wright *et al.* (2012), is used to inform the assessment of collision risk at Hornsea Three on migratory waterbirds. This approach uses the Strategic Ornithological Support Services (SOSS) Migration Assessment Tool (MAT). A full description of the methodology applied is provided in Appendix D of Annex 5.3: Collision Risk Modelling.

5.6.6.22 Twelve species were selected based on a relatively high proportion of birds occurring at locations (e.g. SPAs) close to Hornsea Three:

- Bewick's swan;
- Taiga bean goose;
- Dark-bellied brent goose;
- Shelduck;
- Wigeon;
- Golden plover;
- Grey plover;
- Lapwing;
- Knot;
- Dunlin;
- Black-tailed godwit; and
- Bar-tailed godwit.

5.6.6.23 This list is consistent with the suite of species incorporated into similar modelling undertaken for other offshore wind farms in the vicinity of Hornsea Three (i.e. Hornsea Project One and Hornsea Project Two) and has been agreed with stakeholders as part of the Evidence Plan process for Hornsea Three.

5.6.6.24 Collision risk modelling for migratory seabirds has been undertaken using the Band (2012) CRM. As the modelling approach used for migratory seabird species uses population estimates, the update to the Band (2012) CRM presented by Masden (2015), which requires density data, cannot be used. The Band (2012) CRM includes two models (basic and extended) which both incorporate two 'Options'. Generic flight height distributions, used for Options 2 and 3 of Band (2012) are unavailable for migratory waterbirds and therefore it is not possible to use these model options. Therefore Option 1 is used incorporating the PCH values from Wright *et al.* (2012). Collision risk estimates are calculated using a default avoidance rate of 98%, as recommended by SNH guidance (SNH, 2010), which is applied for all species.

5.6.6.25 The results of the collision risk modelling for migratory waterbirds are presented in Appendix D of Annex 5.3: Collision Risk Modelling.

5.7 Baseline environment

5.7.1 Designated sites

5.7.1.1 Designated sites within close proximity to Hornsea Three and therefore most likely to be potentially affected by activities associated with it, are described here and discussed in full in Annex 5.1: Baseline Characterisation Report.

5.7.1.2 There is only one designated site that potentially directly overlaps with elements of Hornsea Three, the Greater Wash pSPA, which is located within the Hornsea Three offshore cable corridor.

5.7.1.3 In addition, the potential for birds from breeding colonies to interact offshore with Hornsea Three has been identified based on foraging distances from the following sites:

- Flamborough and Filey Coast pSPA;
- Flamborough Head and Bempton Cliffs SPA;
- Farne Islands pSPA;
- Coquet Island pSPA;
- Forth Islands SPA;
- Outer Firth of Forth pSPA and
- Alde-Ore Estuary SPA.

5.7.1.4 The rationale for the identification of these sites and the specific features potentially affected are described in Section 1.5 of Annex 5.1: Baseline Characterisation Report.

5.7.1.5 It was concluded following consultation on the HRA Screening Report and discussion with the Expert Working Group (EWG), that a Likely Significant Effect (LSE) on three of the pSPA/SPAs above (Greater Wash pSPA, Flamborough and Filey Coast pSPA, and Flamborough Head and Bempton Cliffs SPA) could not be ruled out during the screening exercise and these sites have therefore be taken forward to the Draft Report to Inform Appropriate Assessment (RIAA) for Hornsea Three.

5.7.2 Valued Ornithological Receptors

5.7.2.1 The species that are considered to be Valued Ornithological Receptors (VOR) for this assessment are identified below and in Table 5.7.

5.7.2.2 The selection criteria used to identify species for impact assessment are informed by ecological impact assessment guidance (CIEEM, 2010), adapted for an offshore setting.

5.7.2.3 Species were identified as VOR and hence taken forward for impact assessment where they satisfy one or more of the following criteria:

- A qualifying species of a SPA within mean maximum foraging range during the breeding season or where non-trivial connectivity may exist during migration or winter with more distant SPAs;
- A qualifying species of a SPA for which specific information is available from GPS/satellite tracking studies during the breeding season to identify connectivity with Hornsea Three;
- A species appearing on Annex I of the Birds Directive and/or on Schedule 1 to the Wildlife and Countryside Act 1981;
- The UK supports an internationally important population of the species;
- There has been a significant long-term decline in breeding population and/or range within the UK;
- The majority of the UK breeding population is localised in ten or fewer sites;
- The species (migratory) is at particular risk of collisions with turbines; and/or
- There is a population within the Hornsea Three offshore ornithology study area that is sufficiently large as to be considered of international, national or regional importance.

5.7.2.4 Table 5.7 presents a range of population thresholds at various geographical scales. Thresholds for international importance have been sourced from Wetlands International (2017), Mitchell *et al.* (2004) or del Hoyo *et al.* (1996) with national population thresholds derived from Musgrove *et al.* (2013). Regional populations were either calculated based on the population predicted to have connectivity with Hornsea Three using population data from JNCC's Seabird Monitoring Programme (SMP) database or sourced from Furness (2015).

5.7.2.5 Details of the information used to evaluate species against these criteria are included in Annex 5.1: Baseline Characterisation Report.

Species accounts

5.7.2.6 The following species accounts summarise information on the identified VOR recorded within Hornsea Three offshore ornithology study area between April 2016 and February 2017. This includes estimated populations and spatial distribution information including contextual information from the former Hornsea Zone, and a summary of each species' conservation status. Full details for each species are provided in Annex 5.1: Baseline Characterisation Report.

<u>Common scoter</u>

5.7.2.7 Common scoter is listed on Schedule 1 of the Wildlife and Countryside Act (1981, as amended). The species is currently red-listed on the UK Birds of Conservation Concern list (Eaton *et al.*, 2015).

5.7.2.8 An estimated 52 pairs of common scoter breed in the UK, with the majority of pairs found in the north and west of Scotland (Musgrove *et al.*, 2013; Balmer *et al.*, 2013). The wintering population around Britain has been estimated at 100,000 individuals (Musgrove *et al.*, 2013) and the 1% threshold for national importance is 1,000 birds (Musgrove *et al.*, 2011).

5.7.2.9 Common scoter is listed as a qualifying interest species in the non-breeding season for four SPAs and one potential SPA on the UK east coast: Firth of Forth SPA; Firth of Tay and Eden Estuary SPA; Lindisfarne SPA; The Wash SPA; and Greater Wash pSPA. The Greater Wash pSPA supports a discrete population of approximately 3,463 individuals or nearly 3.5% of the British wintering population, making the site the fifth most important site for non-breeding common scoter in the UK.

5.7.2.10 No common scoter were recorded in aerial surveys undertaken across Hornsea Three offshore ornithology study area. The absence of common scoter in offshore areas is also supported by the results presented in Stone *et al.* (1995) with high densities of common scoter in inshore areas.

5.7.2.11 The Hornsea Three export cable route runs through the Greater Wash Area of Search making landfall at Weybourne on the North Norfolk coast, approximately 35 km east of the highest densities of common scoter which are located in the mouth of The Wash. The average density of common scoter within the Hornsea Three offshore cable corridor, derived from Lawson et al, 2015, is significantly less than 0.01 birds/km^2.

5.7.2.12 The population of common scoter recorded at Hornsea Three during aerial surveys did not exceed any 1% threshold. The Hornsea Three export cable passes through the Greater Wash pSPA for which common scoter is a proposed qualifying feature and, hence, this species is considered to be of international conservation value in relation to the proposed export cable only.

<u>Red-throated diver</u>

5.7.2.13 Red-throated diver is listed on Annex I of the EU Birds Directive (2009/147/EEC) and Schedule 1 of the Wildlife and Countryside Act (1981, as amended). The species is currently green-listed on the UK Birds of Conservation Concern list (Eaton *et al.*, 2015).

5.7.2.14 An estimated 1,300 pairs of red-throated diver breed in Britain, with the majority of pairs found in the north and west of Scotland (Musgrove *et al.*, 2013; Balmer *et al.*, 2013). The wintering population around Britain has been estimated at 17,000 individuals (O'Brien *et al.*, 2008) and the 1% threshold for national importance is 170 birds (Musgrove *et al.*, 2011). Several important areas off the east coast of England have recently been identified; in particular, the outer Thames Estuary and the Greater Wash (O'Brien *et al.*, 2008).

5.7.2.15 Red-throated diver is listed as a qualifying interest species in the non-breeding season for two SPAs and one potential SPA on the UK east coast: the Outer Thames Estuary SPA; Firth of Forth SPA; and Greater Wash pSPA. The Outer Thames Estuary SPA regularly supports wintering red-throated diver in numbers of European importance (6,466 individuals – wintering 1989–2006/07) (Natural England/JNCC, 2010), which is around 38% of the British wintering population.

5.7.2.16 The Greater Wash pSPA regularly supports 1,511 red-throated diver, or nearly 9% of the British wintering population, making this the second most important area for red-throated diver around the coast of the UK after the Outer Thames Estuary (Natural England, 2016). Higher densities of birds within the Greater Wash pSPA occur close inshore, particularly in the area outside The Wash SPA, north of the Humber Estuary and along the eastern part of North Norfolk Coast (Lawson et al, 2015).

5.7.2.17 Red-throated diver is also included as a potential qualifying feature of a number of Scottish pSPAs in the non-breeding season.

5.7.2.18 Available evidence from ringing studies suggests that red-throated divers may move considerable distances from their breeding grounds in the non-breeding season. Birds ringed in Greenland and Scandinavia have also been recovered in the UK, indicating that not all birds recorded in the former Hornsea Zone may breed in the UK (Wernham *et al.*, 2002).

5.7.2.19 Red-throated diver were recorded in only one of the eleven surveys undertaken between April 2016 and February 2017. A total of six birds were recorded during May 2016 translating to a population estimate of 66 birds. Although this population occurred during the breeding season for red-throated diver these birds are not considered to be breeding birds. There is considered to be no connectivity between Hornsea Three and red-throated diver breeding areas with the closest breeding areas to Hornsea Three in northern Scotland (Cramp & Perrins 1997 – 1994; Forrester *et al.* 2007; Thaxter *et al.* 2012; Wernham *et al.,* 2002;). Birds recorded at Hornsea Three during the defined breeding season for red-throated diver are therefore considered to be non-breeding birds or birds on passage. A population of 66 birds does not surpass the 1% regional threshold of the population of red-throated diver that occurs in the south-west North Sea during migration (133 individuals).

5.7.2.20 The population of red-throated diver recorded at Hornsea Three during aerial surveys did not exceed the 1% threshold of the regional migratory BDMPS population of red-throated diver in the south-west North Sea. Therefore it is considered unlikely that significant impacts will occur on red-throated diver at the array area of Hornsea Three. However, the Hornsea Three export cable passes through the Greater Wash pSPA for which red-throated diver is a proposed qualifying feature and, hence, this species is considered to be of international conservation value in relation to the proposed export cable only.

<u>Fulmar</u>

5.7.2.21 Fulmar is not listed under Annex I of the EU Birds Directive (2009/147/EEC) or Schedule 1 of the Wildlife and Countryside Act (1981, as amended). Fulmar is however currently amber-listed on the UK Birds of Conservation Concern list (Eaton *et al.*, 2015). The species is one of the most common seabirds in Britain, with an estimated breeding population of 499,081 pairs (Mitchell *et al.*, 2004). The largest breeding colonies are located off the north and west coasts of Scotland with birds often present at these colonies outside of the breeding season.

5.7.2.22 Between March and July, fulmars are distributed widely across the southern North Sea, although numbers are relatively low compared to further north along Scottish coasts, where the majority of British colonies occur (Stone *et al.*, 1995). From August to November, distribution extends southwards from the main breeding colonies. Through the rest of the winter this species is very widely distributed across the whole North Sea, although it is evident that the continental shelf edge is important for fulmar at most times of the year, with the closest area of high concentrations to Hornsea Three being at Dogger Bank (Stone *et al.*, 1995).

5.7.2.23 Data between 2004 and 2008 from Aerial Surveys of Waterbirds in the UK (DECC, 2009) show that small numbers of fulmars were recorded throughout the year in the Greater Wash survey blocks GW2, GW9 and GW10, with the average number of birds peaking in December (38 birds).

5.7.2.24 Fulmar is currently listed as a qualifying interest species in the breeding season for 17 SPAs on the UK east coast These SPAs are designated for 200,765 breeding pairs, representing approximately 40% of the national population of fulmar as recorded during Seabird 2000 (Mitchell *et al.* 2004).

5.7.2.25 Hornsea Three lies within the mean maximum foraging range of fulmar (400 km; Thaxter *et al.*, 2012) from two SPAs and two pSPAs: FFC Coast pSPA; Forth Islands SPA; Farne Islands pSPA; and Coquet Island pSPA. Fulmar is not a qualifying feature in its own right but is listed as an assemblage feature at the two SPAs and is a non-listed assemblage feature at the two pSPAs.

5.7.2.26 The review of the FFC pSPA by Natural England includes fulmar as an assemblage feature, and this would be the closest colony to Hornsea Three, being within mean-maximum foraging range of fulmar (Natural England, 2014).

5.7.2.27 Fulmars were recorded in all eleven aerial surveys undertaken across Hornsea Three offshore ornithology study area. In the breeding season (April to August) a peak population of 1,360 birds occurred in July. This population and those recorded in April, May and June exceed the 1% threshold of the regional breeding population (117 individuals). However, none of these populations exceed the 1% threshold of the national breeding population.

5.7.2.28 In surveys undertaken in the post-breeding season (September to October), a peak population estimate of 1,347 birds occurred in September. This population does not exceed the 1% threshold of the post-breeding BDMPS population for fulmar. Similarly, for surveys undertaken in the pre-breeding season (December to March), the peak population of 997 birds that occurred in December was also not of regional importance.

5.7.2.29 The non-breeding season for fulmar is defined as November. A total of 429 fulmars were estimated to be present within Hornsea Three offshore ornithology study area during the aerial survey undertaken during November. This population does not exceed the 1% threshold of the regional BDMPS population for fulmar (5,687 individuals).

5.7.2.30 Cook *et al.* (2012) review of bird flight heights in relation to offshore wind farms showed for fulmar most birds were restricted to low altitudes, well below the minimum height of any turbines rotor blades. In assessing the vulnerability to collision with offshore wind turbines, Wade *et al.* (2016) informed by the reviews of bird flight of Cook *et al.* (2012) and Garthe and Hüppop (2004), estimated for fulmar zero percent of flight at turbine blade height (ca. 20-150 m asl). It is reasonable to assume these findings are equally applicable to Hornsea Three.

5.7.2.31 Fulmar is considered to be of international conservation value due to the potential for interaction between birds from a number of SPA breeding colonies and the Hornsea Three area based on the mean-maximum foraging range of fulmar (Thaxter *et al.*, 2012). In addition to this, population estimates of fulmar in Hornsea Three offshore ornithology study area in the breeding season for April, May, June and July exceed the 1% threshold of the regional population. The 1% thresholds of the national and international populations for fulmar are not surpassed in any month.

Gannet

5.7.2.32 Gannet is not listed under Annex I of the EU Birds Directive (2009/147/EEC) or Schedule 1 of the Wildlife and Countryside Act (1981, as amended). Gannet is currently amber-listed on the UK Birds of Conservation Concern list (Eaton *et al.*, 2015).

5.7.2.33 Gannet is a widely dispersed species throughout the southern North Sea with an estimated flyway population of 892,000 individuals (Stienen *et al.*, 2007). Of this population, it is estimated that 40-60,000 birds pass through the southern North Sea en route to the Strait of Dover, with 10,000 birds remaining in the area through winter (Stienen *et al.*, 2007). From March to August gannets are present in low densities in the southern North Sea with populations concentrated on the shelf edge or, in the breeding season, around the major colonies (Stone *et al.*, 1995).

5.7.2.34 Data between 2004 and 2008 from, Aerial Surveys of Waterbirds in the UK (DECC, 2009), show gannet numbers in the Greater Wash survey blocks GW2, GW9 and GW10, were at their peak during July, with a mean of 390 birds. Birds were seen less frequently during the winter surveys.

5.7.2.35 The UK breeding population of gannet has been estimated at 220,000 pairs (Musgrove *et al.*, 2013). The species breeds at 26 large colonies around the UK, the nearest to the former Hornsea Zone being at Bempton Cliffs within the FFC pSPA (Balmer *et al.*, 2013). This colony was estimated at 7,859 nests in 2009 (SMP, 2017) and increased to an estimated 9,947 pairs in 2011, 11,061 pairs in 2012 and 12,494 pairs in 2015. Breeding birds have been shown by satellite-tagging to range widely across the North Sea, at times as far as the Norwegian coast (Hamer *et al.*, 2007). However, an analysis of tracking data by Wakefield *et al.* (2013) suggested that in the North Sea there was limited overlap between the foraging areas of gannets from the Bempton Cliffs breeding colony and the breeding colony at Bass Rock.

5.7.2.36 Gannet is listed as a qualifying interest species in the breeding season for five SPAs on the UK east coast. These SPAs were designated for 54,495 pairs at time of designation, representing nearly 25% of the current national population of gannet (Wanless *et al.*, 2005). Hornsea Three lies within the mean-maximum forging range of gannet (229.4 km) (Thaxter *et al.*, 2012) from only the Flamborough and Filey Coast pSPA although the Firth of Forth Islands SPA is within the estimated maximum foraging range of 590 km. However, Wakefield *et al.* (2013) indicates that the foraging areas of gannets from these two colonies shows little overlap.

5.7.2.37 Gannets were recorded in all eleven of the aerial surveys conducted across Hornsea Three offshore ornithology study area. The peak population during the breeding season (April to August) was recorded in April when an estimated 1,140 birds occurred. This population and those recorded in May, June and July exceed the 1% threshold of the regional breeding population (250 individuals). However, none of these populations exceed the 1% threshold of the national breeding population (4,400 individuals).

5.7.2.38 In surveys undertaken in the post-breeding season as defined for gannet (September to November) a peak population of 350 birds was recorded during October. This population does not exceed the 1% threshold of the post-breeding BDMPS population for gannet (4,563 individuals). Similarly, during surveys undertaken in the pre-breeding season (December to March) the peak population of 1,099 birds that occurred in December was also not of regional importance (1% threshold of 2,484 individuals).

5.7.2.39 Wade *et al.* (2016) informed by the reviews of bird flight of Cook *et al.* (2012) and Garthe and Hüppop (2004), estimated for gannet 14% of flight at turbine blade height (ca. 20-150 m asl).

5.7.2.40 Following the completion of aerial surveys at Hornsea Three, site-specific flight height data will be available to characterise the flight height of birds at the site so as to inform the final application.

5.7.2.41 Gannet is considered to be of international conservation value as there is the potential for connectivity between the FFC pSPA breeding colony and Hornsea Three based on the mean-maximum foraging range of gannet (229.4 km). In addition, population estimates of gannet in Hornsea Three offshore ornithology study area in the breeding season for all months between April and July exceed the 1% threshold of the regional breeding population. The 1% thresholds of the national and international populations for gannet are not surpassed in any month.

Arctic skua

5.7.2.42 Arctic skua is currently red-listed on the UK Birds of Conservation Concern list (Eaton *et al.*, 2015) due to its significant recent decline with the UK breeding population showing declines of 37% between 1985/88 and 1998/2002 and 64% between 1998/2002 and 2015 (JNCC, 2016).

5.7.2.43 Arctic skua is a passage migrant in spring and autumn in the North Sea, and a scarce UK breeding species, restricted to Shetland, Orkney, north Scotland and the Western Isles (Forrester *et al.*, 2007). Seabird 2000 estimated the Scottish breeding population at 2,136 pairs (Mitchell *et al.*, 2004).

5.7.2.44 Data between 2004 and 2008 from Aerial Surveys of Waterbirds in the UK (DECC, 2009) show that no Arctic skuas were recorded in the Greater Wash survey blocks GW2, GW9 and GW10. Birds recorded as 'skua spp.' were recorded, however, albeit in low numbers, with only one or two birds recorded in March and May.

5.7.2.45 Arctic skua is listed as a qualifying interest species in the breeding season for seven SPAs on the UK east coast. These SPAs are designated for 790 breeding pairs representing approximately 37% of the UK breeding population as recorded during Seabird 2000 (Mitchell *et al.* 2004). Hornsea Three does not lie within the maximum known foraging range of this species (75 km; Thaxter *et al.*, 2012) from these SPAs.

5.7.2.46 Arctic skuas were recorded in four of the eleven aerial surveys conducted across Hornsea Three offshore ornithology study area. Hornsea Three is not considered to be within foraging range of Arctic skua from any UK colonies with the closest located in northern Scotland beyond the maximum foraging range reported for this species (Thaxter *et al.* 2012). As such, all records of Arctic skua at Hornsea Three are considered to be non-breeding or migrating birds with population estimates compared to the relevant regional and national post-breeding season population thresholds.

5.7.2.47 Nine Arctic skuas were recorded across all aerial surveys with seven of these in flight. A flight height was calculable for four of these birds with an equal split of birds above and below the minimum rotor height at Hornsea Three. Wade *et al.* (2016) informed by the reviews of bird flight of Cook *et al.* (2012) and Garthe and Hüppop (2004), estimated for Arctic skua 5% of flight at turbine blade height (ca. 20-150 m asl). Following the completion of aerial surveys at Hornsea Three, site-specific flight height data will be available to characterise the flight height of birds at the site so as to inform the final application.

5.7.2.48 The peak population of Arctic skua estimated at Hornsea Three offshore ornithology study area was 56 birds in September, based on 5 observations This population does not surpass the 1% threshold of the regional post-breeding population of Arctic skua that migrates through the North Sea (64 individuals). However, traditional boat-based and aerial surveys are considered unlikely to accurately quantify the migratory movements of this species that may pass through Hornsea Three. On a precautionary basis Arctic skua is assigned an international conservation value.

<u>Great skua</u>

5.7.2.49 Great skua is not listed under Annex I of the EU Birds Directive (2009/147/EEC) or Schedule 1 of the Wildlife and Countryside Act (1981, as amended). Great skua is currently amber-listed on the UK Birds of Conservation Concern list (Eaton *et al.*, 2015).

5.7.2.50 The species regularly occurs in the North Sea on spring and autumn passage, with some birds remaining for the winter months (Stone *et al.*, 1995). Great skuas breed on Shetland, Orkney and the Western Isles (Balmer *et al.*, 2013), with an estimated population of 9,634 pairs during Seabird 2000 (Mitchell *et al.*, 2004).

5.7.2.51 Data from the 2004 to 2008 reports, Aerial Surveys of Waterbirds in the UK (DECC, 2009), show that almost no great skuas were recorded during aerial surveys of the Greater Wash survey blocks GW2, GW9 and GW10, with only one or two birds recorded during July.

5.7.2.52 Great skua is listed as a qualifying interest species in the breeding season for seven SPAs on the UK east coast. These SPAs are designated for 6,126 breeding pairs representing approximately 64% of the UK population as recorded during Seabird 2000 (Mitchell *et al.* 2004). None of these SPA colonies lie within the maximum known foraging range of this species (219 km) (Thaxter *et al.*, 2012) from Hornsea Three.

5.7.2.53 Great skuas were recorded in two of the eleven aerial surveys undertaken across Hornsea Three offshore ornithology study area. These records occurred during the September and December surveys, translating to population estimates of 19 and 28 birds, respectively. The population estimated during the September survey does not surpass the 1% threshold of the post-breeding BDMPS population for great skua. Similarly, the estimated population in the non-breeding season does not surpass the 1% threshold of the non-breeding BDMPS population (50 birds) for great skua.

5.7.2.54 All of the great skuas recorded during aerial surveys of Hornsea Three offshore ornithology study area were in flight. A flight height was calculable for one of these birds which was estimated to be flying lower than one metre. Wade *et al.* (2016) informed by the reviews of bird flight of Cook *et al.* (2012) and Garthe and Hüppop (2004), estimated for great skua 7% of flight at turbine blade height (ca. 20-150 m asl). Following the completion of aerial surveys at Hornsea Three, site-specific flight height data will be available to characterise the flight height of birds at the site so as to inform the final application.

5.7.2.55 The peak population of great skua estimated at Hornsea Three offshore ornithology study area was 22 birds in July. However, traditional boat-based and aerial surveys are considered unlikely to accurately quantify the migratory movements of this species that may pass through Hornsea Three. As such, on a precautionary basis great skua is considered to be of international conservation value.

<u>Puffin</u>

5.7.2.56 Puffin is not listed under Annex I of the EU Birds Directive (2009/147/EEC) or Schedule 1 of the Wildlife and Countryside Act. The species is however currently red-listed on the UK Birds of Conservation Concern list (Eaton *et al.*, 2015).

5.7.2.57 Puffins are one of the most common seabird species in Britain, breeding in coastal colonies. Seabird 2000 recorded 579,500 pairs at breeding colonies around Britain (Mitchell *et al.*, 2004).

5.7.2.58 During the breeding season puffin are aggregated around their colonies along the east coast and high densities are found in the Flamborough Head area. During post-breeding, however, the birds disperse towards the north-western North Sea before spreading out more widely throughout the winter months (Stone *et al.*, 1995).

5.7.2.59 Between April and July, the Flamborough Head area has densities of up to five birds/km² due to the high numbers of birds foraging in the area local to the breeding colony. This continues into the non-breeding season months of August to September as the puffins are leaving the colony (Stone *et al.*, 1995).

5.7.2.60 Data from the 2004 to 2008 reports, Aerial Surveys of Waterbirds in the UK (DECC, 2009), show that no puffins were recorded during aerial surveys of the Greater Wash survey blocks GW2, GW9 and GW10. Birds recorded as 'auk spp.' were recorded, however, with a means of 693 and 722 in March and May respectively. Numbers were lower throughout the rest of the year, but this was still one of the most frequently recorded species groups during aerial surveys.

5.7.2.61 Puffin is listed as a qualifying interest species in the breeding season for 11 SPAs on the UK east coast. The distance between Hornsea Three and the nearest designated site (FFC pSPA) is within the maximum foraging range of puffin (200 km) (Thaxter *et al.*, 2012). Puffin is a non-listed assemblage feature at FFC pSPA. No other SPAs are within the mean-maximum or maximum foraging range (200 km; Thaxter *et al.*, 2012) of puffin.

5.7.2.62 Puffins were recorded in six of the eleven aerial surveys undertaken across Hornsea Three offshore ornithology study area. Two seasons are defined for puffin, a breeding season from April to July and a non-breeding season from August to March. The peak population recorded in the breeding season occurred in May when a population of 307 birds was estimated. This surpasses the 1% threshold of regional importance for puffin (50 birds) with the population estimated in April also surpassing the threshold for regional importance.

5.7.2.63 In surveys undertaken in the non-breeding season, puffins were recorded in two months (September and December) with an estimated population of eleven birds in both months. This population does not exceed the 1% threshold of the regional non-breeding BDMPS population for puffin (2,320 individuals).

5.7.2.64 Wade *et al.* (2016) informed by the reviews of bird flight of Cook *et al.* (2012) and Garthe and Hüppop (2004), estimated for puffin 0% of flight at turbine blade height (ca. 20-150 m asl). Following the completion of aerial surveys at Hornsea Three, site-specific flight height data will be available to characterise the flight height of birds at the site so as to inform the final application. It is expected to endorse that this species is only considered to be at risk of displacement impacts.

5.7.2.65 On a precautionary basis, puffin is considered to be of international conservation value because there is potential connectivity between Hornsea Three and the breeding colony at the FFC pSPA. Population estimates of puffin at Hornsea Three offshore ornithology study area exceed the 1% thresholds of relevant regional populations in April and May. The 1% thresholds of the national and international populations for puffin are not surpassed in any month.

Razorbill

5.7.2.66 Razorbill is not listed under Annex I of the EU Birds Directive (2009/147/EEC) or Schedule 1 of the Wildlife and Countryside Act (1981, as amended). The species is currently amber-listed on the UK Birds of Conservation Concern list (Eaton *et al.*, 2015).

5.7.2.67 Seabird 2000 recorded 164,557 individuals at breeding colonies around Britain (Mitchell *et al.*, 2004). The closest large colony to Hornsea Three is at FFC pSPA which held an estimated 10,570 pairs in 2008-12. However, Hornsea Three is outside of the mean-maximum (48.5 km) and maximum (95 km) foraging ranges of razorbill as reported by Thaxter *et al.* (2012).

5.7.2.68 High densities of razorbills have been recorded in the north-western North Sea with lower densities recorded overwintering in the southern North Sea (Stone *et al.*, 1995). With a flyway population of some 482,000 birds in the southern North Sea, between 1.3 and 2.0% of the biogeographic population are estimated to move through this area (Stienen *et al.*, 2007).

5.7.2.69 From April to August during the incubating and chick-rearing season, razorbills are generally confined to coastal areas from Flamborough Head northwards along the east coast. From August to September densities of more than five birds/km² can be found in the Flamborough area, as young birds disperse from the colony with their parents. Very few birds were reported in the vicinity of Hornsea Three by Stone *et al.* (1995). Between October and March there are low to moderate densities in the southern North Sea with low densities along the east coast of up to one bird/km² (Stone *et al.*, 1995).

5.7.2.70 Data from the 2004 to 2008 reports, Aerial Surveys of Waterbirds in the UK (DECC, 2009), show razorbill numbers in the Greater Wash survey blocks GW2, GW9 and GW10 were very low, with the average number of birds peaking during the breeding season (May) (2 birds). A higher number of birds recorded as 'auk spp.' were recorded, however, with means of 693 and 722 in March and May.

5.7.2.71 Razorbill is listed as a qualifying interest species in the breeding season for 10 SPAs on the UK east coast. These SPAs are designated for 41,821 pairs representing approximately 38% of the most UK population as counted during Seabird 2000 (Mitchell *et al.* 2004).

5.7.2.72 Razorbills were recorded in all of the eleven aerial surveys undertaken across Hornsea Three offshore ornithology study area with the exception of the August survey. In surveys undertaken during the breeding season defined for razorbill (April to July) a peak population of 583 birds was estimated in June. These population estimates do not exceed the 1% threshold for national importance (2,600 individuals).

5.7.2.73 In the post-breeding season (August to October), the peak population of razorbill was estimated in October (573 birds). This population does not surpass the 1% threshold of regional importance (5,912 individuals). Similarly in the pre-breeding season (January to March), the peak population of 265 birds estimated in January does not exceed the 1% threshold of regional importance (5,912 individuals).

5.7.2.74 The largest populations of razorbill estimated from aerial survey data were in the non-breeding season (November to December). In the two surveys undertaken in this season populations of 4,274 (November) and 3,183 (December) birds were estimated. These populations both exceed the 1% threshold of regional importance (2,186 individuals) but do not exceed the 1% threshold of the national non-breeding population of razorbill (5,600 individuals).

5.7.2.75 Wade *et al.* (2016) informed by the reviews of bird flight of Cook *et al.* (2012) and Garthe and Hüppop (2004), estimated for razorbill 0% of flight at turbine blade height (ca. 20-150 m asl).

5.7.2.76 Population estimates of razorbill at Hornsea Three offshore ornithology study area surpass the 1% threshold of the regional population in all non-breeding season months (November and December), therefore razorbill is assigned a regional conservation value.

Guillemot

5.7.2.77 Guillemot is not listed under Annex I of the EU Birds Directive (2009/147/EEC) or Schedule 1 of the Wildlife and Countryside Act (1981, as amended). The species is currently amber-listed on the UK Birds of Conservation Concern list (Eaton *et al.*, 2015).

5.7.2.78 Seabird 2000 recorded 1,322,830 individuals at breeding colonies in Britain (Mitchell *et al.*, 2004). The closest large colonies to Hornsea Three are at the Farne Islands and Bempton Cliffs (including Flamborough Head).

5.7.2.79 The southern North Sea is important for guillemots throughout the year with high densities in all months. With a total flyway population of 1,990,000 birds, 1.5 to 3.0% of the biogeographic population resides in or flies over the southern North Sea (Stienen *et al.*, 2007).

5.7.2.80 From March to June, guillemot densities are high in the southern North Sea, notably in the Dogger Bank area. These densities of between two and five birds/km^2 reflect both high levels of pre-breeding activity (when birds from further afield are foraging more widely) and also that local colonies are showing more concentrated foraging activity at the start of the breeding season. This is evident in the Flamborough Head area (Stone *et al.*, 1995). During July and August, chicks and adults depart the colonies resulting in high densities (more than five birds/km2) being found in both these months around Flamborough Head and Dogger Bank. These high densities remain throughout the winter months from October to February (Stone *et al.*, 1995).

5.7.2.81 Data from the 2004 to 2008 reports, Aerial Surveys of Waterbirds in the UK (DECC, 2009), suggest guillemot numbers in the Greater Wash survey blocks GW2, GW9 and GW10 were very low, with the average number of birds peaking during the breeding season (May) (6 birds). A higher number of birds recorded as ‘auk spp.’ were seen, however, with the highest averages of 693 and 722 in March and May respectively. Numbers were lower throughout the rest of the year, but this was still one of the most frequently recorded species groups during aerial surveys.

5.7.2.82 Guillemot is listed as a qualifying interest species in the breeding season for 20 SPAs on the UK east coast. These SPAs are designated for 487,801 breeding pairs representing approximately 37% of the UK breeding population as recorded during Seabird 2000 (Mitchell *et al.* 2004).

5.7.2.83 The closest colony to Hornsea Three is FFC pSPA which supported 41,607 pairs in 2008-12. The distance between Hornsea Three and Flamborough and Filey Coast pSPA is approximately 149 km, further than the maximum foraging range of guillemot (135 km; Thaxter *et al.*, 2012).

5.7.2.84 Guillemot were recorded in all eleven aerial surveys undertaken across Hornsea Three offshore ornithology study area. During surveys undertaken in the breeding season defined for guillemot (March to July), a peak population of 15,651 birds was estimated in June. The populations estimated to be present at Hornsea Three offshore ornithology study area in all breeding season months did not surpass the 1% threshold of national importance (19,000 individuals).

5.7.2.85 In the non-breeding season a peak population of 17,715 birds was estimated from aerial survey data collected in December. This population exceeds the 1% threshold of regional importance (16,173 individuals) but is not considered to be of national significance (27,565 individuals).

5.7.2.86 Wade *et al.* (2016) informed by the reviews of bird flight of Cook *et al.* (2012) and Garthe and Hüppop (2004), estimated for guillemot 0% of flight at turbine blade height (ca. 20-150 m asl). Following the completion of aerial surveys at Hornsea Three, site-specific flight height data will be available to characterise the flight height of birds at the site so as to inform the final application. It is expected to endorse that this species is only considered to be at risk of displacement impacts.

5.7.2.87 Population estimates of guillemot at Hornsea Three offshore ornithology study area exceed the 1% thresholds of the relevant regional non-breeding population in December. The 1% thresholds of the national and international populations for guillemot are not surpassed in any month. Guillemot is therefore considered to be of regional conservation value.

Common tern

5.7.2.88 Common tern is listed on Annex I of the EU Birds Directive, and the species is currently amber-listed on the UK Birds of Conservation Concern list (Eaton *et al.*, 2015).

5.7.2.89 Common terns are summer visitors to Britain, breeding in colonies at coastal sites and also inland. Seabird 2000 recorded 10,308 pairs in Britain (Mitchell *et al.*, 2004). The closest large colonies to Hornsea Three are Coquet Island, the Farne Islands and Scolt Head. In autumn, common terns migrate south to the west coast of Africa, returning the following spring (Wernham *et al.*, 2002). Data from the 2004 to 2008 reports, Aerial Surveys of Waterbirds in the UK (DECC, 2009), show the common/Arctic tern numbers in the Greater Wash survey blocks GW2, GW9 and GW10 were low, with average numbers peaking during the breeding season (May) (20 birds). A similar number of birds recorded as ‘tern spp.’ were also seen, with the highest average of 22 birds also in May.

5.7.2.90 It is likely that any common terns recorded at Hornsea Three were on passage between breeding colonies and wintering grounds, with birds from UK breeding colonies as well as others in northern Europe (Wernham *et al.*, 2002). Common tern is listed as a qualifying interest species in the breeding season for ten SPAs on the UK east coast. These SPAs are designated for 4,136 breeding pairs representing approximately 40% of the national breeding population as recorded during Seabird 2000 (Mitchell *et al.*, 2004). Hornsea Three lies beyond the maximum foraging range of common tern from these SPAs (30 km) (Thaxter *et al.*, 2012) and therefore common tern occurs only on passage (particularly in autumn) through Hornsea Three with no apparent connectivity to SPAs where they are a breeding feature.

5.7.2.91 Common terns were recorded in only one of the eleven aerial surveys conducted across Hornsea Three offshore ornithology study area. A total of three birds were recorded during the September survey translating to a population estimate of 314 birds when individuals not identified to species level are taken into account. These birds are migratory individuals with this population not surpassing the 1% threshold for regional importance (240 individuals).

5.7.2.92 Only three common terns were recorded during aerial surveys of Hornsea Three offshore ornithology study area with all of these birds in flight.

5.7.2.93 Wade et al. (2016) informed by the reviews of bird flight of Cook et al. (2012) and Garthe and Hüppop (2004), estimated for common tern 4% of flight at turbine blade height (ca. 20-150 m asl). Following the completion of aerial surveys at Hornsea Three, site-specific flight height data will be available to characterise the flight height of birds at the site so as to inform the final application.

5.7.2.94 Traditional boat-based and aerial surveys are considered unlikely to accurately quantify the migratory movements of this species that may pass through Hornsea Three. As a species listed on Annex I of the EU Birds Directive, on a precautionary basis, common tern is considered to be of international conservation value.

<u>Arctic tern</u>

5.7.2.95 Arctic tern is listed on Annex I of the EU Birds Directive, and the species is currently amber-listed on the UK Birds of Conservation Concern list (Eaton *et al.*, 2015).

5.7.2.96 Arctic terns are summer visitors to Britain, breeding in coastal colonies, predominantly in the north. Seabird 2000 recorded 52,621 pairs in Britain (Mitchell *et al.*, 2004). In autumn, Arctic terns migrate down the west coast of Europe and Africa to the Antarctic seas for the winter, returning the following spring (Wernham *et al.*, 2002). The closest large colonies to Hornsea Three are the Farne Islands, Coquet Island and Long Nanny (all Northumberland). Arctic tern is listed as a qualifying interest species in the breeding season for 14 SPAs on the UK east coast. These SPAs are designated for 15,398 breeding pairs representing approximately 29% of the national breeding population as recorded during Seabird 2000 (Mitchell *et al.*, 2004). Hornsea Three lies beyond the maximum known foraging range of Arctic terns from these SPAs (30 km) (Thaxter *et al.*, 2012).

5.7.2.97 Arctic terns were recorded in only one of the eleven aerial surveys undertaken across Hornsea Three offshore ornithology study area. A total of seven birds were recorded during the May survey translating into a population of 399 birds when birds not identified to species level are taken into account. These birds are migratory individuals with this population not surpassing the 1% threshold for regional importance (1,060 individuals).

5.7.2.98 Wade *et al.* (2016) informed by the reviews of bird flight of Cook *et al.* (2012) and Garthe and Hüppop (2004), estimated for Arctic tern 4% of flight at turbine blade height (ca. 20-150 m asl). Following the completion of aerial surveys at Hornsea Three, site-specific flight height data will be available to characterise the flight height of birds at the site so as to inform the final application. .

5.7.2.99 Traditional boat-based and aerial surveys are considered unlikely to accurately quantify the migratory movements of this species that may pass through Hornsea Three. As a species listed on Annex I of the EU Birds Directive, on a precautionary basis Arctic tern is considered to be of international conservation value.

<u>Kittiwake</u>

5.7.2.100 Kittiwake (also known as black-legged kittiwake) is currently red-listed on the UK Birds of Conservation Concern list (Eaton *et al.*, 2015). The species is not listed under Annex I of the EU Birds Directive (2009/147/EEC) or Schedule 1 of the Wildlife and Countryside Act (1981, as amended).

5.7.2.101 Kittiwake is one of the commonest seabirds in the UK, breeding in large colonies on coastal cliff habitat. Seabird 2000 recorded 366,835 pairs in the UK, with the largest numbers on the east coast (Mitchell *et al.*, 2004). The nearest large colony to Hornsea Three is at Flamborough Head and Bempton Cliffs (FFC pSPA).

5.7.2.102 Between April and July, kittiwakes are dispersed widely around the coast of Britain, with relatively low densities throughout the southern North Sea, compared to more northerly areas, where the main breeding colonies are located (Stone *et al.*, 1995). In eastern England, particularly south of Flamborough Head, kittiwake colonies are few, due to the lack of suitable cliff-face breeding habitats.

5.7.2.103 From August to October, kittiwakes begin to disperse across the North Sea, although the predominant distribution still reflects the location of breeding colonies. From November to March, birds are dispersed over much larger areas of the North Sea, and in the southern parts, numbers peak during this period. This reflects the kittiwake's preference for pelagic habitats in winter.

5.7.2.104 Data from the 2004 to 2008 reports, Aerial Surveys of Waterbirds in the UK (DECC, 2009), show kittiwake numbers in the Greater Wash survey blocks GW2, GW9 and GW10, peaked during chick-rearing (July) with a mean of 1,162 birds recorded in GW9 and GW10. The second highest peak occurred during incubation (May) with a mean of 722 birds. Lower numbers were recorded between August and February.

5.7.2.105 Kittiwake is listed as a qualifying interest species in the breeding season for 20 SPAs on the UK east coast. These SPAs are designated for 256,160 breeding pairs representing nearly 70% of the national breeding population as recorded during Seabird 2000 (Mitchell *et al.*, 2004).

5.7.2.106 FFC pSPA is the closest SPA/pSPA to Hornsea Three. However, Hornsea Three is outside of the maximum foraging range of 120 km of kittiwake from the pSPA as reported by Thaxter *et al.* (2012). Preliminary results from the FAME project which has tracked breeding kittiwake from the FFC pSPA colony does however suggest possible (albeit limited) connectivity between the FFC pSPA and Hornsea Three (see Figure 1.38 in Annex 5.1: Baseline Characterisation Report). Of the 93 breeding adults tracked for a few days each within a 3-4 week period of the breeding season of a single year (between 2010 - 2013), no more than two individuals visited Hornsea Three,

5.7.2.107 Kittiwakes were recorded in all eleven of the aerial surveys undertaken across Hornsea Three offshore ornithology study area. Population estimates derived from aerial survey data during all breeding months surpass the 1% threshold for regional importance. The population estimates calculated for April (8,451 birds) and July (12,551 birds) also exceed the 1% threshold for national importance. A marked reduction in the abundance of kittiwake at Hornsea Three array area between April (8,451 birds) and May (4,842 birds) May, and particularly thereafter June (1,152 birds), coincides with chick provisioning by breeding adults when this 'central place forager' is most constrained by distance from their nesting site (see 5.6.5.17). Combined with the preliminary results of the FAME project, the evidence suggests that the kittiwake population in Hornsea Three during June and to a lesser extent May, comprises non-breeders with post-breeding dispersal accounting for, with the likely arrival of further immatures into the area, the 10-fold increase in abundance in July.

5.7.2.108 Populations estimated during the post-breeding season (August to December) did not surpass the 1% threshold of the post-breeding regional BDMPS population for kittiwake (8,299 individuals) The largest population during the post-breeding season was in December with 3,591 birds estimated to be present. Populations estimated during the two surveys undertaken in the pre-breeding season (January to March) also did not surpass the 1% threshold for regional importance (6,278 individuals) with the peak population occurring in the January survey (871 birds).

5.7.2.109 Wade *et al.* (2016) informed by the reviews of bird flight of Cook *et al.* (2012) and Garthe and Hüppop (2004), estimated for kittiwake 14% of flight at turbine blade height (ca. 20-150 m asl). Following the completion of aerial surveys at Hornsea Three, site-specific flight height data will be available to characterise the flight height of birds at the site so as to inform the final application.

5.7.2.110 Kittiwake is considered to be of international conservation value as, although the foraging ranges reported by Thaxter *et al.* (2012) suggest no connectivity between Hornsea Three and any breeding colony, preliminary evidence from tracking studies (FAME project) do suggest connectivity. Population estimates of kittiwake at Hornsea Three offshore ornithology study area exceed the 1% threshold of the regional population (1,020 individuals) in all breeding season months with the populations estimated in April and July also surpassing the 1% threshold for national importance (7,600 individuals).

<u>Little gull</u>

5.7.2.111 Little gull is listed on Annex I of the EU Birds Directive and Schedule 1 of the Wildlife and Countryside Act. It is currently green-listed on the UK Birds of Conservation Concern list (Eaton *et al.*, 2015).

5.7.2.112 Little gull occurs on passage in the North Sea where it is fairly common off the Flamborough coast with the highest numbers occurring in autumn (Thomas, 2011; Stone *et al.*, 1995). Data from the 2004 to 2008 reports, Aerial Surveys of Waterbirds in the UK (DECC, 2009), show that almost no little gulls were recorded during aerial surveys of the Greater Wash survey blocks GW2, GW9 and GW10, with only three birds recorded during November. A slightly higher number of birds recorded as 'small gull spp.' were seen, however, with a mean of 33 in November.

5.7.2.113 Large numbers of little gull occur at Hornsea Mere, on the East Yorkshire coast, in late summer, with up to 21,500 birds present in 2007 (Calbrade *et al.*, 2010). There have been five unsuccessful little gull breeding attempts in England up to 2007 (Holling *et al.*, 2010). There are no terrestrial UK SPAs for little gull, (JNCC, 2013), although the species was considered for marine SPAs in a recent JNCC report (Kober *et al.*, 2010) and is included as a qualifying feature for two pSPAs on the east coast of the UK: the Greater Wash pSPA (1,303 individuals) and the Outer Firth of Forth and St Andrews Bay Complex pSPA (126 individuals).

5.7.2.114 Little gulls were recorded during four of the eleven aerial surveys conducted across Hornsea Three offshore ornithology study area. These birds were recorded during the April, September, October and February surveys with populations of 34 birds, 13 birds, 24 birds and 12 birds estimated for each month respectively. These population estimates do not surpass the 1% threshold for regional importance.

5.7.2.115 Cook *et al.* (2016) review of bird flight height estimated for little gull 5.5% of flight at turbine blade height (ca. 20-150 m asl). Following the completion of aerial surveys at Hornsea Three, site-specific flight height data will be available to characterise the flight height of birds at the site so as to inform the final application.

5.7.2.116 Traditional boat-based and aerial surveys are considered unlikely to accurately quantify the migratory movements of this species that may pass through Hornsea Three. As a species listed on Annex I of the EU Birds Directive, on a precautionary basis, little gull is considered to be of national conservation value.

Lesser black-backed gull

5.7.2.117 Lesser black-backed gull is not listed under Annex I of the EU Birds Directive (2009/147/EEC) or Schedule 1 of the Wildlife and Countryside Act (1981, as amended). The species is currently amber-listed on the UK Birds of Conservation Concern list (Eaton *et al.*, 2015).

5.7.2.118 Lesser black-backed gulls are common and widespread in the UK in summer, and breed in colonies in coastal and inland locations. Seabird 2000 recorded 111,835 pairs in Britain (Mitchell *et al.*, 2004). In winter, many birds leave northern areas between November and March, although some remain all year, particularly in the south-west (Forrester *et al.*, 2007). The UK wintering population of lesser black-backed gull has been estimated at over 125,000 individuals (Burton *et al.*, 2012). Lesser black-backed gull is listed as a qualifying interest species in the breeding season for two SPAs on the UK east coast: Forth Islands SPA and Alde-Ore Estuary SPA. The species is also included as a non-listed assemblage feature at two further pSPAs. These SPAs are designated for 24,626 breeding pairs representing approximately 22% of the national breeding population as recorded during Seabird 2000 (Mitchell *et al.*, 2004). The distance between Hornsea Three and these two SPAs is beyond the maximum known foraging range of lesser black-backed gull (181 km) (Thaxter *et al.*, 2012). There is also a large breeding colony at Outer Trial Bank within The Wash SPA (1,457 pairs in 2009) (SMP, 2017), which is within the maximum foraging range for this species, though they are not a qualifying feature of the SPA.

5.7.2.119 Lesser black-backed gulls were recorded in six of the eleven aerial surveys conducted across Hornsea Three offshore ornithology study area. The peak population in the breeding season (May to July) was recorded in June when 1,002 birds occurred. This population and that estimated in July (381 birds) exceed the 1% threshold for regional importance. However, none of these populations exceed the 1% threshold of the national breeding population (2,200 individuals).

5.7.2.120 In the post-breeding season (August to October) lesser black-backed gulls were recorded in September and October with the peak population of 127 birds estimated in September. In the pre-breeding season (March to April), surveys have so far only been conducted in April when a population of 133 birds was estimated. The population estimates calculated in the post-breeding and pre-breeding seasons do not surpass the respective 1% thresholds for regional importance (2,090 and 1,975 individuals respectively). No birds were recorded in the non-breeding season as defined for lesser black-backed gull (November to February).

5.7.2.121 Wade *et al.* (2016) informed by the reviews of bird flight of Cook *et al.* (2012) and Garthe and Hüppop (2004), estimated for lesser black-backed gull 38% of flight at turbine blade height (ca. 20-150 m asl). Following the completion of aerial surveys at Hornsea Three, site-specific flight height data will be available to characterise the flight height of birds at the site so as to inform the final application. The peak population estimate (June) along with the population estimated in July exceeds the 1% threshold of the regional population of lesser black-backed gull. The 1% thresholds of the national and international populations for lesser black-backed gull are not surpassed in any month. Therefore based on the conservation status of lesser black-backed gull and the populations present at Hornsea Three, lesser black-backed gull is considered to be of regional conservation value.

Great black-backed gull

5.7.2.122 Great black-backed gull is not listed under Annex I of the EU Birds Directive (2009/147/EEC) or Schedule 1 of the Wildlife and Countryside Act (1981, as amended). The species is currently amber-listed on the UK Birds of Conservation Concern list (Eaton *et al.*, 2015).

5.7.2.123 Great black-backed gull is a common resident species in the UK, occurring in coastal areas. Seabird 2000 recorded 17,394 pairs in Britain, with largest numbers on western coasts (Mitchell *et al.*, 2004). Great black-backed gull is a relatively common breeding species in Great Britain. During the pre-breeding and breeding season their distribution tends to be limited to coastal areas. In winter they are a much more widely dispersed species and often travel long distances in pursuit of discards from fishing vessels (Stone *et al.*, 1995). The UK wintering population of great black-backed gull has been estimated at over 76,000 individuals (Burton *et al.*, 2012). The flyway population in the North Sea is estimated at 480,000 birds with 5.2% of the biogeographic population flying over the southernmost part of this area (Stienen *et al.*, 2007).

5.7.2.124 During March and April the highest densities within the UK are found in the northern isles of Scotland with overwintering birds in UK waters returning to breeding grounds in Fennoscandia and Iceland during this time (Furness, 2015), leaving low densities along the east coast. During the post-breeding period of August to October, distribution is more widespread along the east coast with densities of five birds/km^2 recorded to the north of the Humber estuary (Stone *et al.*, 1995). In November to February great black-backed gulls are widespread over much of the North Sea with high densities near the Dogger Bank and the southern North Sea.

5.7.2.125 Data from the 2004 to 2008 reports, Aerial Surveys of Waterbirds in the UK (DECC, 2009), show that small numbers of great black-backed gulls were recorded throughout the year during surveys of the Greater Wash survey blocks GW2, GW9 and GW10, with the average number of birds peaking in December (11 birds). A similar number of the species group 'black-backed gulls' was also recorded with highest average also occurring in December (14 birds). Another species group defined as 'large gull spp.' were similarly abundant, but this time average numbers peaked in March (24 birds). The species group 'gull spp.' Was much more frequent with a mean peak of 166 birds in March.

5.7.2.126 Great black-backed gull is listed as a qualifying interest species in the breeding season for four SPAs on the east coast of the UK. These SPAs held 2,812 pairs at time of designation representing approximately 16% of the national breeding population as recorded during Seabird 2000 (Mitchell *et al.*, 2004). However, Hornsea Three is well outside of foraging range (60 km; Seys *et al.,* 2001) of great black-backed gull from these colonies.

5.7.2.127 Great black-backed gulls were recorded in ten of the eleven aerial surveys undertaken across Hornsea Three offshore ornithology study area. Great black-backed gulls were recorded in all surveys covering the breeding season defined for the species (May to July) with the peak population of 130 birds recorded during the July survey. There is not considered to be any connectivity between great black-backed gull breeding colonies and Hornsea Three and therefore any birds recorded at Hornsea Three are considered to be non-breeding or immature birds.

5.7.2.128 In the non-breeding season (August to March) the peak population was recorded during February (1,455 birds). This population, and those estimated in the November and December surveys surpass the 1% threshold for regional importance (914 individuals) with the population in February also considered to be of national importance (766 individuals).

5.7.2.129 A total of 476 great black-backed gulls were recorded during aerial surveys of Hornsea Three offshore ornithology study area. The majority were associated with the sea surface (over 73%) with remaining birds in flight. Wade *et al.* (2016) informed by the reviews of bird flight of Cook *et al.* (2012) and Garthe and Hüppop (2004), estimated for great black-backed gull 33% of flight at turbine blade height (ca. 20-150 m asl). Following the completion of aerial surveys at Hornsea Three, site-specific flight height data will be available to characterise the flight height of birds at the site so as to inform the final application.

5.7.2.130 The peak population estimate (February) exceeds the 1% threshold of national importance with the populations estimated in November and December surpassing the threshold for regional importance. Therefore based on the conservation status of great black-backed gull and the national importance of great black-backed gull populations present at Hornsea Three, great black-backed gull is considered to be of national conservation importance.

5.7.3 Future baseline scenario

5.7.3.1 A projection of the likely evolution of the baseline for species relevant to Hornsea Three is best assessed from the latest population trends. These, as provided by JNCC, through the SMP (JNCC, 2016), in published annual updates on seabird population trends, and are presented as part of the current assessment within Annex 5.1: Baseline Characterisation Report (in Table 1.2).

5.7.4 Data limitations

5.7.4.1 Site-specific digital aerial surveys of the Hornsea Three offshore ornithology study area commenced in April 2016 and are ongoing. In addition, the meta-analysis of previous boat-based bird data collected within the former Hornsea zone is being undertaken and will be discussed with the Expert Working Group (EWG) and included in the final application. This initial assessment is, therefore, based on a partial and preliminary characterisation of the baseline environment for offshore ornithology.

5.7.4.2 It is intended that the EIA (and RIAA) to be submitted with the DCO Application will include an agreed baseline characterisation, comprising aerial digital surveys supplemented and contextualised with analyses of zonal boat-based survey data.

Table 5.7: Summary of the conservation importance and peak populations of all seabird species identified for consideration as part of the Hornsea Three assessment in relation to national and regional thresholds. (Grey cells indicate seasons which are not applicable to the relevant species)[1]

Species	Conservation status	SPA connectivity	Breeding season		Post-breeding/Pre-breeding season		Non-breeding season		Conservation value	VOR - yes/no?
			Peak population estimate at Hornsea Three	Population importance	Peak population estimate at Hornsea Three	Population importance	Peak population estimate at Hornsea Three	Population importance		
Red-throated diver	Annex I	Yes	66 (May)	Local	Not recorded during aerial surveys of the Hornsea Three array area but may occur along the export cable route				International	Yes
Common scoter	Schedule 1	Yes	Not recorded during aerial surveys of the Hornsea Three array area but may occur along the export cable route						International	Yes
Fulmar	Amber list	Yes	1,360 (July)	Regional	1,347 (September)	Local	429 (November)	Local	International	Yes
Manx shearwater	Amber list	No	11 (July)	Local	179 (August)	Regional	0	-	Regional	No
European storm petrel	Annex I	No	11 (September)	Local			0	-	Local	No
Gannet	Amber list	Yes	1,140 (April)	Regional	1,099 (December)	Local			International	Yes
Arctic skua	Red list	No	11 (July)	Local	55 (September)	Local	0	-	International	Yes
Great skua	Amber list	No	0	-	11 (September)	Local	22 (December)	Local	International	Yes
Puffin	Red list	Yes	307 (May)	Regional			11 (Sept and Dec)	Local	International	Yes
Razorbill	Amber list	No	583 (June)	Local	745 (February)	Local	4,274 (November)	Regional	Regional	Yes
Guillemot	Amber list	No	15,651 (June)	Local			17,715 (December)	Regional	Regional	Yes
Little tern	Annex 1	Yes	Not recorded during aerial surveys of the Hornsea Three array area with relatively low densities possible along the export cable route						International	No
Sandwich tern	Annex 1	Yes	Not recorded during aerial surveys of the Hornsea Three array area with relatively low densities possible along the export cable route						International	No
Common tern	Annex I	No	0	-	314 (September)	Local	0	-	International	Yes
Arctic tern	Annex I	No	0	-	399 (May)	Local	0	-	International	Yes
Kittiwake	Red list	Yes	12,551 (July)	National	3,592 (December)	Local			International	Yes
Black-headed gull	Amber list	No	0	-			12 (October)	Local	Local	No
Little gull	Annex I	No					34 (April)	Local	National	Yes
Common gull	Amber list	No	46 (July)	Local			95 (February)	Local	Local	No
Lesser black-backed gull	Amber list	Yes	1,002 (June)	Regional	133	Local	0	-	Regional	Yes
Herring gull	Red list	No	22 (May)	Local			318 (December)	Local	Local	No
Great black-backed gull	Amber list	No	130 (July)	Local			1,455 (February)	National	National	Yes

[1] Grey cells indicate not relevant for the species.

5.8 Key parameters for assessment

5.8.1 Maximum design scenario

5.8.1.1 The maximum design scenarios identified in Table 5.8 have been selected as those having the potential to result in the greatest effect on an identified receptor or receptor group. These scenarios have been selected from the details provided in the project description (volume 1, chapter 3: Project Description). Effects of greater adverse significance are not predicted to arise should any other development scenario, based on details within the project Design Envelope (volume 1, chapter 3: Project Description), to that assessed here be taken forward in the final design scheme.

5.8.2 Impacts scoped out of the assessment

5.8.2.1 On the basis of the baseline environment and the project description outlined in volume 1, chapter 3: Project Description, no known impacts are proposed to be scoped out of the assessment for offshore ornithology.

Table 5.8: Maximum design scenario considered for the assessment of potential impacts on offshore ornithology

Potential impact	Maximum design scenario	Justification
Construction phase		
The impact of construction activities such as increased vessel activity and underwater noise, may result in direct disturbance or displacement from important foraging and habitat areas of birds.	<u>Maximum design scenario: Construction vessels</u> Up to 11,566 (4,446 + 3,420 + 304 + 2,856 + 540) vessel movements during construction, comprised of: • Up to 4,446 vessel movements (3,420 + 304 + 2,825 + 540) over construction period based on gravity base foundations (self-installing concept); • Up to 3,420 vessel movements (342 installation vessel movements + 2,052 support vessel movements + 1,026 transport vessel movements), over construction period for Wind Turbine Generator (WTG) installation; • Up to 304 vessel movements over construction period for substations; • Up to 2,856 vessel movements over construction period for array cables; and; • Up to 540 vessel movements over construction period for export cable. The offshore components of Hornsea Three will occur over a maximum duration of 11 years, assuming a two phase construction scenario. A gap of six years may occur between the same activity in different phases. <u>Maximum design scenario: Construction activity</u> The potential for disturbance / displacement impacts due to construction activity are considered for two different scenarios – maximum level of construction activity and maximum duration of construction activity. <u>Maximum construction activity level (magnitude)</u> Foundations when using monopiles with concurrent piling • Piling of up to 342 monopile foundations of 7 m diameter; • Piling of up to 19 monopile foundations, 15 m diameter, for substations and platforms including: o Three offshore accommodation platforms; o Twelve offshore HVAC collector substations; and o Four offshore HVAC booster stations (located within the offshore HVAC booster station search area. • Total number of monopiles 361 (342 + 19); • Absolute maximum hammer energy of up to 5,000 kJ, although typically the maximum hammer energy will be considerably less than this and the absolute maximum hammer energy (i.e. up to 5,000 kJ) would not be required at all locations; • Maximum 8 hours piling duration per monopole, although average duration of piling is likely to be 2.5 hours per pile (including 30 minute soft start); • 24 hour pile driving (assumed to be one monopile installed per 24 hours but can up to two installed) • Maximum total duration of actual piling 2,888 hours (8 x 361); • Piling is likely to occur on 361 days phased over a 2.5 year piling phase (allowing for breaks between piling events and contingency days – both estimated as 24 hour periods); and • Concurrent piling using two vessels located at opposite ends of the site.	<u>Maximum design scenario: Construction vessels</u> Maximum design scenario provides for the greatest number of potential vessels associated with the construction phase and hence the highest likelihood of potential disturbance/displacement to bird species, as a result of multiple activities taking place over a 11 year offshore construction period. Maximum design scenario also reflects season and location with respect to a species abundance and vulnerability to an impact in the zone of influence i.e. seasonality distribution is considered as part of the sensitivity rating. <u>Maximum design scenario: Construction activity</u> Maximum Design Scenario provides for the greatest disturbance/displacement effects to bird species due to construction activities (magnitude and duration). **Maximum magnitude of piling** provides for the maximum increase in background noise levels generated over the largest area. Maximum diameter of pile and maximum number of simultaneous piling events provides for the maximum construction activity generated. Maximum separation distance provides the maximum spatial extent of construction activity impact (construction activity footprint area). All other foundation scenarios considered for WTGs (GBS, piled jackets and suction caisson jackets) would result in reduced levels of construction activity. **Maximum piling duration** provides for the maximum duration of disturbance / displacement to bird species. Maximum piling duration assumes active piling over 2.5 years over a six years construction period with piling being intermittent when using a three phase partially-parallel construction programme. All other foundation scenarios considered for WTGs (GBS, monopiles and suction caisson jackets) would result in reduced pile duration.

Potential impact	Maximum design scenario	Justification
	Offshore cables: • Installation of export cables will occur over a maximum duration of three years. The export cables could be installed in up to two phases with a gap of six years between phases. Therefore the maximum duration over which export cables could be installed is nine years. • Installation of 1,038 km of export cables (six cable trenches 173 km in length) within the cable route corridor. 30 m width of disturbance per cable where sandwave clearance is necessary, elsewhere 10 m width of disturbance per cable. • Installation of up to 850 km of array cables, 225 km of platform inter-connector cables. 30 m width of disturbance per cable where sandwave clearance is necessary, elsewhere 10 m width of disturbance per cable. <u>Maximum construction activity duration</u> • Foundations when using Jacket foundations with single piling • Piling of up to 342 4 m diameter jacket foundations (four piles per foundation), with up to 1,368 piles (342 x 4) in total; • Piling of up to 19 jacket foundations, up to 4 m diameter, for substations and platforms including: o Three offshore accommodation platforms (six legs with four piles per leg), with up to 72 piles (3 x 24) in total; o Twelve offshore HVAC collector substations (six legs with four piles per leg), with up to 288 piles (12 x 24) in total; and o Four offshore HVDC converter substations (72 piles per foundation) with up to 288 piles (4 x 72) in total. • Total number of pin piles 2,016 (1,368 + 72 + 288 + 288); • Maximum hammer energy of up to 2,500 kJ, although typically the maximum hammer energy will be considerably less than this, with only a proportion of the piles requiring the maximum hammer energy (i.e. up to 2,500 kJ); • Maximum 8 hours piling duration per pile although average duration of piling is likely to be 2.5 hours per pile (including 30 minute soft start); • Maximum total piling duration 16,128 hours of piling (8 x 2,016); • 24 hour pile driving (assumed to be four jacket piles but can be up to eight installed per 24 hours); • Piling is likely to occur on 433 days phased over a two and a half year piling phase (allowing for breaks between piling events and contingency days – both estimated as 24 hour periods); and • Single vessel piling only. Offshore cables: • Installation of export cables will occur over a maximum duration of three years. The export cables could be installed in up to two phases with a gap of six years between phases. Therefore the maximum duration over which export cables could be installed is nine years. • Installation of 1,038 km of export cables (six cable trenches 173 km in length) within the cable route corridor. 30 m width of disturbance per cable where sandwave clearance is necessary, elsewhere 10 m width of disturbance per cable.	

Potential impact	Maximum design scenario	Justification
	• Installation of up to 850 km of array cables, 225 km of platform inter-connector cables. 30 m width of disturbance per cable where sandwave clearance is necessary, elsewhere 10 m width of disturbance per cable.	
Indirect effects, such as changes in habitat or abundance and distribution of prey.	Temporary habitat loss: Total subtidal temporary habitat loss of up to 27,484,896 m^2 and total intertidal temporary habitat loss of up to 271,914 m^2 comprising the following: *Hornsea Three array area - Foundations* 736,440 m^2 temporary loss due to jack-up barge deployments for foundations for up to 361 structures (maximum design scenario assumes up to 342 7 MW turbines, up to 12 offshore HVAC collector substations, up to four offshore HVDC substations and up to three offshore accommodation platforms) assuming six spud cans per barge, 170 m^2 seabed area affected per spud can and two jack up operations per turbine (361 foundations x 6 spud cans x 170 m^2 per spud can x 2 jack ups); Up to a total of 4,351,094 m^2 of spoil from placement of coarse dredged material to a uniform thickness of 0.5 m (see justification, right) as a result of seabed preparation works prior to the installation of all GBFs. Comprising: • 1,289,682 m3 (3,771 m^3 x 342) from up 342 WTG foundation installation (2,579,364 m^2); • 735,000 m3 (61,250 m^3 x 12) from up to 12 offshore HVAC collector substations (1,470,000 m^2); • 139,552 m3 (34,888 m^3 x 4) from up to four HVDC substations (279,104 m^2); and • 11,313 m3 (3,771 m^3 x 3) from up to three accommodation platforms (22,626 m^2). *Hornsea Three array area - Cables* 8,500,000 m^2 from burial of up to 850 km of inter-array cables, by trenching, jetting, mass flow excavator, ploughing or vertical injection and similar tools currently under development (up to 10 m wide corridor). 2,250,000 m^2 from burial of up to 225 km of substation interconnector cables, by trenching, jetting, mass flow excavator, ploughing or vertical injection and similar tools currently under development (up to 10 m corridor). 215,000 m^2 from cable barge anchor placement associated with array and substation interconnector cable laying assuming: one anchor (footprint 100 m^2) repositioned every 500 m ((850,000 m + 225,000) x 1 x 100 m^2 / 500 m =215,000 m^2). Up to a total of 336,650 m^2 from placement of coarse dredged material to a uniform thickness of 0.5 m as a result of sandwave clearance within the Hornsea Three array area, assuming a volume of up to 168,325 m^3, placed on the seabed within the array. *Hornsea Three offshore cable corridor - Subtidal* 10,380,000 m^2 from burial of up to 1,038 km of export cable (up to six trenches of 173 km length) by trenching, jetting, mass flow excavator, ploughing or vertical injection and similar tools currently under development augmented by mobile sediment clearance and cable protection installation; up to 10 m width of seabed). 351,600 m^2 from cable barge anchor placement associated with cable laying for all subtidal export cables broken down as follows: • First 20 km of the Hornsea Three offshore cable corridor: Up to seven anchors	The maximum design scenario is represented by the largest footprint from the foundation structures (and associated scour protection) under consideration and hence greatest influence on habitat and physical processes, created by greatest number of turbines etc. Temporary habitat loss: The maximum design scenario presented is associated with HVDC transmission due to the larger foundation sizes associated with the offshore HVDC substations compared to the HVAC booster substations. Seabed preparation works prior to gravity base installation represents the maximum design scenario, with respect to spatial extent, for temporary habitat loss, compared to the temporary habitat loss associated with drill arisings resulting from jacket foundation installation. The area affected by the placement of material as a result of seabed preparation and sandwave clearance has been calculated based on the maximum volume of sediment placed across the entire Hornsea Three array area, assuming all this sediment is coarse material and therefore is placed on the seabed (i.e. is not dispersed through tidal currents; see "Temporary increases in suspended sediment concentrations" impact assessment below). The total area of seabed affected was calculated assuming a mound of uniform thickness of 0.5 m height. As detailed in volume 5, annex 1.1: Marine Processes Technical Report, the area of seabed affected by this scenario broadly aligns with the scenario of a cone shaped mound of 1.7 m maximum height (see Table 4.24 of volume 5, annex 1.1). Temporary loss of benthic habitat is assumed beneath this within the Hornsea Three array area. The maximum design scenario for temporary habitat loss has considered the burial of all subtidal cables, except where the necessary burial depth cannot be achieved. Temporary habitat loss within the entire Hornsea Three offshore cable corridor and temporary working area at the landfall has been considered as the maximum design scenario (including anchor placements), though direct impacts (i.e. excavation) will only occur within a proportion of these areas. *Drilling operations for foundation installation: Greatest sediment disturbance from a single foundation location* Drilling of individual turbine monopile foundations results in the release of relatively larger volumes of relatively fine sediment, at relatively lower rates (e.g. potentially leading to SSC effects over a wider area or longer duration), than similar potential impacts for bed preparation via dredging for individual gravity base foundations (which are separately assessed). The greatest volume of sediment disturbance by drilling, for both individual foundations and for the array as a whole, is associated with the largest diameter monopile and piled jacket foundations for substations in the array area. The volume of sediment released through drilling of other turbine and offshore accommodation platform foundation types (e.g. piled jackets) is smaller than for monopiles. The HVDC transmission system option (up to12 offshore HVAC collector substations and up to four offshore HVDC converter substations) results in the largest number of offshore HVDC substation foundations and the largest total volume of associated sediment disturbance in the array area compared to the HVAC transmission system option.

Potential impact	Maximum design scenario	Justification
	(footprint of 100 m^2 each) repositioned every 500 m for up to 6 export cables (20,000 m x 7 x 100 m^2 x 6 / 500 m = 168,000 m^2); and • Export cables beyond 20 km: one anchor (footprint of 100 m^2) repositioned every 500 m for up to 6 export cables ((173,000 m – 20,000) x 1 x 100 m^2 x 6 / 500 m = 183,600 m^2). Up to a total of 364,112 m^2 from placement of coarse, dredged material to a uniform thickness of 0.5 m as a result of sandwave clearance on the Hornsea Three offshore cable corridor, assuming a volume of up to 182,056 m^3, placed on the seabed within the Hornsea Three offshore cable corridor. *Hornsea Three offshore cable corridor - Intertidal* 43,363 m^2 from works to bury up to 500 m of cable length (from MHWS to MLWS) with up to six cable circuits (i.e. up to 3 km of export cable in the intertidal) by trenching (assuming habitat loss/disturbance within the entire corridor width). Some limited habitat loss/disturbance may also occur within the intertidal temporary working areas either side of the intertidal cable corridor (228,551 m^2) due to activities such as vehicle movements, anchor placement and the purposeful grounding of the cable laying barge. Offshore construction works in up to three phases within an offshore construction window of up to nine years. Works to install the export cable in the intertidal in up to four phases over the construction period. *Drilling operations for foundation installation: Greatest sediment disturbance from a single foundation location* Total sediment volume of 581,611 m^3 (113,104 + 253,338 + 193,962 + 21,207), comprising: 113,104 m^3 total spoil volume, from largest turbine monopile foundations (up to 160 monopiles), associated diameter 15 m, drilling to 40 m penetration depth, spoil volume per foundation 7,069 m^3, up to 10% of foundations may be drilled (160 x 10% x 7,069 m^3 = 113,104 m^3). 253,338 m^3 total spoil volume from largest offshore High Voltage Alternating Current (HVAC) collector substation piled jacket foundations (up to 12 foundations), 24 piles per foundation (six legs, four piles per leg), 4 m diameter, drilling to 70m penetration depth, spoil volume per foundation 21,112 m^3, up to 100% of foundations may be drilled (12 x 21,112 m^3 = 253,338 m^3). 193,962 m^3 total spoil volume from the largest offshore High Voltage Direct Current (HVDC) converter substation piled jacket foundations (up to four foundations), 72 piles per foundation (18 legs, four piles per leg), 3.5 m diameter, drilling to 70m penetration depth, spoil volume per foundation 48,490 m^3, up to 100% of foundations may be drilled (4 x 48,490 m^3 = 193,962 m^3). 21,207 m^3 total spoil volume from the largest offshore accommodation platform monopile foundations (up to 3 monopiles), associated diameter 15 m, drilling to 40 m penetration depth, spoil volume per foundation 7,069 m^3, up to 100% of foundations may be drilled (3 x 7,069 m^3 = 21,207 m^3). Up to two foundations may be simultaneously drilled, minimum spacing 1,000 m. Disposal of drill arisings at water surface. Construction phase lasting up to 11 years over two phases, with a gap of six years between the same activity.	*Dredging for seabed preparation for foundation installation: Greatest sediment disturbance from a single foundation location* Dredging as part of seabed preparation for individual gravity base foundation foundations results in the release of relatively smaller overall volumes of relatively coarser sediment, at relatively higher rates (e.g. leading to higher concentrations over a more restricted area), than similar potential impacts for drilling of individual monopile or piled jacket foundations (which are separately assessed above). The greatest sediment disturbance from a single gravity base foundation location is associated with the largest diameter or dimension gravity base foundation, which results in the greatest volume of spoil from a single foundation. Due to differences in both scale and number, gravity base foundations for turbines, electrical substations and offshore accommodation platforms are separately considered. The HVDC transmission system option (up to12 offshore HVAC collector substations and up to four offshore HVDC converter substations) results in the largest number of offshore HVDC substation foundations and the largest total volume of associated sediment disturbance in the array area compared to the HVAC transmission system option. Cable Installation Cable installation may involve ploughing, trenching, jetting, rock-cutting, surface laying with post lay burial, and/or surface laying installation techniques. Of these, mass flow excavation will most energetically disturb the greatest volume of sediment in the trench profile and as such is considered to be the maximum design scenario for sediment dispersion. Sandwave clearance may involve dredging or mass flow excavation tools. Of these, mass flow excavation will most energetically disturb sediment in the clearance profile and as such is considered to be the maximum design scenario for sediment dispersion causing elevated SSC over more than a very short period of time. Dredging will result in a potentially greater instantaneous local effect in terms of SSC and potentially a greater local thickness of sediment deposition, but likely of a shorter duration and smaller extent, respectively.

Potential impact	Maximum design scenario	Justification
	Dredging for seabed preparation for foundation installation: Greatest sediment disturbance from a single foundation location Total sediment volume of 1,827,287 m³ (935,200 + 735,000 + 139,552 + 17,535), comprising: 935,000 m³ total spoil volume from largest turbine gravity base foundation (up to 160 gravity base foundations), associated base diameter 53 m, associated bed preparation area diameter 61 m, average depth 2 m), spoil volume per foundation 5,845 m³ (160 x 5,845 = 935,000 m³). 735,000 m³ total spoil volume from largest offshore HVAC collector substation gravity base foundation (up to 12 gravity base foundations), associated base dimensions 75 m, associated bed preparation area dimensions 175 m, average depth 2 m, spoil volume per foundation 61,250 m³ (12 x 61,250 m³ = 935,000 m³). 139,552 m³ total spoil volume from largest offshore HVDC converter substation gravity base foundation (up to four gravity base foundations), associated base dimensions 90 x 170 m, associated bed preparation area dimensions 98 x 178 m, average depth 2 m, spoil volume per foundation 34,888 m³ (4 x 34,888 m³ = 935,000 m³). 17,535 m³ total spoil volume from largest offshore accommodation platform gravity base foundation (up to three gravity base foundations), associated base diameter 53 m, associated bed preparation area diameter 61 m, average depth 2 m), spoil volume per foundation 5,845 m³ (3 x 5,845 m³ = 17,535 m³). Disposal of material on the seabed within Hornsea Three. Dredging carried out using a representative trailer suction hopper dredger (11,000 m³ hopper capacity with split bottom for spoil disposal). Up to TBC dredgers to be working simultaneously, minimum spacing 1,000 m. Construction phase lasting up to 11 years over two phases, with a gap of up to 6 years between the same activity between phases. <u>Cable Installation</u> Cable installation comprising of: Array cables • Installation method: mass flow excavator; • Total length 850 km; • Installation of up to 850 km cables in a V-shape trench of width = 6 m and depth = 2 m; and • Sand wave clearance by dredging or mass flow excavation within the Hornsea Three array area. Substation interconnector cables • Installation method: mass flow excavator; • 15 in-project cables, total length 225 km; and • Installation of up to 225 km cables in a V-shape trench of width = 6 m and depth =2 m. Export cables • Up to six cable trenches; each 173 km in length (1,038 km in total); • Installation method: mass flow excavator;	

Potential impact	Maximum design scenario	Justification
	• Installation of up to 225 km cables in a V-shape trench of width = 6 m and depth =2 m; and • Sandwave clearance via either a dredger or mass flow excavator within the Hornsea Three offshore cable corridor. Construction phase lasting up to 11 years over two phases, with a gap of up to 6 years between the same activity between phases.	
The impact of pollution including accidental spills and contaminant releases which may affect species' survival rates or foraging activity.	Synthetic compound (e.g. from antifouling biocides), heavy metal and hydrocarbon contamination resulting from offshore infrastructure installation and up to 11,566 vessel movements during the construction phase: • 4,446 vessel movements over construction period based on gravity base foundations (self-installing concept); • Up to 3,420 vessel movements over construction period for WTG installation; • Up to 304 vessel movements over construction period for substations; • Up to 2,856 vessel movements over construction period for array cables; and • Up to 540 vessel movements over construction period for export cable. Water-based drilling muds associated with drilling to install foundations, should this be required. A typical offshore accommodation platform is likely to contain up to 10,000 l of coolant, up to 10,000 l of hydraulic oil and up to 3,500 kg of lubricates. Offshore fuel storage tanks: • One tank on each of the up to three offshore accommodation platforms for helicopter fuel and with a total capacity of up to 255,000 l across the entire wind farm; and • One on each of the up to three offshore accommodation platforms for crew transfer vessel fuel and each with a capacity of 210,000 l.	Parameters that create the greatest use of fuel, chemicals and hazardous waste offshore in the project area at any one time, that have the potential to spill into the marine environment. The accidental release of contaminants may directly affect birds or indirectly via their prey. Maximum vessel traffic movements will be associated with greatest turbine numbers (and associated infrastructure) and will cause highest risk of a pollution incident.
Operation phase		
The impact of physical displacement from an area around turbines (342) and other ancillary structures (up to twelve offshore HVAC collector substations, up to three offshore accommodation platforms and four offshore HVAC booster stations) during the operational phase of the development may result in effective habitat loss and reduction in survival or fitness rates.	Operation of maximum number of turbines (up to 342 WTGs), within the total wind farm area of 696 km^2, with a minimum of 1,000 m spacing. Operation of associated offshore HVAC transmission infrastructure (up to twelve offshore HVAC collector substations and four offshore HVAC booster stations (located within the offshore HVAC booster station search area) and up to three offshore accommodation platforms. Infrastructure placed up to the edge of Hornsea Three.	Provides for the maximum amount (spatial extent) of habitat loss due to physical displacement effects. For sensitive species, the wind farm as a whole will be avoided, whereas for others only individual turbines will be avoided while within the wind farm. Edge-weighted layout will potentially maximise area of sea rendered unavailable to birds.
The impact of indirect effects such as changes in habitat or abundance and distribution of prey.	Operation of maximum number of turbines (up to 342 WTGs). Operation of associated offshore HVAC transmission infrastructure (up to twelve offshore HVAC convertor substations, and four offshore HVAC booster stations (located within the offshore HVAC booster station search area) and up to three offshore accommodation platforms.	Provides for the greatest area of habitat loss or creates the greatest area of habitat e.g. artificial reef.
Mortality from collision with rotating turbine blades	Operation of maximum number of turbines (up to 342 WTGs). Rotor swept diameter up to a maximum of 185 m when the maximum number of turbines is used i.e. total rotor swept area for the project of 9.19 km^2, with the lowest rotor tip height of 34.97 m above the Lowest Astronomical Tide. Irregular distribution of the positioning of the foundations within the total wind farm area of 696 km^2, with a minimum of 1,000 m spacing.	Greatest rotor swept area plus parameters that maximise collision risk and therefore mortality rates for all species as the surface area available for collision increases. This is the turbine layout with the largest combined rotor swept area and collision probability, the latter at its highest when turbines are at maximum rotor speed and at the lowest tip height.

Potential impact	Maximum design scenario	Justification
The impact of barrier effects caused by the physical presence of turbines and ancillary structures may prevent clear transit of birds between foraging and breeding sites, or on migration.	Operation of maximum number of turbines (up to 342 WTGs). Rotor swept diameter up to a maximum of 185 m. when the maximum of turbines is used. Irregular distribution of the positioning of the foundations within the total wind farm area of 696 km^2, with a minimum of 1,000 m spacing. Operation of associated offshore HVAC transmission infrastructure (up to twelve offshore HVAC collector substations, and four offshore HVAC booster stations (located within the offshore HVAC booster station search area) and up to three offshore accommodation platforms,	Provides the maximum number of structures in the wind farm across the broadest front in relation to bird trajectory, to increase likelihood that birds will avoid individual turbines or the wind farm as a whole.
The impact of attraction to lit structures by migrating birds in particular may cause disorientation, reduction in fitness and possible mortality.	Operation of maximum number of turbines (up to 342 WTGs). Rotor swept diameter up to a maximum of 185 m when the maximum number of turbines is used. Randomised distribution of the positioning of the foundations within the total wind farm area of 696 km^2, with a minimum 1,000 m spacing. Operation of associated offshore HVAC transmission infrastructure (up to twelve offshore HVAC collector substations, and four offshore HVAC booster stations (located within the offshore HVAC booster station search area ())) and up to three offshore accommodation platforms. Lighting outward and not directional on all structures, maximised intensity and range to provide best visibility for aviation and shipping purposes. Red and white lighting, which has been shown to be more disorienting for migrating birds.	Provides the maximum number of structures in the wind farm, with maximum intensity and extent of red and white light sources to increase likelihood that birds will be attracted to structures and become disoriented or more susceptible to collision risk.
The impact of disturbance as a result of activities associated with maintenance of operational turbines, cables and other infrastructure may result in disturbance or displacement of bird species.	Up to 2,832 vessel return trips per year during operation and maintenance, including crew vessels wind turbine visits (2,433 return trips per year), supply vessels accommodation platform visits (312 return trips per year) and jack-up vessels (87 return trips per year over the design life of the project (i.e. 25 years). Up to 25,234 helicopter flights per year comprising of: • 22,572 wind turbine visits; • 1,102 platform visits; and • 1,560 crew shift transfers.	Option provides for the largest possible source of direct and indirect (prey species) disturbance from noise, vessel movements and other maintenance related activity over the longest time period.

Potential impact	Maximum design scenario	Justification
The impact of pollution including accidental spills and contaminant releases associated with maintenance or supply/service vessels which may affect species' survival rates or foraging activity.	Synthetic compound (e.g. from antifouling biocides), heavy metal and hydrocarbon contamination resulting from up to 342 turbines, up to 12 offshore HVAC collector substations, up to four offshore HVDC substations (or up to four offshore HVAC booster substations on the Hornsea Three offshore cable corridor) and up to three offshore accommodation platforms. Accidental pollution may also result from offshore refuelling for crew vessels and helicopters: i.e. up to 2,832 round trips to port by operational and maintenance vessels (including supply/crew vessels and jack-up vessels) and up to 25,234 round trips by helicopter per year over the 25 year design life. A typical 7 MW turbine is likely to contain approximately 1,300 l of grease, 20,000 l of hydraulic oil and 2,000 l of gear oil, 80,000 l of liquid nitrogen and 7,000 kg of transformer silicon/ester oil, 2,000 l of diesel and 13,000 l of coolant. A typical offshore accommodation platform is likely to contain up to 10,000 l of coolant, up to 10,000 l of hydraulic oil and up to 3,500 kg of lubricates. Offshore fuel storage tanks: • One tank on each of the up to three offshore accommodation platforms for helicopter fuel and with a total capacity of up to 255,000 l across the entire wind farm; and • One on each of the up to three offshore accommodation platforms for crew transfer vessel fuel and each with a capacity of 210,000 l. • Potential leachate from zinc or aluminium anodes used to provide cathodic protection to the turbines. Potential contamination in the intertidal resulting from machinery use and vehicle movement.	Parameters that create the greatest use of fuel usage, chemicals and hazardous waste offshore in the project area at any one time, that have the potential to spill into the marine environment. The release of contaminants may directly affect birds or indirectly via their prey. Maximum vessel traffic movements will be associated with greatest turbine numbers (and associated infrastructure) and will cause highest risk of a pollution incident.
Decommissioning phase		
The impact of direct disturbance and displacement due to underwater noise and vessel traffic may stop birds from accessing important foraging and habitat areas. The impact of indirect disturbance and displacement due to underwater noise and vessel traffic may stop prey species accessing important foraging and habitat areas.	Decommissioning of: • Up to 342 WTGs, 12 offshore HVAC collector substations, three offshore accommodation platforms, four offshore HVDC substations or four offshore HVAC booster stations (located within the offshore HVAC booster station search area ()); • Up to 1,038 km of export cable and 850 km array cables; and • Up to 11,566 vessel movements during the decommissioning phase.	Provides for the largest possible noise over the greatest spatial extent of the Project Three site, over the largest temporal scale.
The impact of indirect effects such as changes in habitat or abundance and distribution of prey.	Decommissioning of: • Up to 342 WTGs, 12 offshore HVAC collector substations, three offshore accommodation platforms, four offshore HVDC substations or four offshore HVAC booster stations (located within the offshore HVAC booster station search area ()); • Up to 1,038 km of export cable and 850 km array cables; and • Up to 11,560 return vessel trips for up to 153 vessels over the decommissioning phase.	Maximum footprint and hence greatest influence on physical processes, created by removal of greatest number of turbines. Impacts may be either positive or negative depending on habitat types created for prey species.
The impact of pollution including accidental spills and contaminant releases associated with removal of infrastructure and supply/service vessels may lead to direct mortality of birds or a reduction in foraging capacity.	Maximum design scenario is identical to that of the construction phase.	Maximum design scenario as per construction phase

5.9 Impact assessment criteria

5.9.1.1 The criteria for determining the significance of effects is a two stage process that involves defining the sensitivity of the receptors and the magnitude of the impacts. This section describes the criteria applied in this chapter to assign values to the sensitivity of receptors and the magnitude of potential impacts. The terms used to define sensitivity and magnitude are based on those used in the DMRB methodology, which is described in further detail in volume 1, chapter 5: Environmental Impact Assessment Methodology. These criteria have been adapted in order to implement a specific methodology for offshore ornithology. The general principle of determining impact significance from levels of sensitivity of the receptors and magnitude of effect is however consistent with DMRB. In this respect, the methodology used also follows the approach outlined by CIEEM (2010).

5.9.1.2 To determine the significance of an impact, a sequence of criteria are evaluated against each species and each impact:

- Receptor sensitivity – based on a combination of the conservation value of the species, the vulnerability of the species to each particular impact, and the recoverability of a species' population after being subject to a particular impact;
- Magnitude of impact – based on a combination of spatial extent (and therefore number of birds that may be affected), duration, frequency and reversibility in relation to reference populations (e.g. regional, national); and
- Significance – based on a combination of receptor sensitivity and magnitude to determine which effects on which species may be considered significant in EIA terms.

5.9.1.3 These three steps are described in sequence in the following sections.

Receptor sensitivity

5.9.1.4 With regard to offshore ornithology, the overall sensitivity rating (negligible to very high) is based on a combination of conservation value, vulnerability and recoverability.

5.9.1.5 The value/importance of each receptor is based on standard guidelines by CIEEM (2010) which places the conservation value of receptors within a geographical frame of reference (e.g. international, national, regional). This is based on standard guidance and available information, and the distribution and status of the ecological features being considered (e.g. qualifying interest of a nearby SPA).

5.9.1.6 Evaluation of the ornithological assemblage identified by the baseline studies has been assessed in relation to its conservation value over a full range of geographical scales as recommended by CIEEM (2010) and listed in Table 5.9. This has been used to determine each species' sensitivity in a regional, national or international context.

5.9.1.7 Attributing levels of vulnerability is a concept that has been used repeatedly within assessments of sensitivity of seabirds to offshore wind farms (e.g. Garthe and Hüppop, 2004; Furness *et al.* 2013; Wade et al, 2016; and is analogous to "sensitivity" defined by Langston, 2010). Vulnerability is species-and impact-specific and in broad terms, relates to the likelihood that individuals of a particular species will incur costs when subject to a particular impact (e.g. a reduction in productivity, fitness or survival rate). It assumes that vulnerability is an ecologically and behaviourally-derived value and that every individual of a particular species is subject to the same likelihood of adverse effect, independent of its population's size, trend or conservation value.

Table 5.9: Definition of terms relating to the conservation value of ornithological receptors.

Conservation value	Definition
Negligible	All species of lowest conservation status (e.g. Green-listed species listed on the Birds of Conservation Concern).
Local	Any other species of conservation status (e.g. Amber-listed species listed on the Birds of Conservation Concern) not covered in the categories below. A species which is present at Hornsea Three in numbers lower than 1% of the regional population.
Regional	Species listed on the Birds of Conservation Concern Red list; Species that are the subject of a specific action plan within the UK or are listed as Species of Principal Importance in England (Section 41 of the NERC Act 2006); and/or A species which is present within the Hornsea Three in numbers of greater than 1% of the regional population.
National	Species listed on Schedule 1 of the Wildlife and Countryside Act 1981 not already covered by international criteria; Bird species that form part of an SSSI that may potentially interact with the Hornsea Three site at some stage of their life cycle; At least 50% of the UK breeding or non-breeding population found in ten or fewer sites; An impact on an ecologically-sensitive species (<300 breeding pairs or <900 wintering individuals in the UK); and/or A species which is present within Hornsea Three site in numbers of greater than 1% of the national population.
International	Species listed on Annex 1 of the EU Birds Directive; Bird species that form part of a cited interest of an SPA or Ramsar site[2] that may potentially interact with Hornsea Three at some stage of their life cycle; At least 20% of the European breeding or non-breeding population is found in the UK; and/or A species which is present within Hornsea Three site in numbers of greater than 1% of the international biogeographic population.

[2] For the purposes of this assessment species listed on SPA assemblage criteria and not qualifying features in their own right, are treated identically and are awarded International conservation value.

5.9.1.8 For each impact considered (e.g. habitat loss, disturbance, collision risk), species' sensitivity also takes into consideration how vulnerable a species is to that impact, for example how flexible the species is in its habitat use or susceptibility to disturbance, based on classification by Wade *et al.* (2016). Where species or impacts are not covered by Wade *et al.*, (2016) other key literary sources on the impacts of offshore wind developments on birds are referenced (i.e. Langston, 2010; Maclean *et al.*, 2009; Garthe & Hüppop, 2004). In general, species are determined to be of low, medium or high vulnerability, based on their particular characteristics or requirements, relative to other seabird species.

5.9.1.9 The assessment of ornithological recoverability considers the ability of species' populations to return to their former status once background conditions return (i.e. when the effects of a particular impact cease, e.g. upon completion of the construction phase, or as birds habituate to an impact). It is thus important to evaluate the nature of the impact in terms of the duration required for recoverability, which is a factor of a species' natural productivity rate and background population trend in the absence of the impact.

5.9.1.10 Species with the potential to produce many young per year are considered to be able to recover more rapidly and hence to be at less risk than species that produce fewer young per year. This was determined using information on clutch size (average clutch size and maximum clutch size) and age at first breeding (as per Williams *et al.*, 1995 and Robinson, 2017). Species such as fulmar, gannet and guillemot that lay only one egg each year and do not breed until they are several years old have the lowest recoverability. Conversely seaduck have large clutches and usually commence breeding at two or three years of age, and so recoverability would be higher.

5.9.1.11 The second factor for recoverability is a species' population status (e.g. stable, declining) of for example, a regional breeding population, or during winter months for a national or flyway population.

5.9.1.12 Regional breeding status has been determined by comparing the trend in the populations of breeding colonies within mean maximum foraging range of Hornsea Three, between the Seabird 2000 survey results in Mitchell *et al.* (2004) and the most recent counts produced in JNCC's Seabird Monitoring Programme database (http://jncc.defra.gov.uk/smp/Default.aspx). Status of migratory/wintering populations has been determined at a broader national scale for each species, based on trends presented by JNCC (http://jncc.defra.gov.uk/page-1419).

5.9.1.13 Using these trends, the recoverability of a population can be determined. It was considered that a significantly increasing population (>25% increase) has a high recoverability, with a stable population (<25% change) rated medium, and a declining population (>25% decrease) rated as having a low recoverability (excluding differences in reproductive rate). In exceptional circumstances where the species' population would be at risk of extinction, there may be no ability for recovery.

5.9.1.14 Evaluation of the sensitivity of a species can therefore be assessed in relation to its conservation value over a range of geographical scales, its vulnerability to a particular impact, and recoverability based on population status and reproduction rate. Combined, this information can be used to determine each species' overall sensitivity to a particular impact using the definitions in Table 5.10. A summary of the overall sensitivity of the ornithological receptors considered for Hornsea Three is presented in Table 5.11. The sensitivities of the ornithological receptors and the location of individual impacts from Hornsea Three with respect to the abundance and distribution of species, as established in the baseline environment (Section 5.7), have been used together with expert judgement to select VORs for assessment for all individual impacts to be considered in this chapter.

5.9.1.15 Table 5.12 presents a summary of VORs selected for assessment for all individual impacts considered in this chapter. Whether a species is to be considered for an individual impact will be made on expert judgement when considering a combination of:

- Abundance of birds at Hornsea Three offshore ornithology study area and / or Hornsea Three offshore cable corridor is of a magnitude considered meaningful to consider an impact on the population;
- Species vulnerability to the impact; and
- Species use of Hornsea Three offshore ornithology study area and / or Hornsea Three offshore cable corridor e.g. for foraging, passage through on migration.

Table 5.10: Definition of terms relating to the overall sensitivity of ornithological receptors.

Sensitivity	Definition
Negligible	VOR is not vulnerable to the impact considered regardless of value/importance. VORs of Local value with low vulnerability and medium to high recoverability.
Low	VORs of Local value with moderate to high vulnerability and low recoverability. VORs of Regional value with low vulnerability and medium to high recoverability. VORs of National or International value with low vulnerability and high recoverability.
Medium	VORs of local value with high vulnerability and no ability for recovery. VORs of Regional value with moderate to high vulnerability and low recoverability. VORs of National or International value with moderate vulnerability and medium recoverability.
High	VORs of Regional value with high vulnerability and no ability for recovery. VORs of National or International value with high vulnerability and low recoverability.
Very High	VORs of National or International value with very high vulnerability and no ability for recovery.

Table 5.11: Information used to determine overall impact sensitivity of VORs, based on indications of conservation value, vulnerability and recoverability.

Species	Conservation value[c] (rationale)	Vulnerability (applicable across all phases of Hornsea Three) [d]					Factors potentially influencing recoverability					
		Collision	Displacement: structures	Displacement : vessels and helicopter	Barrier Effects	Habitat / prey interactions [i]	Clutch size and year of 1st breeding [e]	Mean-maximum/maximum foraging range (km) [f]	Regional breeding population (individuals)	Regional trend (2000-10)	National trend (2000-16) [g]	Overall recoverability
Red-throated diver	International (SPA)	Moderate	Very high	Very high	High	High	2 egg / 3 years	9 / 9	10,177 (non-breeding)	-	Not available	Medium
Common scoter	International (SPA)	Low	Very high	Very high	Moderate	High	6-8 egg / 2 years	8 / 200[10]	3,517 (non-breeding)[11]	-	Not available	Medium
Fulmar	International (SPA)	Very low	Very low	Very low	Low	Very low	1 egg / 9 years	400 / 580	11,745	+ 16%	- 31%	Low
Gannet	International (SPA)	High	High	Very low	Very low	Very low	1 egg / 5 years	229.4 / 590	24,988	+ 289%	+ 34%[k]	High
Arctic skua	International (population importance)	High	Very low	Very low	Low	Low	2 eggs / 4 years	62.5 / 75	0	-	- 64%	Low
Great skua	International (>20% of European pop[n] in UK)	High	Very low	Very low	Low	Low	2 eggs / 7 years	86.4 / 219	0	-	+ 18%	Medium
Puffin	International (SPA)	Very low	Moderate	Moderate	High	Moderate	1 egg / 5 years	105.4 / 200	1,960	-	Not available	Low
Razorbill	Regional (Breeding/post-breeding population importance)	Very low	High	Moderate	high	Moderate	1 egg / 4 years	48.5 / 95	0	+ 84%	+ 32%	High
Guillemot	Regional (Non-breeding population importance)	Very low	High	Moderate	High	Moderate	1 egg / 5 years	84.2 / 135	0	+ 40%	+ 5%	Medium
Common tern	International (population importance)	Moderate	Low	Low	Very low	Moderate	2-3 eggs / 3 years	15.2 / 30	0	-	- 10%	Medium
Arctic tern	International (population importance)	Moderate	Low	Low	Very low	Moderate	1-2 eggs / 4 years	24.2 / 30	0	-	- 17%	Medium
Kittiwake	International (SPA)	High	Low	Low	Low	Low	2 eggs / 4 years	60 / 120	102,002	- 47%	- 44%	Low
Little gull	National (Migratory species)	Moderate	Very low	Very low	Low	Moderate	2-3 eggs / 2-3 years	50 [b]	0	-	Not available	High
Lesser black-backed gull	Regional (Breeding population importance)	Very high	Low	Low	Very low	Very low	3 eggs / 4 years	141 / 181	4,544	+ 3%	Not available	Medium
Great black-backed gull	National (Non-breeding population importance)	Very high	Low	Very low	Low	Very low	2-3 eggs / 4 years	40 [a]	0	-	- 11%	Medium

Notes:

[a] maximum foraging range from Ratcliffe *et al.* (2000);

[b] maximum foraging range from seabird.wikispaces.com;

[c] SPA = qualifying species of an SPA either within foraging range during the breeding season or on migratory route;

[d] taken from Wade *et al.* (2016);

[e] taken from Robinson (2017);

[f] taken from Thaxter *et al.* (2012) unless otherwise stated;

[g] taken from JNCC (2016);

[h] Natural England (2014)

[i] Population estimated using foraging range buffer from Hornsea Three, including east coast populations only.

[j] Habitat/prey interactions is termed habitat flexibility by Wade *et al.* (2016).

[k] Change between censuses in 2003-04 and colonies surveyed in 2013-14 and 2015

[l] taken from Scottish Government (2011)

[m]Taken from Lawsen *et al.* (2016) for the Greater Wash (Bridlington Bay, East Yorkshire in the north, to where the Norfolk coast meets the Suffolk coast) only.

Table 5.12: Summary of VORs selected for assessment for all individual impacts considered in this chapter.

Species	Conservation value[a] (rationale)	Construction / Decommissioning			Operation					
		Disturbance/displacement (vessels activity / construction activity)	Indirect effects (prey species and habitat loss)	Pollution	Displacement	Indirect effects (prey or habitat availability)	Collision	Barrier Effects	Lighting	Disturbance (maintenance activities)	Pollution
Red-throated diver	International (SPA)	✓	✓	✓	×	✓	×	×	✓	✓	✓
Common scoter	International (SPA)	✓	✓	✓	×	✓	×	×	✓	✓	✓
Fulmar	International (SPA)	×	✓	✓	✓	✓	×	✓	✓	✓	✓
Gannet	International (SPA)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Arctic skua	National (SPA migrant)	×	×	×	×	✓	✓	✓	✓	×	×
Great skua	National (SPA migrant)	×	×	×	×	✓	✓	✓	✓	×	×
Puffin	International (SPA)	✓	✓	✓	✓	✓	×	✓	✓	✓	✓
Razorbill	Regional (Breeding/post-breeding population importance)	✓	✓	✓	✓	✓	×	✓	✓	✓	✓
Guillemot	International (SPA)	✓	✓	✓	✓	✓	×	✓	✓	✓	✓
Common tern	National (Annex 1, migrant)	×	×	×	×	✓	✓	✓	✓	×	×
Arctic tern	National (Annex 1, migrant)	×	×	×	×	✓	✓	✓	✓	×	×
Kittiwake	International (SPA)	×	✓	✓	×	✓	✓	✓	✓	×	✓
Little gull	National (Migratory species)	×	×	×	×	✓	✓	✓	✓	×	×
Lesser black-backed gull	Regional (Breeding population importance)	×	✓	✓	×	✓	✓	✓	✓	×	✓
Great black-backed gull	National (Non-breeding population importance)	×	✓	✓	×	✓	✓	✓	✓	×	✓

Notes:

[a] SPA = qualifying species of an SPA either within foraging range during the breeding season or on migratory route.

Magnitude

5.9.1.16 Magnitude of effect is the degree of change predicted to occur to the sensitive receptor and, for the purposes of this assessment, is largely based on the CIEEM (2010) guidance. This guidance offers a standardised ecological impact assessment approach, which has been tailored for this assessment using expert judgement. The factors taken into account when determining the magnitude of the impact are:

- Spatial extent;
- Duration (long (more than five years), medium (greater than one year and less than five years) or short term (less than one year));
- Frequency (whether the receptor is subject to the effect once, intermittently or continuously); and
- Reversibility (recovery from) of the effect.

5.9.1.17 These factors are combined to determine the scale of the change from baseline conditions ('no change' to 'high'), in relation to the conservation status of a particular feature (in this case a species' population size). The criteria for defining magnitude in this chapter are outlined in Table 5.13 below.

Table 5.13: Definition of terms relating to the magnitude of an impact upon ornithological receptors.

Magnitude	Definition
High	The proposal would affect the conservation status of the VOR with loss of ecological functionality. Recovery expected to be long term (i.e. 10 years) or irreversible following cessation of activity.
Medium	The VORs conservation status would not be affected, but the impact is likely to be significant in terms of ecological objectives or populations. Recovery expected to be medium term (i.e. 5 years) following cessation of activity.
Low	Minor shift away from baseline but the impact is of limited temporal or physical extent. Recovery expected to be short-term (i.e. 1 year) following cessation of activity.
Negligible	Very slight change from baseline condition. Any recovery expected to be rapid (i.e. ~ 6 months) following cessation of activity.
No change	No change from baseline conditions.

Significance

5.9.1.18 The significance of the effect upon offshore ornithology is determined by correlating the magnitude of the impact and the sensitivity of the VOR. The particular method employed for this assessment is presented in Table 5.14. Where a range of significance of effect is presented in Table 5.14, the final assessment for each effect is based upon expert judgement.

5.9.1.19 Here, the assessment of the significance of potential impacts on ornithological interests uses a matrix-based approach (Table 5.14) whereby the sensitivity of each species to an impact, and the corresponding magnitude of impact are cross-tabulated to quantitatively assess the significance of impacts. Significance is described as 'Substantial', 'Major', 'Moderate', 'Minor' or 'Negligible', or within a range (e.g. 'Minor - moderate').

Table 5.14: Matrix used for assessment of significance showing the combinations of receptor sensitivity and the magnitude of effect.

Sensitivity of receptor	Magnitude of Impact				
	No Change	Negligible	Low	Medium	High
Negligible	Negligible	Negligible	Negligible or minor	Negligible or minor	Minor
Low	Negligible	Negligible or minor	Negligible or minor	Minor	Minor or moderate
Medium	Negligible	Negligible or minor	Minor	Moderate	Moderate or major
High	Negligible	Minor	Minor or moderate	Moderate or major	Major or substantial
Very high	Negligible	Minor	Moderate or major	Major or substantial	Substantial

5.9.1.20 Where Natura 2000 sites (i.e. internationally designated sites) are considered, this chapter summarises the assessments made on the interest features of internationally designated sites as described within section 5.7.1 of this chapter (with the assessment on the site itself deferred to the RIAA for Hornsea Three).

5.9.1.21 With respect to nationally and locally designated sites, where these sites fall within the boundaries of an internationally designated site (e.g. SSSIs which have not been assessed within the RIAA for Hornsea Three), only the international site has been taken forward for assessment. This is because potential effects on the integrity and conservation status of the nationally designated site are assumed to be inherent within the assessment of the internationally designated site (i.e. a separate assessment for the national site is not undertaken). However, where a nationally designated site falls outside the boundaries of an international site, but within the study area, an assessment of the impacts on the overall site is made in this chapter using the EIA methodology.

5.9.1.22 The RIAA is currently being prepared in accordance with Advice Note Ten: Habitats Regulations Assessment Relevant to Nationally Significant Infrastructure Projects (PINS, 2016) and will be submitted as part of the Application for Development Consent. A draft RIAA will be available for consultation as part of this PEIR (Phase Two consultation). It should be noted that a conclusion drawn within this chapter of 'no significant effect' on regional, national or international populations of a given species does not rule out the conclusion of an adverse effect within the HRA process as the context of the assessment may differ.

5.10 Measures adopted as part of Hornsea Three

5.10.1.1 As part of the project design process, a number of designed-in measures have been proposed to reduce the potential for impacts on offshore ornithology (see Table 5.15). This approach has been employed in order to demonstrate commitment to measures by including them in the design of Hornsea Three and have therefore been considered in the assessment presented in section 5.11 below. These measures are considered standard industry practice for this type of development. Assessment of sensitivity, magnitude and therefore significance includes implementation of these measures.

5.11 Assessment of significance

5.11.1 Construction phase

5.11.1.1 The impacts of the offshore construction of Hornsea Three are being assessed on offshore ornithology. The environmental impacts arising from the construction of Hornsea Three are listed in Table 5.8 above along with the maximum design scenario against which each construction phase impact has been assessed.

5.11.1.2 A description of the potential effect on offshore ornithology receptors caused by each identified impact is given below.

Table 5.15: Designed-in measures adopted as part of Hornsea Three.

Measures adopted as part of Hornsea Three	Justification
Relevant HSE procedures will be followed for all activities during construction, operation and maintenance, and decommissioning periods.	When using consumables that are potentially hazardous, or refuelling offshore, relevant HSE procedures will be followed, with the objective of mitigating any risk of pollution incidents.
A Code of Construction Practice (CoCP) will be developed and implemented to cover the construction phase. A Project Environmental Management and Monitoring Plan (PEMMP) will be produced and followed. The PEMMP will cover the operation and maintenance phase of Hornsea Three and will include planning for accidental spills, address all potential contaminant releases and include key emergency contact details (e.g. Environment Agency, Natural England and Maritime and Coastguard Agency (MCA)). A Decommissioning Programme will be developed to cover the decommissioning phase..	Measures will be adopted to ensure that the potential for release of pollutants from construction, operation and maintenance, and decommissioning plant is minimised. In this manner, accidental release of contaminants from rigs and supply/service vessels will be strictly controlled, thus providing protection for birds and their prey species across all phases of the wind farm development.
Installation of appropriate lighting on wind farm structures.	Lighting of wind turbines will meet minimum requirements, namely as set out in the International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) Recommendation O-117 on 'The Marking of Offshore Wind Farms' for navigation lighting and by the Civil Aviation Authority in the Air Navigation Orders (CAP 393 and guidance in CAP 764). In keeping with the minimum legal requirements, this will minimise the risks of migrating birds becoming attracted to, or disorientated by turbines at night or in poor weather.
A minimum wind turbine hub-height of 127.47 m (above LAT) will be used for Hornsea Three. This provides for a lower blade tip height clearance of 34.97 m LAT.	This hub-height is considered appropriately conservative so as to minimise the risk of bird collisions.

The impact of construction activities such as increased vessel activity and underwater noise may result in direct disturbance or displacement from important foraging and habitat areas of birds.

5.11.1.3 Disturbance during the construction of a wind farm (visual presence, vessel activity and underwater noise) may displace birds from an area of sea, effectively amounting to habitat loss during the period of disturbance (Drewitt and Langston, 2006). Disturbance caused by construction activities may directly displace birds from foraging or loafing areas thus potentially affecting breeding productivity or survival rates of an individual or population. However, on several occasions during the construction of Lincs offshore wind farm gulls were clearly associated with the jack-up barge, the guard vessels and with the construction vessel while piling was in progress (RPS, 2012).

5.11.1.4 For each ornithological receptor, the increase in vibration and noise disturbance associated with human construction activities has been evaluated. This involves initially assessing the potential for displacement of mean peak densities within a particular extent around the disturbance source (e.g. piling activities) within Hornsea Three or along the cable route corridor, in the context of relevant regional, national, international or SPA populations due to construction activities.

5.11.1.5 In general, it is considered that effects are likely to last only for the duration of construction activity, and therefore will be direct, but temporary, reversible and short-term in nature for a specific event. The offshore components of Hornsea Three will occur over a maximum duration of 11 years, assuming a two phase construction scenario (Table 5.8). A gap of six years may occur between the same activity in different phases with in consequence the construction period considered of medium term duration. During the construction period, birds may return to areas when activities are not currently occurring. The largest impacts are likely to be due to irregular but intensive pile-driving activities which may cause extensive, intermittent noise and vibrations. Although effects of underwater noise associated with pile-driving activity are well known on cetaceans and fish (Madsen *et al.*, 2006), very little is known about the effects on seabirds.

5.11.1.6 The U.S. Department of the Interior (2004) concluded that noise from seismic studies might only impact those species that spend large quantities of time underwater. Bird species most likely to be vulnerable to underwater sound are those that forage by diving after fish or shellfish, and include auks, divers and seaduck. Gull and tern species feed at the surface only and are considered the least vulnerable.

5.11.1.7 Fulmar, gulls and skuas are opportunistic scavengers that like terns will forage within tens of metres of moving machinery, including vessels, and where feeding opportunities are recognised, close to humans when confident from experience to do so. On that basis together with consideration of their vulnerability to underwater noise, species therefore considered for this impact are common scoter, red-throated diver, gannet, guillemot, razorbill and puffin.

5.11.1.8 For the purposes of defining the conservation value of a VOR population for this assessment of Hornsea Three, a precautionary geographical extent of Hornsea Three offshore ornithology study area is used (Table 5.7). However it is recognised that smaller geographical scales are relevant (depending on an individual species vulnerability) within the assessment of displacement impacts (Natural England and JNCC, 2012). As previously mentioned (section 5.6.5), buffers taken forward to assessment of displacement impacts for Hornsea Three are the wind farm plus a 2 km buffer and the Export Cable Route plus a 2 km buffer (i.e. Hornsea Three offshore cable corridor) for all species.

Common Scoter

Magnitude of impact

5.11.1.9 No common scoter were recorded in aerial surveys undertaken across Hornsea Three offshore ornithology study area and as such, only displacement impacts associated with construction activities along the Hornsea Three export cable route are considered. The absence of common scoter in offshore areas is also supported by the results presented in Stone *et al.* (1995) with high densities of common scoter in inshore areas.

5.11.1.10 In order to calculate the magnitude of impact associated with construction activities associated with export cable installation survey data incorporated into Lawson *et al.* (2015) has been analysed in order to calculate the population of common scoter that may be affected. These surveys were undertaken during the wintering period (October to March) between 2002 and 2008 and covered the Greater Wash Area of Search, an area stretching from Bridlington Bay, East Yorkshire in the north and Great Yarmouth, Norfolk in the south, extending over 50 km offshore in some places (Figure 5.2).

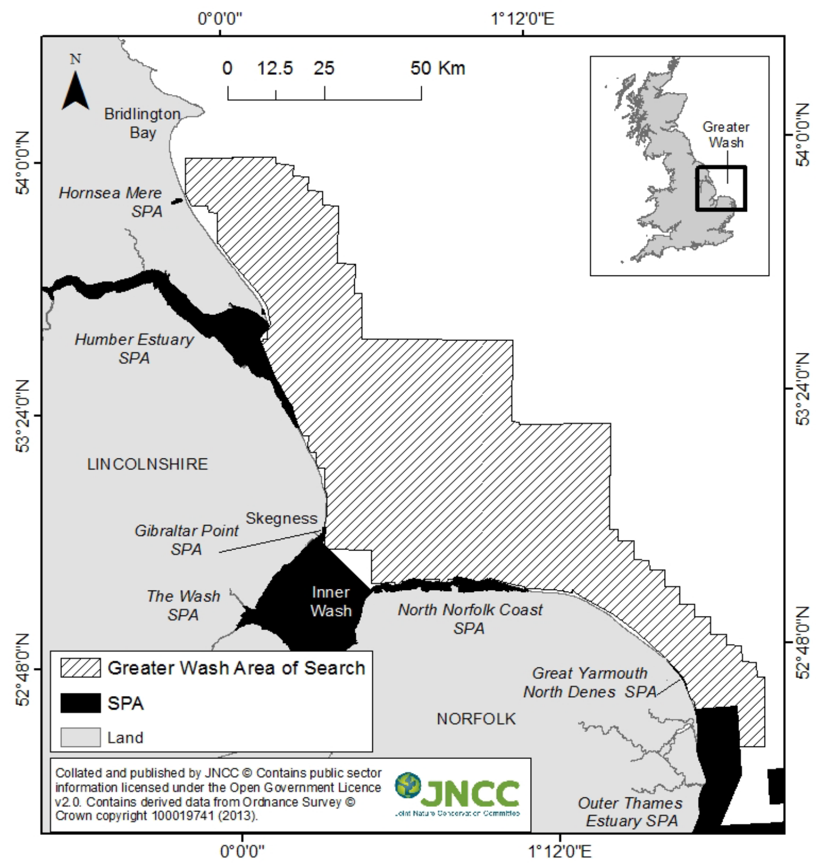

Figure 5.2: The Greater Wash Area of Search as defined in Lawson *et al.* (2015). (Source: Lawson *et al.*, 2015).

5.11.1.11 The main concentrations of common scoter in the Greater Wash Area of Search occur along the North Norfolk Coast and into The Wash, with densities of up to 56.6 birds/km^2 occurring in these areas (Figure 5.3). Densities of up to 0.002 birds/km^2 were present along the export cable route with this figure derived by interrogating the underlying data supporting the density map presented in Figure 5.3.

5.11.1.12 The effects associated with export cable installation are expected to be highly localised as cable laying vessels are slow moving during the installation of cables. Furthermore, cable laying activity will be intermittent and therefore any displacement will be temporary and short term in nature. The level of noise associated with offshore cable installation activity is low when compared to activities such as piling with the presence of vessels the main cause of disturbance. The area of habitat disturbed due to vessel movements (see paragraph 3.11.1.42 of volume 2, chapter 3: Fish and Shellfish Ecology) is considered to be very small in the context of the distribution of common scoter (i.e. limited to the immediate vicinity of where works are being carried out) within the Greater Wash Area of Search. This also holds true when including the vessel activities associated with the potential offshore HVAC booster stations located along the cable route (within the HVAC booster station search area). The cable route does not pass through areas that contain notable densities of common scoter with the highest density recorded only 0.002 birds/km^2 as derived from interrogating the underlying data supporting the density map presented in Figure 5.3.

5.11.1.13 Lawson *et al.* (2015) demonstrated that the distribution of common scoter in the Greater Wash Area of Search is limited and consistently restricted to specific areas. The Hornsea Three export cable route runs through the Greater Wash Area of Search making landfall at Weybourne on the North Norfolk coast, approximately 35 km east of the highest densities of common scoter which are located in the mouth of The Wash (Figure 5.3). It is worth noting that the export cable route runs through an area of high vessel activity associated with vessels travelling adjacent to the north-east coast of Norfolk (Figure 5.4). Shipping statistics for ports along the east coast of England between Berwick and Lowestoft indicate that in 2015 there were a total of 23,968 vessel arrivals into these ports, in addition there will many vessels moving through the Greater Wash Area of Search travelling towards ports in Scotland. The baseline therefore already represents an area of high disturbance thus further limiting the impact Project activity in this area will have.

5.11.1.14 The average density of common scoter within the Hornsea Three offshore cable corridor as calculated from the underlying data used in Figure 5.3 is significantly less than 0.01 birds/km^2. Even if it is assumed that displacement will occur throughout the entire Hornsea Three offshore cable corridor (1,168 km^2) at the same time, this would affect a population of less than one bird.

5.11.1.15 It should be noted that installation of export cables will occur over a maximum duration of three years. The export cables could be installed in up to three phases, however, for this assessment the maximum design scenario is considered to be construction in two phases with a gap of six years between phases. Therefore the maximum duration over which export cables could be installed is nine years (Table 5.8). A worst-case of displacement is considered to be limited to the area around construction activities within the Hornsea Three offshore cable corridor that will be transitory in nature. Numbers affected will depend on the overlap of such activity with food resources at any particular time. This is considered the worst case as a consequence of it being the scenario with the greatest gap between phases, two in this scenario and therefore the greatest temporal span disturbance events would occur. Other scenarios include the export cables being installed in one, two or three phases. Overall the impact is predicted to be of local spatial extent, medium term duration, intermittent and with high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be of **no change**.

<u>Sensitivity of the receptor</u>

5.11.1.16 Common scoters are considered to be particularly vulnerable to disturbance from ship traffic and are identified as one of the most sensitive species to disturbance (Wade *et al.*, 2016). Common scoters are known to aggregate in areas that have little shipping activity with the number of birds declining steeply with an increase in the level of shipping traffic (Kaiser *et al.*, 2002). The sensitivity to disturbance as defined by Wade *et al.* (2016) is based on the work by Kaiser *et al.* (2002), in particular the observations that common scoter flushed from a 35 m vessel at distances of 1000-2000 m for large flocks (26 observations) and <1000 m for smaller flocks (23 observations). Similar observations were also recorded by Schwemmer *et al.* (2011) with boats flushing birds over 1000 m distant.

5.11.1.17 Common scoter is deemed to be of very high vulnerability, moderate recoverability and international value. The sensitivity of the receptor is therefore, considered to be **high**.

<u>Significance of the effect</u>

5.11.1.18 Overall, it is predicted that the sensitivity of the receptor is considered to be high and the magnitude is deemed to be no change. The effect will, therefore, be of **negligible** adverse significance, which is not significant in EIA terms.

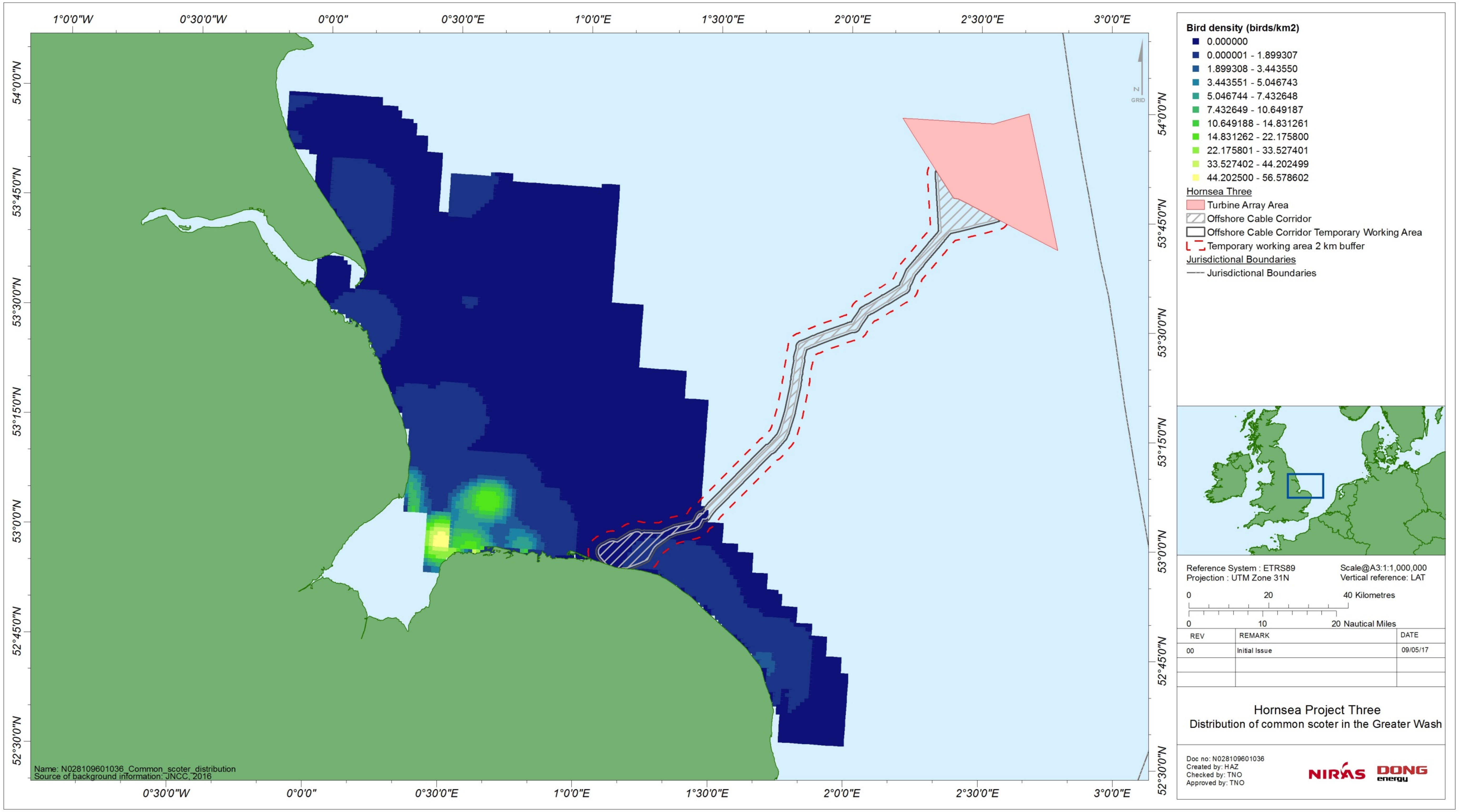

Figure 5.3: Distribution of common scoter in the Greater Wash.

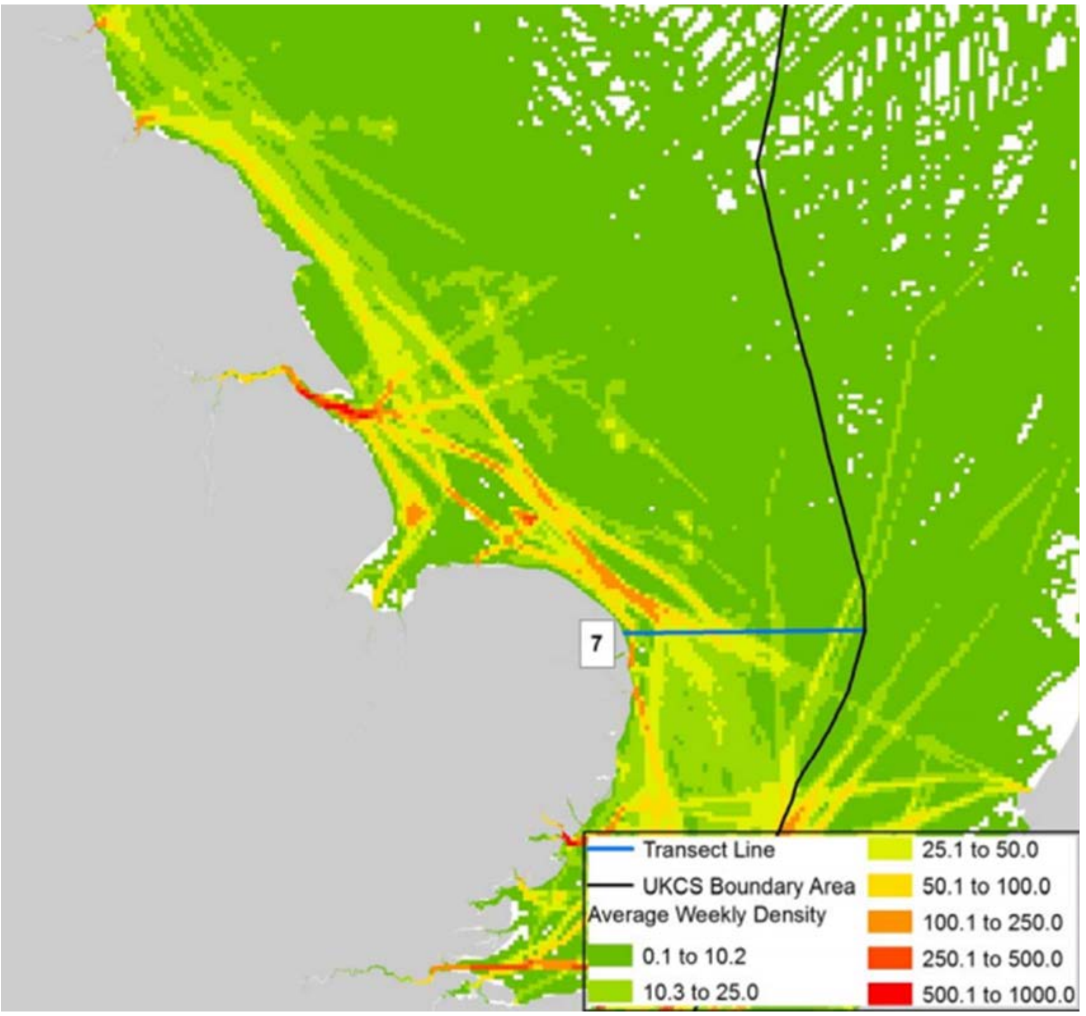

Figure 5.4: East coast vessel density and routes 2012 (Source: MMO, 2014).

Red-throated Diver

Magnitude of impact

5.11.1.19 As noted in in the assessment presented above for common scoter, the nature of cable laying activities (highly localised, slow moving vessel, low noise levels and limited spatial extent of impact) reduces the likelihood for impacts on red-throated diver.

5.11.1.20 The main concentrations of red-throated diver in the Greater Wash Area of Search are located off the north Norfolk coast and the Lincolnshire coast, around Gibraltar Point with densities of up to 3.38 birds/km^2 occurring in these areas (Table 5.4). The Hornsea Three cable route runs through an area of relatively low densities, when compared to densities elsewhere in the Greater Wash with densities of up to 0.51 birds/km^2 possible along the cable route (Table 5.4).

5.11.1.21 The maximum area from which red-throated divers could be displaced due to construction activities associated with the Hornsea Three export cable route is defined as a 2 km buffer around each of the vessels directly involved in the installation of the export cable. This equates to an area of 113.1 km^2 (2 km buffer around nine vessels) which is considered to be precautionary as each vessel will not be located 2 km or more from other vessels and disturbance areas are expected to overlap.

5.11.1.22 The density of red-throated diver within the Hornsea Three offshore cable corridor as calculated from the underlying data used in Figure 5.4 is 0.18 birds/km^2. If it is assumed that 100% of birds within the area in which construction activities will occur (113.1 km^2) are displaced, then using a bird density of 0.18 birds/km^2 it is predicted that 20 birds would be displaced during the installation of the export cable.

5.11.1.23 Following JNCC *et al.* (2017) interim guidance, a range of mortality rates have been applied to the displaced population of birds (Table 5.16). The regional population for red-throated diver is defined as the BDMPS population of red-throated diver that occurs in the south-west North Sea (10,177 birds) (Furness, 2015).

Table 5.16: Displacement mortality of red-throated diver along the Hornsea Three export cable route

Magnitude of impact	Mortality rate (%)			
	1	2	5	10
Displacement mortality (no. of birds)	0.20	0.40	1.00	1.99
% of regional population	0.00	0.00	0.01	0.02
% increase in baseline mortality	0.01	0.02	0.06	0.12

5.11.1.24 It should be noted that installation of export cables will occur over a maximum duration of three years. The export cables could be installed in up to two phases with a gap of six years between phases. Therefore the maximum duration over which export cables could be installed is nine years (Table 5.8). A worst-case of displacement is considered to be limited to the area around construction activities that will be transitory in nature within the Hornsea Three offshore cable corridor. Numbers affected will depend on the overlap of such activity with food resources at any particular time.

5.11.1.25 The impact is predicted to be of local spatial extent, medium term duration, intermittent and with high reversibility. It is predicted that the impact will affect the receptor directly although a very small number of individuals would be affected representing a limited fraction of the regional population. The magnitude is therefore, considered to be of **negligible**.

Sensitivity of the receptor

5.11.1.26 Red-throated diver is considered to be a species with a high sensitivity to vessel and helicopter disturbance (Wade *et al.*, 2016). Divers exhibit a degree of susceptibility to disturbance by flushing on approach by a vessel and the distance of displacement may be substantial (Ruddock and Whitfield, 2007).

5.11.1.27 Red-throated diver is deemed to be of very high vulnerability, moderate recoverability and international value. The sensitivity of the receptor is therefore, considered to be high.

Significance of the effect

5.11.1.28 Mortality rates associated with the disturbance of birds due to construction activities are unknown with no evidence that displacement by vessels will result in direct mortality of individual birds. Mortality as a consequence of displacement is more likely to occur as a result of increased densities outside of the impacted area, which may lead to increased competition for resources. Displacement of birds from low density areas (e.g. the area associated with the cable route) is less likely to result in mortality as these areas are likely to be of lower habitat quality. As such, the use of a 1% mortality rate is considered appropriate for this assessment.

5.11.1.29 Applying a 1% mortality rate results in a displacement mortality of less than one bird. This level of impact is considered to be of an insignificant magnitude in relation to the regional population of red-throated diver. Such a low level of displacement mortality represents less than 0.01% of the regional population of red-throated diver and only a 0.01% increase in the baseline mortality of this population. It is therefore considered that activities associated with the installation of the export cable do not have the potential to cause an effect that would significantly impact red-throated diver.

5.11.1.30 Overall, it is predicted that the sensitivity of the receptor is considered to be high and the magnitude is deemed to be negligible. The effect will, therefore, be of minor adverse significance, which is not significant in EIA terms.

Gannet

Magnitude of impact

5.11.1.31 As gannet is likely to be largely unaffected by disturbance, it is considered that the extent of any impact due to construction activities will extend no further than the close proximity (i.e. within no more than 500 m, based on deflection distances of birds in flight around turbines recorded by Krijgsveld *et al.*, 2011) around disturbance sources within Hornsea Three itself..

5.11.1.32 The peak population estimate within Hornsea Three offshore ornithology study area occurred during the breeding period with the highest peak of 1,140 individuals occurring in April. This corresponds to approximately 4.6% regional population (24,988 breeding adults). Hornsea Three array area with a 2 km buffer zone would then have a population of 790, which is equivalent to approximately 3.2% of the regional population.

5.11.1.33 Assuming even an unlikely worst-case of total displacement within Hornsea Three only, the impact is predicted to be of local spatial extent, medium term duration, intermittent, and with high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore considered to be low at a regional population scale (Table 5.7).

Sensitivity of the receptor

5.11.1.34 Gannet is of international conservation value as the population at Flamborough and Filey Coast pSPA is within mean maximum foraging range of Hornsea Three. The species' regional (which is identical to the pSPA population) and national populations are likely to be stable at least and so recoverability is rated medium, since productivity rates are low for this species.

5.11.1.35 In common with gulls and fulmar, gannet is likely to be largely unaffected by construction disturbance, being wide-ranging and seemingly tolerant of human activities at sea, with recent evidence showing that discards from fishing vessels form an important source of food for the species (Votier *et al.*, 2013). Indeed, Wade *et al.* (2016) consider gannet as being of very low vulnerability to displacement by vessels. As Wade *et al.* (2016) consider gannet as being of high vulnerability to displacement by structures, and construction does involve the building of structures at the start, for the purpose of this impact the species is deemed to be of low vulnerability to construction.

5.11.1.36 In summary, gannet is deemed to be of very low vulnerability (to e.g. construction vessels), high recoverability and international value. The sensitivity of the receptor is therefore, considered to be low.

Significance of the effect

5.11.1.37 Overall, it is predicted that the sensitivity of the receptor is considered to be low and the magnitude is deemed to be low. The effect will, therefore, be of negligible or minor adverse significance, which is not significant in EIA terms.

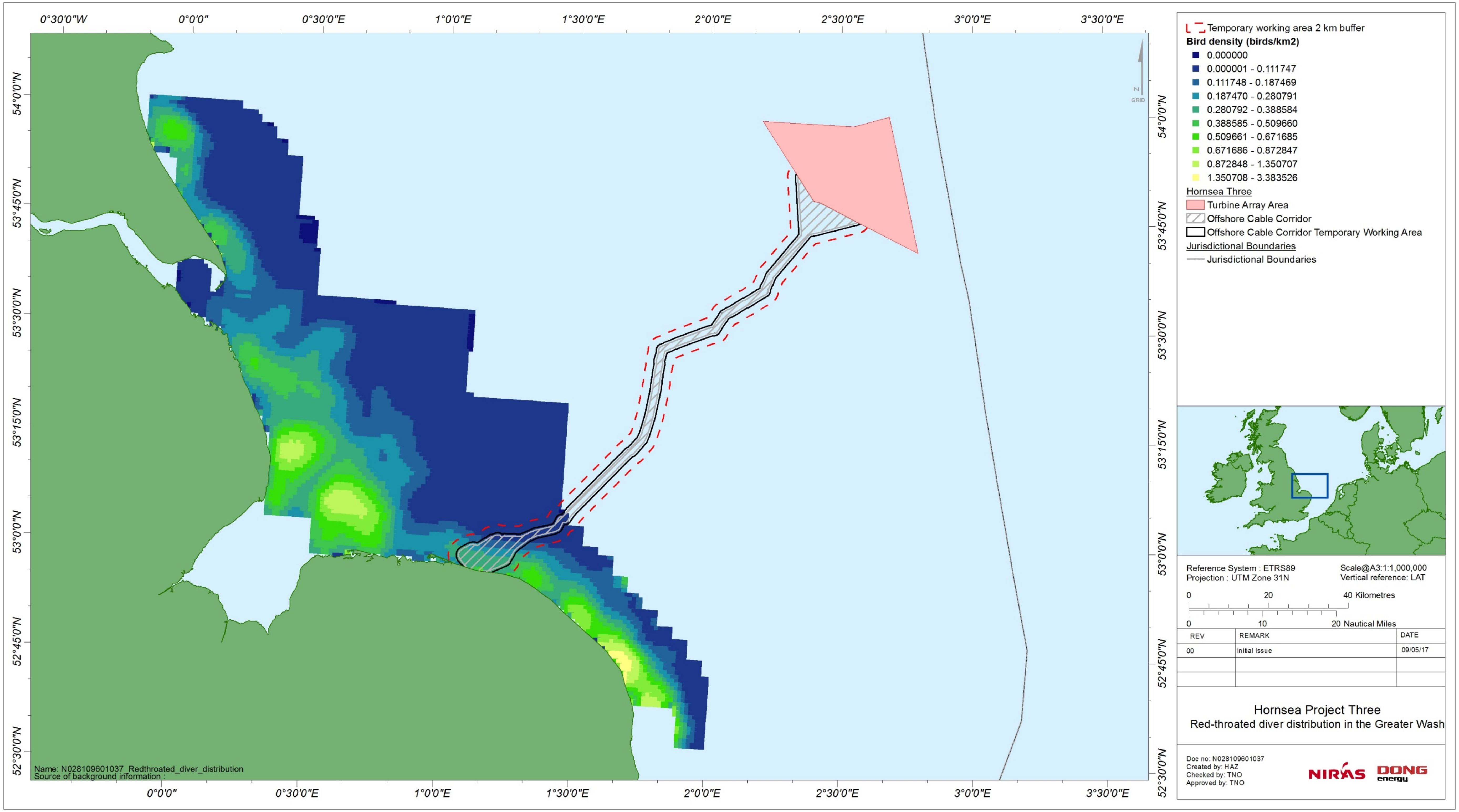

Figure 5.5: Red-throated diver distribution in the Greater Wash

Puffin

Magnitude of impact

5.11.1.38 JNCC *et al.* (2017) recommend to use for auks, an operational wind farms displacement buffer of 2 km. However considering the limited spatial relevance of construction disturbance with construction slowly moving out across the project, it is considered very unlikely that all birds will be displaced within Hornsea Three array area plus 2 km buffer, even if construction activity is concurrent at two locations. Puffin, in common with other auk species, may continue to forage beyond a 1 km buffer from temporary construction activities but may still be located within Hornsea Three since construction activities will take place only within a small area of the site at any time. It should also be noted that no gradient of impact of displacement level is applied to the 2 km buffer zone on the advice of JNCC *et al.* (2017), a precautionary approach that doesn't represent the reality of some degree of gradient on the closeness of approach by individual birds.

5.11.1.39 Cable installation may also disturb birds although this is generally considered to be of lower magnitude than foundation installation for example.

5.11.1.40 The highest mean peak estimate in Hornsea Three array area and 2 km buffer of 252 puffins occurred in May in the middle of the breeding season. This is equivalent to 12.9% of the Flamborough and Filey Coast (regional) breeding population (1,960 birds). Outside of the breeding season, abundance of puffin in Hornsea Three was relatively low amounting to a few tens of birds at most.

5.11.1.41 A worst-case of total displacement within Hornsea Three array area plus 2 km buffer is considered very unlikely. Wernham *et al.* (2002) indicate that puffins rarely congregate away from colonies and so any disturbance impacts would only affect a small number of individuals at any particular time. In addition, even if birds are displaced, the medium-term nature of this, and the availability of alternative habitat mean that this would be unlikely to result in a significant decline in productivity or survival at a population level, especially due to the long lifespan of the species.

5.11.1.42 The impact is predicted to be of local spatial extent, medium term duration, intermittent and with high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be low.

Sensitivity of the receptor

5.11.1.43 As a potential qualifying species of the Flamborough and Filey Coast SPA, puffin is considered to be an ornithological receptor of international conservation value within the context of Project Three. The species is deemed to be of moderate vulnerability to displacement (Wade *et al.*, 2016), although in comparison to other auks, the period of moult is much later in the winter, and may occur in the pre-breeding period.

5.11.1.44 Although there are no recent national trends available, puffin has experienced an apparent large decline in regional numbers, and so has a low recoverability potential.

5.11.1.45 Puffin is deemed to be of moderate vulnerability, low recoverability and international value. The sensitivity of the receptor is therefore, considered to be medium to high.

Significance of the effect

5.11.1.46 A disturbance impact of low magnitude on a medium to high sensitivity receptor such as puffin in the breeding season is predicted to produce (at worse case) a minor to moderate adverse effect on the regional population. For reasons outlined above (e.g. extensive availability of foraging habitat), this is considered to tend towards minor adverse which is not considered significant in EIA terms.

Razorbill

Magnitude of impact

5.11.1.47 Effects of construction disturbance on razorbill are currently unclear; for example during construction surveys at Lynn and Inner Dowsing there appeared to be no significant patterns of change in razorbill abundance between the wind farm and control sites (ECON, 2012).

5.11.1.48 Similar to puffin, it is considered that the extent of any disturbance due to construction activities is unlikely to extend to 2 km from source. Cable installation may also disturb birds although this is generally considered to be of lower magnitude than foundation installation for example.

5.11.1.49 The peak population estimates of razorbill within Hornsea Three occurred in the non-breeding period (November and December) with the highest mean peak monthly estimate of 3,782 razorbills occurring in November in Hornsea Three array area plus 2 km buffer. Compared to the non-breeding regional population estimate (218,622 birds), the peak population at Hornsea Three array area plus 2 km buffer represents an equivalent of 1.73%. The mean peak razorbill population estimate in the post-breeding season is equivalent of 0.10% of the defined regional population (591,874 individuals.)

5.11.1.50 Total displacement of razorbill within Hornsea Three array area plus 2 km buffer is considered to be very unlikely during the construction phase. The worst case for this assessment is more realistic assessed as displacement limited to the area around construction activities. The actual numbers of birds affected will depend on the location of food sources at a particular time, although the species is likely to be wide ranging once breeding ends (Cramp and Perrins, 1977 - 1994).

5.11.1.51 The impact is predicted to be of local spatial extent, medium term duration, intermittent and with medium reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be low at a regional population scale (Table 5.7) during the post-breeding period.

Sensitivity of the receptor

5.11.1.52 Regionally important populations of razorbill occurred within the Hornsea Three offshore ornithology study area during the non-breeding season. Hornsea Three is located outside of mean maximum (and maximum) foraging range from Flamborough and Filey Coast pSPA. Razorbill is considered to be a VOR of regional conservation value within the context of Project Three.

5.11.1.53 Due to its potential connectivity and concentration of breeding within a few colonies across the UK the species is considered to be of high vulnerability to displacement (Wade *et al.*, 2016), although it may be particularly sensitive during the post-breeding period during moult and when attending young. With a sizeable increase in national and regional populations over the last decade, but a low productivity rate, razorbill has medium recoverability potential.

5.11.1.54 Razorbill is deemed to be of high vulnerability, medium recoverability and regional value. The sensitivity of the receptor is therefore, considered to be **low to medium**.

Significance of the effect

5.11.1.55 A disturbance impact of low magnitude on a medium sensitivity receptor such as razorbill in the post-breeding season will produce a minor adverse effect on the regional population.

5.11.1.56 Although the sensitivity of razorbill may be high during the post-breeding period, and Hornsea Three may be of some importance to the species at this time, it is considered very unlikely that all birds will be displaced within Hornsea Three array area plus 2 km buffer, even if construction activity is concurrent at two locations. Razorbills are likely to continue to forage beyond the Hornsea Three boundary as a result of temporary construction activities and may also still be located within Hornsea Three. In addition, even if birds are displaced, the short-term nature of this and the availability of alternative habitat are unlikely to result in a significant decline in productivity or survival at a population level.

5.11.1.57 Overall, it is predicted that the sensitivity of the receptor is considered to be low to medium and the magnitude is deemed to be low. The effect will, therefore, be of **negligible to minor adverse** significance, which is not significant in EIA terms.

Guillemot

Magnitude of impact

5.11.1.58 Effects of construction disturbance on guillemots are currently unclear; for example during construction surveys at Lynn and Inner Dowsing there appeared to be no significant patterns of change in guillemot abundance between the wind farm and control sites (ECON, 2012). Leopold *et al.* (2010) found indications of disturbance to auks during some surveys at Egmond aan Zee, but numbers were too low to reach statistical significance.

5.11.1.59 Wade *et al.* (2016) report that auks may be disturbed by boats at several hundreds of metres distance although survey vessels have often approached to less than ten of metres before eliciting an evasion response (K. Neal pers. comm).

5.11.1.60 Like the other auks, it is considered that the extent of any disturbance due to construction activities is unlikely to extend to 2 km from source. Cable installation may also disturb birds although this is generally considered to be of lower magnitude than foundation installation for example.

5.11.1.61 The highest mean peak population estimate within Hornsea Three array area plus 2 km buffer occurred during the non-breeding period (December) but there was also a notable peak in June at the end of the breeding period. Birds may be particularly vulnerable at the end of the breeding period if they are undergoing moult and attending young and have restricted mobility. A mean peak breeding population of 12,140 birds was calculated in this period for Hornsea Three array area plus 2 km buffer (see volume 5, annex 5.1: Baseline Characterisation Report for population estimates at this scale). This is equivalent to around 0.64% of the national breeding population (1,900,000 individuals). A mean peak non-breeding population of 13,795 birds was calculated in this period for Hornsea Three array area plus 2 km buffer which is approximately 0.85% of the national breeding population of 1,617,306 individuals.

5.11.1.62 Considering that disturbance of the guillemot population within Hornsea Three array area plus 2 km buffer is very unlikely, and any disturbance will be localised within an area around the source (e.g. turbine installation or cable laying) and up to a 1 km buffer. Numbers affected will depend on the overlap of such activity with food resources at any particular time.

5.11.1.63 The impact is predicted to be of local spatial extent, medium term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **low** at a regional population scale (Table 5.7).

Sensitivity of the receptor

5.11.1.64 As a proposed qualifying species of the Flamborough and Filey Coast pSPA, guillemot is considered to be a VOR of international conservation value within the context of Project Three. The species is considered to be of high vulnerability to displacement (Wade *et al.*, 2016), and may be particularly sensitive during the post-breeding period during moult and when attending young at sea.

5.11.1.65 There has been an increase in regional and national populations over the last decade (+40% and +4% respectively), although as a single egg layer and late first breeder (Table 5.11), guillemot is considered to have a medium recoverability potential. The sensitivity of this receptor to this impact is therefore considered to be medium.

5.11.1.66 Guillemot is deemed to be of high vulnerability, medium recoverability and international value. The sensitivity of the receptor is therefore, considered to be **medium**.

Significance of the effect

5.11.1.67 Although the sensitivity of guillemots may be high at the end of the breeding period, and Hornsea Three being of some importance to the species at this time, it is considered very unlikely that all birds will be displaced within Hornsea Three array area plus 2 km buffer, even if construction activity is concurrent at two locations. Guillemots may continue to forage beyond a 1 km buffer from temporary construction activities but may still be located within Hornsea Three since construction activities will take place only within a small area of the site at any time. In addition, even if birds are displaced, the short-term nature of this and the availability of alternative habitat are unlikely to result in a significant decline in productivity or survival at a population level, with the wider previously defined former Hornsea Zone also being used consistently by guillemots (Smart Wind, 2015a).

5.11.1.68 Overall, it is predicted that the sensitivity of the receptor is considered to be medium and the magnitude is deemed to be low. The effect will, therefore, be of minor adverse significance, which is not significant in EIA terms.

Summary

5.11.1.69 A summary of the impact of disturbance/displacement due to construction activity on each VOR is presented in Table 5.17.

Table 5.17: Summary of impacts of disturbance/displacement due to construction activity on each VOR.

VOR	Sensitivity	Magnitude	Significance
Common scoter	High	No change	Negligible
Red-throated diver	High	Negligible	Minor adverse
Gannet	Low	Low	Negligible or minor adverse
Puffin	Medium to high	Low	Minor adverse
Razorbill	Low to medium	Low	Negligible or minor adverse
Guillemot	Medium	Low	Minor adverse

Indirect effects, such as changes in habitat or abundance and distribution of prey

5.11.1.70 The indirect impacts on seabird prey resource and habitats are detailed in Chapter 2: Benthic Ecology and Chapter 3: Fish and Shellfish Ecology. Principal impacts on these resources and habitats are likely to be as a result of construction noise and physical disturbance experienced during foundation, particularly piling activities, and cable installation.

5.11.1.71 Detailed assessments of the following potential construction impacts have been undertaken in chapter 3: Fish and Shellfish Ecology for key seabird prey species (including cod, sprat, herring, mackerel and sandeel species):

- Temporary habitat loss/disturbance from construction operations including foundation installation and cable laying operations;
- Increased suspended sediment concentrations as a result of foundation installation, cable installation and seabed preparation resulting in potential effects on fish and shellfish receptors;
- Sediment deposition as a result of foundation installation, cable installation and seabed preparation resulting in potential effects on fish and shellfish receptors; and
- Underwater noise as a result of foundation installation (i.e., piling) and other construction activities (e.g., cable installation) resulting in potential effects on fish and shellfish receptors

5.11.1.72 Details of the fish and shellfish ecology assessment are summarised in Table 5.18 justifications for this assessment will not be repeated in this chapter. Evidence, modelling and justifications for these assessments are provided in chapter 3: Fish and Shellfish Ecology.

Table 5.18: Significance of effects of construction impacts on fish and shellfish ecology.

Potential impact	Species	Significance of effect
Habitat loss/ disturbance	Sandeel and herring	Minor
	All other fish and shellfish species	Minor
Increased suspended sediment concentrations	Sandeel and herring	Minor
	All other fish and shellfish species	Minor
Sediment deposition	Sandeel and herring	Minor
	All other fish and shellfish species	Minor
Release of sediment contaminants	All fish and shellfish species	To be confirmed in the Environmental Statement
Underwater noise	Shellfish	Negligible
	Demersal finfish	Negligible
	Pelagic finfish	Negligible

5.11.1.73 An assessment of the significance of indirect effects on sensitive receptors (i.e. those resulting from the influence of construction activity on prey species) was made on the basis of knowledge of the prey species targeted by each species, as well as their level of inflexibility of habitat use (Garthe and Hüppop, 2004; Wade *et al.*, 2016). The results of these analyses were evaluated against the indirect impacts on seabird prey resource and habitats as detailed in Chapter 2: Benthic Ecology and Chapter 3: Fish and Shellfish Ecology, prior information from operational wind farms and specific information from surveys at Hornsea Three.

5.11.1.74 Direct habitat loss may result in removal or fragmentation of foraging or loafing habitat for particular species. For wind farm developments, this long-term habitat loss is generally relatively small, amounting to the area lost to turbine bases and associated infrastructure; typically <1% of the total development footprint (Drewitt and Langston, 2006), although short-term habitat loss associated with construction processes (see Table 5.8) may be larger.

5.11.1.75 The VORs fulmar, gannet, kittiwake, lesser black-backed gull, great black-backed gull, puffin, razorbill and guillemot, are included in the assessment of habitat loss in the construction phase.

Common Scoter

Magnitude of impact

5.11.1.76 No common scoter were recorded in aerial surveys undertaken across Hornsea Three offshore ornithology study area and as such, only indirect impacts on seabird prey resource and habitats associated with construction activities along the Hornsea Three export cable route are considered (5.6.5.15). The absence of common scoter in offshore areas is also supported by the results presented in Stone *et al.* (1995) with high densities of common scoter in inshore areas.

5.11.1.77 As presented above in paragraphs 5.11.1.13 and 5.11.1.14, the average density of common scoter within the Hornsea Three offshore cable corridor is significantly less than 0.01 birds/km^2. Even if it is assumed that the impact will occur simultaneously throughout the entire Hornsea Three offshore cable corridor (1,168 km^2) at the same time, this would affect a population of less than one bird.

5.11.1.78 It should be noted that installation of export cables will occur over a maximum duration of three years. The export cables could be installed in up to two phases with a gap of six years between phases. Therefore, the maximum duration over which export cables could be installed is nine years (Table 5.8). Numbers of common scoter affected will depend on the overlap of such activity with food resources at any particular time. Overall the impact is predicted to be of local spatial extent, medium term duration, intermittent and with high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be of no change.

Sensitivity of the receptor

5.11.1.79 Common scoters show limited flexibility in feeding habitats, being dependant on shallow feeding grounds with shellfish banks (Furness *et al.* 2012; Wade *et al.*, 2016). In consequence, the species is more likely to be adversely impacted by loss of habitat if construction activities take place within areas that they would otherwise use for foraging.

5.11.1.80 Common scoter is deemed to be of very high vulnerability, medium recoverability and international value. The sensitivity of the receptor is therefore, considered to be high.

Significance of the effect

5.11.1.81 Overall, it is predicted that the sensitivity of the receptor is considered to be high and the magnitude is deemed to be no change. The effect will, therefore, be of negligible adverse significance, which is not significant in EIA terms.

Red-throated Diver

Magnitude of impact

5.11.1.82 Red-throated diver qualified as a VOR in this assessment for only the Hornsea Three offshore cable corridor (5.6.5.15). As noted in in the assessment presented above for common scoter, the nature of cable laying activities (highly localised, limited vessel movement, low noise levels and limited spatial extent of impact) reduces the likelihood for impacts on red-throated diver.

5.11.1.83 As presented above in paragraphs 5.11.1.22, the average density of red-throated diver within the Hornsea Three offshore cable corridor is calculated from Lawsen *et al.* (2015) as 0.18 birds/km^2. If it is assumed that the impact will occur simultaneously throughout the entire Hornsea Three offshore cable corridor (1,168 km^2) at the same time, this would have the potential to impact 210 birds. However, it should be noted that export cable installation will be highly localised as cable laying vessels are slow moving during the installation of cables which will occur over a maximum duration of three years. The export cables could be installed in up to two phases with a gap of six years between phases. Therefore the maximum duration over which export cables could be installed is nine years (Table 5.8).

5.11.1.84 Numbers of red-throated diver affected will depend on the overlap of such activity with food resources at any particular time. Moreover the above mentioned spatial and temporal parameters of the cable installation together with the findings of chapter 3: Fish and Shellfish Ecology that the relevant significance of effects of construction impacts on prey species is no greater than minor, suggest any potential impact from construction being upon a much reduced number of red-throated diver than the 210 birds estimated in the entire Hornsea Three offshore cable corridor. This equally applies when also considering the construction activities associated with the potential offshore HVAC booster stations located along the cable route (within the HVAC booster station search area).

5.11.1.85 Overall the impact is predicted to be of local spatial extent, medium term duration, intermittent and with high reversibility. It is predicted that the impact will affect the receptor directly although a very small number of individuals would be affected representing a limited fraction of the regional population. The magnitude is therefore, considered to be of negligible.

Sensitivity of the receptor

5.11.1.86 Herring and sprat are amongst the most frequently recorded prey species of red-throated divers (Cramp & Simmons 1977 - 1994), although this species is considered to be an opportunistic feeder, taking a rather broad range of fish species (Guse *et al.,* 2009). The species however shows limited flexibility in feeding habitats, being dependant on shallow feeding grounds with shellfish banks (Furness *et al.* 2012; Wade *et al.*, 2016). In consequence, the species is amongst those more likely to be adversely impacted by loss of habitat if construction activities take place within areas that they would otherwise use for foraging.

5.11.1.87 Red-throated diver is deemed to be of very high vulnerability, medium recoverability and international value. The sensitivity of the receptor is therefore, considered to be high.

Significance of the effect

5.11.1.88 Overall, it is predicted that the sensitivity of the receptor is considered to be high and the magnitude is deemed to be negligible. The effect will, therefore, be of minor adverse significance, which is not significant in EIA terms.

Kittiwake

Magnitude of impact

5.11.1.89 In the maximum design scenario layout (Table 5.8), maximum long-term seabed habitat loss within Hornsea Three array area will be the total area of 342 turbine bases, plus other ancillary structures, and associated scour protection, to give a total habitat loss of 8.7 km^2. The total area affected will constitute 1.3% of the total area of Hornsea Three array area (696 km^2). However the significance of impacts on seabird prey resource and habitats from the effects of construction impacts, as detailed in Chapter 2: Benthic Ecology and Chapter 3: Fish and Shellfish Ecology (Table 5.18) are assessed at most as minor adverse, which is not significant in EIA terms.

5.11.1.90 The impact on kittiwake is therefore predicted to be of local to regional spatial extent, short to long term duration (cable route corridor versus turbine infrastructure), continuous and low to high reversibility (long-term turbine infrastructure versus temporary loss from cable installation). It is predicted that the impact will affect the receptor both directly and indirectly. Kittiwakes feed on mobile prey species such as herring and sandeels, and therefore the magnitude of habitat loss is considered to be negligible at a national population scale (Table 5.7).

Sensitivity of the receptor

5.11.1.91 The vulnerability of bird species to changes in habitat or abundance and distribution of prey depends on their foraging flexibility, in particular their specific habitat and dietary requirements. Wade *et al.* (2016) consider that kittiwake is of low sensitivity as birds forage across the continental shelf within the 200 m depth contour, and are extremely pelagic, particularly in winter months. This has been shown in recent studies by Fredericksen *et al.* (2012) for example, where birds range widely across the North Sea and Atlantic. Langston (2010) also rated the species as being of low vulnerability to habitat and prey interactions.

5.11.1.92 Kittiwake is an ornithological receptor of international conservation value within the context of Hornsea Three and has low recoverability potential due to regional and national declines. The sensitivity of the receptor to this impact is therefore considered to be low to medium, particularly during the winter period when numbers are augmented by continental birds and foraging will occur over a much wider area away from colonies.

Significance of the effect

5.11.1.93 Overall, it is predicted that the sensitivity of kittiwake is considered to be low to medium and the magnitude is deemed to be negligible. The effect will, therefore, be of a negligible or minor adverse effect on the regional population, which is not significant in EIA terms.

Auks

5.11.1.94 The auks (puffin, razorbill and guillemot) foraging behaviour and prey species are similar and therefore for the purposes of this assessment are considered together.

Magnitude of impact

5.11.1.95 Based on respective densities of guillemot and razorbill in comparison with the wider North Sea area, there is some evidence that Hornsea Three is of importance in at least a regional context during the non-breeding period (annex 5.1: Baseline Characterisation Report). Populations of guillemot and puffin were also found to be regionally important during the breeding season.

5.11.1.96 Auks may preferentially forage for sandeels, but they also obtain wide-ranging mobile prey species during this period. Whilst there may be intermittent displacement of prey from a region around the wind farm, there is no indication that the overall availability of prey for auk species will be reduced. It is expected that for those periods when auk peak abundance and construction activities coincide that auk species will redistribute themselves in relation to the availability of prey abundance. Although there is evidence that waters closer to the coast within the former Hornsea Zone are preferred in the breeding season at least (Smart Wind 2015b), in the absence of a complete dataset from Project-specific surveys to suggest otherwise, it is considered likely that there is no area of Hornsea Three that is of disproportionate importance.

5.11.1.97 The impact is predicted to be of local to regional spatial extent, short to long term duration (cable route corridor versus turbine infrastructure), continuous and low to high reversibility (long-term turbine infrastructure versus temporary loss from cable installation and piling activity). It is predicted that the impact will affect the receptor both directly and indirectly. The magnitude is therefore, considered to be negligible at a regional population scale (Table 5.7)l.

Sensitivity of the receptor

5.11.1.98 Auks feed mainly on sandeels, sprat and herring and typically forage offshore with inshore and pelagic feeding less common. Guillemot, razorbill and puffin were all classified as being of moderate vulnerability to habitat/prey interactions and therefore likely habitat loss by Wade *et al.* (2016).

5.11.1.99 Guillemot and razorbill are considered to be of regional conservation value (Table 5.11). While puffin is of international conservation value within the context of Hornsea Three.

5.11.1.100 Whilst it appears that both regional guillemot and razorbill populations have remained stable and even increased (signifying medium and high recoverability respectively for the species), the international puffin population appears to have significantly declined, indicating a low level of recoverability.

5.11.1.101 When considering the above factors, it is determined that the sensitivity of guillemot and razorbill is low to medium and for puffin it is medium to high.

Significance of the effect

5.11.1.102 Overall, it is predicted that the sensitivity of the receptor is considered to be low to medium or medium to high and the magnitude is deemed to be negligible. The effect will, therefore, be of negligible or minor adverse, or minor significance, which are both not significant in EIA terms.

All other species

5.11.1.103 This assessment is considering the indirect impacts on seabird prey resource and habitats at Hornsea Three and therefore is of minimal importance to species actively migrating and briefly transiting Hornsea Three. In the absence of a pathway for effect for migrant seabirds, the VORs considered for this potential impact are those species using The Hornsea Three offshore ornithology study area and The Hornsea Three offshore cable corridor i.e. fulmar, gannet, puffin, razorbill, guillemot, kittiwake, lesser black-backed gull and great black-backed gull.

Magnitude of impact

5.11.1.104 The magnitude of changes in habitat or abundance and distribution of prey, will be negligible compared to overall foraging range for each species, the impact is predicted to be of local to regional spatial extent, short to long term duration (cable route corridor versus turbine infrastructure), continuous and of low to high reversibility. It is predicted that the impact will affect each receptor directly and indirectly. The magnitude is therefore for all other ornithological receptors considered to be negligible.

Sensitivity of the receptor

5.11.1.105 For other ornithological receptors, the vulnerability to habitat/prey interactions was considered by Wade *et al.* (2016) (where it is termed habitat flexibility in this reference) as being very low for fulmar, gannet, lesser black-backed gull and great black-backed gull. Conservation value ranged from regional (lesser black-backed gull), national (great black-backed gull) to international (fulmar and gannet) and all four species are rated as having low (fulmar), high (gannet) or medium recoverability.

5.11.1.106 As a result, the sensitivity to changes in habitat or abundance and distribution of preyis considered to be low for gannet, lesser black-backed gull and great black-backed gull, as well as fulmar which is unlikely to reach moderate sensitivity due to the wide-ranging nature of the species.

5.11.1.107 These VORs are deemed to be of very low vulnerability and regional to international value. The sensitivity of the receptors is therefore, considered to be at most medium.

Significance of the effect

5.11.1.108 Overall, it is predicted that the sensitivity of these receptors will be medium at most and the magnitude is deemed to be negligible. The effect will, therefore, be of negligible or minor adverse significance, which is not significant in EIA terms.

Summary

5.11.1.109 A summary of the indirect impacted by impacts of habitat loss the during construction phases on each VOR is presented in Table 5.19.

Table 5.19: Summary of impacts of indirect effects, such as changes in habitat or abundance and distribution of prey on each VOR.

VOR	Sensitivity	Magnitude	Significance
Common scoter	High	No change	Negligible
Red-throated diver	High	Negligible	Minor adverse
Fulmar	Medium	Negligible	Negligible or minor adverse
Gannet	Low	Negligible	Negligible or minor adverse
Kittiwake	Low to medium	Negligible	Negligible or minor adverse
Puffin	Medium to high	Negligible	Minor adverse
Razorbill	Low to medium	Negligible	Negligible or minor adverse
Guillemot	Low to medium	Negligible	Negligible or minor adverse
Lesser black-backed gull	Low	Negligible	Negligible or minor adverse
Great black-backed gull	Low	Negligible	Negligible or minor adverse

The impact of pollution including accidental spills and contaminant releases which may affect species' survival rates or foraging activity

5.11.1.110 During construction, support vessels and machinery present will contain a fuel supply and lubricants which, in the event of an incident such as a collision, may be released into the surrounding sea. A maximum design scenario has identified oil, synthetic compounds, heavy metal and hydrocarbon contamination resulting from offshore infrastructure installation, and a maximum of 11,566 vessel movements within the area of proposed development by construction vessels over the longest construction phase duration (i.e. a maximum duration of 11 years, assuming a two phase construction scenario; Table 5.8).

5.11.1.111 The best available information indicates that the most frequently recorded spills from vessels offshore is associated with upsets in the bilge treatment systems and the losses are usually small. This type of partial inventory loss is likely to result in tens of litres being lost to the environment which is not considered to be significant at any level.

5.11.1.112 The worst-case spill from a single tank rupture in the large installation vessels would release diesel into the marine environment. This scenario is considered, however, to be very unlikely, particularly when mitigation measures are included, and so the assessment will take this likelihood into account when reaching levels of significance

5.11.1.113 Each turbine will contain components which require lubricants, coolant, diesel fuel and hydraulic oils in order to operate (Table 5.8). In addition, substations and accommodation platforms will require coolant, diesel fuel and hydraulic oils whilst there will also be a need for helicopter fuel to be stored across the wind farm. During the operation and maintenance phase, each turbine will undergo a routine service every year. As part of this process, hydraulic fluids, gearbox oils and lubricants will be replaced and solid consumables such as filters will be disposed of.

5.11.1.114 Although likelihood and risks are low, seabirds utilising the environment in the vicinity of a pollution incident may be vulnerable to either direct mortality from oil coverage preventing flight for example, or indirectly via a reduction in ability to forage.

5.11.1.115 Seasonality should be taken into account in the determination of significant effects through consideration of the peak period of bird presence in Hornsea Three.

5.11.1.116 The magnitude of the impact is dependent on the nature of the pollution incident but the Strategic Environmental Assessment carried out by DECC (2011c) recognised that, "*renewable energy developments have a generally limited potential for accidental loss of containment of hydrocarbons and chemicals, due to the relatively small inventories contained on the installations (principally hydraulic, gearbox and other lubricating oils, depending on the type of installation)*". Any spill or leak within the offshore regions of the Hornsea Three site would be immediately diluted and rapidly dispersed. The historical frequency of pollution events in the southern North Sea is low considering the density of existing marine traffic in the area. In addition, a number of designed-in measures outlined in Table 5.15 (e.g. Project Environmental Management and Monitoring Plan (PEMMP) and the Code of Construction Practice (CoCP)) will significantly reduce the likelihood of an incident occurring in either the offshore or intertidal construction areas that would result in accidental pollution.

5.11.1.117 A quantitative oil vulnerability index was developed by Williams *et al.* (1995), based on four factors, to assess the vulnerability of seabird species to surface pollution in the North Sea. These factors were: (a) the proportion which was oiled of each species found dead (or moribund) on the shoreline, and the proportion of time spent on the surface of the sea by that species: (b) the size of the biogeographic population of the species: (c) the potential rate of recovery following a reduction in numbers for each species; and (d) the reliance on the marine environment by each species.

5.11.1.118 Although populations of some species may have changed since the date of this study, it is still considered to generally reflect the relative vulnerability of each species to a pollution incident, and so is used for each VOR considered here.

5.11.1.119 This assessment is considering the impact of pollution which may affect species' survival rates or foraging activity at Hornsea Three and therefore is of minimal importance to species actively migrating when only briefly transiting Hornsea Three. In the absence of a pathway for effect for migrant seabirds, the VORs considered for this potential impact are those species using The Hornsea Three offshore ornithology study area and The Hornsea Three offshore cable corridor i.e. common scoter, red-throated diver, fulmar, gannet, puffin, razorbill, guillemot, kittiwake, lesser black-backed gull and great black-backed gull.

All receptors

Magnitude of impact

5.11.1.120 The magnitude of any incident is difficult to determine due to the unpredictability of such events, as well as the influence of seasonality and conditions.

5.11.1.121 Any impact on receptors within Hornsea Three is therefore considered likely to be of similar magnitude to those outlined in the effects of construction disturbance section, where appropriate. In the example case of guillemot, the highest estimated peaks occur in the non-breeding season. If the peak guillemot population within Hornsea Three array area plus 2 km buffer were affected due to an incident, this would result in the redistribution and/or direct mortality of up to 13,795 birds in the non-breeding period, which represents 0.85% of the regional non-breeding population (1,617,306 individuals). A smaller peak was predicted in the breeding season (12,140 birds), which represents 0.64% of the national breeding population (1,900,000 individuals).

5.11.1.122 With a number of designed-in measures as outlined in Table 5.15 implemented in full i.e. PEMMP and CoCP, complete mortality within the equivalent extent of the Hornsea Three array area plus 2 km buffer is considered very unlikely to occur, and a major incident that may impact any species at a population level is considered very unlikely. Given the likely size of potential pollution incidents (based on the volumes of any chemicals carried by one vessel) and the designed-in measures, the impact is therefore predicted to be of local spatial extent, short term duration, intermittent and high reversibility within the context of the regional populations. It is predicted that the impact will affect the receptor both directly and indirectly. The magnitude is therefore, considered to be no change at a regional population scale (Table 5.7), for all species.

Sensitivity of the receptor

5.11.1.123 The vulnerability of species to accidental spills and pollution incidents depends on their habitat flexibility in addition to their foraging behaviour and dietary requirements.

5.11.1.124 For surface feeders (as in fulmar and all gulls) direct mortality is considered to be of lower likelihood than for other species, and birds are able to forage widely to find alternative resources. In their assessment of seabird vulnerability to surface pollutants, Williams *et al.* (1995) considered fulmar to be of low vulnerability and therefore low sensitivity, ranking it 28th out of 37 seabird species. As surface feeders the sensitivity of lesser black-backed gull and great black-backed gull is also considered to be low.

5.11.1.125 Diving species that are also found for long periods on the sea surface (particularly during moult periods as in auks) are more likely to be affected. Guillemot survival rates on Skomer were negatively affected by the occurrence of major oil spills on their wintering grounds (JNCC, 2013). Williams *et al.* (1995) ranked the species as being medium to high vulnerability and therefore sensitivity, coming 14th out of 37 seabird species.

5.11.1.126 Gannet is a diving species, and so is considered to be relatively vulnerable to pollution incidents by Williams *et al.* (1995), being ranked 13th out of 37 seabird species. It is therefore considered to be of medium to high vulnerability and therefore sensitivity.

Significance of the effect

5.11.1.127 Based on an impact of whose magnitude for all receptors is no change, irrespective of the sensitivity of the receptor, a negligible adverse effect on the regional population is predicted which is not significant in EIA terms.

Summary

5.11.1.128 A summary of pollution impacts on each VOR is presented in Table 5.20.

Table 5.20: Summary of impacts of pollution including accidental spills and contaminant releases associated with rigs and supply/service vessels which may affect species' survival rates or foraging activity.

VOR	Sensitivity	Magnitude	Significance
Common scoter	Medium to high	No change	Negligible
Red-throated diver	Medium to high	No change	Negligible
Fulmar	Low	No change	Negligible
Gannet	Medium to high	No change	Negligible
Puffin	Medium to high	No change	Negligible
Razorbill	Medium to high	No change	Negligible
Guillemot	Medium to high	No change	Negligible
Kittiwake	Low to medium	No change	Negligible
Lesser black-backed gull	Low	No change	Negligible
Great black-backed gull	Low	No change	Negligible

Future monitoring

5.11.1.129 The requirements for pre-construction monitoring have not yet been discussed but further information will be provided in the final application.

5.11.2 Operational and maintenance phase

5.11.2.1 The impacts of the offshore operation and maintenance of Hornsea Three have been assessed on offshore ornithology. The environmental impacts arising from the operation and maintenance of Hornsea Three are listed in Table 5.8 along with the maximum design scenario against which each operation and maintenance phase impact has been assessed.

5.11.2.2 A description of the potential effect on VORs caused by each identified impact is given below.

The impact of physical displacement from an area around turbines (342) and other ancillary structures (up to twelve offshore HVAC collector substations, up to three offshore accommodation platforms and four offshore HVAC booster stations) during the operational and maintenance phase of the development may result in effective habitat loss and reduction in survival or fitness rates.

5.11.2.3 The displacement effects attributable to wind farms are considered to be highly variable and are species, season, and site-specific. As displacement effectively leads to exclusion from areas of suitable habitat, it can be regarded as being similar to habitat loss in its effect on birds, although it may be more spatially extensive.

5.11.2.4 The biological consequences of such displacement and any resultant population-level effects will depend on the importance of the area from which birds are displaced and the capacity of alternative habitats to support these displaced birds. Migratory species are unlikely to find the area particularly important unless it is recognised as an important staging area, whereas impacts may be more acutely felt if a loss of prime foraging habitat for a breeding colony results.

5.11.2.5 The period of time and constancy that individuals within a population may be subject to displacement impacts is uncertain. It is likely that the impacts will be felt at greatest intensity during the first year of exposure, before there is any opportunity for habituation. Mortality is likely to be greatest in this year while in subsequent years it is possible that birds may become habituated to a certain extent, thereby reducing mortality rates. However, if the population has a large number of non-breeding 'floaters' then mortality rates may stay at similar levels for a number of years until this pool is used up.

5.11.2.6 If this is the case then absolute mortality may be lower in subsequent years because the population reaches an equilibrium as the result of previous loss of habitat available for foraging. In the long-term the impact is potentially more likely to result in a decrease in productivity rather than an additive annual mortality that has been predicted here, and so these predicted values of annual mortality should not be summed to make total mortality across the lifespan of the project.

5.11.2.7 Disturbance by operating wind turbines can exclude birds from suitable breeding, roosting, and feeding habitats around a larger area than otherwise would occur through direct habitat loss (Exo *et al.*, 2003; Petersen *et al.*, 2006; Maclean *et al.*, 2009). Although some species show little avoidance, others such as divers, auks and pelagic birds may not fly or forage within hundreds of metres of the turbines (Kerlinger and Curry, 2002).

5.11.2.8 Comparatively, some gull species, cormorant and terns have generally shown little avoidance to wind farms and for instance were seen regularly foraging within the Egmond aan Zee offshore wind farm (Krijgsveld *et al.*, 2010; 2011). Post-construction surveys at Ormonde Offshore Wind Farm in the north-east Irish Sea inferred an 'attractive' effect of the turbines on kittiwake as abundance was significantly higher compared to control areas (CMACS, 2014). Displacement effects are therefore likely to be minimal on these species.

5.11.2.9 A study at Tuno Knob, in Denmark, reported effects on nocturnal flights of eiders out to 1,500 m from turbines (Tulp *et al.*, 1999). Conversely, other studies at operational wind farms have not observed significant effects on the abundance or distribution of local seabirds (Leopold *et al.*, 2010; Barrow Offshore Wind Ltd., 2009). With the exception of red-throated diver, monitoring at Kentish Flats also reported no avoidance behaviour (Percival, 2009; 2010). It has been postulated that other natural environmental variables were the driver for any observed effects, as well as the influence of fishing vessels on some species (particularly gulls) (e.g. Leopold *et al.*, 2011).

5.11.2.10 In general, migrants appear to be more obviously displaced than local resident birds, likely due to the lack of habituation of birds passing briefly through the area (Petersen *et al.*, 2004; Petersen, 2005). Habituation is likely to occur for some species once turbines are operational and human activity is reduced. A study conducted at Blyth Harbour in Northumberland showed that eiders and other birds did habituate to the turbines so that impacts were not considered significant (Lowther, 2000). Seaducks initially avoided the Horns Rev Offshore Wind Farm, but later assembled between turbines, possibly after successful recruitment of benthic prey (Petersen and Fox, 2007).

5.11.2.11 Significant degrees of precaution are built into the assessment of displacement effects During discussions with JNCC and Natural England, and based on JNCC *et al.* (2017) interim guidance it was agreed that in order to assess the displacement effect the current assessment uses the mean peak number of birds recorded within Hornsea Three (plus an appropriate buffer) during appropriate seasons defined for each VOR. The mean peak number (i.e. the mean of the highest population estimates within a particular season, which do not necessarily occur within the same month each year) is considered sufficiently precautionary for the realistic worst-case. It is considered likely that displacement responses by seabirds are highly likely to decline the further distant from the disturbance source. A notable example of this was recorded for red-throated divers at Kentish Flats Offshore Wind Farm (Percival, 2010). However, in general, species specific information is lacking on geographically defined displacement rates and therefore on a precautionary basis a consistent displacement rate is applied through Hornsea Three array area plus 2 km buffer.

5.11.2.12 Within this assessment of operational displacement, VORs considered are fulmar, gannet, guillemot, razorbill and puffin. Full displacement matrices for each biological season are presented in Annex 5.2: Analysis of displacement impacts on seabirds. Buffers taken forward to impact assessment for Hornsea Three are the wind farm plus a 2 km buffer for all species (see paragraph 5.6.5.15). Section 5.6.5 presents proposed rates for displacement and mortality for VORs which form the focus of this assessment.

Fulmar

Magnitude of impact

5.11.2.13 Fulmar has undergone one of the most dramatic expansions in range and population of any UK breeding seabird in recent years (Brown and Grice, 2005; Forrester *et al.*, 2007). Fulmars feed on a wide diversity of food including planktonic crustacean, cephalopods and small fish (Cramp and Perrins, 1977).

5.11.2.14 Fulmar have an extensive foraging range with Hornsea Three only representing a small percentage of the available foraging area, as defined by the mean-maximum foraging range of 400 km from their breeding colonies (Thaxter *et al.*, 2012). They are a highly pelagic seabird and foraging trips can last up to 30 hours (Furness and Todd, 1984).

Breeding season

5.11.2.15 The mean peak fulmar population estimate within Hornsea Three array area plus 2 km buffer during the main breeding season (April to August) was 1,375 birds. Based on a mortality rate of 2% during the breeding season (due to the large foraging range of the species providing sufficient alternative foraging opportunities) and 30% displacement, eight individuals may be lost as a result of displacement (Table 1.5 of Annex 5.2: Analysis of displacement impacts on seabirds).

5.11.2.16 This predicted level of mortality surpasses the threshold 1% of baseline mortality of the regional breeding population although the impact is on an extremely small proportion of the regional population. The impact of displacement on fulmar during the breeding season is predicted to be of regional spatial extent, long term duration, continuous and of medium reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **low**.

Post-breeding season

5.11.2.17 During the post-breeding season (September to October) the mean peak population estimate within Hornsea Three array area plus 2 km buffer was 1,096 birds. Based on a mortality rate of 1% (due to the larger distributional range of the species during this season providing sufficient alternative foraging opportunities), three individuals may be lost as a result of displacement. This predicted low level of mortality does not surpass 1% of baseline mortality of the regional post-breeding population (Table 1.6 in Annex 5.2: Analysis of displacement impacts on seabirds).

5.11.2.18 The impact of displacement on fulmar during the post-breeding season is predicted to be of local spatial extent, long term duration, continuous and of high reversibility involving only a small number of individual birds representing a limited proportion of the regional population. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **negligible**.

Non-breeding season

5.11.2.19 During the non-breeding season (November) the mean peak population estimate Hornsea Three array area plus 2 km buffer was 273 individual fulmar. Based on a mortality rate of 1% (due to the very large distributional range of the species providing sufficient alternative foraging opportunities), one individual may be lost as a result of displacement. This predicted level of mortality does not surpass 1% of baseline mortality of the regional non-breeding population (Table 1.7 in Annex 5.2: Analysis of displacement impacts on seabirds).

5.11.2.20 The impact of displacement on fulmar during the non-breeding season is predicted to be of local spatial extent, long term duration, continuous and of high reversibility involving only a small number of individual birds representing a limited proportion of the regional population. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **negligible**.

Pre-breeding season

5.11.2.21 The mean-peak population estimate in the pre-breeding season (December to March) was 778 fulmar. Based on a mortality rate of 1% (again based on the larger distributional range of the species providing foraging opportunities), two individuals may be lost as a result of displacement. This predicted level of mortality does not surpass 1% of baseline mortality of the regional pre-breeding population (Table 1.8 in Annex 5.2: Analysis of displacement impacts on seabirds).

5.11.2.22 The impact of displacement on fulmar during the pre-breeding season is predicted to be of local spatial extent, long term duration, continuous and of high reversibility involving only a small number of individual birds representing a limited proportion of the regional population. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be negligible.

Sensitivity of the receptor

Fulmar is considered to be of international conservation value as a result of Hornsea Three being in mean maximum foraging range of Flamborough and Filey Coast pSPA, Fowlsheugh SPA and Forth Islands SPA. With a regional and national population trend likely to be at relatively stable, but with low productivity rate, the species' recoverability is considered low. Behaviourally, fulmar was considered to be of very low vulnerability by Wade *et al.* (2016) to displacement. In summary, fulmar is deemed to be of very low vulnerability, low recoverability and international value. The sensitivity of the VOR is therefore, considered to be medium

Significance of the effect

5.11.2.23 Overall, it is predicted that the sensitivity of the receptor is considered to be medium and the magnitude is deemed to be negligible - low. The effect will, therefore, be of negligible – minor adverse significance, which is not significant in EIA terms.

Gannet

Magnitude of impact

5.11.2.24 Despite the wide foraging range of the species, Krijgsveld *et al.* (2010; 2011) have shown that gannets in flight strongly avoid wind farms, albeit relatively close to turbines (within 500 m). A displacement value of 70% from the Hornsea Three array area plus 2 km buffer during the breeding and non-breeding seasons (post-breeding and pre-breeding seasons) is highlighted for focus in terms of the impact assessment for gannet. A lower displacement rate (50%) was estimated from raw data for the first year of operation at Robin Rigg Offshore Wind Farm (Walls *et al.*, 2013). Simple modelling found a decrease in numbers on the sea (pre vs. post-construction) but not for birds in flight.

5.11.2.25 In each of the three years 2010-2012, adult gannets from Bempton Cliffs, a component of the pSPA, were fitted with satellite tags by RSPB to investigate their foraging ranges during chick-rearing and early post-breeding periods. This was undertaken in order to establish whether there was overlap with any proposed Round 3 Zones (Langston, Teuten and Butler, 2013). The study had the following objectives: to determine foraging ranges, flight directions, and foraging destinations of adult gannets from the breeding colony at Bempton Cliffs; to determine whether adult gannets from Bempton Cliffs forage within or pass through, on their way to foraging locations, the Round 3 zones of Dogger Bank, Hornsea and East Anglia; and to seek to obtain a measure of relative importance of the sea areas used.

5.11.2.26 The three seasons of study, in 2010 (n=14 birds), 2011 (n=13) and 2012 (n=15), showed tagged birds during the breeding season to coincide with the western half of the former Hornsea Zone in particular (with only occasional records from the Hornsea Three area), and some birds recorded on Dogger Bank and a few records in the East Anglia Zone, as well as within the Greater Wash strategic area. Post-breeding locations overlapped with the Hornsea, Dogger Bank, and East Anglia zones before dispersal out of the North Sea or cessation of recording. The tags remained on the birds for between 6 to 132 days, which enabled tracking of the longest functioning tag to north-west Africa during autumn 2012.

5.11.2.27 The overall distribution of foraging locations during chick-rearing was broadly similar in all three years, although at higher density further out to sea in 2012 (Figure 5.6) (this is potentially in response to the poorer climatic conditions affecting prey during the 2012 breeding season). Most locations were within 200 km of Bempton Cliffs, with the highest density of locations mostly within 50-100 km. The mean foraging range was less than 50 km (maximum foraging range was within approximately 300-400 km), whilst the average foraging trip length was less than 150 km (maximum trip length ranged from approximately 1,200 - 1,700 km). Foraging trip duration was highly variable, on average lasting approximately eight hours.

5.11.2.28 It is evident from Figure 5.6 and the annual reports (Langston, Teuten and Butler, 2013) that the operational footprint of Hornsea Three may provide disturbance to a limited extent to foraging gannets from the pSPA. The distance of Hornsea Three from the colony is, however, well above the mean foraging range measured by Langston, Teuten and Butler (2013), and so it is unlikely that it forms a notably important area for breeding gannet in comparison with waters closer to the colony.

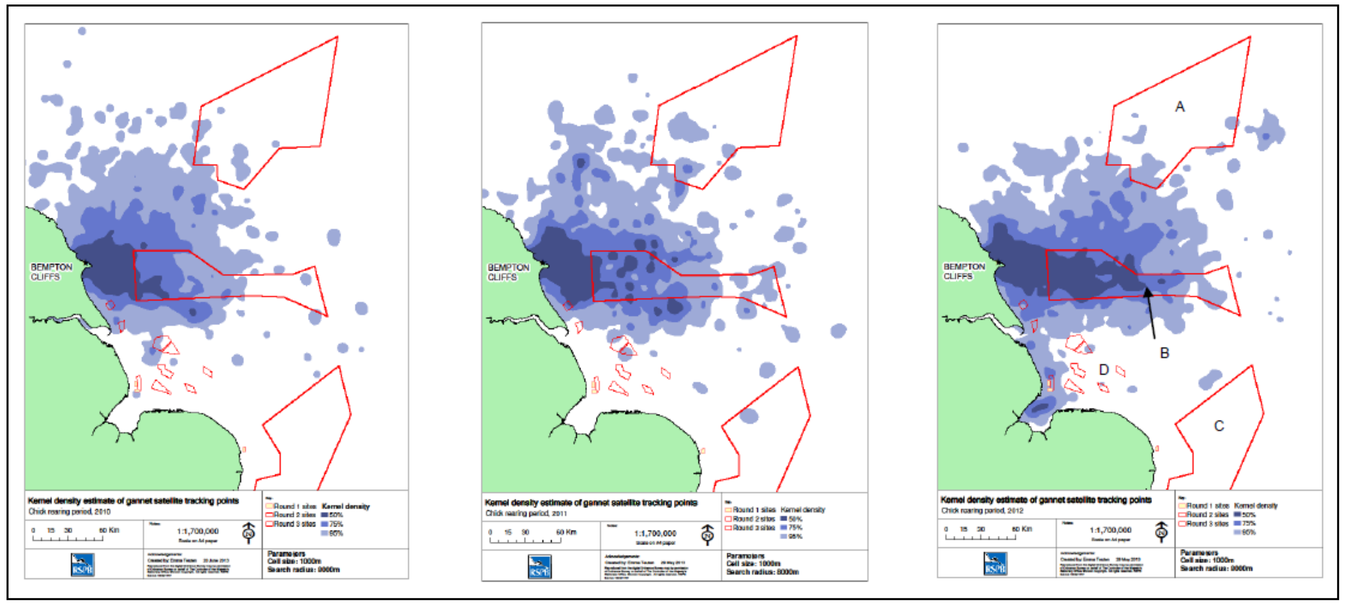

Figure 5.6: Gannet foraging Kernel Density Estimation (kernel density tool, ArcGIS Desktop 10) from satellite-tagged birds from Bempton Cliffs breeding colony in 2010 (left), 2011 (middle) and 2012 (right) during the chick-rearing period, showing the 50%, 75% and 95% density contours. From Langston, Teuten and Butler (2013).

Breeding season

5.11.2.29 The mean peak gannet population estimate within Hornsea Three array area plus 2 km buffer during the main breeding season (April to August) was 928 birds. Based on a mortality rate of 2% during the breeding season (due to the large foraging range of the species providing sufficient alternative foraging opportunities), thirteen individuals may be lost as a result of displacement (Table 1.9 in Annex 5.2: Analysis of displacement impacts on seabirds). This predicted level of mortality does not surpass 1% of baseline mortality of the regional breeding population.

5.11.2.30 The impact of displacement on gannet during the breeding season is predicted to be of local spatial extent, long term duration, continuous and of medium reversibility involving a small number of individuals representing a small proportion of the regional population. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **negligible**.

Post-breeding season

5.11.2.31 During the post-breeding season (September to November) the mean peak population estimate within Hornsea Three array area plus 2 km buffer was 277 individual gannet. Based on a mortality rate of 1% during the post-breeding season (due to the very large distributional range of the species providing sufficient alternative foraging opportunities), two individuals may be lost as a result of displacement (Table 1.10 in Annex 5.2: Analysis of displacement impacts on seabirds). This predicted level of mortality does not surpass 1% of baseline mortality of the regional post-breeding population.

5.11.2.32 The impact of displacement on gannet during the post-breeding season is predicted to be of local spatial extent, long term duration, continuous and of high reversibility involving a small number of individuals representing a small proportion of the regional population. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **negligible**.

Pre-breeding season

5.11.2.33 In the pre-breeding period (December - March), the mean peak population estimate within Hornsea Three array area plus 2 km buffer was 936 birds. At a mortality rate of 1%, this would result in the loss of seven birds per year. This predicted level of mortality does not surpass 1% of baseline mortality of the regional pre-breeding population (Table 1.11 in Annex 5.2: Analysis of displacement impacts on seabirds).

5.11.2.34 The impact of displacement on gannet during the pre-breeding season is predicted to be of local spatial extent, long term duration, continuous and of high reversibility involving a small number of individuals representing a small proportion of the regional population.. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **negligible**.

<u>Sensitivity of the receptor</u>

5.11.2.35 Gannet is considered to be of international conservation value as a result of Hornsea Three being in mean maximum foraging range of Flamborough and Filey Coast pSPA. With an increasing regional and national population trend, and despite a low productivity rate, the species' recoverability is considered high. Behaviourally, gannet was considered to be of high vulnerability by Wade *et al.* (2016) to displacement (from structures).

5.11.2.36 In summary, gannet is deemed to be of high vulnerability, high recoverability and international value. The sensitivity of the VOR is therefore, considered to be **medium**.

<u>Significance of the effect</u>

5.11.2.37 Overall, it is predicted that the sensitivity of the receptor is considered to be medium and the magnitude is deemed to be negligible. The effect will, therefore, be of **negligible or minor adverse** significance, which is not significant in EIA terms.

Puffin

<u>Population structure within Hornsea Three and the former Hornsea Zone</u>

5.11.2.38 The population from which puffins present at Hornsea Three can be considered to be predominantly young immatures and potentially a smaller proportion of breeding birds during the breeding season, and a mixture of adults and immatures from colonies on the east coast of the UK with smaller proportions from colonies further afield during the non-breeding season.

Magnitude of impact

5.11.2.39 There have been few studies which have included puffin as a separate species to assess displacement rates, with the majority combining all auks together. For assessment purposes, a displacement value of 40% from the Hornsea Three array area plus 2 km buffer during the breeding and non-breeding seasons has been used for puffin, based on the rationale described for guillemot (paragraphs 5.11.2.68 - 5.11.2.70), but with an added degree of precaution due to a lower level of empirical evidence.

Breeding season

5.11.2.40 The mean peak puffin population estimate within Hornsea Three array area plus 2 km buffer during the breeding season (April to July) was 252 birds. Based on a displacement rate of 40% and a mortality rate of 10% during the breeding season, ten puffins may be lost as a result of displacement.

5.11.2.41 Assessed against the defined regional breeding population (1,960 birds) this surpasses the 1% baseline mortality figure of two birds (Table 1.12 in Annex 5.2: Analysis of displacement impacts on seabirds). However, this population estimate does not take into account the presence of immature and non-breeding puffins that are likely to be present in Hornsea Three in the breeding season. Based on the evidence available from survey results and the scientific literature, the regional reference population for the breeding season detailed above is considered to be unrealistic. The peak breeding season population estimate for puffins in Hornsea Three was 307 birds in the Hornsea Three offshore ornithology study area; the equivalent population for Hornsea Three array area plus 2 km buffer was 252 individuals). In order to achieve this peak estimate, over 13% of all birds from the Flamborough and Filey Coast pSPA colony would have to be present, which is not ecologically and behaviourally likely. This suggests that either the puffin's mean maximum foraging range is larger than previously recorded, and/or a large number of non-breeding birds are present during summer months that do not form part of the Flamborough and Filey Coast pSPA breeding population.

5.11.2.42 The maximum reported foraging range for puffin during the breeding period is 200 km, while the mean maximum and mean foraging ranges are 105 and 4 km respectively (Thaxter *et al.*, 2012).

5.11.2.43 During the breeding season not all puffins attending colonies and adjacent waters are breeding adults. Puffins do not usually breed until they are five years old (Cramp and Perrins 1977 - 1994) and unlike gannets and gulls it is not easy to separate adults from immature birds from site-specific observations offshore. However, data from other studies indicate that during the breeding period at least 35% of all puffins present may be non-breeding or immature birds and therefore not part of the SPA breeding population (Harris and Wanless, 2011).

5.11.2.44 This is potentially an underestimate of actual proportions of non-breeders further offshore at Hornsea Three and Dogger Bank. Votier *et al.* (2008) observed that immature and non-breeding guillemots from Skomer Island, Wales spread out further than breeding adults and it is likely that this pattern is replicated by puffins. Boat-based surveys in the North Sea by Camphuysen (2005) found that most foraging was concentrated around the major colonies, and that within 20 km of land, 99% of puffins were adults in breeding plumage. In contrast, further offshore, many puffins still had traces of winter plumage, suggesting that they were non-breeders that spent less time ashore. A higher proportion of non-breeders is therefore likely to occur further offshore.

5.11.2.45 It is considered likely that at least half of all birds recorded in the breeding season are immature individuals. In addition, a further proportion are likely to be non-breeding adult birds. Therefore, mortality predicted during the breeding season is considered likely to result in considerably less than ten adult birds from the regional breeding population.

5.11.2.46 The impact of displacement on puffin during the breeding season is predicted to be of regional spatial extent, long term duration, continuous and of high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be low.

Non-breeding season

5.11.2.47 During the non-breeding season (August to March) the mean peak puffin population estimate was eleven birds for Hornsea Three array area plus 2 km buffer.

5.11.2.48 Based on a 1% mortality rate and 40% displacement rate during this period, it is predicted that less than one bird will be lost as a result of displacement. From a regional non-breeding population of 231,957 individuals this would not represent a change in over 1% baseline mortality (Table 1.13 in Annex 5.2: Analysis of displacement impacts on seabirds).

5.11.2.49 The impact of displacement on puffin during the non-breeding season is predicted to be of local spatial extent, long term duration, continuous and of medium reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be negligible.

Sensitivity of the receptor

5.11.2.50 Puffin is considered to be of international conservation value, with species recoverability considered as low. Behaviourally Wade *et al.* (2016) have rated puffin as being of moderate vulnerability to displacement.

5.11.2.51 In summary, puffin is deemed to be of moderate vulnerability, low recoverability and international value. The sensitivity of the VOR is therefore, considered to be medium to high.

Significance of the effect

5.11.2.52 Overall, it is predicted that the sensitivity of the receptor is considered to be medium and the magnitude is deemed to be negligible - low. The effect will, therefore, be no greater than minor adverse significance, which is not significant in EIA terms

Razorbill

Population structure within the Hornsea Three and former Hornsea Zone

5.11.2.53 The population of razorbill in Hornsea Three during the breeding season is considered to be predominantly young immatures and potentially a smaller proportion of breeding adults. During the non-breeding season the population is predicted to comprise a mixture of adults and immatures from colonies on the east coast of the UK with smaller proportions from colonies further afield during the non-breeding season.

Magnitude of impact

5.11.2.54 In a number of studies of operational displacement, it has been observed that razorbills follow the same behaviours as do guillemots, with analysis often combining auk species together. At Robin Rigg for example, a 30% displacement rate was estimated when combining all auk species (Walls *et al.*, 2013). For assessment purposes, a displacement value of 40% from the Hornsea Three array area plus 2 km buffer during the breeding, post-breeding, non-breeding and pre-breeding seasons has been used for razorbill, assuming a similar behaviour to that described for guillemot (paragraphs 5.11.2.68 - 5.11.2.70), but adding a degree of precaution based on a lower level of empirical evidence.

Breeding season

5.11.2.55 The mean peak razorbill population estimate within Hornsea Three array area plus 2 km buffer during the breeding season (April to July) was 577 birds. Based on a displacement rate of 40% and a mortality rate of 10% during the breeding season, a precautionary estimate of 23 razorbills may be lost as a result of displacement (Table 1.14 in Annex 5.2: Analysis of displacement impacts on seabirds).

5.11.2.56 Assessed against the defined national breeding population (260,000 birds calculated using the highly precautionary assumption of including all colonies within maximum foraging range) this does not surpasses the 1% baseline mortality figure of 273 birds.

5.11.2.57 The impact of displacement on razorbill during the breeding season is predicted to be of regional spatial extent, long term duration, continuous and of medium reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be low.

Post-breeding season

5.11.2.58 During the post-breeding period (August to October), the mean peak population estimate was 398 birds within Hornsea Three array area plus 2 km buffer. Using a 2% mortality rate and 40% displacement, this would result in the death of three birds as a result of displacement (Table 1.15 in Annex 5.2: Analysis of displacement impacts on seabirds). Based on the estimated current regional population at this time (591,874 birds) this equates to an increase in baseline mortality rate of less than 1% (Table 1.15 in Annex 5.2: Analysis of displacement impacts on seabirds).

5.11.2.59 The impact of displacement on razorbill during the post-breeding season is predicted to be of regional spatial extent, long term duration, continuous and of high reversibility involving a small number of individuals representing a small proportion of the regional population. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be negligible.

Non-breeding season

5.11.2.60 During the non-breeding season (November to December), the mean peak razorbill population estimate was 3,782 birds for Hornsea Three array area plus 2 km buffer. Based on a 1% mortality rate and 40% displacement rate during this period, it is predicted that fifteen birds will be lost as a result of displacement. From a regional non-breeding population of 218,622 individuals this would not represent a change in over 1% baseline mortality (Table 1.16 in Annex 5.2: Analysis of displacement impacts on seabirds).

5.11.2.61 The impact of displacement on razorbill during the non-breeding season is predicted to be of local spatial extent, long term duration, continuous and of medium reversibility involving a small number of individuals representing a small proportion of the regional population. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be negligible.

Pre-breeding season

5.11.2.62 The mean peak population estimate of razorbill in the pre-breeding season was 576 birds for Hornsea Three array area plus 2 km buffer. Based on a 2% mortality rate and 40% displacement rate during this period, it is predicted that five birds will be lost as a result of displacement. From a regional pre-breeding population of 591,874 individuals this represents less than the 1% baseline mortality (Table 1.17 in Annex 5.2: Analysis of displacement impacts on seabirds).

5.11.2.63 The impact of displacement on razorbill during the post-breeding season is predicted to be of regional spatial extent, long term duration, continuous and of medium reversibility involving a small number of individuals representing a small proportion of the regional population. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be negligible.

Sensitivity of the receptor

5.11.2.64 Razorbill is considered to be of regional conservation value as a result of regionally important populations of this species being recorded in Hornsea Three offshore ornithology study area in the non-breeding season. With a regional and national population trend likely to be at least stable, the species recoverability is considered medium, and behaviourally Wade *et al.* (2016) has rated it as being of high vulnerability to displacement.

5.11.2.65 In summary, razorbill is deemed to be of high vulnerability, high recoverability and regional value. The sensitivity of the VOR is therefore, considered to be low to medium.

Significance of the effect

5.11.2.66 Overall, it is predicted that the sensitivity of the receptor is considered to be medium and the magnitude is deemed to be negligible - low. The effect will, therefore, be of negligible or minor adverse significance, which is not significant in EIA terms.

Guillemot

Population structure within Hornsea Three and the former Hornsea Zone

5.11.2.67 The population of guillemots present within Hornsea Three during the breeding season can be considered to be predominantly young immatures and potentially a smaller proportion of breeding birds. During the non-breeding season the population is predicted to comprise a mixture of adults and immatures from colonies on the east coast of the UK with smaller proportions from colonies further afield.

Magnitude of impact

5.11.2.68 Dierschke and Garthe (2006) indicated a level of displacement on guillemots from offshore wind farms that would warrant relatively high sensitivity to displacement to be attributed to them. Danish studies at Horns Rev, whilst showing considerable variability, indicate displacement of auk species, noting total absence from the wind farm footprint following construction (Petersen *et al.*, 2006).

5.11.2.69 However, a number of more recent studies undertaken at other offshore wind farms have not shown a similar level of effect. Arklow Bank Offshore Wind Farm did not find any significant difference in the number of guillemots present pre- and post-construction (Barton *et al.*, 2009) and post construction monitoring at North Hoyle Offshore Wind Farm indicated an increase of up to 55% in the number of guillemots present compared to before the wind farm was constructed (nPower, 2008). Studies undertaken at Dutch wind farms have reported displacement effects of less than 50% (Leopold *et al.*, 2011). Leopold *et al.* (2010) found that at Egmond aan Zee, auks enter the wind farm area by swimming, and guillemots and razorbills regularly foraged within the site.

5.11.2.70 At Robin Rigg (Walls *et al.*, 2013), there was an increase in guillemot numbers in the first year of operation compared to the construction phase, and although there was some preliminary evidence that guillemots may be avoiding the wind farm area, when statistically analysing all auks combined, a displacement rate of 30% was predicted.

5.11.2.71 On the basis of the above information, the displacement impact assessment considers the mean peak guillemot population within Hornsea Three array area plus 2 km buffer, with a mortality rate of 10% during the breeding season and 1% during the non-breeding season.

5.11.2.72 A displacement value of 30% has been used for guillemots based on evidence from Arklow Bank (Barton *et al.*, 2009), North Hoyle (nPower, 2008) and Robin Rigg (Walls *et al.*, 2013) in particular.

Breeding season

5.11.2.73 The mean peak guillemot population estimate within Hornsea Three array area plus 2 km buffer during the breeding season (March to July) was 12,140 birds. Based on a displacement rate of 30% and a mortality rate of 10% during the breeding season, a precautionary estimate of 364 guillemots over the duration of the lifetime of the project may die as a result of displacement (Table 1.18 in Annex 5.2: Analysis of displacement impacts on seabirds).

5.11.2.74 Assessed against the defined national population (1,900,000 birds calculated using the highly precautionary assumption of including all colonies within maximum foraging range) this does not surpass the 1% baseline mortality figure of 1159 birds.

5.11.2.75 The impact of displacement on guillemot during the breeding season is predicted to be of regional spatial extent, long term duration, continuous and of medium reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be low.

Non-breeding season

5.11.2.76 During the non-breeding season (August to February) the mean peak guillemot population estimate was 13,795 birds for Hornsea Three array area plus 2 km buffer.

5.11.2.77 Based on a 1% mortality rate and 30% displacement rate during this period, a precautionary estimate of 41 birds will be lost as a result of displacement. From a regional winter population of 1,617,306 individuals (Table 1.19 in Annex 5.2: Analysis of displacement impacts on seabirds), this would not surpass the 1% threshold of baseline mortality.

5.11.2.78 The impact of displacement on guillemot during the non-breeding season is predicted to be of local spatial extent, long term duration, continuous and of medium reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be low.

Sensitivity of the receptor

5.11.2.79 Guillemot is considered to be of regional conservation value as a result of regionally important populations of this species being recorded in Hornsea Three offshore ornithology study area in the non-breeding season. The species is deemed to be of high vulnerability to displacement (Wade *et al.*, 2017), and with an increase in regional and national populations over the last decade (+40% and +5% respectively), guillemot has medium recoverability potential (Table 5.11).

5.11.2.80 In summary, guillemot is deemed to be of high vulnerability, medium recoverability and regional value. The sensitivity of the VOR is therefore, considered to be low to medium.

Significance of the effect

5.11.2.81 Overall, it is predicted that the sensitivity of the receptor is considered to be medium and the magnitude is deemed to be low. The effect will, therefore, at most be of minor adverse significance, which is not significant in EIA terms.

Summary

5.11.2.82 A summary of physical displacement impacts in the operation and maintenance phase is presented in Table 5.21.

Table 5.21: Summary of the impact of physical displacement from an area around turbines and other ancillary structures during the operation and maintenance phase of the development.

VOR	Sensitivity	Magnitude				Significance
		Breeding season	Post-breeding season	Non-breeding season	Pre-breeding season	
Fulmar	Medium	Low	Negligible	Negligible	Negligible	Negligible or minor adverse
Gannet	Medium	Negligible	Negligible		Negligible	Negligible or minor adverse
Puffin	Medium to high	Low		Negligible		Minor adverse
Razorbill	Low to medium	Low	Negligible	Negligible	Negligible	Negligible or minor adverse
Guillemot	Low to medium	Low		Low		Minor adverse

The impact of indirect effects, such as changes in habitat or abundance and distribution of prey.

5.11.2.83 The physical presence of foundation and potential scour protection, as well as potential changes in commercial fishing activities may impact upon the availability of prey species.

5.11.2.84 The indirect impacts on seabird prey resource and habitats are detailed in Chapter 2: Benthic Ecology and Chapter 3: Fish and Shellfish Ecology. Principal impacts on these resources and habitats are likely to be from the presence of foundations include potential changes to the wave climate, creation of hard substrate around turbine foundations and array/export cables, increases in sedimentation in the water column and noise and vibration from operational turbines.

5.11.2.85 Detailed assessments of the following potential operation and maintenance phase impacts have been undertaken in chapter 3: Fish and Shellfish Ecology for key seabird prey species (including cod, sprat, herring, mackerel and sandeel species) and include:

- Long term habitat loss due to presence of turbine foundations and scour/cable protection;
- Underwater noise as a result of operational turbines and maintenance vessel traffic;
- Temporary habitat loss and disturbance from maintenance operations (e.g. jack up operations and cable reburial);
- Accidental release of pollutants (e.g. from accidental spillage/leakage);
- Introduction of turbine foundations and scour/cable protection (hard substrates and structural complexity); and
- Electromagnetic fields (EMF) emitted by array and export cables.

5.11.2.86 Details of the fish and shellfish ecology assessment are summarised in Table 5.22 justifications for this assessment will not be repeated in this chapter. Evidence, modelling and justifications for these assessments are provided in chapter 3: Fish and Shellfish Ecology.

5.11.2.87 Potential reduction in fishing activity within the vicinity of turbines could have a positive benefit on prey stocks as could the aggregation of fish and shellfish around the introduced hard substrates, although this is likely to be localised.

5.11.2.88 The VORs fulmar, gannet, puffin, razorbill, guillemot, kittiwake, lesser black-backed gull and great black-backed gull, are included in the assessment of indirect effects, such as changes in habitat or abundance and distribution of prey in the operation and maintenance phase.

Table 5.22: Significance of effects of operation and maintenance impacts on fish and shellfish ecology.

Potential impact	Species	Significance of effect
Long term habitat loss	Sandeel and herring	Minor adverse
	All other fish and shellfish species	Minor adverse
Underwater noise	All fish and shellfish species	Negligible adverse
Introduction of turbine foundations and scour/cable protection	All fish and shellfish species	Minor adverse
Electromagnetic fields (EMF)	All fish and shellfish species	Minor adverse
Temporary habitat loss and disturbance	All fish and shellfish species	Negligible adverse
Accidental release of pollutants	All fish and shellfish species	Negligible

All receptors

Magnitude of impact

5.11.2.89 Any changes to the distribution of prey species and habitat during operation and maintenance for seabirds is likely to be negligible or, for common scoter no change when considering the size of Hornsea Three and the export cable route corridor in relation to each species' total foraging range. The assessments in the benthic and fish chapters predicted either negligible or minor adverse effects for these impacts (Chapter 3: Fish and Shellfish Ecology). It is also possible that the attraction of birds to the base of structures to forage may result in a small increase in flight activity around rotors, and therefore birds at risk of collision, which may cancel out any benefits. The impact for all VORs therefore is predicted to be of local spatial extent, long term duration, continuous and of high reversibility. It is predicted that the impact will affect the receptor indirectly. The magnitude is therefore, considered to be **negligible** or, for common scoter (as explained in paragraphs 5.11.1.9 - 5.11.1.15), **no change** on all receptors.

Sensitivity of the receptor

5.11.2.90 As described previously, Wade *et al.* (2016) ranked each seabird species based on habitat flexibility. The vulnerability of the VORs ranged from very low (fulmar, gannet, lesser black-backed gull and great black-backed gull) to high (red-throated diver and common scoter) (Wade *et al.* 2016.)

5.11.2.91 Each VOR is deemed to be of very low to high vulnerability, low to high recoverability and regional to international value. The sensitivities of the receptors are therefore, considered to range from **low to medium** or **medium**, with the exception of puffin, which was considered to be **medium** to **high**, and common scoter and red-throated diver, considered to be **high**.

Significance of the effect

5.11.2.92 An indirect impact of negligible magnitude on a low to medium sensitivity receptor is predicted to produce a **negligible or minor adverse** effect. An indirect impact of negligible magnitude on a medium to high or high sensitivity receptor (puffin and red-throated diver respectively) is predicted to produce at worst case, a **minor adverse** effect on the regional (puffin) or local (red-throated diver) population. The effects on all of these receptors are not significant in EIA terms.

Summary

5.11.2.93 A summary of operation and maintenance indirect disturbance impacts on each VOR is presented in Table 5.23.

Table 5.23: Summary of the impact of indirect effects, such as changes in habitat or abundance and distribution of prey.

VOR	Sensitivity	Magnitude	Significance
Common scoter	High	No change	Negligible
Red-throated diver	High	Negligible	Minor adverse
Puffin	Medium to high	Negligible	Minor adverse
All other receptors	Low to medium	Negligible	Negligible or minor adverse

Mortality from collision with rotating turbine blades.

Collision risk impact assessment - seabirds

5.11.2.94 Hornsea Three has committed to a significantly increased lower blade tip height than previous planning applications for offshore wind farms in the UK, in an effort to mitigate impacts of collision risk. Hornsea Three presents a potential collision risk to birds which fly through the turbine array whilst foraging for food, commuting between breeding sites and foraging areas, or when on migration. The risk to birds arises from colliding with the wind turbine rotors and associated infrastructure resulting in injury or fatality.

5.11.2.95 Although it is evident that there are a number of areas of uncertainty relative to estimating collision risk at offshore wind farms, a quantitative impact assessment has been made in this PEIR. This assessment is informed by the site-specific data collected to date with the output being the estimated annual additional mortality due to Hornsea Three for each VOR.

5.11.2.96 The Basic model (Annex 5.3: Collision Risk Modelling) assumes a uniform distribution of 'at-risk' flights between lowest and highest levels of the rotors, thereby likely overestimating risk for species that predominantly fly at lower heights (e.g. gulls and terns).

5.11.2.97 The Extended model uses modelled site-specific flight height distributions to allow comparison of the impact of varying the height of wind turbines, and to account for the fact that collision risk is not distributed evenly within the rotor swept area. This is only possible for the more abundant species with sufficient data confidence, and so for other species only the basic model was available, which will likely overestimate collision risk. Full details of the collision risk modelling protocol followed for the assessment of Hornsea Three VORs is presented in section 5.6.6.

5.11.2.98 It is acknowledged that migratory passage movements may be ‘missed’ by aerial survey methods. Therefore for migratory waterbirds, the application of the Strategic Ornithological Support Services (SOSS) Migration Assessment Tool (MAT) for migratory species takes this into consideration, by assessing the theoretical passage movements based on estimated flyway populations. For migratory seabirds, a generic ‘migratory front’ is defined for a species which is then used to calculate the number of birds from a relevant seasonal Biologically Defined Minimum Population Scale (BDMPS) population that has the potential to interact with Hornsea Three during spring and autumn migration. The interacting populations are then incorporated into collision risk modelling to provide a mortality estimate for each species.

5.11.2.99 For all VORs Band (2012) model results are presented in Annex 5.3: Collision Risk Modelling. The full SOSS MAT model data is presented in Appendix D of Annex 5.3: Collision Risk Modelling.

Annual and seasonal mortality estimates as a result of predicted collision

5.11.2.100 The predicted annual mortality estimates for each species are presented below, with the model type (Band Options 2 or, 3, or SOSS MAT) also detailed.

5.11.2.101 A summary of the seasonal breakdown of predicted collisions for each species is presented in Table 5.24.

Table 5.24: Seasonal breakdown of collision risk mortality using the maximum design scenario turbine layout.[a]

Species	Band model Option	Avoidance rate (%)	Annual mortality rate at appropriate avoidance rate[b]	Number of collisions			
				Breeding season mortality	Post-breeding season mortality	Non-breeding season mortality	Pre-breeding season mortality
Gannet	2	98.9	33	16	7		15
	3	98	14	6	3		6
Arctic skua	2	98	0		0		0
	3	98	0		0		0
Great skua	2	98	0		0		0
	3	98	0		0		0
Little gull	2	98	0		0		0
	3	99.2	0		0		0
Kittiwake	2	99.2	248	162	74		12
	3	98	124	81	37		6
Lesser black-backed gull	2	99.5	22	22	0	0	1
	3	98.9	16	15	0	0	1
Great black-backed gull	2	99.5	59	8		51	
	3	98.9	49	7		42	
Common tern	2	98	1		0		0
	3	98	0		0		0
Arctic tern	2	98	0		0		0
	3	98	0		0		0

a The grey cells denote where no mortality estimates were calculated due to inappropriate model type for the data available and/or a season (1) in which a species has no population that interacts with Hornsea Three, or (2) not defined for the species considered.

b All mortality estimates are presented are rounded to a whole number (i.e. whole bird). Mortality estimates have been summated across seasons using the actual value, the resultant decimal value only then rounded to a whole number. The latter rounded value may differ to the less accurate summation of whole numbers presented for each season.

Gannet

Magnitude of impact

5.11.2.102 An annual mortality rate of 39 collisions per annum are predicted using Band Option 2 at an avoidance rate of 98.9%, 14 collisions/annum are predicted when using Band Option 3 at a 98% avoidance rate (Table 5.25).

Table 5.25: Gannet seasonal collision risk results expressed as change in regional population baseline mortality.

CRM option (Avoidance rate)	Season	Collision mortality	Baseline mortality of regional population (individuals/annum)	Increase in baseline mortality (%)
Band Option 2 (98.9%)	Breeding	14	2,024	0.69
	Post-breeding	6	36,960	0.02
	Pre-breeding	13	20,119	0.06
	Total	39	-	-
Band Option 3 (98%)	Breeding	6	2,024	0.29
	Post-breeding	3	36,960	0.01
	Pre-breeding	6	20,119	0.03
	Total	14	-	-

Breeding season

5.11.2.103 The breeding season for gannet accounts for approximately 43% of annual collisions (6 collisions per annum using Option 3 at a 98% avoidance rate). This represents a 0.29% change in baseline mortality of the regional breeding population (24,988 individuals).

5.11.2.104 The impact is predicted to be of regional spatial extent, long term duration, continuous, medium reversibility with a very slight change from baseline conditions (due to a small number of collisions). It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **negligible**.

Post-breeding season

5.11.2.105 The post-breeding season for gannet accounts for approximately 21% of annual collisions (3 collisions per annum using Option 3 at a 98% avoidance rate). This represents a 0.01% change in baseline mortality of the regional post-breeding population (456,298 individuals).

5.11.2.106 The impact is predicted to be of regional spatial extent, long term duration, continuous, medium reversibility with a very slight change from baseline conditions (due to a small number of collisions). It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **negligible**.

Pre-breeding season

5.11.2.107 The pre-breeding season for gannet accounts for approximately 43% of annual collisions (6 collisions per annum using Option 3 at a 98% avoidance rate). This represents a 0.04% change in baseline mortality of the regional pre-breeding population (248,385 individuals).

5.11.2.108 The impact is predicted to be of regional spatial extent, long term duration, continuous, medium reversibility with a very slight change from baseline conditions (due to a small number of collisions). It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **negligible**.

Sensitivity of the receptor

5.11.2.109 As a proposed qualifying feature of FFC pSPA, where Hornsea Three is within mean maximum foraging range, gannet is afforded international conservation value. It was ranked high in terms of vulnerability to collisions by Wade *et al.* (2016) although moderate vulnerability by Langston (2010). High vulnerability is considered appropriate within this assessment.

5.11.2.110 Gannet is deemed to be of high vulnerability, high recoverability and international value. The sensitivity of the receptor is therefore, considered to be **medium**.

Significance of the effect

5.11.2.111 For the purposes of this preliminary assessment, it is considered that model predictions provide an approximate indication of the likely risk.

5.11.2.112 Overall, it is predicted that the sensitivity of the receptor is considered to be medium and the magnitude is deemed to be negligible. The effect will, therefore, be of **negligible or minor adverse** significance, which is not significant in EIA terms.

Arctic skua

Magnitude of impact

5.11.2.113 An annual mortality rate of less than one collisions per annum are is predicted using Band Option 2 at an avoidance rate of 98%, less than one collision per annum is predicted when using Band Option 3 at a 98% avoidance rate.

5.11.2.114 The impact is predicted to be of local spatial extent, long term duration, continuous and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **no change**.

Sensitivity of the receptor

5.11.2.115 Arctic skua is considered to be of international conservation value due to the likelihood of a large proportion of the UK SPA populations passing down the east coast on migration. Recoverability, based on population trends and reproduction rates, are is considered to be low.

5.11.2.116 Skuas are rated as being of relatively high vulnerability to collisions by Wade *et al.* (2016) as they spend a large proportion of their time in flight, albeit, not as frequently at potential collision height compared to gull species.

5.11.2.117 Very little empirical data on behaviour around wind farms is available specifically for skuas, although evidence in Krijgsveld *et al.* (2010) and Christensen *et al.* (2004) suggests that they may act in a similar manner to gulls, and in general do not obviously avoid wind farms. Within the Horns Rev Offshore Wind Farm, skuas were observed chasing terns at various heights on a number of occasions, and this behaviour may put birds at risk of collisions (assuming the other species are still present in the wind farm to pursue) (Petersen *et al.*, 2006). Vulnerability is therefore considered to be high.

5.11.2.118 In summary, Arctic skua is deemed to be of high vulnerability, low recoverability and international value. The sensitivity of the receptor is therefore, considered to be **high**.

Significance of the effect

5.11.2.119 Overall, it is predicted that the sensitivity of Arctic skua is considered to be high and the magnitude is deemed to be of no change. The effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.

Great skua

Magnitude of impact

5.11.2.120 An annual mortality rate of less than one collisions per annum are predicted using Band Option 2 at an avoidance rate of 98%, less than one collisions/annum are predicted when using Band Option 3 at a 98% avoidance rate.

5.11.2.121 The impact is predicted to be of local spatial extent, long term duration, continuous and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **no change**.

Sensitivity of the receptor

5.11.2.122 Great Skua is considered to be of international conservation value due to the likelihood of a large proportion of the UK SPA populations passing down the east coast on migration. Recoverability, based on population trends and reproduction rates, is considered to be medium.

5.11.2.123 Skuas are rated as being of relatively high vulnerability to collisions by Wade *et al.* (2016) as they spend a large proportion of their time in flight, albeit, not as frequently at potential collision height compared to gull species. As detailed for Arctic skua, very little empirical data on behaviour around wind farms is available and on a precautionary basis vulnerability is therefore considered to be high.

5.11.2.124 In summary, great skua is deemed to be of high vulnerability, medium recoverability and international value. The sensitivity of the receptor is therefore, considered to be **high**.

Significance of the effect

5.11.2.125 Overall, it is predicted that the sensitivity of great skua is considered to be high and the magnitude is deemed to be of no change. The effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.

Lesser black-backed gull

Magnitude of impact

5.11.2.126 An annual mortality rate of 22 collisions per annum are predicted using Band Option 2 at an avoidance rate of 99.5%, 16 collisions per annum are predicted when using Band Option 3 at a 98.9% avoidance rate (Table 5.26).

Breeding season

5.11.2.127 The breeding season for lesser black-backed gull accounts for approximately 95% of annual collisions (22 collisions per annum using Option 3 at a 98.9% avoidance rate). This represents a 2.88% change in baseline mortality of the regional breeding population (523 individuals).

5.11.2.128 Although this represents over a 1.00% increase in baseline mortality of the regional population, the collision rate is low. This does not consider birds from outside of the region (e.g. from large Dutch colonies such as Texel) which are likely to forage occasionally within the site (see results of satellite tag studies of lesser black-backed gulls from Texel at http://www.sovon.nl, and also submitted documents for Galloper Wind Farm application (GWFL, 2011), and so this is likely to be an overestimate.

5.11.2.129 The impact is predicted to be of regional spatial extent, long term duration, continuous and medium reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **low**.

Table 5.26: Lesser black-backed gull seasonal collision risk results expressed as change in regional population baseline mortality[a].

CRM option (Avoidance rate)	Season	Collision mortality	Baseline mortality of regional population (individuals/annum)	Increase in baseline mortality (%)
Band Option 2 (99.5%)	Breeding	22	523	4.13
	Post-breeding	0	24,036	0
	Non-breeding	0	4,521	0
	Pre-breeding	1	22,711	0
	Total	22	-	-
Band Option 3 (98.9%)	Breeding	15	523	2.88
	Post-breeding	0	24,036	0
	Non-breeding	0	4,521	0
	Pre-breeding	1	22,711	0
	Total	16	-	-

a Row in **bold** indicates those seasons in which collision mortality is above 1% of the baseline mortality of the regional population.

Post-breeding season

5.11.2.130 The post-breeding season for lesser black-backed gull accounts for less than one collision per annum (using Option 3 at a 98.9% avoidance rate). This therefore represents a negligible change in baseline mortality of the regional post-breeding population (209,007 individuals).

5.11.2.131 The impact is predicted to be of local spatial extent, long term duration, continuous and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be no change.

Non-breeding season

5.11.2.132 The non-breeding season for lesser black-backed gull accounts for less than one collisions per annum (using Option 3 at a 98.9% avoidance rate). This therefore represents a negligible change in baseline mortality of the regional non-breeding population (39,314 individuals).

5.11.2.133 The impact is predicted to be of local spatial extent, long term duration, continuous and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be no change.

Pre-breeding season

5.11.2.134 The pre-breeding season for lesser black-backed gull accounts for 5% of annual collisions (1 collisions per annum using Option 3 at a 98.9% avoidance rate). This represents less than 0.01% change in baseline mortality of the regional pre-breeding population (197,483 individuals).

5.11.2.135 In non-breeding seasons, a large mixed population of lesser black-backed gulls is likely to be present in the North Sea region as they migrate to and from wintering areas. Such individuals are likely to be from the *Larus fuscus graellsii / intermedius* subspecies' populations that form large colonies along continental Europe spreading north up to Norway.

5.11.2.136 The impact is predicted to be of local spatial extent, long term duration, continuous and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be negligible.

<u>Sensitivity of the receptor</u>

5.11.2.137 Lesser black-backed gull was ranked the second highest marine bird species most vulnerable to collision impacts by Wade *et al.* (2016), mainly due to the high proportion of flights at potential collision heights, and the percentage of time in flight, including at night.

5.11.2.138 In summary, Lesser black-backed gull is deemed to be of very high vulnerability, medium recoverability and regional value. The sensitivity of the receptor is therefore, considered to be medium.

<u>Significance of the effect</u>

5.11.2.139 For the purposes of this preliminary assessment, it is considered that model predictions provide an approximate indication of the likely risk.

5.11.2.140 Overall, it is predicted that the sensitivity of Lesser black-backed gull is considered to be medium and the magnitude is deemed to be no greater than low. The effect will, therefore, be of minor adverse significance, which is not significant in EIA terms.

Great black-backed gull

<u>Magnitude of impact</u>

5.11.2.141 An annual mortality of 59 collisions per annum are predicted using Band Option 2 at an avoidance rate of 99.5%, 49 collisions/annum are predicted when using Band Option 3 at a 98.9% avoidance rate (Table 5.27).

Table 5.27: Great black-backed gull seasonal collision risk results expressed as change in regional population baseline mortality.

CRM option (Avoidance rate)	Season	Collision mortality	Baseline mortality of regional population (individuals/annum)	Increase in baseline mortality (%)
Band Option 2 (99.5%)	Breeding	8	2,380	0.34
	Non-breeding	51	6,398	0.80
	Total	59	-	-
Band Option 3 (98.9%)	Breeding	7	2,380	0.28
	Non-breeding	42	6,398	0.66
	Total	49	-	-

Breeding season

5.11.2.142 The breeding season for great black-backed gull accounts for approximately 14% of annual collisions (7 collisions per annum using Option 3 at a 98% avoidance rate). This represents a 0.35% change in baseline mortality of the regional breeding population (34,000 individuals).

5.11.2.143 The impact is predicted to be of regional spatial extent, long term duration, continuous and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be negligible.

Non-breeding season

5.11.2.144 The post-breeding season for great black-backed gull accounts for approximately 86% of annual collisions (42 collisions per annum using Option 3 at a 98.9% avoidance rate). This represents a 0.66% change in baseline mortality of the regional non-breeding population (91,399 individuals).

5.11.2.145 The impact is predicted to be of regional spatial extent, long term duration, continuous and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be negligible.

Sensitivity of the receptor

5.11.2.146 Great black-backed gull was rated the seabird species most vulnerable to collision impacts by Wade *et al.* (2016), mainly due to the high proportion of flights at potential collision heights, and the percentage of time in flight, including at night.

5.11.2.147 In summary, great black-backed gull is deemed to be of very high vulnerability, medium recoverability and national value. The sensitivity of the receptor is therefore, considered to be medium.

Significance of the effect

5.11.2.148 For the purposes of this preliminary assessment, it is considered that model predictions provide an approximate indication of the likely risk.

5.11.2.149 Overall, it is predicted that the sensitivity of great–black backed gull is considered to be high sensitivity and the magnitude is deemed to be negligible – low. The effect will, therefore, be of negligible or minor adverse significance, which is not significant in EIA terms.

Little gull

Magnitude of impact

5.11.2.150 As little gull is found within the eastern North Sea generally on autumn passage only, the most appropriate reference populations are considered to be the flyway population, given as 30,000 to 75,000 birds by Stienen *et al.* (2007), and also the Hornsea Mere population, with a five-year mean of 3,076 birds (Frost *et al.,* 2016) and peaks around July / August, coinciding with the moult period for adult and sub-adult birds. Surveys by RPS in 2009 determined that Hornsea Mere is used as a pre-roost aggregation site, before birds headed 1 to 2 km offshore to spend the night. The 'population' at Hornsea Mere, at least in 2008, appeared to be in a constant state of flux involving the incoming and outgoing of different individuals despite the appearance of a relatively smooth increase from mid-August to the end of August followed by a relatively rapid decline through September.

5.11.2.151 The Flamborough Front (see Section 1.3.2 in Annex 5.1: Baseline Characterisation Report) offers a range of foraging opportunities for little gulls, numbers of which are likely to vary hugely in time and space. Birds utilising Hornsea Mere may travel considerable distances to find suitable feeding habitat.

5.11.2.152 Only a small number of little gulls were recorded during aerial surveys. The collision risk modelling undertaken was therefore that as described for migratory seabirds (Appendix C of Annex 5.3: Collision Risk Modelling).

5.11.2.153 An annual mortality rate of less than one collision per annum is predicted using Band Option 2 at an avoidance rate of 98.9%, less than one collision per annum is predicted when using Band Option 3 at a 98% avoidance rate.

5.11.2.154 The impact is predicted to be of local spatial extent, long term duration, continuous and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be no change.

Sensitivity of the receptor

5.11.2.155 Little gull is listed on both Annex 1 of the EU Birds Directive and Schedule 1 of the Wildlife and Countryside Act and is therefore considered to be of national conservation value. Recoverability is considered to be high. Although not assessed specifically by Wade *et al.* (2013), the vulnerability of the species to collisions is likely to be similar to other small gull species. Krijgsveld *et al.* (2011) found little gulls to be relatively abundant within the Egmond aan Zee Offshore Wind Farm, compared to buffer areas outside. However, as described for kittiwake, micro avoidance rates of small gulls are likely to be high, and during baseline surveys the species was recorded predominantly below potential collision height. Vulnerability is therefore considered to be **moderate**.

5.11.2.156 In summary, little gull is deemed to be of moderate vulnerability, high recoverability and national value. The sensitivity of the receptor is therefore, considered to be **medium**.

Significance of the effect

5.11.2.157 Overall, it is predicted that the sensitivity of little gull is considered to be medium and the magnitude is deemed to be of no change. The effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.

Kittiwake

Magnitude of impact

5.11.2.158 An annual mortality of 248 collisions per annum are predicted using Band Option 2 at an avoidance rate of 99.2%, 124 collisions per annum are predicted when using Band Option 3 at a 98% avoidance rate (Table 5.28).

Breeding season

5.11.2.159 The breeding season for kittiwake accounts for approximately 65% of annual collisions (81 collisions per annum using Option 3 at a 98% avoidance rate). This represents a 0.54% change in baseline mortality of the regional breeding population (102,002 individuals). Note that this is the population of breeding adults only there will, in addition, be immature birds and non-breeding adult birds within the regional population. Collision risk modelling, at this stage, however, does not discriminate between adult and immature birds and breeding and non-breeding adults, with all birds observed during surveys being included in the risk assessment. Comparing this predicted collision rate (for all birds) with a regional population composed only of breeding adult birds is, therefore, highly precautionary and significantly over-estimates the likely change in baseline mortality.

5.11.2.160 The impact is predicted to be of regional spatial extent, long term duration, continuous and medium reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **low**.

Table 5.28: Kittiwake seasonal collision risk results expressed as change in regional population baseline mortality.[a]

CRM option (Avoidance rate)	Season	Collision mortality	Baseline mortality of regional population (individuals/annum)	Increase in baseline mortality (%)
Band Option 2 (99.2%)	Breeding	162	14,893	1.08
	Post-breeding	74	121,171	0.06
	Pre-breeding	12	91,661	0.01
	Total	248	-	-
Band Option 3 (98%)	Breeding	81	14,893	0.54
	Post-breeding	37	121,171	0.03
	Pre-breeding	6	91,661	0.01
	Total	124	-	-
	Total	121 (=/-27.4 SD)	-	-

a Note: the predicted collision mortality rate during the breeding season includes birds of all age classes as well as non-breeding birds observed at Hornsea Three. The regional breeding population against which this rate is compared in the breeding season, however, comprises only breeding adult birds.

Post-breeding season

5.11.2.161 The post-breeding season for kittiwake accounts for approximately 30% of annual collisions (37 collisions per annum using Option 3 at a 98% avoidance rate). This represents a 0.03% change in baseline mortality of the regional post-breeding population (829,937 individuals).

5.11.2.162 The impact is predicted to be of local spatial extent, long term duration, continuous and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **low**.

Pre-breeding season

5.11.2.163 The pre-breeding season for kittiwake accounts for approximately 5% of annual collisions (3 collisions per annum using Option 3 at a 98% avoidance rate). This represents a 0.01% change in baseline mortality of the regional pre-breeding population (627,816 individuals).

5.11.2.164 The impact is predicted to be of local spatial extent, long term duration, continuous and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be negligible..

Sensitivity of the receptor

5.11.2.165 Kittiwake was rated as being relatively high vulnerability to collision impacts by Wade *et al.* (2016), due to the proportion of flights likely to occur at potential risk height and percentage of time in flight, including at night. From previous studies in Flanders that have recorded mortality rates and collision rates, estimated micro-avoidance rates were, however, high for smaller gulls (Everaert, 2006; 2008; 2011; Everaert *et al.*, 2002; Everaert and Kuijken, 2007). Studies have also shown that rates are consistently above 98% for flights at rotor height (GWFL, 2011). The recently published report for Marine Scotland (Cook *et al.,* 2014) considers that a 99.2% avoidance rate is appropriate for the 'Basic' Band Model.

5.11.2.166 FFC pSPA is the closest breeding colony for kittiwake to Hornsea Three. However, Hornsea Three is outside of the mean-maximum (± 1 SD) foraging range of kittiwake (60 km) from the pSPA as reported by Thaxter *et al.* (2012). Preliminary results from the FAME project which has tracked breeding kittiwake from the FFC pSPA colony does however suggest that there may be connectivity between the FFC pSPA and Hornsea Three as presented in Annex 5.1: Baseline Characterisation Report.

5.11.2.167 Kittiwake is deemed to be of high vulnerability, low recoverability and international value. The sensitivity of the receptor is therefore, considered to be high.

Significance of the effect

5.11.2.168 For the purposes of this preliminary assessment, it is considered that model predictions provide an approximate indication of the likely risk.

5.11.2.169 Overall, it is predicted that the sensitivity of kittiwake is considered to be high and the magnitude is deemed to be low (breeding season). Consequently, the effect could be either minor or moderate adverse significance. However, the predicted collision mortality rate is based on conservative assumptions, including the use of precautionary avoidance rates and a breeding regional population that is based only on breeding adult birds (excluding immature and non-breeding adult birds) whereas the predicted collision rate is based on the observed birds at Hornsea Three which will include immature and non-breeding adults. Notwithstanding this, the predicted mortality rate still represents a very small proportion of the relevant regional populations and, in all cases, represents less than 1% of baseline mortality for those relevant populations.

5.11.2.170 On this basis it is judged that the impact is of minor adverse significance, which is not significant in EIA terms.

Common tern

Magnitude of impact

5.11.2.171 Only a small number of common terns were recorded during aerial surveys (see Annex 5.1: Baseline Characterisation Report). The collision risk modelling undertaken was therefore that as described for migratory seabirds (see Appendix C of Annex 5.3: Collision Risk Modelling).

5.11.2.172 An annual mortality of one collision per annum is predicted using Band Option 2 at an avoidance rate of 98%, less than one collisions/annum are predicted when using Band Option 3 at a 98% avoidance rate.

5.11.2.173 The impact is predicted to be of local spatial extent, long term duration, continuous and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be no change.

Post-breeding season

5.11.2.174 The post-breeding season for common tern accounts for less than one collision per annum using Option 3 at a 98% avoidance rate. This represents a negligible change in baseline mortality of the regional post-breeding population (144,911 individuals).

5.11.2.175 The impact is predicted to be of local spatial extent, long term duration, continuous and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be no change.

Pre-breeding season

5.11.2.176 The pre-breeding season for common tern accounts for less than one collision per annum using Option 3 at a 98% avoidance rate. This represents a negligible change in baseline mortality of the regional pre-breeding population (144,911 individuals).

5.11.2.177 The impact is predicted to be of local spatial extent, long term duration, continuous and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be no change.

Sensitivity of the receptor

5.11.2.178 Common tern is listed on Annex 1 of the EU Birds Directive and due to potential connectivity to SPAs along the east coast, common tern is therefore afforded international conservation value, and recoverability is considered to be medium. Vulnerability to collisions was rated as moderate by Wade *et al.* (2016), as although the species spends much time in flight, little of it will be at risk height.

5.11.2.179 In summary, common tern is deemed to be of moderate vulnerability, medium recoverability and International value. The sensitivity of common tern is therefore, considered to be medium.

Significance of the effect

5.11.2.180 Overall, it is predicted that the sensitivity of common tern is considered to be medium and the magnitude is deemed to be of no change. The effect will, therefore, be of negligible adverse significance, which is not significant in EIA terms.

Arctic tern

Magnitude of impact

5.11.2.181 Only a small number of arctic terns were recorded during aerial surveys (see Annex 5.1: Baseline Characterisation Report). The collision risk modelling undertaken was therefore that as described for migratory seabirds (see Appendix C of Annex 5.3: Collision Risk Modelling).

5.11.2.182 An annual mortality of less one collisions per annum are predicted using Band Option 2 at an avoidance rate of 98%, less than one collisions/annum are predicted when using Band Option 3 at a 98% avoidance rate.

5.11.2.183 The impact is predicted to be of local spatial extent, long term duration, continuous and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be no change.

Sensitivity of the receptor

5.11.2.184 Arctic tern is listed on Annex 1 of the EU Birds Directive and due to potential connectivity to SPAs along the east coast, common tern is therefore afforded international conservation value, and recoverability is considered to be medium. Vulnerability to collisions was rated as moderate by Wade *et al.* (2016), as although the species spends much time in flight, little of it will be at risk height.

5.11.2.185 In summary, Arctic tern is deemed to be of moderate vulnerability, medium recoverability and International value. The sensitivity of common tern is therefore, considered to be medium.

Significance of the effect

5.11.2.186 Overall, it is predicted that the sensitivity of common tern is considered to be medium and the magnitude is deemed to be of no change. The effect will, therefore, be of negligible adverse significance, which is not significant in EIA terns.

Other seabird species

Significance of the effect

5.11.2.187 No collision risk modelling was undertaken for fulmar, guillemot, razorbill or puffin due to the negligible numbers of birds that are recorded at collision risk heights Cook *et al.* (2012). Common scoter was not recorded by the aerial surveys at Hornsea Three whilst only six red-throated diver on one of the eleven aerial surveys of The Hornsea Three offshore ornithology study area were recorded.

5.11.2.188 Overall, it is predicted that the sensitivity of the receptors is considered to be medium for red-throated diver and low for all other receptors, and the magnitude is deemed to be no change. The effect will, therefore, be of negligible adverse significance, which is not significant in EIA terms.

Other migratory species

Magnitude of impact

5.11.2.189 For the purposes of collision risk modelling, a list of 12 species were selected based on a relatively high proportion of birds occurring at locations (e.g. SPAs) close to Hornsea Three (Appendix D of Annex 5.3: Collision Risk Modelling Report), only one of which has been recorded within the aerial surveys, golden plover.

5.11.2.190 The collision risk modelling has predicted low numbers of collisions with proposed turbines for most species, although slightly higher numbers i.e. 22 – 25 individuals per annum of dark-bellied brent geese, golden plover, lapwing and dunlin are predicted to collide (Appendix D of Annex 5.3: Collision Risk Modelling Report). It can be concluded, however, that in relation to flyway, regional and SPA populations, the additional mortality due to turbine collisions is likely to be negligible for all species based on known population sizes e.g. Calbrade *et al.* (2010).

5.11.2.191 The impact is predicted to be of local spatial extent, long term duration, continuous and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be no change.

Sensitivity of the receptor

5.11.2.192 Although migratory non-seabird species have not been significantly studied in the offshore environment, vulnerability to collisions is likely to be generally low, since most migration will occur on a broad front and also above rotor height, although during periods of poor weather this risk may increase. Recoverability of populations of migrants may vary considerably, with smaller wader species with a relatively favourable conservation status (e.g. golden plover) faring better than larger, rarer species with lower reproductive rates (e.g. taiga bean goose). On a precautionary basis and purposes of this assessment these species are assumed to have high sensitivity.

Significance of the effect

5.11.2.193 Overall, it is predicted that the sensitivity of these receptors is considered to be high and the magnitude is deemed to be of no change. The effect will, therefore, be of negligible adverse significance, which is not significant in EIA terms.

Summary

5.11.2.194 A summary of collision impacts in the operation and maintenance phase on each VOR is presented in Table 5.29. For species where no collision risk modelling was undertaken, negligible magnitude was predicted, and overall sensitivities were based on species' vulnerability to collisions (Wade *et al.*, 2017), recoverability and conservation value.

Table 5.29: Summary of the impact of collisions with rotating turbine blades may result in direct mortality of an individual[3].

VOR	Sensitivity	Magnitude				Significance
		Breeding season	Post-breeding season	Non-breeding season	Pre-breeding season	
Gannet	Medium	Negligible	Negligible		Negligible	Negligible or minor adverse
Arctic skua	High	No change (Annual)				Negligible adverse
Great skua	High	No change (Annual)				Negligible adverse
Common tern	Medium		No change		No change	Negligible adverse
Arctic tern	Medium	No change (Annual)				Negligible adverse
Kittiwake	High	Low	Low		Negligible	Minor adverse
Little Gull	Medium	No change (Annual)				Negligible adverse
Lesser black-backed gull	Medium	Low	No change	No change	Negligible	Minor adverse
Great black-backed gull	Medium	Negligible		Negligible		Negligible or minor adverse
Other seabird species	Medium	No change (Annual)				Negligible adverse
Other migratory species	High	No change (Annual)				Negligible adverse

The impact of barrier effects caused by the physical presence of turbines and ancillary structures may prevent clear transit of birds between foraging and breeding sites, or on migration.

5.11.2.195 Barrier effects may arise in addition to displacement. However unlike displacement (which is defined as the effect on birds that would have utilised resources that have since become occupied by turbines), barrier effects do not suggest such links with resource inside Hornsea Three. The effect refers to the disruption of preferred flight lines, so that some individuals may chose to re-navigate to alternative routes. Such re-navigation has the potential to lead to increased energetic costs and could affect birds on annual migration or species on foraging excursions from breeding colonies.

5.11.2.196 Barrier effects are considered for the operation and maintenance phase only; this impact during the construction phase from vessels and construction infrastructure is considered to be negligible.

5.11.2.197 Barrier effects may occur due to the potential disruption of bird flight lines, which then imposes an extra energetic cost to daily movements or migratory routes (Speakman *et al.*, 2009; Masden *et al.*, 2010).

5.11.2.198 Hornsea Three is within mean maximum foraging range of gannet (229 km; Thaxter *et al.* 2012) from the nearest breeding colony (Bempton Cliffs within FFC pSPA). However, Hornsea Three is unlikely to provide a barrier to foraging gannets from the colony given the species extensive foraging range and efficient flying capabilities. It is more likely that birds may be displaced from the Hornsea Three site due to turbine presence. The assessment of displacement effects on gannet can be found in paragraphs 5.11.2.24 to 5.11.2.37 of this chapter.

5.11.2.199 Hornsea Three lies outside of the mean maximum foraging range for kittiwake from the nearest breeding colony (Bempton Cliffs within FFC Coast pSPA). Hornsea Three is unlikely to provide a barrier to foraging kittiwakes, as with other gull species (great black-backed, lesser black-backed and little gull) it is expected that birds will continue to pass through the Project area and are at more risk to collision than barrier effects (see collision assessment in paragraphs 5.11.2.158 to 5.11.2.168).

5.11.2.200 Hornsea Three lies outside of the mean-maximum foraging range of guillemot, razorbill, and puffin from the seabird colonies of Flamborough Head and Bempton Cliffs and so the Project is unlikely to provide a barrier to breeding auks on foraging excursions.

All receptors

Magnitude of impact

5.11.2.201 For seabird species which are within mean maximum foraging range of breeding colonies, these generally forage widely (e.g. fulmar and gannet). As such, turbines associated with Hornsea Three are unlikely to form a significant barrier to movement from any colony, with the closest being at Flamborough Head, at about 149 km away. The impact is therefore predicted to be of local spatial extent, long term duration, intermittent and medium reversibility within the context of the regional or national populations. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **low** at a regional level.

5.11.2.202 For breeding species which are outside of the mean maximum foraging range of breeding colonies (e.g. most gull and auk species), by definition it is highly unlikely that there will be any barrier effect at all. The magnitude is therefore, considered to be **negligible** at a regional level.

5.11.2.203 For migratory species, the impact is predicted to be of local spatial extent, short term duration, intermittent and medium to high reversibility within the context of the flyway or European breeding populations. It is predicted that the impact will affect the receptor directly. Because of the species' apparent tolerance of turbines the magnitude is therefore, considered to be **negligible** for all species at an international level during the migratory periods.

[3] Grey cells indicate not relevant for the species.

Sensitivity of the receptor

5.11.2.204 The vulnerability of a species to barrier effects is most likely to be reflected in the species' reaction to the presence of turbines as considered by Maclean *et al.* (2009). The vulnerability ratings to barrier effects of the Hornsea Three VORs range from very low to high.

5.11.2.205 The migratory species in the impact assessment have been included due to their potential connectivity to SPAs (Arctic skua, great skua, Arctic tern, common tern), and/or a migratory species listed on Annex 1 of the EU Birds Directive (little gull). Based on Table 5.11, the former species are therefore assigned, on a precautionary basis, international conservation value, whereas little gull is of national conservation value.

5.11.2.206 Evidence from studies at operational wind farms (Everaert, 2006; Everaert and Kuijken, 2007; Lawrence *et al.*, 2007; Krijgsveld *et al.*, 2011) has shown that gulls, terns and skuas are unlikely to see turbines as a barrier to movement, with some evidence of attraction by little gulls in Krijgsveld *et al.* (2011).

5.11.2.207 All species except gannet, little gull and great skua have shown indications of national declines in breeding numbers and so recoverability is considered medium. For little gull, the species is considered to be increasing in numbers at an international scale (Wetlands International, 2006), albeit at an unknown level, and so recoverability is rated as medium to high. Great skua has shown an upward population trend in recent years although evidence suggests that growth rate is slowing (http://jncc.defra.gov.uk/page-2879) this species is also deemed to have a medium-high recoverability

5.11.2.208 The overall sensitivity for migratory species is therefore considered to be low.

Significance of the effect

5.11.2.209 .An impact of low magnitude on low sensitivity receptors during the migratory periods will produce a negligible or minor adverse effect on the national population, which is considered to be not significant in EIA terms.

Summary

5.11.2.210 A summary of barrier effect impacts in the operation and maintenance phase on each VOR is presented in Table 5.30.

Table 5.30: Summary of the impact of barrier effects caused by the physical presence of turbines and ancillary structures may prevent clear transit of birds between foraging and breeding sites, or on migration.

Species	Sensitivity	Magnitude	Significance
Fulmar	Low	Low	Negligible or minor adverse
Gannet	Low	Low	Negligible or minor adverse
Arctic skua	Low	Negligible	Negligible or minor adverse
Great skua	Low	Negligible	Negligible or minor adverse
Puffin	Low	Negligible	Negligible or minor adverse
Razorbill	Low	Negligible	Negligible or minor adverse
Guillemot	Low	Negligible	Negligible or minor adverse
Common tern	Low	Negligible	Negligible or minor adverse
Arctic tern	Low	Negligible	Negligible or minor adverse
Kittiwake	Low	Negligible	Negligible or minor adverse
Little Gul	Low	Negligible	Negligible or minor adverse
Lesser black-backed gull	Low	Negligible	Negligible or minor adverse
Great black-backed gull	Low	Negligible	Negligible or minor adverse

The impact of attraction to lit structures by migrating birds in particular may cause disorientation, reduction in fitness and possible mortality

5.11.2.211 Birds are often attracted to structures such as oil rigs during the hours of darkness, as they may provide opportunities for extended feeding periods, shelter and resting places or navigation aids for migrating birds. Any benefits of lighting, however, may be outweighed by increased risks of collision with gas flares, or in the case of turbines, rotating blades. Turbines are not likely to be extensively lit, compared to oil rigs for example, and so any benefits relating to increased provision of foraging opportunities during hours of darkness are likely to be negligible.

5.11.2.212 The complexity of this issue arises from the fact that disturbance effects of lighting may derive from changes in orientation, disorientation and attraction or repulsion from the altered light environment, which in turn may affect foraging, migration and communication (Longcore and Rich, 2004). Birds may collide with each other or a structure, or become exhausted as a result. Conversely, for unlit turbines at night or during foggy conditions, it is possible that the risk of collision may be greater because moving rotors may not be detectable (Trapp, 1998).

5.11.2.213 Migrating birds are likely to be particularly susceptible to any adverse effects of lighting. Around two thirds of all bird species migrate during darkness, when collision risk is expected to be higher than during daylight (Hüppop *et al.*, 2006).

5.11.2.214 The evidence for this impact is however mixed. ICES (2011) state that birds are somewhat less inclined to avoid turbines at night, but in contrast extended periods of infra-red monitoring at night using a Thermal Animal Detection System (TADS) at Nysted provided unexpected evidence that no movements of birds were detected below 120 m during the hours of darkness, even during periods of heavy [seabird] migration (Desholm, 2005). Welcker *et al.* (2017) found nocturnal migrants do not have a higher risk of collision with wind energy facilities than do diurnally active species, but rather appear to circumvent collision more effectively.

5.11.2.215 In terms of attraction to lit structures, the worst-case scenario for Hornsea Three would involve 342 turbines and the maximum number of ancillary structures. For maximum visibility, each structure would be fitted with lighting requirements for aviation and shipping..

All receptors

Magnitude of impact

5.11.2.216 The species that are likely to be present in largest numbers (kittiwake, gannet and guillemot) are unlikely to be active at night, either returning to colonies or roosting on the sea surface. In addition, auks and gannet have been shown to avoid wind farms to some degree, and it is therefore possible that this will continue at night, although auks have been found in close proximity to lit oil rigs. Fulmars are unlikely to be found in large aggregations and so any impacts would occur on a relatively small proportion of birds within Hornsea Three at any time. Since gulls are visual foragers that may follow lit trawlers and other vessels, it is unlikely that birds, at least those local to the area, would be disoriented by lit turbines to a significant degree.

5.11.2.217 It is therefore most likely that a significant impact would only occur on any species if large numbers of migrants pass through the site at one time, leading to mass disorientation or collisions. The migratory species (skuas, little gull and terns) may theoretically all move at night and therefore be at risk, although all of these species are given the lowest ranking for nocturnal activity rate by Wade *et al.* (2016). As reported above in the Barrier Effects section (paragraph 5.11.2.195 onwards), precise numbers of birds moving through the site are unknown, but in relation to national or international populations, proportions travelling through Hornsea Three during hours of darkness are likely to be low (see Wade *et al.* (2016) for determination of nocturnal activity rates), particularly as most flights would be below potential collision height. Moreover, there is no evidence from any existing offshore wind farms to suggest mass collision events as a result of the navigational and aviation lighting that is typical for offshore wind farms. As previously referenced, Welcker *et al.* (2017) found nocturnal migrants do not have a higher risk of collision with wind energy facilities than do diurnally active species, but rather appear to circumvent collision more effectively.

5.11.2.218 As such, the impact is therefore predicted to be of local spatial extent, short term duration, intermittent and of medium reversibility within the context of any international, national or regional population. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be low for all receptors.

Sensitivity of the receptor

5.11.2.219 The attraction to lit structures and therefore any resulting impacts are likely to depend much on each species' presence within Hornsea Three during the hours of darkness, as well as the proportion of flights likely to occur at potential collision height. Based on nocturnal activity rates advocated in Garthe and Hüppop (2004) and *et al.* (2013), gulls are likely to have moderate levels of nocturnal activity. Garthe and Hüppop (1996) reported that in the southern North Sea, gulls (including kittiwake) frequently forage at fishing vessels during the night. However, Kotzerka *et al.* (2010) reported that kittiwake foraging trips mainly occurred during daylight and birds were mostly inactive during the night, and so risks may be lower for this species despite the proportion of flights at risk heights being higher than for some other species.

5.11.2.220 Gannets have been shown to rarely fly at night, although may do so slightly more during the migratory periods, and their activity rate was rated as low (Wade *et al.*, 2016). A moderate number of flights are likely to be at risk height (Johnston *et al.*, 2014). Fulmar was given a relatively high nocturnal activity rate (4 out of 5) (Wade *et al.*, 2016), which is likely to be due to the long duration of foraging trips undertaken by the species. Very few flights are likely to be at risk height (Wade *et al.* 2016).

5.11.2.221 Auks were attributed a very low nocturnal activity rate score, as were skuas and terns, which is likely to be due to foraging requirements related to visibility rather than smell or obtaining discards, and their relatively short foraging durations. Few flights from these species are likely to be at risk height (Johnston *et al.*, 2014, Wade *et al.* 2016).

5.11.2.222 Based on previously reported conservation status and recoverability levels for each species, in combination with vulnerability, the sensitivity of all receptors is considered to be low, with species generally either having low nocturnal activity rates at potential collision height and high conservation status (e.g. guillemot, terns, skuas, kittiwake) or high nocturnal activity rates at potential collision height and low conservation status (e.g. great black-backed gull), or a similar combination.

Significance of the effect

5.11.2.223 An impact of low magnitude on low sensitivity receptors during the migratory periods will produce a negligible or minor adverse effect, which is considered to be not significant in EIA terms for all receptors. This evaluation is supported by literature evidence that those species that are most active at night are unlikely to be affected by lit turbines and other structures, whereas those species that may have been sensitive on account of their conservation status or recoverability are unlikely to be present on site at night.

Summary

5.11.2.224 A summary of the impact of attraction to lit structures is provided in Table 5.31.

Table 5.31: Summary of the impact of attraction to lit structures by migrating birds.

Species	Sensitivity	Magnitude	Significance
All receptors	Low	Low	Negligible or minor adverse

The impact of disturbance as a result of activities associated with maintenance of operational turbines, cables and other infrastructure may result in disturbance or displacement of bird species

5.11.2.225 Disturbance to birds due to operational offshore wind farms is considered to be of a lower intensity than during construction/decommissioning phases, and limited to maintenance activities as well as vessel and helicopter trips to and from the site and accommodation platforms, and also post-construction monitoring survey activity. The maximum design scenario for the wind farm considered for operation and maintenance disturbance is outlined in Table 5.8.

5.11.2.226 In many cases operation and maintenance disturbance may be indistinguishable from displacement, as birds of particular species may be susceptible to both impacts. A bird that has already been displaced from the wind farm may not be affected by operation and maintenance disturbance. Conversely, operation and maintenance disturbance may exacerbate the impact of displacement if it occurs in an area where birds have been displaced to (e.g. supply vessels en route to and from Hornsea Three). As it is not easy to predict the long-term displacement reactions of birds to turbines, the impacts of operation and maintenance disturbance have been considered in isolation.

5.11.2.227 The operation and maintenance of Hornsea Three may be managed on site using an offshore accommodation platform (with the use of crew boats and/or helicopters) or a floatel (with the use of crew boats and/or helicopters). Regular maintenance of turbines will occur throughout the year. Periodic inspection of the cable will be undertaken by remotely operated vehicles and/or geophysical survey to check that cables have not been exposed due to seabed movements, in which case remedial burial work or other cable protection methods will be required

All receptors

Magnitude of impact

5.11.2.228 It is expected that there will be daily boat movements within the offshore Hornsea Three area during operation and maintenance, with up to 20 crew vessels predicted on the site. Operational vessels are likely to be much less intrusive to seabird species than those associated with construction activities. Impacts are therefore likely to be of a lower magnitude than disturbance during construction, with birds likely to be affected in a smaller radius around the activity, compared to piling activities during construction for example.

5.11.2.229 The ultimate consequence of disturbance may be increased mortality to an extent similar (although likely more restricted in spatial extent) to displacement impacts, with birds during the breeding season more likely to be susceptible to such impacts. As such, the impact is predicted to be of local spatial extent, long term duration, and intermittent and medium reversibility within the context of any international, national or regional population. It is predicted that the impact will affect the receptor directly. If it is assumed that the magnitude of loss is similar to identified displacement impacts (Table 5.21) although reduced in spatial scale it is considered to be **negligible** for all species.

Sensitivity of the receptor

5.11.2.230 The overall sensitivity of receptors is considered to be of the same levels as those relating to construction disturbance in the Construction Phase impact assessment (see paragraph 5.11.1.3 onwards). Although scientific evidence on the effects of wind farm maintenance activities is lacking, there is no reason to suggest that any receptor will react differently to operation and maintenance activity as opposed to construction phase activity.

Significance of the effect

5.11.2.231 An impact of negligible magnitude on low to medium sensitivity receptors will produce a **negligible or minor adverse** effect on regional populations for all receptors, which is considered to be not significant in EIA terms. For common scoter and red-throated diver which are deemed to be of medium-high sensitivity, an impact of negligible magnitude will produce a **minor adverse** effect, which is considered to be not significant in EIA terms.

Summary

5.11.2.232 A summary of operation and maintenance disturbance impacts on each VOR is presented in Table 5.32.

Table 5.32: Summary of the impact of disturbance as a result of activities associated with maintenance of operational turbines, cables and other infrastructure may result in disturbance or displacement of bird species.

Species	Sensitivity	Magnitude	Significance
Common scoter	Medium to high	Negligible	Minor adverse
Red-throated diver	Medium to high	Negligible	Minor adverse
Fulmar	Low	Negligible	Negligible or minor adverse
Gannet	Low	Negligible	Negligible or minor adverse
Puffin	Medium	Negligible	Negligible or minor adverse
Razorbill	Low to medium	Negligible	Negligible or minor adverse
Guillemot	Medium	Negligible	Negligible or minor adverse

The impact of pollution including accidental spills and contaminant releases associated with maintenance or supply/service vessels which may affect species' survival rates or foraging activity

5.11.2.233 During the operation phase, each turbine will undergo a routine service every year. As part of this process, hydraulic fluids, gearbox oils and lubricants will be replaced and solid consumables such as filters will be disposed of.

5.11.2.234 Maintenance of the turbines may involve a range of processes, from an exchange of major components up to complete removal of a faulty turbine and replacement using jack-up or crane barges. Scour protection may need to be added to turbine foundations and removal or replacement of other structures such as substations and accommodation platforms may occur.

5.11.2.235 The most likely solution for a break in the subsea cables is to splice in a new section of cable, adding scour protection if required.

5.11.2.236 Maintenance vessels and machinery present will contain a fuel supply and lubricants which, in the event of an incident such as a collision, may be released into the surrounding sea. Details on the potential worst-case spills are presented in paragraph 5.11.1.110 onwards including Table 5.8, for the Construction Phase.

5.11.2.237 This assessment is considering the impact of pollution which may affect species' survival rates or foraging activity at Hornsea Three and therefore is of minimal importance to species actively migrating when only briefly transiting Hornsea Three. In the absence of a pathway for effect for migrant seabirds, the VORs considered for this potential impact are those species using The Hornsea Three offshore ornithology study area and The Hornsea Three offshore cable corridor i.e. common scoter, red-throated diver, fulmar, gannet, puffin, razorbill, guillemot, kittiwake, lesser black-backed gull and great black-backed gull.

<u>Magnitude of impact</u>

5.11.2.238 As outlined above, it is expected that there will be daily boat movements within Hornsea Three during operation and maintenance, with up to 20 crew vessels on site. In general, maintenance vessels are likely to have lower volumes of potential pollution sources than their construction equivalents, except in the event of turbine replacement. With a lower intensity of activity than during construction, impacts are therefore likely to be of a lower likelihood and magnitude. In addition, PEMMP commitments are part of the mitigation measures adopted as part of design. This will reduce likelihood of event and also reduce the consequence of any spills.

5.11.2.239 Given the likely size of potential pollution incidents (based on the volumes of any chemicals carried by one vessel) and the designed-in measures, the impact is therefore predicted to be of local spatial extent, short term duration, intermittent and high reversibility within the context of the regional populations. It is predicted that the impact will affect the receptor both directly and indirectly. The magnitude is therefore, considered to be **no change** at a regional population scale (Table 5.7), for all species.

<u>Sensitivity of the receptor</u>

5.11.2.240 The overall level of sensitivity of receptors is considered to be the same as those relating to pollution impacts in the Construction Phase impact assessment (see paragraph 5.11.1.110 onwards including Table 5.8). A summary of sensitivity for each receptor is provided in Table 5.33 below.

<u>Significance of the effect</u>

5.11.2.241 Based on an impact of whosemagnitude for all receptors is no change irrespective of the sensitivity of the receptor a **negligible adverse** effect on the regional population is predicted which is not significant in EIA terms.

Summary

5.11.2.242 A summary of operation and maintenance pollution impacts on each VOR is presented in Table 5.33.

Table 5.33: Summary of impacts of pollution including accidental spills and contaminant releases associated with maintenance or supply/service vessels which may affect species' survival rates or foraging activity.

Species	Sensitivity	Magnitude	Significance
Common scoter	Medium to high	No change	Negligible
Red-throated diver	Medium to high	No change	Negligible
Fulmar	Low	No change	Negligible
Gannet	Medium to high	No change	Negligible
Puffin	Medium to high	No change	Negligible
Razorbill	Medium to high	No change	Negligible
Guillemot	Medium to high	No change	Negligible
Kittiwake	Low to medium	No change	Negligible
Lesser black-backed gull	Low	No change	Negligible
Great black-backed gull	Low	No change	Negligible

Future monitoring

5.11.2.243 The requirements for monitoring have not yet been discussed but further information will be provided in the final application following initial discussions with the Expert Working Group. The eventual monitoring will be subject to discussion and agreement with the Licensing Authority and relevant statutory nature conservation agencies.

5.11.3 Decommissioning phase

5.11.3.1 The impacts of the offshore decommissioning of Hornsea Three have been assessed on offshore ornithology. The environmental effects arising from the decommissioning of Hornsea Three are listed in Table 5.8 along with the maximum design scenario against which each decommissioning phase impact has been assessed.

5.11.3.2 A description of the potential effect on offshore ornithology receptors caused by each identified impact is given below.

The impact of decommissioning activities such as increased vessel activity and underwater noise may result in direct disturbance or displacement from important foraging and habitat areas of birds.

5.11.3.3 A degree of temporary disturbance and displacement is likely to occur throughout the decommissioning phase. The magnitude and significance of any impacts is likely to be of a similar scale to those presented for the construction phase above (from paragraph 5.11.1.9. onwards). The magnitude and significance for each relevant receptor is presented in Table 5.34 below but, overall, the long term effect of this would be to return the area to its former state and the impact on regional or national populations of concern would be neutral with no impact over the long term.

Table 5.34: Summary of the impact of decommissioning activities such as underwater noise and vessel traffic that may result in direct disturbance or displacement from accessing important foraging and habitat areas (highest magnitude shown).

Species	Sensitivity	Magnitude	Significance
Common scoter	High	No change	Negligible
Red-throated diver	High	Negligible	Minor adverse
Gannet	Low	Low	Negligible or minor adverse
Puffin	Medium to high	Low	Minor adverse
Razorbill	Low to medium	Low	Negligible or minor adverse
Guillemot	Medium	Low	Minor adverse

The impact of indirect effects, such as changes in habitat or abundance and distribution of prey

5.11.3.4 Indirect impacts will likely be similar to those described for the construction phase e.g. physical disturbance, smothering and re-mobilisation of contaminants affecting prey species. Given the likely low sensitivity of the prey species, including sandeels within the wind farm and cable array footprint to disturbance (see volume 2, chapter 3: Fish and Shellfish Ecology; volume 2, chapter 2: Benthic Subtidal and Intertidal Ecology) and the low magnitude of indirect effects likely to occur on foraging seabirds, the significance of the impact overall would be minor adverse at worst.

Table 5.35: Summary of impact of indirect effects, such as changes in habitat or abundance and distribution of prey.

Species	Sensitivity	Magnitude	Significance
Common scoter	High	Negligible	Minor
Red-throated diver	High	Negligible	Minor
Fulmar	Low	Negligible	Negligible or minor adverse
Gannet	Low	Low	Negligible or minor adverse
Puffin	Medium to high	Low	Minor
Razorbill	Low to medium	Low	Negligible or minor adverse
Guillemot	Medium	Low	Minor
Kittiwake	Low	Low	Negligible or minor adverse
Lesser black-backed gull	Low to medium	Negligible	Negligible or minor adverse
Great black-backed gull	Low	Negligible	Negligible or minor adverse

The impact of pollution including accidental spills and contaminant releases associated with removal of infrastructure and supply/service vessels may lead to direct mortality of birds or a reduction in foraging capacity

5.11.3.5 The impacts of pollution during the decommissioning activities are expected to be the same or similar as during construction. A summary of these impacts on each species is presented in Table 5.36, which reflects those predicted during the construction phase.

Future monitoring

5.11.3.6 No offshore ornithology monitoring to test the predictions made within the impact assessment for the decommissioning phase is considered necessary at this stage.

Table 5.36: Summary of the impact of pollution including accidental spills and contaminant releases associated with removal of infrastructure, rigs and supply/service vessels may lead to direct mortality of birds or a reduction in foraging capacity.

Species	Sensitivity	Magnitude	Significance
Common scoter	Medium to high	No change	Negligible
Red-throated diver	Medium to high	No change	Negligible
Fulmar	Low	No change	Negligible
Gannet	Medium to high	No change	Negligible
Puffin	Medium to high	No change	Negligible
Razorbill	Medium to high	No change	Negligible
Guillemot	Medium to high	No change	Negligible
Kittiwake	Low to medium	No change	Negligible
Lesser black-backed gull	Low	No change	Negligible
Great black-backed gull	Low	No change	Negligible

5.12 Cumulative Effect Assessment methodology

Screening of other projects and plans into the Cumulative Effect Assessment

5.12.1.1 The Cumulative Effect Assessment (CEA) takes into account the impact associated with Hornsea Three together with other projects and plans. The projects and plans selected as relevant to the CEA presented within this chapter are based upon the results of a screening exercise undertaken as part of the 'CEA long list' of projects (see annex 4.5: Cumulative Effects Screening Matrix and Location of Schemes). Each project on the CEA long list has been considered on a case by case basis for scoping in or out of this chapter's assessment based upon data confidence, effect-receptor pathways and the spatial/temporal scales involved.

5.12.1.2 In undertaking the CEA for Hornsea Three, it is important to bear in mind that other projects and plans under consideration will have differing potential for proceeding to an operational stage and hence a differing potential to ultimately contribute to a cumulative impact alongside Hornsea Three. For example, relevant projects and plans that are already under construction are likely to contribute to cumulative impact with Hornsea Three (providing effect or spatial pathways exist), whereas projects and plans not yet approved or not yet submitted are less certain to contribute to such an impact, as some may not achieve approval or may not ultimately be built due to other factors. For this reason, all relevant projects and plans considered cumulatively alongside Hornsea Three have been allocated into 'Tiers', reflecting their current stage within the planning and development process. This allows the CEA to present several future development scenarios, each with a differing potential for being ultimately built out. Appropriate weight may therefore be given to each Tier in the decision making process when considering the potential cumulative impact associated with Hornsea Three (e.g. it may be considered that greater weight can be placed on the Tier 1 assessment relative to Tier 2).

5.12.1.3 An explanation of each tier is included below:

- Tier 1: Hornsea Three considered alongside other project/plans currently under construction and/or those consented but not yet implemented, and/or those submitted but not yet determined and/or those currently operational that were not operational when baseline data was collected, and/or those that are operational but have an on-going impact;
- Tier 2: All projects/plans considered in Tier 1, as well as those on relevant plans and programmes likely to come forward but have not yet submitted an application for consent (the PINS programme of projects is the most relevant source of information). Specifically, this Tier includes all projects where the developer has submitted a Scoping Report; and
- Tier 3: All projects/plans considered in Tier 2, as well as those on relevant plans and programmes likely to come forward but have not yet submitted an application for consent (the PINS programme of projects is the most relevant source of information). Specifically, this Tier includes all projects where the developer has advised PINS in writing that they intend to submit an application in the future but have not submitted a Scoping Report.

5.12.1.4 It is noted that Tier 1 includes projects, plans and activities that are operational, under construction, consented but not yet implemented and submitted but not yet determined. The certainty associated with other projects, plans and activities, in terms of the scale of the development and the likely impacts, increase as they progress from submitted applications to operational projects. In particular, offshore wind farms seek consent for a maximum design scenario and the as built offshore wind farm will be selected from the range of consented scenarios. In addition, the maximum design scenario quoted in the application (and the associated Environmental Statement) are often refined during the determination period of the application. For example, it is noted that the Applicant for Hornsea Project One has gained consent for an overall maximum number of turbines of 240, as opposed to 332 considered in the Environmental Statement. Similarly, Hornsea Project Two has gained consent for an overall maximum number of turbines of 300, as opposed to 360 considered in the Environmental Statement.

5.12.1.5 It should be noted that the CEA presented in this offshore ornithology chapter has been undertaken on the basis of information presented in the Environmental Statements for the other projects, plans and activities. The level of impact on offshore ornithology would likely be reduced from those presented here. In addition, Hornsea Three is currently considering how the different levels of certainty associated with projects in Tier 1 can be reflected in the CEA and an update, in terms to the approach to tiering, will be presented in the Environmental Statement.

5.12.1.6 The tiered approach is consistent with PINS Advice Note Seventeen: (PINS, 2015) and the Renewable UK CIA Guidelines, specifically Guiding Principle 4 and Guiding Principle 7 (Renewable UK, 2013).

5.12.1.7 The specific projects scoped into this CEA and the Tiers into which they have been allocated, are outlined in Table 5.37. The projects included as operational in this assessment have been commissioned since the baseline studies for this project were undertaken and as such were excluded from the baseline assessment.

5.12.1.8 The range of projects considered within the CEA is dependent on the particular impact as well as each species' population distribution and behaviour (e.g. foraging range). In general the initial scope of projects has considered all operational, in-construction or planned wind farms along the east coast of Britain, as well as non-UK projects in the North Sea, within potential foraging range.

5.12.1.9 Following PINS guidance received in the Hornsea Project One Second Scoping Opinion, projects will, however, not be considered within the ornithological CIA where its influence on an ornithological receptor, which is also predicted to be significantly affected by Hornsea Three, is considered to be captured within the baseline (i.e. from data collected during baseline surveys for Hornsea Three), as this would lead to effective double-counting of an impact. This takes into account any time-lag for effects to be displayed at a population level (e.g. reductions in productivity, increased mortality), which is particularly relevant for seabird species that breed only after a number of years, and then often intermittently.

5.12.1.10 As per the Hornsea Three Screening Report, some of the projects within the initial area of search have been excluded from assessment. Scroby Sands has been operational since 2004 and so its effects on birds are considered to be incorporated into the baseline survey results for Hornsea Three, even when considering a time-lag for impacts to occur at a population level. Because the site was consented some time ago, there will be very low confidence in the data or predictions in the project's EIA, due to differences in assessment methods. As a small site, its impact is expected to be negligible. This is also considered to be the case for the two-turbine Beatrice Demonstrator site in the Moray Firth, which has been operational since 2008, and the two turbine Blyth Wind Farm, Northumberland, operational since 2000.

5.12.1.11 Although some non-UK offshore wind farms may be within the potential zone of influence for particular ornithological receptors (but less likely to contribute to cumulative impacts due to distances from Hornsea Three), compatible data on these projects are largely unavailable and so these could not be included within a detailed quantitative assessment. It has been assumed, for the purposes of this assessment, that any contribution from these projects to cumulative mortality will be negligible.

5.12.1.12 Owing to the evolution of the methods used to determine impacts of offshore wind farm projects on birds in the UK over the last decade, there is considerable variation in style and detail of presentation of results and subsequent assessment in other project Environmental Statements and technical reports. In many cases, particularly with the older, smaller Round 1 and 2 projects, no attempt has been made to separate, for example, mortality due to collisions between seasons, or between SPA and non-SPA birds. Instead total annual mortality (if this has been estimated) has been assessed against an undetermined population as a 'worst-case' scenario, which would likely overestimate actual impacts on, for example, individual SPA populations, if it is assumed all mortality is to this population.

5.12.1.13 For some impacts, particularly disturbance-displacement related, often a qualitative assessment was deemed sufficient, and there is no reference to displacement rates and/or mortality rates particular to that project.

5.12.1.14 The projects that are included within the cumulative assessment for each species are based on the availability of data, and are presented in the individual impact sections below. For collision impacts this includes all projects for which collision risk modelling has been undertaken, but excludes those where collision risk estimates have not been quantified. Projects without appropriate data have been considered, where possible, qualitatively, acknowledging that they may contribute to a cumulative impact. For displacement, an analytical approach has been used which attempts seeks to calculate displacement mortality, comparable with those produced for Hornsea Project Two. This approach follows that used during the examination process for previous projects within the North Sea (e.g. Dogger Bank Creyke Beck A and B). These approaches are discussed further within the relevant sections for each impact.

5.12.1.15 It should be recognised that as some projects are currently within the application process, figures presented will be subject to refinement as a result of consultation and agreements with stakeholders. The figures presented should be seen as being both preliminary and precautionary, and of lower confidence than would otherwise have been the case. As a general rule, projects which presented updated data on or prior to early-2017 have been included in the CIA, this will continue to be updated as the assessment is completed..

5.12.1.16 The guidelines by King *et al.* (2009) recommend that only regulated projects subject to EIA should be included and that unregulated or unplanned activities are usually integrated into baseline results and not required for consideration. A quantitative approach to assessing the potential impacts of other (non-wind) offshore activities was, however, not possible, and a qualitative approach was instead considered. Other activities in the southern North Sea area that may have a direct or indirect impact on birds include the following types of project:

- Marine aggregate and disposal;
- Cable and pipeline construction;
- Commercial fisheries; and
- Oil and gas exploration and production.

5.12.1.17 Activities that were considered to be recorded in the baseline, and where no recent changes have occurred, or future changes are predicted, have been omitted. For activities such as commercial fishing, for example, numbers and distribution of vessels may alter upon commencement of construction of Hornsea Three, hence its inclusion in the CEA.

Table 5.37: List of other projects and plans considered within the CEA..

Tier	Phase	Project/Plan	Distance from Hornsea Three (km)	Details	Date of Construction (if applicable)	Overlap of construction phase with Hornsea Three construction phase	Overlap of operation and maintenance phase with Hornsea Three operation and maintenance phase
1	*Offshore wind farms*						
	Construction	Aberdeen Demo	444	Up to 100MW with no more than 11 turbines	2019	No	Yes
		Beatrice	564	588MW 88 turbines	2017-2019	No	Yes
		Blyth Demo	258	Consented: 99MW (up to 15) In Construction: 41.5MW (5x8MW)	2019	No	Yes
		Dogger Bank Creyke Beck A	76	Up to 1.2GW (Up to 200 turbines of up to 10MW capacity)	2021 – 2024	Yes	Yes
		Dogger Bank Creyke Beck B	99	Up to 1.2GW (Up to 200 turbines of up to 10MW turbines)	2021 – 2024	Yes	Yes
		Dogger Bank Teesside A	107	Up to 1.2GW	2023 - 2026	Yes	Yes
		Dogger Bank Teesside B	95	Up to 1.2GW	2023 - 2026	Yes	Yes
		Dudgeon	87	20 miles off the coast of Cromer, N North Norfolk. Up to 402 MW and 67 turbines	2015 – 2017	No	Yes
		East Anglia One	152	714MW (102x7MW)	2017 – 2019	No	Yes
		Galloper	195	Up to 336MW (56x6MW turbines)	2019	No	Yes
		Hornsea Project One	7	Up to 300 6-15MW turbines (DCO)	2017 – 2018	No	Yes
		Hywind Scotland Pilot Park	438	30MW (5x6MW turbines)	2019	No	Yes
		Inch Cape	384	Up to 784MW (95-110 turbines of up to 7 - 8MW capacity) Consent over-turned on Judicial Review (currently being appealed)	After 2019	Yes	Yes
		Moray East	548	1116MW up to 137 turbines	Not known	Not known	Yes
		Neart na Gaoithe	372	448MW (64x7MW turbines) Consent over-turned on Judicial Review (currently being appealed)	After 2019	Yes	Yes
		Race Bank	114	Up to 580MW	2017 - 2018	No	Yes
		Rampion Wind Farm	388	400MW (116x3.45MW)	2017 - 2018	No	Yes
		SeaGreen Alpha	383	Up to 525MW (75x7MW) Consent over-turned on Judicial Review (currently being appealed)	After 2019	Yes	Yes

Tier	Phase	Project/Plan	Distance from Hornsea Three (km)	Details	Date of Construction (if applicable)	Overlap of construction phase with Hornsea Three construction phase	Overlap of operation and maintenance phase with Hornsea Three operation and maintenance phase
		Seagreen Bravo	367	Up to 525MW (75x7MW) Consent over-turned on Judicial Review (currently being appealed)	After 2019	Yes	Yes
		Triton Knoll	100	Up to 288 turbines consented	2017 – 2021	No	Yes
	Operation and maintenance	Greater Gabbard	198	504MW (140x3.6MWturbines)	N/A	No	Yes
		Gunfleet Sands Demo	245	12MW (2x6MW)	N/A	No	Yes
		Gunfleet Sands I	240	108MW (30x3.6MW)	N/A	No	Yes
		Gunfleet Sands II	239	64.8MW (18x3.6MW)	N/A	No	Yes
		Humber Gateway	128	Up to 219MW (73x3MW turbines)	N/A	No	Yes
		Kentish Flats	272	90MW (30x3MW Vestas turbines). Fully commissioned Dec 2005	N/A	No	Yes
		Kentish Flats Extension	273	49.5MW (15x3.3MW Vestas turbines)	N/A	No	Yes
		Lincs / LID61	139	270MW (75x3.6 MW)	N/A	No	Yes
		London Array	230	630MW (175x3.6MW)	N/A	No	Yes
		Lynn and Inner Dowsing Wind Farms	147	194 MW(54x 3.6MW Siemens monopiles). Commissioned March 2009. 5km off the coast of Skegness.	N/A	No	Yes
		Methil (Samsung) Demo	412	1x7MW turbine Operated by Scottish Enterprise, round/type - Demonstration/Lease	N/A	No	Yes
		Scroby Sands	132	60MW (30x2MW turbines)	N/A	No	Yes
		Shreingham Shoal	109	316.8MW (88x3.6MW) Sheringham, Greater Wash 17-23 km off North Norfolk	N/A	No	Yes
		Teesside	224	1.5km NE Teesmouth. 62.1MW (27x2.3 MW) Commissioned July 2013.	N/A	No	Yes
		Thanet	260	300MW (100x3 MW monopile turbines) UK, offshore wind, Round 2. 12 km off Foreness Point, Kent Fully commissioned Sep 2010	N/A	No	Yes
		Westermost Rough	132	210MW (35x6MW)	N/A	No	Yes
2	*Offshore wind farms*						
	Application	Norfolk Vanguard	73	Up to 1800MW (between 120 - 257 turbines of up to 7 - 15MW capacity)	2020 – 2022	Yes	Yes

Tier	Phase	Project/Plan	Distance from Hornsea Three (km)	Details	Date of Construction (if applicable)	Overlap of construction phase with Hornsea Three construction phase	Overlap of operation and maintenance phase with Hornsea Three operation and maintenance phase
		East Anglia Three	103	Up to 1200MW (up to 172 turbines of up to 7 - 12MW capacity)	2020 – 2022	Yes	Yes
		Kincardine Offshore Wind Farm	422	48MW (8x6MW turbines)	2019	No	Yes
		Moray West	554	750MW Up to 90 turbines	2022-2024	Yes	Yes
		Methil Demonstration Project - 2B Energy	411	Demonstrator site	Not known	Not known	Yes
	Judicial Review	Inch Cape	384	Up to 784MW (95-110 turbines of up to 7 - 8MW capacity) Consent over-turned on Judicial Review (currently being appealed)	After 2019	Yes	Yes
		Neart na Gaoithe	372	448MW (64x7MW turbines) Consent over-turned on Judicial Review (currently being appealed)	After 2019	Yes	Yes
		SeaGreen Alpha	383	Up to 525MW (75x7MW) Consent over-turned on Judicial Review (currently being appealed)	After 2019	Yes	Yes
		Seagreen Bravo	367	Up to 525MW (75x7MW) Consent over-turned on Judicial Review (currently being appealed)	After 2019	Yes	Yes
	Cables						
	Application	Viking Link Interconnector	13	High voltage (up to 500 kV) Direct Current (DC) electricity interconnector	2018	No	Yes
3	Offshore wind farms						
	Pre-planning	Hornsea Project Four	36	1,000 MW	After 2020	Yes	Yes
		East Anglia One North	141	600 MW - 800 MW	Assumed after 2020	Yes	Yes
		East Anglia Two	158	Up to 800MW	2022 – 2024	Yes	Yes
		Norfolk Boreas	53	Up to 1800MW	Assumed after 2020	Yes	Yes
		Seagreen Charlie	366	Not known	After 2022	Yes	Yes
		Seagreen Delta	355	Not known	After 2022	Yes	Yes
		Seagreen Echo	345	Not known	After 2022	Yes	Yes
		Seagreen Foxtrot	383	Not known	After 2022	Yes	Yes
		Seagreen Golf	355	Not known	After 2022	Yes	Yes

5.12.2 Maximum design scenario

5.12.2.1 The maximum design scenarios identified in Table 5.38 have been selected as those having the potential to result in the greatest effect on an identified receptor or receptor group. The cumulative impact presented and assessed in this section have been selected from the details provided in the Hornsea Three project description (volume 1, chapter 3: Project Description), as well as the information available on other projects and plans, in order to inform a 'maximum design scenario'. Effects of greater adverse significance are not predicted to arise should any other development scenario, based on details within the project Design Envelope (e.g. different turbine layout), to that assessed here be taken forward in the final design scheme. . Other aspects, namely indirect impacts associated with prey redistribution and availability, pollution incidents, lighting and barrier effects are very difficult to quantify, and although it is acknowledged that cumulative impacts are possible, the magnitude of these impacts is not considered to be significant at a population level for any VOR, and is therefore not considered further within the CIA for offshore ornithology.

5.12.2.2 It should be recognised that as some projects are currently within the application process or have been consented but have not yet approached the construction phase, the numbers and parameters of the turbines presented will be worst case and can be expected to be subject to refinement, in some cases resulting in much lower numbers of turbines. The assessment presented should be seen as being both preliminary and very precautionary.

5.13 Cumulative Effect Assessment

5.13.1 Construction phase

5.13.1.1 Any cumulative impacts on the VORs will only occur if the construction phases of wind farm projects within a particular spatial extent (for example foraging range during breeding season or the North Sea in winter) are coincidental or sequential, leading to a short- to mid-term impact.

5.13.1.2 Although it is difficult to quantify, numbers affected are likely to be lower than those predicted in the cumulative displacement assessment in the following Operation and maintenance Impacts section, since the number of projects relevant to the assessment is smaller, and the duration and extent of impacts are unlikely to be as large. With species likely to be of similar vulnerability to construction and displacement impacts, the levels of magnitude and significance predicted by operation and maintenance displacement can be used as a basis for construction disturbance effects.

The impact of construction activities such as increased vessel activity and underwater noise, may result in direct disturbance or displacement from important foraging and habitat areas of birds

5.13.1.3 In section 5.11 the potential impact of construction activities that may result in direct disturbance or displacement from important foraging and habitat areas of birds, was assessed for common scoter, red-throated diver, gannet and auks

Tier 1

Magnitude of impact

5.13.1.4 Those Tier 1 projects predicted to overlap with the construction of Hornsea Three are the Dogger Zone projects (Creyke Beck A & B and Teesside A & B). Disturbance events during construction activities (including piling of foundations) will disturb and displace birds for the duration of the construction period As construction activities will be focused at specific locations within the Hornsea Three array area, it is expected to lead to a displacement impact of lesser magnitude than that predicted during operation and maintenance. Any impacts resulting from disturbance and displacement from construction activities are considered likely to be short-term, temporary and reversible in nature, lasting only for the duration of construction activity, with birds expected to return to the area once construction activities have ceased. The offshore components of Hornsea Three will occur over a maximum duration of 11 years, assuming a two phase construction scenario (Table 5.8). A gap of six years may occur between the same activity in different phases with in consequence the construction period considered of medium term duration as birds may return to areas when activities are not currently occurring.

5.13.1.5 At this stage, the likely origin and routing of vessels involved in the construction of Hornsea Three or any of the Dogger projects is not known. However, for the purposes of this assessment it is considered that construction vessels involved in construction and cable laying activities associated with the Dogger projects would be unlikely to originate in the Greater Wash area and are, therefore, unlikely to affect areas within the Greater Wash known to support relatively high densities of common scoter and red-throated diver. It is more likely that there will be a cumulative disturbance of gannet and the auk species.

5.13.1.6 In Section 5.11, the assessment of this impact for Hornsea Three alone was predicted to be at most of low magnitude for the VORs, on the basis that the extent of disturbance is limited, as construction activities will take place only within a small area of the site at any time (i.e. local spatial extent and intermittent with respect to any one area). The other projects under consideration have also typically predicted effects of negligible magnitude for this impact.

5.13.1.7 The impact is predicted to be of local spatial extent, medium term duration, intermittent and medium reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be at most **low** dependent upon on the VOR.

Table 5.38: Maximum design scenario considered for the assessment of potential cumulative impacts on offshore ornithology.

Potential impact	Maximum design scenario	Justification
Construction phase		
The impact of construction activities such as increased vessel activity and underwater noise, may result in direct disturbance or displacement from important foraging and habitat areas of birds.	Maximum design scenario: Construction vessels For Hornsea Three it is assumed (see Table 5.8) Up to 11,566 vessel movements during construction, comprised of: • Up to 4,446 vessel movements over construction period based on gravity base foundations (self-installing concept); • Up to 3,420 vessel movements over construction period for Wind Turbine Generator (WTG) installation; • Up to 304 vessel movements over construction period for substations; • Up to 2,856 vessel movements over construction period for array cables; and; • Up to 540 vessel movements over construction period for export cable. The offshore components of Hornsea Three will occur over a maximum duration of 11 years, assuming a two phase construction scenario. A gap of six years may occur between the same activity in different phases. Maximum design scenario: Construction activity • The potential for disturbance / displacement impacts due to construction activity are considered for two different scenarios – maximum level of construction activity and maximum duration of construction activity (see Table 5.8). Comprising of up to 342 x Wind Turbine Generators (WTG), 12 offshore HVAC collector substations, three offshore accommodation platforms, and four offshore HVDC substations and associated construction activity including: • Maximum construction activity level (magnitude) as indicated in Table 5.8 • Maximum construction activity duration as indicated in Table 5.8 This will be assessed cumulatively with projects with Tier 1 and 2 projects with potentially overlapping construction programmes: Tier 1 • Dogger Bank Creyke Beck A • Dogger Bank Creyke Beck B • Dogger Bank Teesside A • Dogger Bank Teesside B Tier 2 • Norfolk Vanguard • East Anglia Three	Maximum design scenario: Construction vessels Maximum design scenario provides for the greatest number of potential vessels associated with the construction phase and hence the highest likelihood of potential disturbance / displacement to bird species, as a result of multiple activities taking place over a 11 year offshore construction period. Maximum design scenario also reflects season and location with respect to a species abundance and vulnerability to an impact in the zone of influence. Maximum design scenario: Construction activity Maximum Design Scenario provides for the greatest disturbance/displacement effects to bird species due to construction activities (magnitude and duration).
Operation and maintenance phase		
The impact of physical displacement from an area around turbines (342) and other ancillary structures (up to twelve offshore HVAC collector substations, up to three offshore accommodation platforms and four offshore HVAC booster stations) during the operation phase of the development may result in effective habitat loss and reduction in survival or fitness rates.	For Hornsea Three it is assumed that the operation of maximum number of turbines (up to 342 WTGs), within the total wind farm area of 696 km^2, with a minimum of 1,000 m spacing. Operation of associated offshore HVAC transmission infrastructure (up to twelve offshore HVAC collector substations, up to three offshore accommodation platforms and four offshore HVAC booster stations (part way along cable route)) and up to three offshore accommodation platforms. Infrastructure placed up to the edge of Hornsea Three. This will be assessed cumulatively with all projects included in each Tier.	Provides for the maximum amount (spatial extent) of habitat loss due to physical displacement effects. For sensitive species, the wind farm as a whole will be avoided, whereas for others only individual turbines will be avoided while within the wind farm. Edge-weighted layout will potentially maximise area of sea rendered unavailable to birds.
Mortality from collision with rotating turbine blades	For Hornsea Three it is assumed that there will be operation of maximum number of turbines (up to 342 WTGs). Rotor swept diameter up to a maximum of 185 m when the maximum number of turbines is used i.e. total rotor swept area for the project of 9.19 km^2, with the lowest rotor tip height of 34.97 m above the Lowest Astronomical Tide. Irregular distribution of the positioning of the foundations within the total wind farm area of 696 km^2, with a minimum of 1,000 m spacing. This will be assessed cumulatively with all projects included in each Tier.	Greatest rotor swept area plus parameters that maximise collision risk and therefore mortality rates for all species as the surface area available for collision increases. This is the turbine layout with the largest combined rotor swept area and collision probability, the latter at its highest when turbines are at maximum rotor speed and at the lowest tip height.

Potential impact	Maximum design scenario	Justification
The impact of disturbance as a result of activities associated with maintenance of operational turbines, cables and other infrastructure may result in disturbance or displacement of bird species.	For Hornsea Three is assumed that there will be up to 2,832 vessel return trips per year during operation and maintenance, including crew vessels wind turbine visits (2,433 return trips per year), supply vessels accommodation platform visits (312 return trips per year) and jack-up vessels (87 return trips per year over the design life of the project (i.e. 25 years). Up to 25,234 helicopter flights per year comprising of: • 22,572 wind turbine visits; • 1,102 platform visits; and • 1,560 crew shift transfers. This will be assessed cumulatively with all projects included in each Tier.	Option provides for the largest possible source of direct and indirect (prey species) disturbance from noise, vessel movements and other maintenance related activity over the longest time period.

Sensitivity of receptor

5.13.1.8 The sensitivity of all VORs to cumulative disturbance/displacement due to construction activity is considered to be the same as predicted in Table 5.17 when assessing this impact for Hornsea Three alone.

5.13.1.9 For the receptors assessed, common scoter, red-throated diver, gannet and auks, are deemed to be of very low to very high vulnerability, low to high recoverability and regional to international value. The sensitivity of the receptor is therefore, considered to be low for gannet, medium for guillemot, low to medium for razorbill, medium to high for puffin and, high for common scoter and red-throated diver.

Significance of Effect

5.13.1.10 Overall, it is predicted that the sensitivity of the receptor is considered to be low to high and the magnitude is deemed to be at most low. The effect will, therefore, be at most of minor adverse significance, which is not significant in EIA terms.

Tier 2

Magnitude of impact

5.13.1.11 In addition to the Tier 1 projects considered above, those Tier 2 projects predicted to overlap with the construction of Hornsea Three are East Anglia Zone projects (Norfolk Vanguard and East Anglia Three). An assessment of the effects of Norfolk Vanguard has yet to be made, but the Environmental Statement for East Anglia Three considered the likely magnitude of the effects of construction activities to be of negligible magnitude for all species.

5.13.1.12 The impact is predicted to be of local spatial extent, medium term duration, intermittent and with medium reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be at most low dependent on the VOR.

Sensitivity of receptor

5.13.1.13 The sensitivity of all ornithological receptors to cumulative disturbance/displacement due to construction activity is considered to be the same as predicted in Table 5.17 when assessing this impact for Hornsea Three alone.

5.13.1.14 For the receptors assessed, common scoter, red-throated diver, gannet and auks, are deemed to be of very low to very high vulnerability, low to high recoverability and regional to international value. The sensitivity of the receptor is therefore, considered to be low for gannet, low to medium for razorbill, medium for guillemot, medium to high for puffin and, high for common scoter and red-throated diver.

Significance of Effect

5.13.1.15 Overall, it is predicted that the sensitivity of the receptor is considered to be low to high and the magnitude is deemed to be at most low. The effect will, therefore, be at most of minor adverse significance, which is not significant in EIA terms.

Future monitoring

5.13.1.16 Pre-construction monitoring will be detailed and agreed with consultees prior to construction.

5.13.2 Operation and maintenance phase

The impact of physical displacement from an area around turbines (342) and other ancillary structures (up to twelve offshore HVAC collector substations, three offshore accommodation platform and four offshore HVAC booster stations) during the operational phase of the development may result in effective habitat loss and reduction in survival or fitness rates.

Methodology for cumulative impact assessment - displacement

5.13.2.1 Predicted displacement effects for Hornsea Three alone during the operation and maintenance phase are discussed in depth in section 5.6.5 above. With respect to this cumulative assessment of displacement effects, suitable information was obtained from each relevant project's Environmental Statement chapter, Technical Report or other submitted documents.

5.13.2.2 When assessing the resultant effects of displacement on a population, it is now recognised that a worst-case scenario of 100% mortality for displaced birds is unrealistic and over-precautionary. Recently published interim guidance by JNCC *et al.* (2017) state that displacement impacts for each relevant species should be assessed based on a wide range of potential displacement and mortality rates in a 'matrix'. While some recent Environmental Statements use this matrix approach (e.g. Hornsea Project One, Aberdeen European Offshore Wind Deployment Centre, Dogger Bank Creyke Beck Projects A and B, Dogger Bank Teesside Projects A and B, and Seagreen Alpha and Bravo), many older projects do not. Instead of discounting data from all projects without a matrix approach, their data has been considered here where appropriate.

5.13.2.3 For Hornsea Three, the mean peak population estimates were calculated for Hornsea Three array area plus 2 km buffer, following JNCC *et al.* (2017). It is argued however, that this is an over-precautionary approach when considering references of sensitivity to disturbance summarised in Wade *et al.* (2016), and in other literature sources. As described in paragraph 5.11.2.8 for example, gulls (e.g. kittiwake) have a low sensitivity to disturbance/displacement, and so any displacement impacts are unlikely to extend further than the wind farm itself, whereas a moderate vulnerability species such as guillemot may show displacement up to a buffer of 1 km. Predicted displacement mortality is not expected to occur on a year on year basis; it is considered more likely to relate to a singular event following which seabirds will respond to by either redistribution or habituation.

5.13.2.4 No species where Natural England and JNCC (2013) recommend a 4 km buffer (divers and scoters) are relevant in this assessment of the Hornsea Three array area, none of these species having been identified as VORs for the latter area..

Methodology

5.13.2.5 In the large majority of cases, projects have made no attempt to quantify either the number of birds displaced by the wind farm, or the resultant mortality levels. Instead a qualitative assessment is usually conducted and as such these projects cannot be included as part of a quantitative assessment. For other projects, 100% displacement has been assumed, but the resultant mortality rate is not considered and in some (e.g. Beatrice), the impact on productivity rather than mortality is considered the more appropriate metric. These projects are also excluded from quantitative assessment.

5.13.2.6 As noted for the cumulative assessment of collision effects, some applications are still within the planning process at the time of writing. It is therefore considered that the figures provided in such cases have not been finalised. The levels of mortality predicted are therefore subject to change, and so the confidence level in their results is low.

Auk cumulative displacement

5.13.2.7 As part of the Hornsea Project One & Two and Dogger Bank Creyke Beck A and B and Dogger Bank Teesside Projects A and B examination processes, Natural England raised concerns relating to the potential cumulative displacement of auks from projects within the North Sea. Therefore for these species, an extensive analysis has been undertaken.

5.13.2.8 Two data sources have been used to determine the potential levels of displacement and mortality from wind farms included in the cumulative effect assessment:

- Population data held in individual wind farm project Environmental Statements and Habitats Regulations Assessments consisting of population estimates for individual project areas rather than raw survey data; and
- Density data provided in the Natural England seabird Sensitivity Mapping for English Territorial water (WWT and MacArthur Green, 2013).

5.13.2.9 The latter dataset has been compiled from the JNCC's European Seabirds at Sea databased from boat surveys; Wildfowl and Wetlands Trust (Consulting) Ltd.'s aerial survey database and several publically available boat based survey datasets from surveys for offshore wind farms and comprises predicted densities at a resolution of 3km x 3km grid cells.

5.13.2.10 For the Natural England data, GIS has been used to derive mean densities for common guillemot, razorbill, and puffin and for individual wind farm project areas. GIS has also been used to calculate the development area plus a 2 km buffer for each wind farm project. Numbers of birds present within the footprint of each project (and project + buffer) has then been calculated through simply multiplying area (in km^2) by mean density. The Natural England data is presented for both breeding and non-breeding seasons, with no further division into a post-breeding dispersion season.

5.13.2.11 For the project data, monthly population estimates have been collated where available. For some projects data is not available for the Hornsea Three array area plus 2 km buffer and the data has been scaled up or down based on data from the project area alone.

5.13.2.12 Upon obtaining mean-peak population estimates for the individual projects the numbers of birds affected through displacement and subsequent mortality has been calculated using the displacement and mortality rates agreed for Hornsea Project Two.

5.13.2.13 For earlier Round 1 and 2 projects monthly population data is not available and it has not been possible to derive specific apportioned displacement and mortality values. For these projects a combination of both the Natural England data and available project data has been used to derive representative values. This has been undertaken by comparing known project population estimates against those from the Natural England dataset and deriving appropriate scaling factors that can then be applied to projects for which the population estimate data is lacking.

Puffin

Tier 1

Magnitude of impact

Breeding season

5.13.2.14 Using the same assumptions as for Hornsea Three alone (40% displacement and 10% mortality), the predicted cumulative mortality of puffin due to the displacement predicted to arise from Hornsea Three and Tier 1 projects in the breeding season is up to 95 birds (see Table 5.39).

5.13.2.15 It is considered likely that at least half of all birds recorded in the breeding season are immature individuals. In addition, a further proportion are likely to be non-breeding adult birds. Therefore, mortality predicted during the breeding season is considered likely to result in considerably less than 95 adult birds from the regional breeding population.

5.13.2.16 The impact of displacement mortality on puffin during the breeding season is predicted to be of regional spatial extent, long term duration, continuous and of high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be low.

Non-breeding season

5.13.2.17 Using the same assumptions as for Hornsea Three alone (40% displacement and 1% mortality), the precautionary predicted cumulative mortality of puffin due to the displacement predicted to arise from Hornsea Three and Tier 1 projects in the non-breeding season is 51 birds (see Table 5.39), which represents a small proportion of the regional non-breeding season population of 231,957 individuals. The magnitude of this effect would not exceed 1% of the baseline mortality within this population.

5.13.2.18 The impact of displacement mortality on puffin during the non-breeding season is predicted to be of regional spatial extent, long term duration, continuous and of high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be negligible.

Sensitivity of receptor

5.13.2.19 Puffin is considered to be of international conservation value, with species recoverability considered as low. Behaviourally, Wade *et al.* (2016) have rated puffin as being of moderate vulnerability to displacement.

5.13.2.20 In summary, puffin is deemed to be of moderate vulnerability, low recoverability and international value. The sensitivity of the VOR is, therefore, considered to be medium.

Significance of Effect

5.13.2.21 The sensitivity of puffin is considered to be medium and the magnitude is deemed to be low (breeding season). The effect is predicted, therefore, to be of minor adverse significance, which is not significant in EIA terms.

<u>Tier 2</u>

Magnitude of impact

Breeding season

5.13.2.22 There is not predicted to be any additional mortality as a result of displacement impacts at Tier 2 projects in the breeding season as all Tier 2 projects are outside of the area in which the regional breeding population of puffin with connectivity to Hornsea Three is expected to occur.

Non-breeding season

5.13.2.23 Using the same assumptions as for Hornsea Three alone (40% displacement and 1% mortality), the precautionary predicted cumulative mortality of puffin due to the displacement predicted to arise from Hornsea Three and Tier 2 projects in the non-breeding season is 54 (see Table 5.39), which represents a small proportion of the regional non-breeding season population of 231,957 individuals. The magnitude of this effect would not exceed 1% of the baseline mortality within this population.

5.13.2.24 The impact of displacement mortality on puffin during the non-breeding season is predicted to be of regional spatial extent, long term duration, continuous and of high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be negligible.

Sensitivity of receptor

5.13.2.25 Puffin is considered to be of international conservation value, with species recoverability considered as low. Behaviourally, Wade *et al.* (2016) have rated puffin as being of moderate vulnerability to displacement.

5.13.2.26 In summary, puffin is deemed to be of moderate vulnerability, low recoverability and international value. The sensitivity of the VOR is, therefore, considered to be medium.

Significance of effect

5.13.2.27 The sensitivity of puffin is considered to be medium and the magnitude is deemed to be low (breeding season). The effect is predicted, therefore, to be of minor adverse significance, which is not significant in EIA terms.

Razorbill

<u>Tier 1</u>

Magnitude of impact

Breeding season

5.13.2.28 Using the same assumptions as for Hornsea Three alone (40% displacement and 10% mortality) the precautionary predicted cumulative mortality of razorbill due to the displacement predicted to arise from Hornsea Three and Tier 1 projects in the breeding season is 764 (Table 5.40).

5.13.2.29 Assessed against the defined national breeding population (260,000 birds) this surpasses the 1% baseline mortality figure of 273 birds. Such predicted mortality is not however expected to occur on a year on year basis; it is considered more likely to relate to a singular event following which seabirds will respond by either redistribution or habituation. It is also considered likely that a substantial proportion of all birds recorded in the breeding season are immature individuals. In addition, a further proportion are likely to be non-breeding adult birds. Therefore, mortality predicted during the breeding season is considered likely to be less than 273 adult birds from the national breeding population.

5.13.2.30 The impact of displacement mortality on razorbill during the breeding season without considering the likely age structure of population affected is predicted to be of regional spatial extent, long term duration, continuous and of medium reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be medium.

Table 5.39: Puffin cumulative mortality as a result of displacement (all birds).

Offshore wind farm	Breeding season (40% displacement, 10% mortality)	Non-breeding season (40% displacement, 1% mortality)
Hornsea Three	10	0
Tier 1		
Aberdeen		0
Beatrice		10
Blyth Demonstration	9	0
Dogger Bank Creyke Beck A	1	1
Dogger Bank Creyke Beck B	4	3
Dogger Bank Teesside A	1	1
Dogger Bank Teesside B	1	1
Dudgeon	0	0
East Anglia ONE		0
Galloper		0
Greater Gabbard		0
Hornsea Project One	43	5
Hornsea Project Two	19	8
Humber Gateway	1	0
Inch Cape		11
Lincs and LID6	0	0
London Array		0
Moray East		3
Neart na Gaoithe		8
Race Bank	0	0
Seagreen A		0
Seagreen B		0
Sheringham Shoal	0	0
Teesside	1	0
Thanet		0
Triton Knoll	1	0
Westermost Rough	2	0
Tier 1 total	95	53
Tier 2		
East Anglia Three		1
Tier 2 total	0	1
Total	95	54

Post-breeding season

5.13.2.31 During the post-breeding season, using a displacement rate of 40% and a mortality rate of 2% the precautionary predicted cumulative mortality of razorbill due to the displacement predicted to arise from Hornsea Three and Tier 1 projects in the post-breeding season is 213 birds (Table 5.40). This represents a small proportion of the regional population (591,874 birds) and does not represent an increase in baseline mortality of greater than 1%.

5.13.2.32 The impact of displacement mortality on razorbill during the post-breeding season is predicted to be of regional spatial extent, long term duration, continuous and of high reversibility involving a small number of individuals representing a small proportion of the regional population. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **negligible**.

Non-breeding season

5.13.2.33 During the non-breeding season, using a displacement rate of 40% and a mortality rate of 1% the precautionary predicted cumulative mortality of razorbill due to the displacement predicted to arise from Hornsea Three and Tier 1 projects in the non-breeding season is 67 birds (Table 5.40). This represents a small proportion of the regional population (218,622 birds) and does not represent an increase in baseline mortality of greater than 1%.

5.13.2.34 The impact of displacement mortality on razorbill during the non-breeding season is predicted to be of regional spatial extent, long term duration, continuous and of high reversibility involving a small number of individuals representing a small proportion of the regional population. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **negligible**.

Pre-breeding season

5.13.2.35 During the pre-breeding season, using a displacement rate of 40% and a mortality rate of 2% the precautionary predicted cumulative mortality of razorbill due to the displacement predicted to arise from Hornsea Three and Tier 1 projects in the pre-breeding season is 167 birds (Table 5.40). This represents a small proportion of the regional population (591,874 birds) and does not represent an increase in baseline mortality of greater than 1%.

5.13.2.36 The impact of displacement mortality on razorbill during the pre-breeding season is predicted to be of regional spatial extent, long term duration, continuous and of high reversibility involving a small number of individuals representing a small proportion of the regional population. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be negligible.

Sensitivity of receptor

5.13.2.37 Razorbill is considered to be of regional conservation value as a result of regionally important populations of this species being recorded in Hornsea Three offshore ornithology study area in the breeding season. With a regional and national population trend likely to be at least stable, the species recoverability is considered medium, and behaviourally Wade *et al.* (2016) has rated it as being of high vulnerability to displacement.

5.13.2.38 In summary, razorbill is deemed to be of high vulnerability, medium recoverability and regional value. The sensitivity of the VOR is therefore, considered to be low to medium.

Significance of Effect

5.13.2.39 The sensitivity of razorbill is considered to be low to medium and the magnitude is deemed to be medium (breeding season). Consequently, the effect could be either minor or moderate adverse significance. However, the predicted displacement mortality is based on conservative assumptions, including the use of precautionary displacement and mortality rates and worst case assumptions about the effects of a breeding regional population that is based only on breeding adult birds (excluding immature and non-breeding adult birds) whereas predicted displacement effects are based on the observed birds at Hornsea Three which will include immature and non-breeding adults. In addition, it is considered unlikely that all projects included in Tier 1 will be brought forward or, if constructed, they are unlikely to be built out to the worst case assumptions made in the respective impact assessments.

5.13.2.40 On this basis it is judged that the cumulative impact of Hornsea Three together with Tier 1 projects is likely to be of minor significance, which is not significant in EIA terms.

Tier 2

Magnitude of impact

Breeding season

5.13.2.41 Using the same assumptions as for Hornsea Three alone (40% displacement and 10% mortality) the precautionary predicted cumulative mortality of razorbill due to the displacement predicted to arise from Hornsea Three and Tier 2 projects in the breeding season is 791 (Table 5.40).

5.13.2.42 Assessed against the defined regional breeding population (260,000 birds calculated using the highly precautionary assumption of including all colonies within maximum foraging range) this surpasses the 1% baseline mortality figure of 273 birds. Such predicted mortality is not however expected to occur on a year on year basis; it is considered more likely to relate to a singular event following which seabirds will respond to by either redistribution or habituation. It is also considered likely that a substantial proportion of all birds recorded in the breeding season are immature individuals. In addition, a further proportion are likely to be non-breeding adult birds. Therefore, mortality predicted during the breeding season is considered likely to be less than 273 adult birds from the national breeding population.

5.13.2.43 The impact of displacement mortality on razorbill during the breeding season without considering the likely age structure of population affected is predicted to be of regional spatial extent, long term duration, continuous and of medium reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be medium.

Post-breeding season

5.13.2.44 During the post-breeding season, using a displacement rate of 40% and a mortality rate of 2% the precautionary predicted cumulative mortality of razorbill due to the displacement predicted to arise from Hornsea Three and Tier 2 projects in the breeding season is 218 (Table 5.40). This represents a small proportion of the regional population (591,874) and does not represent an increase in baseline mortality of greater than 1%.

5.13.2.45 The impact of displacement mortality on razorbill during the post-breeding season is predicted to be of regional spatial extent, long term duration, continuous and of high reversibility involving a small number of individuals representing a small proportion of the regional population. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be negligible.

Non-breeding season

5.13.2.46 During the non-breeding season, using a displacement rate of 40% and a mortality rate of 1% the precautionary predicted cumulative mortality of razorbill due to the displacement predicted to arise from Hornsea Three and Tier 2 projects in the non-breeding season is 72 (Table 5.40). This represents a small proportion of the regional population (218,622) and does not represent an increase in baseline mortality of greater than 1%.

Table 5.40: Razorbill cumulative mortality as a result of displacement (all birds)

Offshore wind farm	Breeding season (40% displacement, 10% mortality)	Post-breeding season (40% displacement, 2% mortality)	Non-breeding season (40% displacement, 1% mortality)	Pre-breeding season (40% displacement, 2% mortality)
Hornsea Three	23	3	15	5
Tier 1				
Aberdeen	6	1	0	0
Beatrice	35	7	2	7
Blyth Demonstration	5	1	0	1
Dogger Bank Creyke Beck A	50	13	7	33
Dogger Bank Creyke Beck B	62	17	9	41
Dogger Bank Teesside A	33	2	4	15
Dogger Bank Teesside B	46	5	6	24
Dudgeon	10	3	3	3
East Anglia ONE	1	0	1	3
Galloper	2	0	0	3
Greater Gabbard	0	0	2	1
Hornsea Project One	44	38	6	14
Hornsea Project Two	100	34	3	13
Humber Gateway	1	0	0	0
Inch Cape	57	23	3	0
Lincs and LID6	2	0	0	0
London Array	1	0	0	0
Moray East	97	9	0	1
Neart na Gaoithe	13	44	2	0
Race Bank	1	0	0	0
Seagreen A	128	0	0	0
Seagreen B	35	0	0	0
Sheringham Shoal	4	11	1	0
Teesside	1	0	0	0
Thanet	0	0	0	0
Triton Knoll	2	2	3	1
Westermost Rough	4	1	1	1
Tier 1 total	764	213	67	167
Tier 2				
East Anglia Three	27	5	5	12
Tier 2 total	27	5	5	12
Total	791	218	72	180

5.13.2.47 The impact of displacement mortality on razorbill during the non-breeding season is predicted to be of regional spatial extent, long term duration, continuous and of high reversibility involving a small number of individuals representing a small proportion of the regional population. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be negligible.

Pre-breeding season

5.13.2.48 During the pre-breeding season, using a displacement rate of 40% and a mortality rate of 2% the precautionary predicted cumulative mortality of razorbill due to the displacement predicted to arise from Hornsea Three and Tier 2 projects in the pre-breeding season is 180 (Table 5.40). This represents a small proportion of the regional population (591,874 birds) and does not represent an increase in baseline mortality of greater than 1%.

5.13.2.49 The impact of displacement mortality on razorbill during the pre-breeding season is predicted to be of regional spatial extent, long term duration, continuous and of high reversibility involving a small number of individuals representing a small proportion of the regional population. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be negligible.

Sensitivity of receptor

5.13.2.50 Razorbill is considered to be of national conservation value as a result of nationally important populations of this species being recorded in Hornsea Three offshore ornithology study area in the breeding season. With a regional and national population trend likely to be at least stable, the species recoverability is considered medium, and behaviourally Wade *et al.* (2016) has rated it as being of high vulnerability to displacement.

5.13.2.51 In summary, razorbill is deemed to be of high vulnerability, medium recoverability and regional value. The sensitivity of the VOR is therefore, considered to be low to medium.

Significance of Effect

5.13.2.52 The sensitivity of razorbill is considered to be low to medium and the magnitude is deemed to be medium (breeding season). Consequently, the effect could be either minor or moderate adverse significance. However, the predicted displacement mortality is based on conservative assumptions, including the use of precautionary displacement and mortality rates and worst case assumptions about the effects of a breeding regional population that is based only on breeding adult birds (excluding immature and non-breeding adult birds) whereas predicted displacement effects are based on the observed birds at Hornsea Three which will include immature and non-breeding adults. In addition, it is considered unlikely that all projects included in Tier 2 will be brought forward or, if constructed, they are unlikely to be built out to the worst case assumptions made in the respective impact assessments.

5.13.2.53 On this basis it is judged that the cumulative impact of Hornsea Three together with Tier 2 projects is likely to be of minor significance, which is not significant in EIA terms.

Guillemot

Tier 1

Magnitude of impact

Breeding season

5.13.2.54 Using the same assumptions as for Hornsea Three alone (30% displacement and 10% mortality) the precautionary predicted cumulative mortality of guillemot due to the displacement predicted to arise from Hornsea Three and Tier 1 projects in the breeding season is 3,627 (Table 5.41).

5.13.2.55 Assessed against the defined national population (1,900,000 pairs) this surpasses the 1% baseline mortality figure of 1,159 birds. However, predicted mortality is not expected to occur on a year on year basis; it is considered more likely to relate to a singular event following which seabirds will respond to by either redistribution or habituation. It is also considered likely that a substantial proportion of all birds recorded in the breeding season are immature individuals. In addition, a further proportion are likely to be non-breeding adult birds. Therefore, mortality predicted during the breeding season is considered likely to result in considerably less than 3,627 adult birds from the national breeding population.

5.13.2.56 The impact of displacement mortality on guillemot during the breeding season without considering the likely age structure of population affected is predicted to be of regional spatial extent, long term duration, continuous and of medium reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be medium.

Non-breeding season

5.13.2.57 During the non-breeding season, the precautionary predicted cumulative mortality of guillemot due to the displacement predicted to arise from Hornsea Three and Tier 1 projects in the non-breeding season is 229 (Table 5.41), which represents a small proportion of the regional winter population of 1,617,306 and does not represent an increase in baseline mortality of greater than 1%.

5.13.2.58 The impact of displacement mortality on guillemot during the non-breeding season is predicted to be of local spatial extent, long term duration, continuous and of medium reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be low.

Sensitivity of receptor

5.13.2.59 As a qualifying species of the former Flamborough Head and Bempton Cliffs SPA (and as such of the proposed extension, Flamborough and Filey Coast pSPA), guillemot is considered to be an ornithological receptor of international conservation value within the context of Hornsea Three. The species is deemed to be of high vulnerability to displacement (Wade *et al.*, 2016), and with an increase in regional and national populations over the last decade (+40% and +6% respectively), guillemot has medium recoverability potential.

5.13.2.60 In summary, guillemot is deemed to be of high vulnerability, medium recoverability and international value. The sensitivity of the VOR is therefore, considered to be medium.

Significance of Effect

5.13.2.61 The sensitivity of guillemot is considered to be medium and the magnitude is deemed to be medium (breeding season). The predicted displacement mortality is based on conservative assumptions, including the use of precautionary displacement and mortality rates and worst case assumptions about the effects on a breeding regional population that is based only on breeding adult birds (excluding immature and non-breeding adult birds) whereas predicted displacement effects are based on the observed birds at Hornsea Three which will include immature and non-breeding adults. In addition, it is considered unlikely that all projects included in Tier 1 will be brought forward or, if constructed, they are unlikely to be built out to the worst case assumptions made in the respective impact assessments.

5.13.2.62 On this basis, at this stage, it is judged that the cumulative impact of Hornsea Three together with Tier 1 projects could be of moderate significance, which is potentially significant in EIA terms. However, further assessment of the potential effects of Hornsea Three (including, for example, refinements of assumptions on the population age class structure etc.) and other relevant projects will continue to be undertaken along with an analysis of the likely population effects of those impacts.

Tier 2

Magnitude of impact

Breeding season

5.13.2.63 Using the same assumptions as for Hornsea Three alone (30% displacement and 10% mortality) the precautionary predicted cumulative mortality of guillemot due to the displacement predicted to arise from Hornsea Three and Tier 2 projects in the breeding season is 3,646 (Table 5.41.

5.13.2.64 Assessed against the defined national population (1,900,000 birds) this surpasses the 1% baseline mortality figure of 1,159 birds. However, predicted mortality is not expected to occur on a year on year basis; it is considered more likely to relate to a singular event following which seabirds will respond to by either redistribution or habituation. It is also considered likely that a substantial proportion of all birds recorded in the breeding season are immature individuals. In addition, a further proportion are likely to be non-breeding adult birds. Therefore, mortality predicted during the breeding season is considered likely to result in considerably less than 3,646 adult birds from the national breeding population.

5.13.2.65 The impact of displacement mortality on guillemot during the breeding season without considering the likely age structure of population affected is predicted to be of regional spatial extent, long term duration, continuous and of medium reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be medium.

Non-breeding season

5.13.2.66 During the non-breeding season, the precautionary predicted cumulative mortality of guillemot due to the displacement predicted to arise from Hornsea Three and Tier 2 projects in the non-breeding season is 234 (Table 5.41), which represents a small proportion of the regional winter population of 1,617,306 and does not represent an increase in baseline mortality of greater than 1%.

5.13.2.67 The impact of displacement mortality on guillemot during the non-breeding season is predicted to be of local spatial extent, long term duration, continuous and of medium reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be medium.

Sensitivity of receptor

5.13.2.68 Guillemot is deemed to be of high vulnerability, medium recoverability and international value. The sensitivity of the VOR is therefore, considered to be medium.

Table 5.41: Guillemot cumulative mortality as a result of displacement (all birds)

Offshore wind farm	Breeding season (30% displacement, 10% mortality)	Non-breeding season (30% displacement, 1% mortality)
Hornsea Three	364	41
Tier 1		
Aberdeen	16	1
Beatrice	408	8
Blyth Demonstration	37	4
Dogger Bank Creyke Beck A	162	18
Dogger Bank Creyke Beck B	284	32
Dogger Bank Teesside A	99	7
Dogger Bank Teesside B	156	11
Dudgeon	10	2
East Anglia ONE	8	2
Galloper	9	2
Greater Gabbard	10	2
Hornsea Project One	295	24
Hornsea Project Two	232	39
Humber Gateway	3	0
Inch Cape	131	10
Lincs and LID6	17	2
London Array	6	1
Moray East	295	2
Neart na Gaoithe	53	11
Race Bank	11	2
Seagreen A	495	0
Seagreen B	482	0
Sheringham Shoal	12	2
Teesside	8	3
Thanet	1	0
Triton Knoll	13	2

Offshore wind farm	Breeding season (30% displacement, 10% mortality)	Non-breeding season (30% displacement, 1% mortality)
Westermost Rough	10	1
Tier 1 total	3,627	229
Tier 2		
East Anglia Three	19	4
Tier 2 total	19	4
Total	3,646	233

Significance of Effect

5.13.2.69 The sensitivity of guillemot is considered to be medium and the magnitude is deemed to be medium (breeding season). The predicted displacement mortality is based on conservative assumptions, including the use of precautionary displacement and mortality rates and worst case assumptions about the effects of a breeding regional population that is based only on breeding adult birds (excluding immature and non-breeding adult birds) whereas predicted displacement effects are based on the observed birds at Hornsea Three which will include immature and non-breeding adults. In addition, it is considered unlikely that all projects included in Tier 2 will be brought forward or, if constructed, they are unlikely to be built out to the worst case assumptions made in the respective impact assessments.

5.13.2.70 On this basis, at this stage, it is judged that the cumulative impact of Hornsea Three together with Tier 2 projects could be of **moderate significance**, which is potentially significant in EIA terms. However, further assessment of the potential effects of Hornsea Three and other relevant projects will be continue to be undertaken along with an analysis of the likely population effects of those impacts. If required, further options for further mitigation will also be investigated.

Mortality from collision with rotating turbine blades.

Methodology for cumulative impact assessment – collision risk

5.13.2.71 Direct comparison of the collision risks predicted by the wind farms in the wider area is problematic due to the differing assumptions made in the calculations used in the different studies, and the limited amount of species data presented in Environmental Statement chapters (Maclean *et al.*, 2009). Nevertheless, a combined quantitative assessment of the cumulative impacts posed by Hornsea Three in conjunction with other projects has been undertaken, based on the information presented in other projects' supporting documentation available to date.

5.13.2.72 It is possible that migratory birds may pass through a number of project sites within the central North Sea each year and so the initial scope of the CIA for collision mortality has taken into account all relevant projects along the east coast of Britain plus other non-UK projects (Table 5.37). Due to a lack of compatible project information it has not been possible to include a quantitative assessment for each project. Suitable quantitative data from relevant projects are therefore presented in each species assessment below.

5.13.2.73 The CEA has been separated into seasonal mortality, based on relevant reference populations (Table 1.5 in volume 5, annex 5.1: Baseline Characterisation Report). Cumulative impacts of Hornsea Three and other relevant projects during the breeding season have been based on mean maximum foraging range given for each species (or other information e.g. tracking information). For regional breeding species (taken to be gannet, lesser black-backed gull and kittiwake), each species has a colony, which can be used to determine the scope of the CIA (i.e. the projects which overlap with foraging ranges of these species. In the case of gannet and lesser black-backed gull this is taken to be mean-maximum foraging range and for kittiwake this is based on information from tracking studies). This assumes that the majority of collisions involve individuals from that colony in the breeding season. However, it is also important to consider the populations of immature and non-breeding individuals that may be impacted by wind farms considered cumulatively with Hornsea Three to which a proportion of collision impacts will be attributable.

5.13.2.74 For the purposes of this assessment, the definition of cumulative effects is the effect of Hornsea Three, alongside the effect of other developments on a single VOR. Although further mortality will occur during the breeding season due to collisions from birds from other colonies with other projects outside of foraging range (e.g. kittiwakes at Scottish east coast projects), Hornsea Three will contribute zero collisions to this as it is outside of foraging range, and so these projects are not considered to require inclusion in a breeding season cumulative assessment.

5.13.2.75 During the non-breeding period, it is assumed that individuals present from each species will originate from a wider range of colonies, with intermixing throughout the North Sea, and so the most appropriate reference populations (e.g. east coast or flyway) have been taken forward to assessment, based on literature evidence available (Furness, 2015). A greater range of projects are included, reflecting the wider movements of birds (i.e. all east coast UK wind farm projects).

Data confidence from other projects

5.13.2.76 The earliest collision risk assessments of offshore wind farms for Round 1 and 2 projects were generally undertaken by adapting the Band (2000) collision risk model (updated in Band *et al.*, 2007), developed on behalf of Scottish Natural Heritage to quantify mortality rates for birds at offshore wind farms. As flight data are collected in a fundamentally different way in the onshore and offshore environments, the boat survey data collected at these offshore sites required significant reinterpretation to become compatible with the model. This is a potential source of variability in interpretation and results between projects, particularly as a standard method of interpretation was not available at that time.

5.13.2.77 For these projects' models it was also assumed that for birds transiting through turbines at risk height, collision risk was distributed evenly within the rotor swept area (as per Option 1 or 2 of the Band model), which in the majority of cases overestimates the risk for most species which predominantly fly at lower altitudes (including some within the lower rotor swept area). As the probability of colliding with a rotor blade is lower at these lower altitudes, using the mean value instead will invariably overestimate risk, and therefore resultant mortality rates.

5.13.2.78 The most recent projects have run collision risk analyses using the Band model, updated for the offshore environment (Band, 2012; sometimes the draft version Band (2011)). The updated Band model differs from the original developed for onshore wind farms (Band, 2000; Band *et al.*, 2007) in two key ways. Firstly, bird numbers are inputted as densities rather than raw counts, better reflecting the way in which data are collected in the offshore environment. Secondly, the updated Band model is capable of incorporating four options for considering flight heights:

- Option 1 - using the Basic model (i.e. assuming that a uniform distribution of flight heights between lowest and highest levels of the rotors; and using the proportion of birds at risk height as derived from site survey);
- Option 2 - again using the Basic model, but using the proportion of birds at risk height as derived from the generic flight height information Johnston et al. (2014);
- Option 3 - using the Extended model, using the generic flight height information to estimate collision risk (Johnston et al. 2014); and
- Option 4 - using the Extended model, but if site survey information is sufficient to generate a flight height distribution, this should be used.

5.13.2.79 Therefore Options 1 and 2 reflect the choices available from using the Band (2000) and Band *et al.* (2007) models. Options 3 and 4 which use modelled flight height distributions allow comparison of the impact of varying the height of wind turbines, and to account for the fact that collision risk is not distributed evenly within the rotor swept area.

5.13.2.80 This means that projects that have used the Band (2012) or Band (2011) models are likely to produce more realistic mortality rates than earlier projects that had to interpret the onshore Band models. This is particularly the case for those that undertook modelling using the Extended Option 3 or 4 variants.

5.13.2.81 In addition to the different models used to estimate collision mortality, different avoidance rates have been selected for impact assessment in different projects. This is the most sensitive parameter in the model, and so leads to a great deal of uncertainty in results. Mortality estimates from other projects have been converted to a common currency in this assessment consistent with those avoidance rates recommended by Cook *et al.* (2014).

5.13.2.82 A process of caution is applied however when altering outputs (by updating prescribed avoidance rates) within projects considered within the CIA. This is particularly relevant for projects that have been consented, where values have already been accepted by decision-makers. In some other cases it is not clear in the collision modelling process, using different Band model versions, where precaution may have been built in. If this was at an earlier stage, then a higher avoidance rate may be acceptable, and so results should can be converted to a "common currency" as advocated by Natural England and JNCC in their Relevant Representation for Hornsea Project One and subsequent consultation for Hornsea Project Two.

5.13.2.83 As well as different models being used for different projects, as some applications are still within the planning process at the time of writing, then the figures provided have not been finalised. The levels of mortality predicted are therefore subject to change, and so the confidence level in their results is low. Therefore, whilst the modelling approach applied may lead to an assumption of high confidence, in reality given that the numbers used in this assessment are known to be subject to refinement (which we understand in the majority of cases will lead to a reduction in predicted mortality numbers) the confidence in these data is low. This issue is highlighted in the tiered approach applied to this CEA. Furthermore, it is frequently the case that projects when constructed do not reflect the maximum design scenario assessed. In many cases, the as-built scenario will represent a significantly lower impact than that assessed as the worst case for the purpose of obtaining a consent. As the assessment progresses, further information will be gathered on the as-built scenarios for projects included in cumulative assessment and, where appropriate, the information on the likely impact of those projects will be included in the assessment. Summation of the individual project assessments for the cumulative impact assessment results an increased degree of pre-caution to the overall assessment.

Gannet

5.13.2.84 Table 5.42 presents a seasonal breakdown of predicted cumulative collision mortality using results from the Extended Band model, where available, for gannet.

Tier 1

Magnitude of impact

Breeding season

5.13.2.85 When considering all Tier 1 projects which are within foraging range, the combined breeding season mortality is estimated to be 236 gannets, of which Hornsea Three contributes just 2.5%. The mortality of these additional birds in the breeding season is equal to an increase in baseline mortality of 11.7% on the regional breeding population (24,988 individuals) using a baseline mortality rate of 0.081 (Horswill and Robinson, 2015). However it is considered likely that a substantial proportion of all birds recorded in the breeding season are immature individuals. In addition, a further proportion are likely to be non-breeding adult birds. Therefore, mortality predicted during the breeding season is considered likely to result in considerably less than 236 adult birds from the regional breeding population.

5.13.2.86 The impact of collision on gannet during the breeding season without considering the likely age structure of population affected is predicted to be of regional spatial extent, long term duration, continuous and of medium reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **medium**.

Post-breeding season

5.13.2.87 In the post-breeding season a total of 479 collisions are estimated to occur at Tier 1 projects with Hornsea Three making a very small contribution (0.6%) of this total (Table 5.42). This level of additional mortality represents a 1.3%increase in baseline mortality of the post-breeding BDMPS population of gannet.

5.13.2.88 The impact of collision on gannet during the post-breeding season is predicted to be of regional spatial extent, long term duration, continuous and of medium reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **medium.**

Pre-breeding season

5.13.2.89 There are estimated to be 268 collisions at Tier 1 projects during the pre-breeding season with Hornsea Three contributing 3.2% of these collisions (Table 5.42). This total represents an increase of more than 1% of the baseline mortality of the pre-breeding BDMPS population of gannet.

5.13.2.90 The impact of collision mortality on gannet during the pre-breeding season is predicted to be of regional spatial extent, long term duration, continuous and of medium reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **medium**.

Sensitivity of receptor

5.13.2.91 As a proposed qualifying feature of FFC pSPA, where Hornsea Three is within mean maximum foraging range, gannet is afforded international conservation value. It was ranked high in terms of vulnerability to collisions by Wade *et al.* (2016) although moderate vulnerability by Langston (2010). High vulnerability is considered appropriate within this assessment.

5.13.2.92 Gannet is deemed to be of high vulnerability, high recoverability and international value. The sensitivity of the receptor is therefore, considered to be **high**.

Significance of Effect

5.13.2.93 The sensitivity of gannet is considered to be high and the magnitude is deemed to be medium (all seasons). The predicted collision mortality rate is based on conservative assumptions, including the use of precautionary avoidance rates and worst case assumptions about the effects of a breeding regional population that is based only on breeding adult birds (excluding immature and non-breeding adult birds) whereas predicted displacement effects are based on the observed birds at Hornsea Three which will include immature and non-breeding adults. In addition, it is considered unlikely that all projects included in Tier 1 will be brought forward or, if constructed, they are unlikely to be built out to the worst case assumptions made in the respective impact assessments.

5.13.2.94 On this basis, at this stage, it is judged that the cumulative impact of Hornsea Three together with Tier 1 projects could be of moderate or major significance, which is potentially significant in EIA terms. However, further assessment of the potential effects of Hornsea Three and other relevant projects will continue to be undertaken along with an analysis of the likely population effects of those impacts. If required, further options for further mitigation will also be investigated.

<u>Tier 2</u>

Magnitude of impact

Breeding season

5.13.2.95 There are not predicted to be any additional collisions at Tier 2 projects in the breeding season as all Tier 2 projects are outside of the area in which the regional breeding population of gannet with connectivity to Hornsea Three is expected to occur.

Post-breeding season

5.13.2.96 When Tier 2 projects are considered in the post-breeding season, a total of 512 collisions are estimated to occur with Hornsea Three contributing only 0.5% of this total. The mortality of these additional birds in the post-breeding season represents a 1.4% increase in baseline mortality of the post-breeding BDMPS population of gannet.

5.13.2.97 The impact of collision mortality on gannet during the post-breeding season is predicted to be of regional spatial extent, long term duration, continuous and of medium reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **medium**.

Pre-breeding season

5.13.2.98 In the pre-breeding season, an additional 104 collisions are estimated to occur at Tier 2 projects providing a total estimate of 278 collisions in the pre-breeding season of which Hornsea Three contributes 2.0%. A total of 278 collisions represents a 1.4% increase in baseline mortality of the pre-breeding BDMPS population of gannet.

Table 5.42: Seasonal breakdown of predicted cumulative collision mortality using results from the Extended Band model, where available, for gannet.

Offshore wind farm	Tier	Collision risk model	Option	Avoidance rate (%)	Annual collisions	Breeding	Post-breeding	Pre-breeding	Notes
Hornsea Three	2	Band (2012)	3	98	14	6	3	6	
Tier 1									
Aberdeen Demo	1	Band (2012)	2	98.9	9		5	0	
Beatrice	1	Band (2012)	3	98	42		21	4	Corrected to account for reduction in number of turbines
Blyth Demo	1	Band *et al.* (2007)	1	98.9	8	4	2	3	
Dogger Bank Creyke Beck A and B	1	Band (2012)	3	98	121	41	48	32	
Dogger Bank Teesside A and B	1	Band (2012)	3	98	136	68	34	34	
Dudgeon	1	Band (2000)	1	98.9	37	10	18	9	Corrected to account for reduction in number of turbines
East Anglia One	1	Band (2012)	3	98	68		64	2	Corrected to account for reduction in number of turbines
Galloper	1	Band *et al.* (2007)	1	98.9	62		31	13	
Greater Gabbard	1	Band (2000)	1	98.9	28		9	5	
Hornsea Project One	1	Band (2012)	4	98	38	7	18	13	
Hornsea Project Two	1	Band (2012)	4	98	63	17	32	13	
Humber Gateway	1	Not available	1	98.9	4	2	1	1	
Inchcape	2	Band (2012)	1	98.9	371		29	5	
Kentish Flats Extension	1	Band (2012)	1	98.9	3		0	0	
Lincs	1	Band (2000)	1	98.9	5	2	1	2	
London Array	1	Band (2000)	1	98.9	6		1	2	
Moray East	2	Band (2012)	3	98	18		5	1	Corrected to account for reduction in number of turbines
Neart na Gaoithe	2	Band (2012)	1	98.9	570		30	30	
Race Bank	1	Band (2000)	1	98.9	50	34	12	4	
Seagreen Alpha	2	Band (2012)	3	98	494		21	28	
Seagreen Bravo	2	Band (2012)	3	98	332		23	31	
Sheringham Shoal	1	Band (2000)	1	98.9	18	14	3	0	
Teesside	1	Band (2000)	1	98.9	7	5	2	0	
Thanet	1	Band (2000)	1	98.9	1		0	0	Collision figures apportioned equally across the year
Triton Knoll	1	Band (2000)	1	98.9	122	27	64	30	

Offshore wind farm	Tier	Collision risk model	Option	Avoidance rate (%)	Annual collisions	Breeding	Post-breeding	Pre-breeding	Notes
Westermost Rough	1	Band *et al.* (2007)	1	98.9	1	0	0	0	Collision figures apportioned equally across the year
Tier 1 total					2,626	236	479	268	
Tier 2									
East Anglia Three	2	Band (2012)	3	98	48		33	10	
Tier 2 total					48	0	33	10	
Overall total					2,674	236	512	278	

5.13.2.99 The impact of collision mortality on gannet during the pre-breeding season is predicted to be of regional spatial extent, long term duration, continuous and of medium reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be medium.

Sensitivity of receptor

5.13.2.100 As a proposed qualifying feature of FFC pSPA, where Hornsea Three is within mean maximum foraging range, gannet is afforded international conservation value. It was ranked high in terms of vulnerability to collisions by Wade *et al.* (2016) although moderate vulnerability by Langston (2010). High vulnerability is considered appropriate within this assessment.

5.13.2.101 Gannet is deemed to be of high vulnerability, high recoverability and international value. The sensitivity of the receptor is therefore, considered to be high.

Significance of effect

5.13.2.102 The sensitivity of gannet is considered to be high and the magnitude is deemed to be medium (post-breeding and pre-breeding seasons). The predicted collision mortality rate is based on conservative assumptions, including the use of precautionary avoidance rates and worst case assumptions about the effects of a breeding regional population that is based only on breeding adult birds (excluding immature and non-breeding adult birds) whereas predicted displacement effects are based on the observed birds at Hornsea Three which will include immature and non-breeding adults. In addition, it is considered unlikely that all projects included in Tier 2 will be brought forward or, if constructed, they are unlikely to be built out to the worst case assumptions made in the respective impact assessments.

5.13.2.103 On this basis, at this stage, it is judged that the cumulative impact of Hornsea Three together with Tier 2 projects could be of moderate or major significance, which is potentially significant in EIA terms. However, further assessment of the potential effects of Hornsea Three and other relevant projects will continue to be undertaken along with an analysis of the likely population effects of those impacts. If required, further options for further mitigation will also be investigated.

Kittiwake

5.13.2.104 Table 5.43 presents a seasonal breakdown of predicted cumulative collision mortality using results from the Extended Band model, where available, for kittiwake.

<u>Tier 1</u>

Magnitude of impact

Breeding season

5.13.2.105 Any collision mortality impact is predicted to be of regional spatial extent, long term duration, continuous and of medium reversibility.

5.13.2.106 It is predicted that the impact will affect the receptor directly. When considering all Tier 1 projects which are within foraging range, the combined breeding season mortality is estimated to be 207 kittiwakes, of which Hornsea Three contributes 39.1%. The mortality of these additional birds in the breeding season is equal to an increase in baseline mortality of 1.4% on the regional breeding population (102.002 individuals) using a baseline mortality rate of 0.146 (Horswill and Robinson, 2015). However it is considered likely that a substantial proportion of all birds recorded in the breeding season are immature individuals. In addition, a further proportion are likely to be non-breeding adult birds. Therefore, mortality predicted during the breeding season is considered likely to result in considerably less than 205 adult birds from the regional breeding population.

5.13.2.107 The impact of collision on kittiwake during the breeding season without considering the likely age structure of the population affected is predicted to be of regional spatial extent, long term duration, continuous and of medium reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be medium.

Post-breeding season

5.13.2.108 In the post-breeding season a total of 650 collisions are estimated to occur at Tier 1 projects with Hornsea Three contributing 5.7% of this total. This level of additional mortality represents an increase of 0.6% in baseline mortality of the post-breeding BDMPS population of kittiwake.

5.13.2.109 The impact of collision on kittiwake during the post-breeding season is predicted to be of regional spatial extent, long term duration, continuous and of medium reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be medium.

Pre-breeding season

5.13.2.110 There are estimated to be 328 collisions at Tier 1 projects during the pre-breeding season with Hornsea Three contributing 1.8% of these collisions. This total represents a 0.3% increase in the baseline mortality of the pre-breeding BDMPS population of kittiwake.

5.13.2.111 The impact of collision on kittiwake during the pre-breeding season is predicted to be of regional spatial extent, long term duration, continuous and of medium reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be medium.

Sensitivity of receptor

5.13.2.112 Kittiwake was rated as being relatively high vulnerability to collision impacts by Wade *et al.* (2016), due to the proportion of flights likely to occur at potential risk height and percentage of time in flight, including at night. From previous studies in Flanders that have recorded mortality rates and collision rates, estimated micro-avoidance rates were, however, high for smaller gulls (Everaert, 2006; 2008; 2011; Everaert *et al.*, 2002; Everaert and Kuijken, 2007).Studies have also shown that rates are consistently above 98% for flights at rotor height (GWFL, 2011). The recently published report for Marine Scotland (Cook *et al.*, 2014) considers that a 99.2% avoidance rate is appropriate for the 'Basic' Band Model.

Table 5.43: Seasonal breakdown of predicted cumulative collision mortality using results from the Extended Band model, where available, for kittiwake.

Offshore wind farm	Tier	Band model	Option	Avoidance rate (%)	Annual collisions	Breeding	Post-breeding	Pre-breeding	Notes
Hornsea Project Three	2	Band (2012)	3	98	124	81	37	6	
Tier 1									
Aberdeen Demo	1	Band (2012)	2	99.2	14		4	0	
Beatrice	1	Band (2012)	3	98	18		1	2	Corrected to account for reduction in number of turbines
Blyth Demo	1	Band (2011)	1	99.2	4		2	1	
Dogger Bank Creyke Beck Projects A and B	1	Band (2012)	3	98	218	87	41	90	
Dogger Bank Teesside Projects A and B	1	Band (2012)	3	98	135		27	16	
Dudgeon	1	Band (2000)	1	99.2	0		0	0	Corrected to account for reduction in number of turbines
East Anglia One	1	Band (2012)	3	98	24		17	6	Corrected to account for reduction in number of turbines
Galloper	1	Band *et al.* (2007)	1	99.2	48		20	20	Corrected to account for reduction in number of turbines
Greater Gabbard	1	Band (2000)	1	99.2	20		11	6	
Hornsea Project One	1	Band (2012)	4	98	21	8	9	4	
Hornsea Project Two	1	Band (2012)	4	98	12	7	4	1	
Humber Gateway	1	Not available	1	99.2	6	2	2	1	
Inchcape	2	Band (2012)	1	99.2	219		163	45	
Kentish Flats	1	Band (2012)	1	98.9	2		1	0	
Lincs	1	Band (2000)	1	99.2	2	1	1	1	
London Array	1	Band (2000)	1	99.2	4		2	1	
Moray East	2	Band (2012)	3	98	43		2	6	Corrected to account for reduction in number of turbines
Neart na Gaoithe	2	Band (2012)	1	99.2	68		41	1	
Race Bank	1	Band (2000)	1	99.2	23	1	17	4	
Seagreen Alpha	2	Band (2012)	3	98	172		79	52	
Seagreen Bravo	2	Band (2012)	3	98	121		50	30	
Teesside	1	Band (2000)	1	99.2	56		17	2	
Thanet	1	Band (2000)	1	99.2	1		0	0	Collision figures apportioned equally across the year
Triton Knoll	1	Band (2000)	1	99.2	152	18	101	33	
Westermost Rough	1	Band *et al.* (2007)	1	99.2	0	0	0	0	Collision figures apportioned equally across the year

Offshore wind farm	Tier	Band model	Option	Avoidance rate (%)	Annual collisions	Breeding	Post-breeding	Pre-breeding	Notes
Tier 1 total					1,506	207	650	328	
Tier 2									
East Anglia Three	2	Band (2012)	3	98	89		54	25	
Tier 2 total					89	0	54	25	
Total					1,595	207	704	353	

5.13.2.113 FFC pSPA is the closest breeding colony for kittiwake to Hornsea Three. However, Hornsea Three is outside of the mean-maximum (± 1 SD) foraging range of kittiwake (60 km) from the pSPA as reported by Thaxter *et al.* (2012) (Figure 1.30). Preliminary results from the FAME project which has tracked breeding kittiwake from the FFC pSPA colony does however suggest that there may be some connectivity between the FFC pSPA and Hornsea Three as presented in Annex 5.1: Baseline Characterisation Report.

5.13.2.114 Kittiwake is deemed to be of high vulnerability, low recoverability and international value. The sensitivity of the receptor is therefore, considered to be high.

Significance of Effect

5.13.2.115 The sensitivity of kittiwake is considered to be high and the magnitude is deemed to be medium (all seasons). The predicted collision mortality rate is based on conservative assumptions, including the use of precautionary avoidance rates and worst case assumptions about the effects of a breeding regional population that is based only on breeding adult birds (excluding immature and non-breeding adult birds) whereas predicted displacement effects are based on the observed birds at Hornsea Three which will include immature and non-breeding adults. In addition, it is considered unlikely that all projects included in Tier 1 will be brought forward or, if constructed, they are unlikely to be built out to the worst case assumptions made in the respective impact assessments.

5.13.2.116 On this basis, at this stage, it is judged that the cumulative impact of Hornsea Three together with Tier 1 projects could be of moderate or major significance, which is potentially significant in EIA terms. However, further assessment of the potential effects of Hornsea Three and other relevant projects will continue to be undertaken along with an analysis of the likely population effects of those impacts. If required, further options for further mitigation will also be investigated.

<u>Tier 2</u>

Magnitude of impact

Breeding season

5.13.2.117 There are not predicted to be any additional collisions at Tier 2 projects in the breeding season as all Tier 2 projects are outside of the area in which the regional breeding population of kittiwake with connectivity to Hornsea Three is expected to occur.

Post-breeding season

5.13.2.118 When Tier 2 projects are considered alongside Tier 1 projects in the post-breeding season, a total of 704 collisions are estimated to occur with Hornsea Three contributing 5.2% of this total. The mortality of these additional birds in the post-breeding season represents a 0.6% increase in baseline mortality of the post-breeding BDMPS population of kittiwake.

5.13.2.119 The impact of collision on kittiwake during the post-breeding season without considering the likely age structure of the population affected is predicted to be of regional spatial extent, long term duration, continuous and of medium reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be medium.

Pre-breeding season

5.13.2.120 In the pre-breeding season, an additional 25 collisions are estimated to occur at Tier 2 projects providing a total estimate of 353 collisions in the pre-breeding season of which Hornsea Three contributes 1.8%. A total of 353 collisions represents a 0.4% increase in baseline mortality of the pre-breeding BDMPS population of kittiwake.

5.13.2.121 The impact of collision on kittiwake during the pre-breeding season without considering the likely age structure of the population affected is predicted to be of regional spatial extent, long term duration, continuous and of medium reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be medium.

Sensitivity of receptor

5.13.2.122 As described in paragraphs 5.13.2.75 and 5.13.2.76, kittiwake is deemed to be of high vulnerability, low recoverability and international value. The sensitivity of the receptor is therefore, considered to be high.

Significance of Effect

5.13.2.123 The sensitivity of kittiwake is considered to be high and the magnitude is deemed to be medium (all seasons). The predicted collision mortality rate is based on conservative assumptions, including the use of precautionary avoidance rates and worst case assumptions about the effects of a breeding regional population that is based only on breeding adult birds (excluding immature and non-breeding adult birds) whereas predicted displacement effects are based on the observed birds at Hornsea Three which will include immature and non-breeding adults. In addition, it is considered unlikely that all projects included in Tier 2 will be brought forward or, if constructed, they are unlikely to be built out to the worst case assumptions made in the respective impact assessments.

5.13.2.124 On this basis, at this stage, it is judged that the cumulative impact of Hornsea Three together with Tier 2 projects could be of moderate or major significance, which is potentially significant in EIA terms. However, further assessment of the potential effects of Hornsea Three and other relevant projects will continue to be undertaken along with an analysis of the likely population effects of those impacts. If required, further options for further mitigation will also be investigated.

Lesser black-backed gull

5.13.2.125 Table 5.44 presents a seasonal breakdown of predicted cumulative collision mortality using results from the Extended Band model, where available, for lesser black-backed gull.

<u>Tier 1</u>

Magnitude of impact

Breeding season

5.13.2.126 Any collision mortality impact is predicted to be of regional spatial extent, long term duration, continuous and of low reversibility. It is predicted that the impact will affect the receptor directly.

5.13.2.127 When considering all Tier 1 projects which are within foraging range, the combined breeding season mortality is estimated to be 159 lesser black-backed gulls, of which Hornsea Three contributes 9.4%. The mortality of these additional birds in the breeding season is equal to an increase in baseline mortality of 30.4% on the regional breeding population (4,544 individuals) using a baseline mortality rate of 0.115 (Horswill and Robinson, 2015). However it is considered likely that a substantial proportion of all birds recorded in the breeding season are immature individuals. In addition, a further proportion are likely to be non-breeding adult birds. Therefore, mortality predicted during the breeding season is considered likely to result in considerably less than 162 adult birds from the regional breeding population.

5.13.2.128 The impact of collision on lesser black-backed gull during the breeding season without considering the likely age structure of the population affected is predicted to be of regional spatial extent, long term duration, continuous and of medium reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be medium.

Post-breeding season

5.13.2.129 In the post-breeding season a total of 103 collisions are estimated to occur at Tier 1 projects with Hornsea Three contributing no collisions to this total. This level of additional mortality represents an increase of 0.4% in baseline mortality.

5.13.2.130 The impact of collision on lesser black-backed gull during the post-breeding season is predicted to be of regional spatial extent, long term duration, continuous and of medium reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be low.

Non-breeding season

5.13.2.131 There are estimated to be 115 collisions at Tier 1 projects during the pre-breeding season with Hornsea Three contributing no collisions to this total. This level of additional mortality represents a 2.5% increase in the baseline mortality of the pre-breeding regional population of lesser black-backed gulls.

5.13.2.132 The impact of collision on lesser black-backed gull during the post-breeding season is predicted to be of regional spatial extent, long term duration, continuous and of medium reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be low.

Pre-breeding season

5.13.2.133 There are estimated to be 62 collisions at Tier 1 projects during the pre-breeding season with Hornsea Three contributing 1.6% of these collisions. This total represents a 0.3% increase in the baseline mortality of the pre-breeding BDMPS population of lesser black-backed gulls.

5.13.2.134 The impact of collision on lesser black-backed gull during the pre-breeding season is predicted to be of regional spatial extent, long term duration, continuous and of medium reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be low.

Sensitivity of receptor

5.13.2.135 Lesser black-backed gull was ranked the second highest marine bird species most vulnerable to collision impacts by Wade *et al.* (2016), mainly due to the high proportion of flights at potential collision heights, and the percentage of time in flight, including at night.

5.13.2.136 In summary, Lesser black-backed gull is deemed to be of very high vulnerability, medium recoverability and regional value. The sensitivity of the receptor is therefore, considered to be medium.

Significance of Effect

5.13.2.137 The sensitivity of lesser black-backed gull is considered to be medium and the magnitude is deemed to be medium (breeding season). The predicted collision mortality rate is based on conservative assumptions, including the use of precautionary avoidance rates and worst case assumptions about the effects of a breeding regional population that is based only on breeding adult birds (excluding immature and non-breeding adult birds) whereas predicted displacement effects are based on the observed birds at Hornsea Three which will include immature and non-breeding adults. In addition, it is considered unlikely that all projects included in Tier 1 will be brought forward or, if constructed, they are unlikely to be built out to the worst case assumptions made in the respective impact assessments.

5.13.2.138 On this basis, at this stage, it is judged that the cumulative impact of Hornsea Three together with Tier 1 projects could be of moderate significance, which is potentially significant in EIA terms. However, further assessment of the potential effects of Hornsea Three and other relevant projects will continue to be undertaken along with an analysis of the likely population effects of those impacts. If required, further options for further mitigation will also be investigated.

Table 5.44: Seasonal breakdown of predicted cumulative collision mortality using results from the Extended Band model, where available, for lesser black-backed gull.

Offshore wind farm	Tier	Band model	Option	Avoidance rate (%)	Annual collisions	Breeding	Post-breeding	Non-breeding	Pre-breeding	Notes
Hornsea Three	2	Band (2012)	3	99.5	16	15	0	0	1	
Tier 1										
Dogger Bank Creyke Beck	1	Band (2012)	3	98.9	19	12	1	1	4	
Dogger Bank Teesside A and B	1	Band (2012)	3	98.9	18		8	5	0	
Dudgeon	1	Band (2000)	1	99.5	13	4	3	4	2	Corrected to account for reduction in number of turbines
East Anglia ONE	1	Band (2012)	3	98.9	43	6	19	18	0	Corrected to account for reduction in number of turbines
Galloper	1	Band *et al.* (2007)	1	99.5	139	63	24	31	22	Corrected to account for reduction turbine scenario to be built out; Collision figures apportioned equally across the year
Greater Gabbard	1	Band (2000)	1	99.5	62	12	13	23	14	
Hornsea Project One	1	Band (2012)	4	98.9	9	5	2	1	1	
Hornsea Project Two	1	Band (2012)	4	98.9	2	1	0	0	0	
Humber Gateway	1	Not available	1	98.9	2	0	0	1	0	Collision figures apportioned equally across the year
Kentish Flats Extension	1	Band *et al.* (2007)	1	98.9	2	0	0	1	0	Collision figures apportioned equally across the year
Lincs	1	Band (2000)	1	98.9	9	2	2	3	2	Collision figures apportioned equally across the year
Neart na Gaoithe	2	Band (2012)	1	98.9	1		0	0	0	
Race Bank	1	Band (2000)	1	98.9	54	13	13	18	9	Collision figures apportioned equally across the year
Seagreen Alpha	2	Band (2012)	2	99.5	3		1	1	0	
Seagreen Bravo	2	Band (2012)	2	99.5	7		0	0	1	
Sheringham Shoal	1	Band (2000)	1	98.9	8	2	2	3	1	Collision figures apportioned equally across the year
Thanet	1	Band (2000)	1	98.9	16	2	3	8	3	Collision figures apportioned equally across the year
Triton Knoll	1	Band (2000)	1	98.9	32	19	10	0	3	Corrected to account for reduction in number of turbines
Westermost Rough	1	Band *et al.* (2007)	1	98.9	0	0	0	0	0	Collision figures apportioned equally across the year
Tier 1 total					454	159	103	115	62	
Tier 2										
East Anglia Three	2	Band (2012)	3	98.9	11	2	6	2	1	
Tier 2 total					11	2	6	2	1	
Total					465	161	109	117	64	

Tier 2

Magnitude of impact

Breeding season

5.13.2.139 An additional 2 collisions are estimated to occur at Tier 2 projects in the breeding season with this resulting in a total collision risk of 161 collisions in the breeding season to which Hornsea Three contributes 9.4%. The mortality of these additional birds in the breeding season is equal to an increase in baseline mortality of 30.8% on the regional breeding population (4,544 individuals) using a baseline mortality rate of 0.115 (Horswill and Robinson, 2015).

5.13.2.140 The impact of collision on lesser black-backed gull during the breeding season is predicted to be of regional spatial extent, long term duration, continuous and of medium reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be medium.

Post-breeding season

5.13.2.141 When Tier 2 projects are considered alongside Tier 1 projects in the post-breeding season, a total of 109 collisions are estimated to occur with Hornsea Three contributing no collisions to this total. The mortality of these additional birds in the post-breeding season represents a 0.5% increase in baseline mortality of the post-breeding regional population of lesser black-backed gull.

5.13.2.142 The impact of collision on lesser black-backed gull during the post-breeding season is predicted to be of regional spatial extent, long term duration, continuous and of medium reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be low.

Non-breeding season

5.13.2.143 When Tier 2 projects are considered alongside Tier 1 projects in the non-breeding season, a total of 117 collisions are estimated to occur with Hornsea Three contributing no collisions to this total. The mortality of these additional birds in the post-breeding season represents a 2.6% increase in baseline mortality of the post-breeding regional population of lesser black-backed gull.

5.13.2.144 The impact of collision on lesser black-backed gull during the non-breeding season is predicted to be of regional spatial extent, long term duration, continuous and of medium reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be low.

Pre-breeding season

5.13.2.145 In the pre-breeding season, an additional 2 collisions are estimated to occur at Tier 2 projects providing a total estimate of 64 collisions in the pre-breeding season of which Hornsea Three contributes 1.0%. A total of 64 collisions represents a 0.3% increase in baseline mortality of the pre-breeding regional population of lesser black-backed gull.

5.13.2.146 The impact of collision on lesser black-backed gull during the pre-breeding season is predicted to be of regional spatial extent, long term duration, continuous and of medium reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be low.

Sensitivity of receptor

5.13.2.147 Lesser black-backed gull was ranked the second highest marine bird species most vulnerable to collision impacts by Wade *et al.* (2016), mainly due to the high proportion of flights at potential collision heights, and the percentage of time in flight, including at night.

5.13.2.148 In summary, lesser black-backed gull is deemed to be of very high vulnerability, medium recoverability and regional value. The sensitivity of the receptor is therefore, considered to be medium.

Significance of Effect

5.13.2.149 The sensitivity of lesser black-backed gull is considered to be medium and the magnitude is deemed to be medium (breeding season). The predicted collision mortality rate is based on conservative assumptions, including the use of precautionary avoidance rates and worst case assumptions about the effects of a breeding regional population that is based only on breeding adult birds (excluding immature and non-breeding adult birds) whereas predicted displacement effects are based on the observed birds at Hornsea Three which will include immature and non-breeding adults. In addition, it is considered unlikely that all projects included in Tier 2 will be brought forward or, if constructed, they are unlikely to be built out to the worst case assumptions made in the respective impact assessments.

5.13.2.150 On this basis, at this stage, it is judged that the cumulative impact of Hornsea Three together with Tier 2 projects could be of moderate significance, which is potentially significant in EIA terms. However, further assessment of the potential effects of Hornsea Three and other relevant projects will continue to be undertaken along with an analysis of the likely population effects of those impacts. If required, further options for further mitigation will also be investigated.

Great black-backed gull

5.13.2.151 Table 5.45 presents a seasonal breakdown of predicted cumulative collision mortality using results from the Extended Band model, where available, for great black-backed gull.

Tier 1

Magnitude of impact

Breeding season

5.13.2.152 When considering all Tier 1 projects which are within foraging range, the combined breeding season mortality is estimated to be 120 great black-backed gulls, of which Hornsea Three contributes 4.2%. The mortality of these additional birds in the breeding season is equal to an increase in baseline mortality of 5.0% on the regional breeding population (34,000 individuals) using a baseline mortality rate of 0.07 (Horswill and Robinson, 2015). However it is considered likely that a substantial proportion of all birds recorded in the breeding season are immature individuals. In addition, a further proportion are likely to be non-breeding adult birds. Therefore, mortality predicted during the breeding season is considered likely to result in considerably less than 120 adult birds from the regional breeding population.

5.13.2.153 The impact of collision on great black-backed gull during the breeding season without considering the likely age structure of the population affected is predicted to be of regional spatial extent, long term duration, continuous and of medium reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be medium.

Non-breeding season

5.13.2.154 In the non-breeding season a total of 501 collisions are estimated to occur at Tier 1 projects with Hornsea Three contributing 8.8% of this total. This level of additional mortality represents an increase of 7.5% in baseline mortality.

5.13.2.155 The impact of collision on great black-backed gull during the breeding season is predicted to be of regional spatial extent, long term duration, continuous and of medium reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be medium.

Sensitivity of receptor

5.13.2.156 Great black-backed gull was rated the seabird species most vulnerable to collision impacts by Wade *et al.* (2016), mainly due to the high proportion of flights at potential collision heights, and the percentage of time in flight, including at night.

5.13.2.157 In summary, great black-backed gull is deemed to be of very high vulnerability, medium recoverability and national value. The sensitivity of the receptor is therefore, considered to be high.

Significance of Effect

5.13.2.158 The sensitivity of great black-backed gull is considered to be high and the magnitude is deemed to be medium (all seasons). The predicted collision mortality rate is based on conservative assumptions, including the use of precautionary avoidance rates and worst case assumptions about the effects of a breeding regional population that is based only on breeding adult birds (excluding immature and non-breeding adult birds) whereas predicted displacement effects are based on the observed birds at Hornsea Three which will include immature and non-breeding adults. In addition, it is considered unlikely that all projects included in Tier 1 will be brought forward or, if constructed, they are unlikely to be built out to the worst case assumptions made in the respective impact assessments.

5.13.2.159 On this basis, at this stage, it is judged that the cumulative impact of Hornsea Three together with Tier 1 projects could be of moderate significance, which is potentially significant in EIA terms. However, further assessment of the potential effects of Hornsea Three and other relevant projects will continue to be undertaken along with an analysis of the likely population effects of those impacts. If required, further options for further mitigation will also be investigated.

Tier 2

Magnitude of impact

Breeding season

5.13.2.160 An additional 8 collisions are estimated to occur at Tier 2 projects in the breeding season with this resulting in a total collision risk of 122 collisions in the breeding season, Hornsea Three contributing 5.5% of the total. The mortality of these additional birds in the post-breeding season represents a 5.6% increase in baseline mortality of the regional population of great black-backed gull.

5.13.2.161 The impact of collision on great black-backed gull during the breeding season is predicted to be of regional spatial extent, long term duration, continuous and of medium reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be medium.

Non-breeding season

5.13.2.162 When Tier 2 projects are considered alongside Tier 1 projects in the non-breeding season, a total of 544 collisions are estimated to occur with Hornsea Three contributing 10.0% of this total. The mortality of these additional birds in the post-breeding season represents a 8.5% increase in baseline mortality of the non-breeding regional population of great black-backed gull.

5.13.2.163 The impact of collision on great black-backed gull during the non-breeding season is predicted to be of regional spatial extent, long term duration, continuous and of medium reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be medium.

Table 5.45: Seasonal breakdown of predicted cumulative collision mortality using results from the Extended Band model, where available, for great black-backed gull

Offshore wind farm	Tier	Band model	Option	Avoidance rate (%)	Annual collisions	Breeding	Non-breeding	Notes
Hornsea Three	2	Band (2012)	3	98.9	49	5	44	
Tier 1								
Beatrice	1	Band (2012)	3	98.9	53	11	42	Corrected to account for reduction in number of turbines
Blyth Demo	1	Band (2007)	1	99.5	8	3	6	Collision figures apportioned equally across the year
Dogger Bank Creyke Beck	1	Band (2012)	3	98.9	29	5	24	
Dogger Bank Teesside A and B	1	Band (2012)	3	98.9	32	9	23	
East Anglia ONE	1	Band (2012)	3	98.9	47	1	46	Corrected to account for reduction in number of turbines
Aberdeen Demo	1	Band (2012)	2	99.5	3	1	2	
Galloper	1	Band (2007)	1	99.5	22	7	15	Corrected to account for reduction in turbine scenario to be built out;
Hornsea Project One	1	Band (2012)	4	98.9	49	5	44	
Hornsea Project Two	1	Band (2012)	4	98.9	30	3	26	
Humber Gateway	1	Not available	1	99.5	7	2	4	Collision figures apportioned equally across the year
Inchcape	2	Band (2012)	1	99.5	37	0	37	
Kentish Flats Extension	1	Band (2007)	1	99.5	0	0	0	Collision figures apportioned equally across the year
Moray East	2	Band (2012)	3	98.9	19	5	14	Corrected to account for reduction in number of turbines
Neart na Gaoithe	2	Band (2012)	1	99.5	5	0	5	
Seagreen Alpha	2	Band (2012)	2	99.5	37	1	35	
Seagreen Bravo	2	Band (2012)	2	99.5	30	4	26	
Teesside	1	Band (2000)	1	99.5	44	15	29	Collision figures apportioned equally across the year
Thanet	1	Band (2000)	1	99.5	0	0	0	Collision figures apportioned equally across the year
Triton Knoll	1	Band (2000)	1	99.5	122	41	81	Corrected to account for reduction in turbine scenario to be built out;
Westermost Rough	1	Band (2007)	1	99.5	0	0	0	Collision figures apportioned equally across the year
Tier 1 total					622	120	501	
Tier 2								
East Anglia Three	2	Band (2012)	3	98.9	45	2	43	
Tier 2 total					45	2	43	
Total					667	122	544	

Sensitivity of receptor

5.13.2.164 Great black-backed gull was rated the seabird species most vulnerable to collision impacts by Wade *et al.* (2016), mainly due to the high proportion of flights at potential collision heights, and the percentage of time in flight, including at night.

5.13.2.165 In summary, great black-backed gull is deemed to be of very high vulnerability, medium recoverability and national value. The sensitivity of the receptor is therefore, considered to be **high**.

Significance of Effect

5.13.2.166 The sensitivity of great black-backed gull is considered to be high and the magnitude is deemed to be medium (all seasons). The predicted collision mortality rate is based on conservative assumptions, including the use of precautionary avoidance rates and worst case assumptions about the effects of a breeding regional population that is based only on breeding adult birds (excluding immature and non-breeding adult birds) whereas predicted displacement effects are based on the observed birds at Hornsea Three which will include immature and non-breeding adults. In addition, it is considered unlikely that all projects included in Tier 2 will be brought forward or, if constructed, they are unlikely to be built out to the worst case assumptions made in the respective impact assessments.

5.13.2.167 On this basis, at this stage, it is judged that the cumulative impact of Hornsea Three together with Tier 2 projects could be of moderate significance, which is potentially significant in EIA terms. However, further assessment of the potential effects of Hornsea Three and other relevant projects will continue to be undertaken along with an analysis of the likely population effects of those impacts. If required, further options for further mitigation will also be investigated.

Migratory seabirds

5.13.2.168 In section 5.11.2 the potential impact of collision risk was assessed for Arctic skua, great skua, little gull, common tern and Arctic tern. The collision risk modelling conducted for these species for Hornsea Three has predicted less than one collision for all five species (Table 5.24).

5.13.2.169 Impacts of this magnitude are considered to represent no change in the baseline mortality of the relevant populations for these species and as such the significance of these effects is considered to be **negligible adverse**. It is therefore considered that Hornsea Three will not contribute to any cumulative impact on these species and no further consideration of collision risk to migratory seabirds is required.

5.14 Transboundary effects

5.14.1.1 A screening of transboundary impacts has been carried out and is presented in annex 5.5: Transboundary Impacts Screening Note. This screening exercise identified that there was potential for significant transboundary effects with regard to offshore ornithology from Hornsea Three upon the interests of other EEA States.

5.14.1.2 In the IPC's (2010) Scoping Opinion for Hornsea Project One, it was noted that given the movements of birds between SPAs across the North Sea, it was considered necessary to consider the potential impact of this development on the interest features of mainland European coastal SPAs.

5.14.1.3 SPAs across continental Europe have been designated as part of the network for important bird populations found during breeding, staging/migration and/or wintering periods. For each of these periods, the potential impacts of Hornsea Three on the ornithological receptors that comprise qualification components of continental SPAs and non-designated but recognised important bird areas have been assessed here.

Dogger Bank

5.14.1.4 The UK/German/Dutch Dogger Bank SAC was also considered as it has ornithological receptors listed in its citation (http://eunis.eea.europa.eu/sites/DE1003301). The citation was created by the German office responsible for overseeing European designated sites (Bundesamt für Naturschutz), and lists fulmar, gannet, kittiwake and guillemot as either resident or present during staging.

5.14.1.5 Hotspots of seabird concentrations within the extent of British Fishery Limits at Dogger Bank were identified by JNCC in order to identify potential marine SPAs, based on the top 1% qualifying numbers and regularity of occurrence (Kober *et al.,* 2010). A number of 'near-qualifying' areas (top 5% numbers and regularity) were identified, including Dogger Bank, which is important for guillemot in winter (as reported by Skov *et al*., 1995). Kober *et al*. (2010) reported an estimated 35,869 individuals within the area. Variability in numbers, however, meant that the area would not qualify in most years, and so currently fails to meet SPA qualification criteria.

Brown Ridge

5.14.1.6 The Brown Ridge has been identified as an area of sensitivity, and recent information suggests the area qualifies as SPA for wintering guillemot and razorbill, which have migrated from Scotland with their young. The sand bank lies almost entirely on the Dutch part of the North Sea and is located roughly halfway between the Dutch and English coast, some 20 nautical miles northeast of the East Anglia One project.

5.14.2 Species considered for assessment

5.14.2.1 The impact assessment in section 5.11 concluded that the effects of Hornsea Three on the ornithological receptors will be no greater than minor adverse significance. For migratory seabird species (little gull, Arctic skua, great skua, common tern and Arctic tern), collision risk and barrier effects were demonstrated to be very low magnitude, and not significant at a population level. It is therefore concluded that no non-UK SPA population of these species would be significantly affected by impacts associated with Hornsea Three, and these species require no further consideration.

5.14.2.2 This is also considered to be the case for non-seabird species such as waders and wildfowl, which may cross the North Sea in large numbers from continental SPAs such as the Waddenzee in the Netherlands. Migration collision risk modelling did, however, demonstrate that the magnitude of mortality to selected representative species is likely to be very low, and not significant compared to any SPA population. Non-seabird species are therefore also discounted from any significant transboundary effects.

5.14.2.3 Equal to Minor adverse effects were, however, recognised in certain circumstances for other seabird receptors, and these are considered below in paragraphs 5.14.3.1 to 5.14.4.32 within the context of non-UK SPA and international populations. The SPAs scoped into this assessment are based on information taken from the European designated sites website (http://www.eea.europa.eu/data-and-maps/data/natura-4)..

5.14.3 Breeding season

5.14.3.1 During the breeding season, seabirds are likely to have a recognised foraging range to be able to return regularly to tend the nest. Hornsea Three is located relatively centrally within the North Sea, close to the boundary between UK and Dutch waters.

5.14.3.2 The results from a desk-based search utilising GIS data from the European designated sites website indicated that no SPAs are located within mean maximum foraging range of Hornsea Three for any of the VORs (Thaxter *et al.,* 2012), with the possible exception of the wide-ranging fulmar and gannet which have large maximum distances.

5.14.3.3 Only one continental European SPA is designated for breeding gannets - the Côte de Granit Rose-Sept Iles SPA, which is on the French Breton Peninsula, and not within mean maximum foraging range of Hornsea Three. A small number of French SPAs hold small breeding colonies of fulmar, but again these sites are outside mean maximum foraging range and it is, therefore, very unlikely that Hornsea Three will play an important role for these birds during the breeding season (see for example Wakefield *et al.* 2013 for core foraging ranges of gannets from individual SPAs). .

5.14.3.4 For most of the seabird species considered here, habitat is generally unsuitable along much of the north-western European coastline, lacking the high cliffs or isolated island habitat preferred by species such as auks, gannet and kittiwake. As such, it can be concluded that during the breeding season, any connectivity between individuals from any continental SPA and Hornsea Three would be infrequent at best, and of a non-significant scale. No significant transboundary effects are therefore predicted during this period, and no more than a minor adverse effect is predicted, which is not significant in EIA terms.

5.14.4 Staging and wintering

5.14.4.1 As shown in the SOSS review by Wright *et al.* (2012), all of the VORs considered for Hornsea Three have broad migration zones within the North Sea, and species such as auks disperse widely rather than having any set migration. Non-trivial connectivity between Hornsea Three and any particular continental population is therefore difficult to determine with any confidence.

5.14.4.2 The SPAs and important bird areas considered here have a mixture of usages, but often the site is designated during both staging and wintering periods for the species. Birds are wider ranging during the non-breeding season, and so there is greater opportunity for connectivity between the SPAs and Hornsea Three, although greater numbers of birds are likely to be present at this time, often coming from across Western Europe. The impacts on each receptor are evaluated below.

Fulmar

5.14.4.3 Fulmar is a qualifying species of a number of continental European SPAs, during breeding, winter and staging periods. The European population has been estimated at 2.8 to 4.4 million pairs (Wright *et al.*, 2012) with 11 to 18% in the UK.

5.14.4.4 Although numbers of fulmar within in the southern and central North Sea are unknown, the total flyway population is large (10,000,000 individuals, Stienen *et al.*, 2007). Birds are likely to forage widely across the North Sea, and it is therefore unlikely that individuals from any non-UK population will selectively forage within Hornsea Three. As a widely-ranging species not rated as being susceptible to wind farm impacts, it can be reasonably concluded that no non-UK populations will be significantly affected by Hornsea Three.

5.14.4.5 A significance of no more than minor adverse is therefore predicted for any effect relating to the construction, operation or decommissioning of Hornsea Three. This is not significant in EIA terms.

5.14.4.6 The impacts on fulmars from non-UK SPAs are considered in the Habitats Regulations Assessment Screening Report for Hornsea Three (DONG Energy, 2016).

Gannet

5.14.4.7 Gannet is a qualifying species within some German SPAs, where a small number (<500) are present at each site during winter and staging periods. The European gannet population is estimated by Wright *et al.* (2012) to be 300,000 to 310,000 pairs, with the UK holding around 70% of the population.

5.14.4.8 Gannets migrate southwards towards Iberia and North Africa after breeding, and so continental SPA birds are mainly likely to be part of the UK breeding population either en route there, or overwintering slightly further north. Birds from Iceland and Ireland conversely are likely to head southwards via the west coast of Britain. Any connectivity of gannets from non-UK SPAs with Hornsea Three will be minimal and likely restricted to migratory flights to or from breeding colonies. It was established in the impact assessment that due to the favourable conservation status of the species in Britain and the rest of Europe, no significant effects on any population would be likely. This is also upheld for transboundary effects. A minor adverse effect is therefore predicted, which is not significant in EIA terms.

5.14.4.9 The impacts on gannets from non-UK SPAs are considered in the Habitats Regulations Assessment Screening Report for Hornsea Three (DONG Energy, 2016).

Great black-backed gull

5.14.4.10 Great black-backed gull is a qualifying species of a sizeable number of SPAs in Belgium, Germany and France, during breeding, winter and staging. With the exception of northeast Scotland and Norway, the species is largely absent as a breeder along North Sea coasts, except in small numbers.

5.14.4.11 Great black-backed gulls are evidently partial migrants, due to the appearance of birds in winter along many eastern coasts where no breeding has taken place (Wernham *et al.*, 2002). Unlike most British breeders, Fennoscandian breeding populations undertake definite migration, with many ringed birds recovered in Britain coming from Norway and Murmansk. As Norway holds the majority of breeding birds, those present in continental SPAs during the non-breeding season are likely to comprise mainly migratory non-SPA birds from Norway, or those from continental SPAs that are largely sedentary. As such, Hornsea Three is unlikely to be important to any particular population, and so no significant transboundary effects are predicted.

5.14.4.12 A significance of no more than minor adverse is therefore predicted for any effect relating to the construction, operation or decommissioning of Hornsea Three. This is not significant in EIA terms.

5.14.4.13 The impacts on great black-backed gulls from non-UK SPAs are considered in Habitats Regulations Assessment Screening Report for Hornsea Three (DONG Energy, 2016).

Kittiwake

5.14.4.14 Kittiwakes are northerly breeders, with those in Britain being nearer the southern part of the breeding range, although there are some colonies in Denmark, France and Spain (Wernham *et al.*, 2002). The East Atlantic biogeographic breeding population was given as 6.6 million pairs by Wright *et al.* (2012). Outside the breeding season, the species is the most pelagic of gulls and is distributed across the North Atlantic Ocean, with continental SPAs in Belgium, Germany and France mainly holding the species in winter. During this time, kittiwakes from many breeding areas mix in the North Sea, and birds make extensive movements to avoid atmospheric depressions and being forced onto continental coasts by strong winds.

5.14.4.15 Their distribution outside the breeding season is probably partly dependent on weather conditions and food supplies, and there can be large movements especially along North Sea coasts in response to weather conditions (Wright *et al.,* 2012).

5.14.4.16 The species ranges widely in winter and it is very unlikely that any particular population will be connected with birds found within Hornsea Three as birds from different colonies are likely to be widely spread throughout the North Sea. No significant transboundary effects are therefore predicted.

5.14.4.17 A significance of no more than minor adverse is therefore predicted for any effect relating to the construction, operation or decommissioning of Hornsea Three. This is not significant in EIA terms.

5.14.4.18 The impacts on kittiwakes from non-UK SPAs are considered in the Habitats Regulations Assessment Screening Report for Hornsea Three (DONG Energy, 2016).

Puffin

5.14.4.19 A small number of SPAs in France have puffin as a qualifying species, with some during the breeding season and others during winter. The European population is an estimated 5,700,000 to 7,300,000 pairs, with the UK hosting up to 10% (Wright *et al.,* 2012). The majority of birds come from Iceland (3 million pairs) and Norway (1.5 million pairs) and hence there are few non-UK SPAs for breeding birds.

5.14.4.20 It is thought that puffins may be dispersive rather than following particular migratory routes, with the birds breeding at sites around Britain and Ireland dispersing very widely to sites as far afield as Norway, Newfoundland and the Canary Islands during the non-breeding season (Wernham *et al*., 2002).

5.14.4.21 Many of the birds present within Hornsea Three may therefore be part of the large Icelandic or Norwegian populations during winter months, and are unlikely to be coming from nearer continental populations. No significant transboundary effects are therefore predicted.

5.14.4.22 A significance of no more than minor adverse is therefore predicted for any effect relating to the construction, operation or decommissioning of Hornsea Three. This is not significant in EIA terms.

5.14.4.23 The impacts on puffins from non-UK SPAs are considered in the Habitats Regulations Assessment Screening Report for Hornsea Three (DONG Energy, 2016).

Razorbill

5.14.4.24 There are a suite of SPAs for razorbill in France, Germany and Denmark, with most holding birds during winter months. The European razorbill population is estimated to be 430,000 to 770,000 breeding pairs (Wright *et al.*, 2012), with 12 to 22% coming from the UK.

5.14.4.25 After the breeding season and post-breeding moult, there is a gradual movement of razorbills southwards from their colonies. No defined migratory routes exist, but concentrations may exist in the Dover strait (Wernham *et al.*, 2002). In winter the species is found in relatively shallow waters close to the shore. British razorbills have been recorded throughout the species' range in the eastern Atlantic and western Mediterranean. Birds in northwest Britain have a strong tendency to move eastwards and winter off Norway and Denmark, with relatively few moving through the English Channel to France and Iberia.

5.14.4.26 It is not considered likely that continental birds from any particular colony are regular visitors to Hornsea Three in winter because although birds may disperse to and from northerly breeding colonies, connectivity is likely to be infrequent, compared to more preferred regions such as Dogger Bank or Brown Ridge. It is acknowledged that some birds may be displaced from Hornsea Three towards these preferred sites, which may increase the pressure on feeding individuals. However, much movement in winter is likely to be in response to locations of food sources, and so any effect will be fleeting. No significant transboundary effects are therefore predicted.

5.14.4.27 A significance of no more than minor adverse is therefore predicted for any effect relating to the construction, operation or decommissioning of Hornsea Three. This is not significant in EIA terms.

5.14.4.28 The impacts on razorbills from non-UK SPAs are considered in the Habitats Regulations Assessment Screening Report for Hornsea Three (DONG Energy, 2016).

Guillemot

5.14.4.29 There are a number of SPAs in Belgium, Denmark, Germany, and France in particular, where guillemot is a qualifying species in winter. The European guillemot population is around 2.0 to 2.7 million breeding pairs (Wright *et al.*, 2012), with around 30% from the UK. Birds may therefore come from a wide variety of breeding sites to winter in particular SPAs. Guillemot is a dispersive rather than migratory species, breeding from Svalbard south to Portugal (Wernham *et al.,* 2002). Birds move further away from breeding colonies until December, when birds increasingly are found in the southern North Sea, eventually peaking in February. There has been evidence that those breeding in the north (Iceland, UK) have furthest movements, whereas those further south travel a shorter distance, heading towards the Bay of Biscay. There is much mixing of populations in the North Sea and English Channel.

5.14.4.30 Like razorbill, any impacts on Hornsea Three will likely be diluted between a large number of breeding populations in Scotland and continental Europe largely on dispersal, and so there will be no significant connectivity with any non-UK population, including those at Dogger Bank or Brown Ridge, which are preferred by the species. No significant transboundary effects are therefore predicted.

5.14.4.31 A significance of no more than minor adverse is therefore predicted for any effect relating to the construction, operation or decommissioning of Hornsea Three. This is not significant in EIA terms.

5.14.4.32 The impacts on guillemots from non-UK SPAs are considered in the Habitats Regulations Assessment Screening Report for Hornsea Three (DONG Energy, 2016).

5.15 Inter-related effects

5.15.1.1 Inter-relationships are considered to be the impacts and associated effects of different aspects of the proposal on the same receptor. These are considered to be:

- Project lifetime effects: Assessment of the scope for effects that occur throughout more than one phase of the project (construction, operation and maintenance, and decommissioning), to interact to potentially create a more significant effect on a receptor than if just assessed in isolation in these three key project stages (e.g. subsea noise effects from piling, operational turbines, vessels and decommissioning).
- Receptor led effects: Assessment of the scope for all effects to interact, spatially and temporally, to create inter-related effects on a receptor. As an example, all effects on [chapter topic], such as [direct habitat loss or disturbance, sediment plumes, scour, jack-up vessel use etc.], may interact to produce a different, or greater effect on this receptor than when the effects are considered in isolation. Receptor-led effects might be short term, temporary or transient effects, or incorporate longer term effects.

5.15.1.2 A description of the likely inter-related effects arising from Hornsea Three on offshore ornithology is provided in chapter 11: Inter-Related Effects (Offshore). The likely impacts are as follows:

- Disturbance and displacement due to construction activity;
- Indirect effects , such as changes in habitat of abundance and distribution of prey species;
- Displacement due to presence of turbines and other ancillary structures;
- Mortality from collision with rotating turbine blades;
- Barrier effects may prevent clear transit of birds between foraging and breeding sites, or on migration;
- Attraction to lit structures by migrating birds may cause disorientation, reduction in fitness and possible mortality; and
- Accidental pollution leading to effects on ornithological receptors.

5.16 Conclusion and summary

5.16.1.1 The potential impacts on offshore ornithology, associated with the construction, operation and maintenance, and decommissioning of Hornsea Three, have been identified and are summarised in Table 5.46. The identified impacts for Hornsea Three alone will have no more than a minor adverse effect on all receptors at a regional or national level. On this basis, there is no indication, at this stage, that Hornsea Three alone will have a significant impact on any VOR.

5.16.1.2 When considering the effects of Hornsea Three together with other projects and activities, several impacts of moderate or major adverse effect are predicted. It is however considered that these predictions involve considerable precaution and further investigation is ongoing..

5.16.1.3 The methods used to predict mortality rates are, for example, based on conservative assumptions, including the use of precautionary parameters in relevant risk assessments (including displacement analysis and collision modelling). Further work is being undertaken to agree appropriately conservative assumptions (whilst reducing levels of excessive precaution) for risk assessment with consultees through the Evidence Plan process.

5.16.1.4 At this stage, the predicted mortality rates are based on the number of birds of each species observed at the wind farm and it is known that these will include a proportion of immature and non-breeding adult birds. This has not been accounted for in the population estimates presented in this document. The reference populations against which the magnitude of impacts are gauged are, however, typically expressed only in terms of breeding adults. Further analysis is being undertaken to estimate the proportion of immatures and non-breeding adults in the populations observed at Hornsea Three so that the magnitude of mortality effects on reference populations is more accurately understood.

5.16.1.5 It is considered highly unlikely that all projects included in the cumulative assessment will be brought forward or, if constructed, they are unlikely to be built out to the worst case assumptions made in the respective impact assessments. Further analysis will be undertaken of the likelihood that projects will progress to implementation and, where, projects have been built or their designs are being completed, the predicted effects assumed for those projects will be updated to better reflect their actual impact.

5.16.1.6 It is considered likely, therefore, that the predictions of the significance of cumulative effects will be refined and reduced as the assessment progresses. If required, though, further options for mitigation will also be investigated to reduce, where possible, the predicted impacts to acceptable levels.

5.17 Next Steps

5.17.1.1 As discussed in paragraph 5.6.4.1, additional aerial surveys will be undertaken across the Hornsea Three offshore ornithology study area. The data collected during these survey will be incorporated into the data analyses presented in volume 5, annex 5.1: Baseline Characterisation Report. In addition, data available from previous surveys of the former Hornsea Zone are being analysed. Together with the aerial survey data, these additional data will be used to establish a robust and up-to-date characterisation of the baseline environment in the Hornsea Three offshore ornithology study area. The results will be discussed and agreed through the Evidence Plan process and used to inform the final Environmental Statement offshore ornithology chapter.

5.17.1.2 Further discussion of the appropriate parameters to be used in the analysis and modelling of likely mortality of the effects of wind farms on birds will be undertaken through the Evidence Plan process. The appropriate way to assess the implications of predicted mortality on reference populations will also be explored and agreed through the Evidence Plan process.

Table 5.46: Summary of potential environment effects, mitigation and monitoring..

Description of impact	Measures adopted as part of the project	Receptor	Magnitude of impact				Sensitivity of receptor	Significance of effect	Additional measures	Residual effect	Proposed monitoring
			Breeding season	Post-breeding season	Non-breeding season	Pre-breeding season					
Construction Phase											
Disturbance/displacement due to construction activity	N/A	Common scoter	No change				High	Negligible (not significant in EIA terms)	None	N/A	Monitoring will be discussed as part of the Evidence Plan process ahead of the final DCO application
		Red-throated diver	Negligible				High	Minor adverse (not significant in EIA terms)			
		Gannet:	Low				Low	Negligible or minor adverse (not significant in EIA terms)			
		Puffin	Low				Medium to high	Minor adverse (not significant in EIA terms)			
		Razorbill	Low				Low to medium	Negligible or minor adverse (not significant in EIA terms)			
		Guillemot	Low				Medium	Minor adverse (not significant in EIA terms)			
Indirect effects, such as changes in habitat or abundance and distribution of prey.	N/A	Common scoter	No change				High	Negligible adverse (not significant in EIA terms)	None	N/A	N/A
		Red-throated diver	Negligible				High	Minor adverse (not significant in EIA terms)	None	N/A	N/A
		Fulmar	Negligible				Medium	Negligible or minor adverse (not significant in EIA terms)	None	N/A	Monitoring will be discussed as part of the Evidence Plan process ahead of the final DCO application
		Gannet:	Negligible				Low	Negligible or minor adverse (not significant in EIA terms)			
		Kittiwake	Negligible				Low to medium	Negligible or minor adverse (not significant in EIA terms)			
		Puffin	Negligible				Medium to high	Negligible (not significant in EIA terms)			
		Razorbill	Negligible				Low to medium	Negligible or minor adverse (not significant in EIA terms)			
		Guillemot	Negligible				Low to medium	Negligible or minor adverse (not significant in EIA terms)			

Description of impact	Measures adopted as part of the project	Receptor	Magnitude of impact				Sensitivity of receptor	Significance of effect	Additional measures	Residual effect	Proposed monitoring
			Breeding season	Post-breeding season	Non-breeding season	Pre-breeding season					
		Lesser black-backed gull	Negligible				Low	Negligible or minor adverse (not significant in EIA terms)			
		Great black-backed gull	Negligible				Low	Negligible or minor adverse (not significant in EIA terms)			
Impact of pollution including accidental spills and contaminant releases which may affect species' survival rates or foraging activity	Development of, and adherence to, a CoCP.	Common scoter	No change				Medium to high	Negligible adverse (not significant in EIA terms)	None	N/A	None
		Red-throated diver	No change				Medium to high	Negligible adverse (not significant in EIA terms)			
		Fulmar	No change				Low	Negligible adverse (not significant in EIA terms)			
		Gannet	No change				Medium to high	Negligible adverse (not significant in EIA terms)			
		Puffin	No change				Medium to high	Negligible adverse (not significant in EIA terms)			
		Razorbill	No change				Medium to high	Negligible adverse (not significant in EIA terms)			
		Guillemot	No change				Medium to high	Negligible adverse (not significant in EIA terms)			
		Kittiwake	No change				Low to medium	Negligible adverse (not significant in EIA terms)			
		Lesser black-backed gull	No change				Low	Negligible adverse (not significant in EIA terms)			
		Great black-backed gull	No change				Low	Negligible adverse (not significant in EIA terms)			

Description of impact	Measures adopted as part of the project	Receptor	Magnitude of impact				Sensitivity of receptor	Significance of effect	Additional measures	Residual effect	Proposed monitoring
			Breeding season	Post-breeding season	Non-breeding season	Pre-breeding season					
Operation and maintenance phase											
Impact of physical displacement from an area around turbines (342) and other ancillary structures (up to twelve offshore HVAC collector substations, three offshore accommodation platforms and four offshore HVAC booster stations) during the operation and maintenance phase of the development may result in effective habitat loss and reduction in survival or fitness rates.	N/A	All receptors	Negligible or low				Low to high	Negligible - minor adverse (not significant in EIA terms)	None	N/A	Monitoring will be discussed as part of the Evidence Plan process ahead of the final DCO application
The impact of indirect effects, such as changes in habitat or abundance and distribution of prey.	N/A	Common scoter	No change				High	Negligible adverse (not significant in EIA terms)	None	N/A	Monitoring will be discussed as part of the Evidence Plan process ahead of the final DCO application
		Red-throated diver	Negligible				High	Minor adverse (not significant in EIA terms)			
		Puffin	Negligible				Medium to high	Minor adverse (not significant in EIA terms)			
		All other receptors	Negligible				Low to medium	Negligible or minor adverse (not significant in EIA terms)			
Mortality from collision with rotating turbine blades	N/A	Gannet	Negligible	Negligible		Negligible	Medium	Negligible or minor adverse (not significant in EIA terms)	None	N/A	Monitoring will be discussed as part of the Evidence Plan process ahead of the final DCO application
		Arctic skua	No change (Annual)				High	Negligible adverse (not significant in EIA terms)			
		Great skua	No change (Annual)				High	Negligible adverse (not significant in EIA terms)			
		Common tern		No change		No change	Medium	Negligible adverse (not significant in EIA terms)			

Description of impact	Measures adopted as part of the project	Receptor	Magnitude of impact				Sensitivity of receptor	Significance of effect	Additional measures	Residual effect	Proposed monitoring
			Breeding season	Post-breeding season	Non-breeding season	Pre-breeding season					
		Arctic tern	No change (Annual)				Medium	Negligible adverse (not significant in EIA terms)			
		Kittiwake	Low	Low		Negligible	High	Minor adverse (not significant in EIA terms)			
		Little gull	No change (Annual)				Medium	Negligible adverse (not significant in EIA terms)			
		Lesser black-backed gull	Low	No change	No change	Negligible	Medium	Minor adverse (not significant in EIA terms)			
		Great black-backed gull	Negligible		Negligible		Medium	Negligible or minor adverse (not significant in EIA terms)			
		Other seabird species	No change (Annual)				Medium	Negligible adverse (not significant in EIA terms)			
		Other migratory species	No change (Annual)				High	Negligible adverse (not significant in EIA terms)			
Impact of barrier effects caused by the physical presence of turbines and ancillary structures may prevent clear transit of birds between foraging and breeding sites, or on migration.	N/A	Fulmar	Low				Low	Negligible or minor adverse (not significant in EIA terms)	None	N/A	Monitoring will be discussed as part of the Evidence Plan process ahead of the final DCO application
		Gannet	Low				Low	Negligible or minor adverse (not significant in EIA terms)			
		Arctic skua	Negligible				Low	Negligible or minor adverse (not significant in EIA terms)			
		Great skua	Negligible				Low	Negligible or minor adverse (not significant in EIA terms)			
		Puffin	Negligible				Low	Negligible or minor adverse (not significant in EIA terms)			
		Razorbill	Negligible				Low	Negligible or minor adverse (not significant in EIA terms)			
		Guillemot	Negligible				Low	Negligible or minor adverse (not significant in EIA terms)			
		Common tern	Negligible				Low	Negligible or minor adverse (not significant in EIA terms)			

Description of impact	Measures adopted as part of the project	Receptor	Magnitude of impact				Sensitivity of receptor	Significance of effect	Additional measures	Residual effect	Proposed monitoring
			Breeding season	Post-breeding season	Non-breeding season	Pre-breeding season					
		Arctic tern	Negligible				Low	Negligible or minor adverse (not significant in EIA terms)			
		Kittiwake	Negligible				Low	Negligible or minor adverse (not significant in EIA terms)			
		Little gull	Negligible				Low	Negligible or minor adverse (not significant in EIA terms)			
		Lesser black-backed gull	Negligible				Low	Negligible or minor adverse (not significant in EIA terms)			
		Great black-backed gull	Negligible				Low	Negligible or minor adverse (not significant in EIA terms)			
Impact of attraction to lit structures by migrating birds in particular may cause disorientation, reduction in fitness and possible mortality	N/A	All receptors	Low				Low	Negligible or minor adverse (not significant in EIA terms)	None	N/A	None
Impact of disturbance as a result of activities associated with maintenance of operation and maintenance turbines, cables and other infrastructure may result in disturbance or displacement of bird species	N/A	Common scoter	Negligible				Medium to high	Minor adverse (not significant in EIA terms)	None	N/A	Monitoring will be discussed as part of the Evidence Plan process ahead of the final DCO application
		Red-throated diver	Negligible				Medium to high	Minor adverse (not significant in EIA terms)			
		Fulmar	Negligible				Low	Negligible or minor adverse (not significant in EIA terms)			
		Gannet	Negligible				Low	Negligible or minor adverse (not significant in EIA terms)			
		Puffin	Negligible				Medium	Minor adverse (not significant in EIA terms)			
		Razorbill	Negligible				Low to medium	Negligible or minor adverse (not significant in EIA terms)			
		Guillemot	Negligible				Medium	Minor adverse (not significant in EIA terms)			
The impact of pollution including accidental spills	Implementation of an appropriate PEMMP	Common Scoter	No change				Medium to high	Negligible adverse (not significant in EIA terms)	None	N/A	N/A

Description of impact	Measures adopted as part of the project	Receptor	Magnitude of impact				Sensitivity of receptor	Significance of effect	Additional measures	Residual effect	Proposed monitoring
			Breeding season	Post-breeding season	Non-breeding season	Pre-breeding season					
and contaminant releases associated with maintenance or supply/service vessels which may affect species' survival rates or foraging activity.		Red-throated diver	No change				Medium to high	Negligible adverse (not significant in EIA terms)			
		Fulmar	No change				Low	Negligible adverse (not significant in EIA terms)			
		Gannet	No change				Medium to high	Negligible adverse (not significant in EIA terms)			
		Puffin	No change				Medium to high	Negligible adverse (not significant in EIA terms)			
		Razorbill	No change				Medium to high	Negligible adverse (not significant in EIA terms)			
		Guillemot	No change				Medium to high	Negligible adverse (not significant in EIA terms)			
		Kittiwake	No change				Low to medium	Negligible adverse (not significant in EIA terms)			
		Lesser black-backed gull	No change				Low	Negligible adverse (not significant in EIA terms)			
		Great black-backed gull	No change				Low	Negligible adverse (not significant in EIA terms)			
Decommissioning Phase											
The impact of decommissioning activities such as increased vessel activity and underwater noise may result in direct disturbance or displacement from important foraging and habitat areas of birds.	N/A	Common scoter	No change				High	Negligible (not significant in EIA terms)	None	N/A	None
		Red-throated diver	Negligible				High	Minor adverse (not significant in EIA terms)			
		Gannet	Low				Low	Negligible or minor adverse (not significant in EIA terms)			
		Puffin	Low				Medium to high	Minor adverse (not significant in EIA terms)			
		Razorbill	Low				Low to medium	Negligible or minor adverse (not significant in EIA terms)			

Description of impact	Measures adopted as part of the project	Receptor	Magnitude of impact				Sensitivity of receptor	Significance of effect	Additional measures	Residual effect	Proposed monitoring
			Breeding season	Post-breeding season	Non-breeding season	Pre-breeding season					
		Guillemot	Low				Medium	Minor adverse (not significant in EIA terms)			
The impact of indirect effects, such as changes in habitat or abundance and distribution of prey	N/A	Common scoter	Negligible				High	Minor adverse (not significant in EIA terms)	None	N/A	None
		Red-throated diver	Negligible				High	Minor adverse (not significant in EIA terms)			
		Fulmar	Negligible				Low	Negligible or minor adverse (not significant in EIA terms)			
		Gannet	Low				Low	Negligible or minor adverse (not significant in EIA terms)			
		Puffin	Low				Medium to high	Minor adverse (not significant in EIA terms)			
		Razorbill	Low				Low to medium	Negligible or minor adverse (not significant in EIA terms)			
		Guillemot	Low				Medium	Minor adverse (not significant in EIA terms)			
		Kittiwake	Low				Low	Negligible or minor adverse (not significant in EIA terms)			
		Lesser black-backed gull	Negligible				Low to medium	Negligible or minor adverse (not significant in EIA terms)			
		Great black-backed gull	Negligible				Low	Negligible or minor adverse (not significant in EIA terms)			
The impact of pollution including accidental spills and contaminant releases associated with removal of infrastructure and supply/service vessels may lead to direct mortality of birds or a reduction in foraging capacity.	Development of a Decommissioning Programme	Common scoter	No change				Medium to high	Negligible adverse (not significant in EIA terms)	None	N/A	None
		Red-throated diver	No change				Medium to high	Negligible adverse (not significant in EIA terms)			
		Fulmar	No change				Low	Negligible adverse (not significant in EIA terms)			
		Gannet	No change				Medium to high	Negligible adverse (not significant in EIA terms)			

Description of impact	Measures adopted as part of the project	Receptor	Magnitude of impact				Sensitivity of receptor	Significance of effect	Additional measures	Residual effect	Proposed monitoring
			Breeding season	Post-breeding season	Non-breeding season	Pre-breeding season					
		Puffin	No change				Medium to high	Negligible adverse (not significant in EIA terms)			
		Razorbill	No change				Medium to high	Negligible adverse (not significant in EIA terms)			
		Guillemot	No change				Medium to high	Negligible adverse (not significant in EIA terms)			
		Kittiwake	No change				Low to medium	Negligible adverse (not significant in EIA terms)			
		Lesser black-backed gull	No change				Low	Negligible adverse (not significant in EIA terms)			
		Great black-backed gull	No change				Low	Negligible adverse (not significant in EIA terms)			

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