Dudgeon and Sheringham Shoal Offshore Wind Farm Extensions

Preliminary Environmental Information Report

Volume 3

Appendix 13.2 - Supplementary Information to Inform the Offshore Ornithology Cumulative Impact Assessment

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Dudgeon and Sheringham Shoal Offshore Wind Farm Extensions **Preliminary Environmental Information Report** **Appendix 13.2 Supplementary Information to Inform the Offshore Ornithology Cumulative Impact Assessment**
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Glossary of Acronyms

CIA	Cumulative Impact Assessment
CRM	Collision Risk Modelling
DCO	Development Consent Order
DECC	Department for Energy and Climate Change
DEP	Dudgeon Extension Project
DOW	Dudgeon Offshore Wind Farm
DSM	Density Surface Model
EIA	Environmental Impact Assessment
EOWDC	European Offshore Wind Development Centre
ES	Environmental Statement
km	Kilometre
JNCC	Joint Nature Conservation Committee
OWF	Offshore Wind Farm
SeaMAST	Seabird Mapping and Sensitivity Tool
SEP	Sheringham Shoal Extension Project
SNCB	Statutory Nature Conservation Body
SPA	Special Protection Area
WWT	Wildfowl and Wetlands Trust

Glossary of Terms

The Applicant	Equinor New Energy Limited
The Dudgeon Offshore Wind Farm Extension Project (DEP)	The Dudgeon Offshore Wind Farm Extension site as well as all onshore and offshore infrastructure.
PEIR boundary	The area subject to survey and preliminary impact assessment to inform the PEIR, including all permanent and temporary works for DEP and SEP. The PEIR boundary will be refined down to the final DCO boundary ahead of the application for development consent.
The Sheringham Shoal Offshore Wind Farm Extension Project (SEP)	The Sheringham Offshore Wind Farm Extension site as well as all onshore and offshore infrastructure.

13.2 SUPPLEMENTARY INFORMATION FOR THE CUMULATIVE IMPACT ASSESSMENT

13.2.1 Introduction

1. This Appendix details the information that underpins the quantitative element of the cumulative impact assessment (CIA) for **Chapter 13 Offshore Ornithology**. Given the number of offshore wind farm (OWF) projects that require consideration in the CIA for some species, and the complexity associated with evolution of project envelopes and changes to collision risk and displacement estimates over time (for example as a project progresses through Development Consent Order (DCO) Examination) it is considered that a full explanation of how the cumulative totals have been derived is required.
2. **Section 13.2.3** and **Section 13.2.4** provide an audit trail for cumulative collision risk and cumulative displacement assessments respectively. For each species included in the CIA, tabulated estimates of collision risk mortality and the number of birds at risk of displacement by project are provided, together with the source of information. These numbers are provided as both seasonal and annual totals (as appropriate). A full discussion of biologically relevant seasons is provided in **Chapter 13 Offshore Ornithology**.
3. For collision risk and/or displacement for gannet, kittiwake, auks and gulls, the numbers used in the CIA are the totals provided at the bottom of the tables in the 'TOTALS FOR CIA' cell. These numbers are calculated from the predicted project alone totals, which themselves are either:
4. The consented total as taken from the Environmental Statement (ES) or subsequent submissions to the consenting process (e.g. Planning Inspectorate DCO Examination responses) upon which the consent is based; or
5. The consented total as taken from a varied consent such as a non-material change (England) or a varied marine licence (Scotland); or
6. For older projects where the original numbers are unclear from the ES (or were not broken down into sufficient detail) totals used within Planning Inspectorate DCO Examination responses are used.
7. For Sandwich tern, collision risk has been recalculated for all OWFs within mean maximum foraging range of the North Norfolk Coast Special Protection Area (SPA) (Woodward et al., 2019) for which density data were available using the Band Collision Risk Model (CRM) (Band, 2012). As per Chapter 13 Offshore Ornithology, a range of avoidance rates have been used. Displacement rates were not considered by any previous OWF assessment for this species; this has been calculated for Sandwich tern by using flying bird densities (which were all that were available) as an input in the matrix-based approach currently advocated by Natural England (UK SNCBs, 2017).

8. In addition to the 'TOTALS FOR CIA', the tables presenting cumulative collision risk also provide a 'THEORETICAL TOTALS' cell for some OWFs (or all OWFs in the case of Sandwich tern). This theoretical total provides context for those projects for which no 'official' information was identified. That is to say that no information was identified which fits the definitions covered by one of the definitions included in the 'TOTALS FOR CIA', but for which it is clear that the project design envelope for the original assessments has been superseded.

9. Notes are provided where it is believed that collision estimates are likely to be reduced but are not formally updated and therefore not carried through to the 'TOTALS FOR CIA'. These are projects which have been constructed differently from, but within the worst case assumptions of, the existing consent, but for which no revised assessment is available. For example, for Triton Knoll was consented at 288 wind turbines of up to 1,200MW nameplate capacity, but is only installing 90, with a nameplate capacity of approximately 855MW. This would reduce collision risk predictions although no updated ornithological assessment is available for the as-built layout.

10. For such projects, revised collision risk predictions for updated, 'as-built' layout have been calculated (Macarthur Green, 2020a). In these cases, the source for the revised total is provided and the revised figures are presented in parentheses for season and annual totals. These numbers are then used to generate the 'THEORETICAL TOTALS'. The difference between the 'TOTALS FOR CIA' and 'THEORETICAL TOTALS' provides an indication of one of the sources of conservatism and overestimation within the cumulative totals (not withstanding other sources of overestimation such as nocturnal activity, precautionary avoidance rates or other sources of precaution within the assessment).

11. The species tables provide details of the version of the project referred to and whether an alternative number of turbines (with potentially quite large variations in parameters compared to those originally modelled) are used in the theoretical total. Note that for many projects, information has not been taken from the original ES, but rather from cumulative assessments for other projects undergoing DCO Examination or similar, where the cumulative totals are considered to have been accepted by the Statutory Nature Conservation Body (SNCB) and/or Competent Authority.

12. In the species tables, OWFs are assigned to tiers (Scottish Power Renewables, 2016), as shown in **Table 13.2-1**.

Table 13.2-1: Tiers for OWFs included in CIA.

Tier	Status
1	Built and operational projects
2	Projects under construction
3	Consented
4	Application submitted and not yet determined
5	In planning (scoped or PEIR available), application not yet formally submitted
6	Identified in Planning Inspectorate list of projects

13.2.2 Methods

13.2.2.1 Red-throated Diver CIA

13. Red-throated diver displacement impacts during the operational phase of OWFs have only been quantitatively assessed within Environmental Impact Assessments (EIAs) for a small number of OWFs in the southern North Sea. Those that did not include all OWFs situated in the Greater Wash (i.e. Lynn and Inner Dowsing, Lincs, Race Bank, SOW, DOW, and Triton Knoll OWF) (Royal HaskoningDHV, 2019a).

14. Whilst potential cumulative effects on this species have been investigated using quantitative data from other OWFs where available, this does not represent a comprehensive approach to assessment given the number of OWFs without quantitative data. An alternative approach to estimating potential cumulative collision risk was required for this species.

15. The Seabird Mapping and Sensitivity Tool (SeaMAST) (Bradbury et al., 2014) provides a common dataset covering the majority of English waters, describing seabird densities in 3x3km squares using both boat-based and visual aerial surveys. This dataset was used to assess the potential relative contribution of UK OWFs in the southern North Sea to displacement of red-throated divers during the non-breeding season.

16. The “BDMPS_Non_Breeding_Boat_Plus_Aerial_D” SeaMAST dataset was selected to describe red-throated diver densities during the non-breeding season (henceforth referred to as “the SeaMAST dataset”). This dataset provides estimated seabird non-breeding season densities (sitting and flying birds summed) from a density surface model (DSM) of Wildfowl and Wetlands Trust (WWT) visual aerial survey data collected between 2001 - 2011, and Joint Nature Conservation Committee (JNCC) European Seabirds At Sea (ESAS) boat-based survey data collected between 1979 and- 2011.

17. OWF boundaries were obtained from the Crown Estate, with any known changes accounted for prior to data processing. All 3x3 km grid squares that had been allocated the value “-99”, indicating a low confidence in the density generated by the DSM for that square, were excluded from the analysis. This led to a number of OWFs in English waters being excluded from the analysis as no abundance data were available. These were DEP, Dudgeon, Hornsea Projects One, Two and Three, Dogger Bank Creyke Beck A and B, Sofia, Teesside A and Triton Knoll. As the SeaMAST dataset does not include Scottish Territorial Waters, Scottish OWFs in the North Sea (i.e. Aberdeen (EOWDC), Beatrice, Beatrice Demonstrator, Hywind, Kincardine, Methil, Seagreen Alpha and Bravo, Inch Cape and Neart na Gaoithe) were not included in the assessment.

18. The red-throated diver non-breeding season is defined as September to February (Furness, 2015; WWT Consulting, 2015), and the SeaMAST dataset included data collected throughout this time period. As the SeaMAST dataset is a collation of available data, which at the time was not collected for the purpose of a wider regional analysis, across some areas, survey effort may have occurred disproportionally over particular months or seasons depending on the original purpose of the surveys. The red-throated diver non-breeding season was further subdivided by Furness (2015) into post-breeding migration (September to November), migration-free winter season (December to January) and return migration (February to April). During the two migration seasons, the north-western and south-western North Sea areas are considered to hold a single population of red-throated divers. During the migration-free winter season, it is considered that the north-western and south-western North Sea area populations are separate (Furness, 2015).

19. To calculate the number of red-throated divers occurring within a given area, the red-throated diver density for each grid square was converted to an abundance by multiplying density by area. For areas inside OWFs, the SeaMAST dataset encompassing the area of interest was clipped to the boundary of each wind farm. When repeating the exercise for the 4km OWF buffers, where there were instances of overlap between the buffers, and sometimes other OWFs, a system was devised to allocate red-throated divers to a particular OWF based on the tiered system for CIA based on advice from UK SNCBs (**Table 13.2-1**).

20. For overlapping OWFs and buffers occurring within tiers 1 and/or 2, buffers were amalgamated into a single polygon. Where a similar situation occurred for OWFs in tier 3 or above, OWF red line boundaries were prioritised over buffers. For overlapping buffers within the same tier, the abundance of red-throated divers within the overlapping area was calculated and split equally between the two buffers.

21. The SeaMAST data set is based on survey methods which may underestimate the numbers of red-throated divers present. This assessment is not intended to provide robust estimates, but a basis for comparison of the relative numbers and proportions of birds in each OWF in relation to the estimated population in the reference area.

22. The reference population size used here for the non-breeding season was 19,978 based on the SeaMAST dataset.

13.2.2.2 Sandwich Tern CIA

13.2.2.2.1 Density Data

23. Monthly density data of Sandwich terns in flight within the Dudgeon OWF (DOW) (Macarthur Green, 2014), Sheringham Shoal OWF (SOW) (SCIRA Offshore Energy Ltd, 2006), Race Bank OWF (Centrica Energy, 2009) and Triton Knoll OWF (RWE NPower Renewables, 2011) were obtained from a review of available literature (**Table 13.2-2)**.

Table 13.2-2: Densities of flying Sandwich terns at Greater Wash OWFs used as input parameters into CRM

Month	DOW	SOW	Race Bank	Triton Knoll
January	0	0	0	0
February	0	0	0	0

Month	DOW	SOW	Race Bank	Triton Knoll
March	0	0	0.025	0
April	0.635	0.042	0.070	0.013
May	0.847	0.444	0.565	0.081
June	0.367	0.293	0.693	0.040
July	0.017	0.206	0.523	0.02
August	0	0.045	0.280	0.121
September	0	0.046	0.050	0
October	0	0	0	0
November	0	0	0	0
December	0	0	0	0

24. These densities were used as inputs into both CRM and displacement modelling. Whilst density estimates of combined flying and sitting birds are preferred for assessment of displacement, these data were not available for other OWFs in the Greater Wash area. 1.3% of Sandwich terns observed during the Dudgeon Offshore Wind Farm Extension Project (DEP) and Sheringham Offshore Wind Farm Extension Project (SEP) baseline surveys were recorded sitting, and it is assumed that this trend would be similar at the other OWFs included within the study. This is therefore not considered to materially affect the assessment.

13.2.2.2.2 Collision Risk

25. CRM was carried out according the method of Band (2012), using Option 2, which required the use of flight height distributions from Johnston et al. (2014). The assessment presents the outputs of models using both the mean and upper 95% confidence interval flight height distributions.

26. Avoidance rates of 0.980, 0.9883 and 0.993 were considered by the assessment, whilst nocturnal activity was set at 0%. The biometric parameters for Sandwich tern used by the assessment are presented in **Table 13.2-3**.

Table 13.2-3: Biometric parameters for Sandwich tern used in CRM.

Species	Flight Type	Body Length (m)	Wingspan (m)	Flight Speed (m/s)
Sandwich tern	Flapping	0.39	1.00	10.5

27. Two sets of parameters for each of the OWFs under consideration were utilised by the CRM. Consented layouts were taken from the specifications considered by the Department of Energy and Climate Change (DECC) (2012), and are presented in **Table 13.2-4**. As-built OWF parameters are presented in **Table 13.2-5**.

Table 13.2-4: Consented turbine parameters for Greater Wash OWFs used in CRM.

Site	No. Turbs.	Rot. Speed (rpm)	Blade Pitch (degs)	Rotor Rad. (m)	Hub height (m)	Air Gap (m)	Max Blade Width (m)
Dudgeon	85	10.59	15	63	85.5	22.5	5.45

Site	No. Turbs.	Rot. Speed (rpm)	Blade Pitch (degs)	Rotor Rad. (m)	Hub height (m)	Air Gap (m)	Max Blade Width (m)
Race Bank	206	15.9	10	45	90	45	3.4
Sheringham Shoal	88	12.7	10	52	74.5	22.5	3.9
Triton Knoll	333	9.47	6	62.5	85	22.5	4.2

Table 13.2-5: As-built turbine parameters for Greater Wash OWFs used in CRM.

Site	No. Turbs.	Rot. Speed (rpm)	Blade Pitch (degs)	Rotor Rad. (m)	Hub height (m)	Air Gap (m)	Max Blade Width (m)
Dudgeon	67	10	10	77	105.6	28.6	5
Race Bank	91	10.3	15	77	106.6	29.6	5
Sheringham Shoal	88	13	15	53.5	81.75	28.25	4.2
Triton Knoll	90	10.8	5.4	82	110.2	28.2	4.2

13.2.2.2.3 Displacement

28. Following statutory guidance from Statutory Nature Conservation Bodies (SNCBS) (UK SNCBs, 2017), mean peak abundance estimates for Sandwich tern for Greater Wash OWFs only (i.e. no buffers) have been used to produce displacement matrices. This spatial extent has been selected as Perrow et al. (2010) suggests that displacement effects for this species are unlikely beyond 1km of an OWF boundary, Harwood et al. (2018), which provides evidence that birds continued to use areas of sea directly adjacent to SOW after the OWF had become operational, and data from Green et al. (2019), which does not show clear displacement beyond existing OWF boundaries.

29. Based on information presented by Cook et al. (2014) and Harwood et al. (2018), displacement rates of 30% to 50% are considered appropriate. The selection of these rates is considered to represent a precautionary approach since it is equally possible based on some previously published data that increases in abundance in operational OWFs are possible. Displacement matrices are presented for the breeding season only; outside the breeding season, displacement rates are zero.

30. As the mortality level of Sandwich tern due to displacement by operational OWFs is currently not known, consideration of a range of mortality rates is appropriate.

13.2.3 Cumulative Collision Risk

13.2.3.1 Gannet

Table 13.2-6: Cumulative collision risk for gannet

Tier	OWF	Predicted Gannet Collisions				Model Parameters			Source and Notes
		Breeding	Autumn	Spring	Annual	Iteration	Option	Avoidance Rate	
1	Aberdeen (EOWDC)	4.2	5.1	0.1	9.4	Band (2012)	2	0.989	Royal HaskoningDHV (2016), from Smart Wind (2015a)
1	Beatrice Demonstrator	0.6	0.9	0.7	2.2	Unknown	Unknown	Unknown	Royal HaskoningDHV (2016), from Natural England (2013)
1	Beatrice	37.4	48.8	9.5	95.7	Band et al. (2007)	1	0.989	Royal HaskoningDHV (2016), from Arcus Consultancy Services (2013). This was calculated for 277 turbines. Smart Wind (2015a) revises their total to 42 collisions, but it is unclear how these calculations were carried out.
		(22.7)	***(29.6)***	***(5.8)***	***(58.1)***	Band (2012)	1	0.989	Recalculated for as-built layout of 84 turbines (Macarthur Green and Royal HaskoningDHV, 2019).
1	Blyth Demonstration	3.5	2.1	2.8	8.4	Band et al. (2007)	1	0.989	Royal HaskoningDHV (2016), from Smart Wind (2015a)

Tier	OWF	Predicted Gannet Collisions				Model Parameters			Source and Notes
		Breeding	Autumn	Spring	Annual	Iteration	Option	Avoidance Rate	
1	Dudgeon	22.3	38.9	19.1	80.3	Band (2000)	1	0.989	Royal HaskoningDHV (2016), from Natural England (2013). This was calculated for 168 turbines. Smart Wind (2015a) revises to 36.6 collisions, but it is unclear how these calculations were carried out.
		(10.3)	***(18.0)***	***(8.8)***	***(37.1)***	Band (2012)	1	0.989	Recalculated for as-built layout of 67 turbines (Macarthur Green and Royal HaskoningDHV, 2019).
1	East Anglia ONE	3.4	131	6.3	140.7	Band (2012)	1	0.989	Macarthur Green (2019a)
		(2.3)	***(88.9)***	***(4.3)***	***(95.5)***	Band (2012)	1	0.989	Based on a revised as-built layout of 102 turbines (Macarthur Green and Royal HaskoningDHV 2019).
1	Galloper	18.1	30.9	12.6	61.6	Band et al. (2007)	1	0.989	Royal HaskoningDHV (2016), from Smart Wind (2015a). This was calculated for 140 turbines.
		(7.8)	***(13.4)***	***(5.5)***	***(26.7)***	Band (2012)	1	0.989	Recalculated for as-built layout of 56 turbines (Macarthur Green and Royal HaskoningDHV, 2019).

Tier	OWF	Predicted Gannet Collisions				Model Parameters			Source and Notes
		Breeding	Autumn	Spring	Annual	Iteration	Option	Avoidance Rate	
1	Greater Gabbard	14	8.8	4.8	27.6	Band (2000)	1	0.989	Royal HaskoningDHV (2016), from Smart Wind (2015a). These numbers are also in Forewind (2014), which appear to have originated from the EA1 DCO Examination. There, Natural England submitted a table citing a total of 50 birds at 0.980 avoidance. The EA1 ES chapter (ERM, 2012) and Greater Gabbard Technical Report (Banks et al., 2006) report no birds, but the method employed appears to be based on a directional model.
		(13.4)	***(8.4)***	***(4.6)***	***(26.4)***	Band (2012)	1	0.989	Recalculated for revised turbine parameters of as-built layout (Macarthur Green and Royal HaskoningDHV, 2019).

Tier	OWF	Predicted Gannet Collisions				Model Parameters			Source and Notes
		Breeding	Autumn	Spring	Annual	Iteration	Option	Avoidance Rate	
1	Gunfleet Sands	0	0	0	0	Unknown	Unknown	Unknown	Royal HaskoningDHV (2016), from Natural England (2013)
1	Hornsea Project One	11.5	32	22.5	66	Band (2012)	2	0.989	Macarthur Green (2020b). Hornsea Offshore Wind Farm Project One (2016) states 29 (5.0 breeding, 14.1 autumn and 9.9 spring).
1	Humber Gateway	1.9	1.1	1.5	4.5	Unknown	1	0.989	Royal HaskoningDHV (2016), from Smart Wind (2015a)
1	Hywind	5.6	0.8	0.8	7.2	Band (2012)	1	0.989	Statoil (2014)
1	Kentish Flats and extension	1.4	0.8	1.1	3.3	Band (2012)	1	0.989	Royal HaskoningDHV (2016), from Natural England (2013)
		(1.1)	***(0.7)***	***(0.9)***	***(2.7)***	Band (2012)	1	0.989	Recalculated for revised turbine parameters of as-built layout (Macarthur Green and Royal HaskoningDHV, 2019).
1	Lincs	2.1	1.3	1.7	5.1	Band (2000)	1	0.989	Royal HaskoningDHV (2016), from Smart Wind (2015a)
1	London Array	2.3	1.4	1.8	5.5	Band (2000)	1	0.989	Royal HaskoningDHV (2016), from Smart Wind (2015a)
1	Lynn and Inner Dowsing	0.2	0.1	0.2	0.5	Unknown	Unknown	Unknown	Royal HaskoningDHV (2016), from Smart Wind (2015a)
1	Race Bank	33.7	11.7	4.1	49.5	Band (2000)	1	0.989	Royal HaskoningDHV (2016), from Smart Wind (2015a). This was calculated for 206 turbines.

Tier	OWF	Predicted Gannet Collisions				Model Parameters			Source and Notes
		Breeding	Autumn	Spring	Annual	Iteration	Option	Avoidance Rate	
		(18.0)	***(6.2)***	***(2.2)***	***(26.4)***	Band (2012)	1	0.989	Recalculated for revised turbine numbers (91) and parameters of as-built layout (Macarthur Green and Royal HaskoningDHV, 2019).
1	Rampion	36.2	63.5	2.1	101.8	Band (2012) – draft 2011 version	1	0.989	Royal HaskoningDHV (2016), from Natural England (2013). This was calculated for 175 turbines.
		(25)	***(43.9)***	***(1.5)***	***(70.4)***	Band (2012)	1	0.989	Recalculated for 116 turbines of as-built layout (Macarthur Green and Royal HaskoningDHV, 2019).
1	Scroby Sands	0	0	0	0	Unknown	Unknown	Unknown	Royal HaskoningDHV (2016), from Natural England (2013)
1	Sheringham Shoal	14.1	3.5	0	17.6	Band (2000)	1	0.989	Royal HaskoningDHV (2016), from Smart Wind (2015a), calculated for a 108 turbine layout.
		(13.2)	***(3.3)***	***(0)***	***(16.5)***	Band (2012)	1	0.989	Recalculated for revised turbine number (88) and parameters of as-built layout (Macarthur Green and Royal HaskoningDHV, 2019).
1	Teesside	4.9	1.7	0	6.6	Band (2000)	1	0.989	Royal HaskoningDHV (2016), from Smart Wind (2015a)

Tier	OWF	Predicted Gannet Collisions				Model Parameters			Source and Notes
		Breeding	Autumn	Spring	Annual	Iteration	Option	Avoidance Rate	
1	Thanet	1.1	0	0	1.1	Band (2000)	1	0.989	Royal HaskoningDHV (2016), from Smart Wind (2015a)
1	Westermost Rough	0.2	0.1	0.2	0.5	Band et al. (2007)	1	0.989	Royal HaskoningDHV (2016), from Smart Wind (2015a)
2	Forth (Seagreen) Alpha and Bravo	800.8	49.3	65.8	915.9	Band (2012)	3	0.989	Royal HaskoningDHV (2016), from Natural England (2013)
		(328)	***(18)***	***(19)***	***(365)***	Band (2012)	2	0.989	Based on a revised layout (Seagreen, 2018).
2	Hornsea Project Two	7	14	6	27	Band (2012)	2	0.989	Smart Wind (2015b)
2	Kincardine	3	0	0	3	Band (2012)	1	0.989	Pilot Renewables (2016)
2	Moray Firth East	80.6	35.4	8.9	124.9	Band (2012)	1	0.989	Royal HaskoningDHV (2016), from Natural England (2013)
2	Neart na Gaoithe	143	47	23	213	Band (2012)	2	0.989	Macarthur Green (2020b)
		(93)	***(7)***	***(7)***	***(107)***	Band (2012)	2	0.989	GoBe Consultants (2018) revised layout.
2	Triton Knoll	26.8	64.1	30.1	121	Band (2012)	1	0.989	Royal HaskoningDHV (2016), from Smart Wind (2015a). This was calculated for 288 turbines.

Tier	OWF	Predicted Gannet Collisions				Model Parameters			Source and Notes
		Breeding	Autumn	Spring	Annual	Iteration	Option	Avoidance Rate	
		(9.4)	***(22.5)***	***(10.5)***	***(42.4)***	Band (2012)	1	0.989	Macarthur Green and Royal HaskoningDHV (2019). Recalculated for 90 turbines (as-built layout).
3	Dogger Bank Creyke Beck Projects A and B	81.1	83.5	54.4	219.0	Band (2012)	1	0.989	Macarthur Green (2020b). Royal HaskoningDHV (2018a) states 180.1 (66.7 breeding, 68.7 autumn and 44.7 spring)
3	Dogger Bank C (formerly Teesside A) and Sofia (formerly Teesside B)	14.8	8.8	9.4	33	Band (2012)	2	0.989	Innogy Renewables UK (2018). This is the consented Teesside A and B total with seasonal numbers based on the proportion of the old numbers in each season. This is due to the lack of availability for revised Teesside A numbers. Only small reductions in total anticipated.
3	East Anglia THREE	5.7	31.1	9.0	45.8	Band (2012)	1	0.989	Macarthur Green (2019b)
3	Hornsea Project Three	26	12	11	49	Band (2012)	2	0.989	Macarthur Green (2020b). Macarthur Green (2019a) stated 38 (18 breeding, 12 autumn, 8 spring).

Tier	OWF	Predicted Gannet Collisions				Model Parameters			Source and Notes
		Breeding	Autumn	Spring	Annual	Iteration	Option	Avoidance Rate	
		(7)	***(3)***	***(3)***	***(13)***	Band (2012)	2	0.989	BEIS (2020)
3	Inch Cape	336.9	29.2	5.2	371.3	Band (2012)	1	0.989	Macarthur Green (2020b)
		(46)	***(1)***	***(1)***	***(48)***	Band (2012)	1	0.989	Inch Cape Offshore (2018) revised layout.
3	Methil	6	0	0	0	Unknown	Unknown	Unknown	Macarthur Green (2020b)
3	Moray Firth West	10	2	1	13	Unknown	Unknown	Unknown	Macarthur Green (2019a)
3	Norfolk Vanguard	8.1	18.6	5.3	32.1	Band (2012)	2	0.989	Macarthur Green (2019a). Revised project design post DCO Examination with two turbine scenarios and draft height of 30-35m above Mean High Water Springs.
4	East Anglia TWO	10.7	24.2	4.8	39.6	Band (2012)	2	0.989	Macarthur Green and Royal HaskoningDHV (2021)
4	East Anglia ONE North	12.4	11.0	1.1	24.5	Band (2012)	2	0.989	Macarthur Green and Royal HaskoningDHV (2021)
4	Norfolk Boreas	14.1	12.7	3.9	30.7	Band (2012)	2	0.989	Macarthur Green (2020c)

Tier	OWF	Predicted Gannet Collisions				Model Parameters			Source and Notes
		Breeding	Autumn	Spring	Annual	Iteration	Option	Avoidance Rate	
5	Hornsea Project Four	43.3	9.9	8.1	61.3	McGregor et al. (2018)	2	0.989	APEM (2019a). Stochastic CRM based on SNCB-approved parameters.
5	DEP	3.63	4.99	0.36	8.98	Band (2012)	2	0.989	This PEIR, mean for 14MW scenario.
5	SEP	0.33	1.44	0	1.77	Band (2012)	2	0.989	This PEIR, mean for 14MW scenario.
TOTALS FOR CIA		1,853	844	339	3,036	TOTALS FOR CIA are the numbers used in the CIA, ***THEORETICAL TOTALS*** show the reductions if as-built / as planned CRM numbers are used, as opposed to the worst-case consented project design.			
THEORETICAL TOTALS		936	568	219	1,723				

13.2.3.2 Kittiwake

Table 13.2-7: Cumulative collision risk for kittiwake.

Tier	OWF	Predicted Kittiwake Collisions				Model Parameters			Source and Notes
		Breeding	Autumn	Spring	Annual	Iteration	Option	Avoidance Rate	
1	Aberdeen (EOWDC)	11.8	5.8	1.1	18.7	Band (2012)	2	0.989	Royal HaskoningDHV (2016), from Natural England (2015)
1	Beatrice Demonstrator	0	2.1	1.7	3.8	Band (2000)	1	0.992	Macarthur Green (2020b)
1	Beatrice	94.7	10.7	39.8	145.2	Band et al. (2007)	1	0.989	Macarthur Green (2020b)

Tier	OWF	Predicted Kittiwake Collisions				Model Parameters			Source and Notes
		Breeding	Autumn	Spring	Annual	Iteration	Option	Avoidance Rate	
		(37.66)	***(4.3)***	***(15.9)***	***(57.86)***	Band et al. (2007)	1	0.989	Royal HaskoningDHV (2016), from Natural England (2015). This figure is taken directly from Natural England's document for Hornsea Project Two. Based on the value of circa 145 from the original ES, it seems that this has been corrected to account for the reduction in turbines (277 to 84).
1	Blyth Demonstration	1.69	2.3	1.4	5.39	Band et al. (2007)	1	0.989	Royal HaskoningDHV(2016), based on data from Natural England (2015)
1	Dudgeon	0	0	0	0	Band (2000)	1	0.989	Royal HaskoningDHV (2016), from Natural England (2015)
1	East Anglia ONE	46.7	1.5	161.0	209.2	Band (2012)	1	0.989	Macarthur Green (2019a)
		(24.7)	***(0.8)***	***(85)***	***(110.5)***	Band (2012)	1	0.989	Recalculated based on 102 turbine as-built layout (Macarthur Green and Royal HaskoningDHV, 2019).
1	Galloper	6.29	27.8	31.8	65.89	Band et al. (2007)	1	0.989	Royal HaskoningDHV (2016), from Natural England (2015). Calculated for 140 turbines.
		(2.1)	***(9.2)***	***(10.5)***	***(21.7)***	Band (2012)	1	0.989	Recalculated for as-built layout of 56 turbines (Macarthur Green and Royal HaskoningDHV, 2019).

Tier	OWF	Predicted Kittiwake Collisions				Model Parameters			Source and Notes
		Breeding	Autumn	Spring	Annual	Iteration	Option	Avoidance Rate	
1	Greater Gabbard	1.1	15	11.4	27.5	Band (2000)	1	0.989	Royal HaskoningDHV (2016), from Natural England (2015), exact origin unknown.
		(0.8)	***(11.1)***	***(8.5)***	***(20.4)***	Band (2012)	1	0.989	Macarthur Green and Royal HaskoningDHV (2019)
1	Gunfleet Sands	0	0	0	0	Unknown	Unknown	Unknown	Royal HaskoningDHV (2016), from Natural England (2013)
1	Hornsea Project One	44.0	55.9	20.9	120.8	Band (2012)	2	0.989	Macarthur Green (2020b)
1	Humber Gateway	2.55	3.19	1.9	7.64	Unknown	1	0.989	Royal HaskoningDHV (2016), from Natural England (2015)
1	Hywind	16.6	0.85	0.85	18.3	Band (2012)	1	0.989	Statoil (2014)
1	Kentish Flats and extension	0	0.9	3.4	4.3	Band (2000)	1	0.989	Macarthur Green (2020b)
1	Lincs	0.92	1.16	0.69	2.77	Band (2000)	1	0.989	Royal HaskoningDHV (2016), from Natural England (2015)
1	London Array	1.4	2.3	1.8	5.5	Band (2000)	1	0.989	Royal HaskoningDHV (2016), from Natural England (2015)
1	Lynn and Inner Dowsing	0	0	0	0	Unknown	Unknown	Unknown	Royal HaskoningDHV (2016), from Natural England (2013)
1	Race Bank	1.86	23.9	5.59	31.35	Band (2000)	1	0.989	Royal HaskoningDHV (2016), from Natural England (2015). Calculated for 206 turbines.

Tier	OWF	Predicted Kittiwake Collisions				Model Parameters			Source and Notes
		Breeding	Autumn	Spring	Annual	Iteration	Option	Avoidance Rate	
		(0.8)	***(10)***	***(2.3)***	***(13.1)***	Band (2012)	1	0.989	Recalculated for as-built layout of 91 turbines (Macarthur Green and Royal HaskoningDHV, 2019).
1	Rampion	54.4	37.4	29.7	121	Band (2012) – draft 2011 version	1	0.989	Royal HaskoningDHV (2016). Calculated for 175 turbines.
		(28.8)	***(19.8)***	***(15.7)***	***(64.1)***	Band (2012)	1	0.989	Recalculated for as-built layout of 116 turbines (Macarthur Green and Royal HaskoningDHV, 2019).
1	Scroby Sands	0	0	0	0	Unknown	Unknown	Unknown	Royal HaskoningDHV (2016), from Natural England (2013)
1	Sheringham Shoal	0	0	0	0	Unknown	Unknown	Unknown	Royal HaskoningDHV (2016), from Natural England (2013)
1	Teesside	38.4	24.0	2.5	64.9	Band (2000)	1	0.989	Macarthur Green (2020b)
1	Thanet	0.2	0.5	0.4	1.2	Band (2000)	1	0.989	Royal HaskoningDHV (2016), from Natural England (2015)
1	Westermost Rough	0.18	0.22	0.13	0.53	Band et al. (2007)	1	0.989	Royal HaskoningDHV (2016), from Natural England (2015)
2	Forth (SeaGreen) Alpha and Bravo	153.2	313.5	247.8	714.5	Band (2012)	1	0.989	Royal HaskoningDHV (2016), from Natural England (2015)
		(165)	***(148)***	***(82)***	***(394)***	Band (2012)	2	0.989	Based on a revised layout (Seagreen, 2018).

Tier	OWF	Predicted Kittiwake Collisions				Model Parameters			Source and Notes
		Breeding	Autumn	Spring	Annual	Iteration	Option	Avoidance Rate	
2	Hornsea Project Two	16	9	3	28	Band (2012)	1	0.989	Smart Wind (2015b)
2	Kincardine	22	9	1	31	Band (2012)	1	0.989	Macarthur Green (2020b)
2	Moray Firth East	43.6	2.0	19.3	64.9	Band (2012)	1	0.989	Macarthur Green (2020b)
2	Neart na Gaoithe	32.9	56.1	4.4	93.4	Band (2012)	2	0.989	Macarthur Green (2020b)
		(9)	***(17)***	***(2)***	***(28)***	Band (2012)	2	0.989	GoBe Consultants (2018), based on a revised layout.
2	Triton Knoll	24.6	139	45.4	209	Band (2012)	1	0.989	Royal HaskoningDHV (2016), from Smart Wind (2015a). This was calculated for 288 turbines.
		(6.8)	***(38.5)***	***(12.6)***	***(57.9)***	Band (2012)	1	0.989	Macarthur Green and Royal HaskoningDHV (2019). Calculated for 90 turbines (as-built layout).
3	Dogger Bank Creyke Beck Projects A and B	288.6	135.0	295.4	719.0	Band (2012)	Unknown	0.989	Macarthur Green (2020b)

Tier	OWF	Predicted Kittiwake Collisions				Model Parameters			Source and Notes
		Breeding	Autumn	Spring	Annual	Iteration	Option	Avoidance Rate	
3	Dogger Bank C (formerly Teesside A) and Sofia (formerly Teesside B)	136.9	90.7	216.9	444.5	Band (2012)	2	0.989	Macarthur Green (2020b)
3	East Anglia THREE	6.1	68.4	37.2	111.6	Band (2012)	1	0.989	Macarthur Green (2019b)
3	Hornsea Project Three	187.5	94.6	15.0	297.1	Unknown	Unknown	Unknown	Macarthur Green (2020b)
3	Inch Cape	13.1	224.8	63.5	301.4	Unknown	Unknown	Unknown	Macarthur Green (2020b)
		(40)	***(26)***	***(6)***	***(72)***	Band (2012)	2	0.989	Inch Cape Offshore (2018), based on a revised layout.
3	Methil	0.6	0	0	0.6	Unknown	Unknown	Unknown	Macarthur Green (2020b)
3	Moray Firth West	79	24	7	110	Unknown	Unknown	Unknown	Macarthur Green (2019a)
3	Norfolk Vanguard	21.9	16.3	19.3	57.5	Band (2012)	2	0.989	Macarthur Green (2019a). Revised project design post DCO examination with two turbine scenarios and draft height of 30-35m above Mean High Water Springs.

Tier	OWF	Predicted Kittiwake Collisions				Model Parameters			Source and Notes
		Breeding	Autumn	Spring	Annual	Iteration	Option	Avoidance Rate	
4	East Anglia TWO	16.8	7.9	17.7	42.3	Band (2012)	2	0.989	Macarthur Green and Royal HaskoningDHV (2021)
4	East Anglia ONE North	33.7	8.1	10.2	52.0	Band (2012)	2	0.989	Macarthur Green and Royal HaskoningDHV (2021)
4	Norfolk Boreas	13.3	32.3	11.9	57.5	Band (2012)	2	0.989	Macarthur Green (2020b)
5	Hornsea Project Four	153.3	34.7	9.9	197.9	McGregor et al. (2018)	2	0.989	APEM (2019a). Stochastic CRM based on SNCB-approved parameters.
5	DEP	17.24	8.55	2.2	27.99	Band (2012)	2	0.989	This PEIR, mean for 14MW scenario.
5	SEP	0.89	1.91	0	2.80	Band (2012)	2	0.989	This PEIR, mean for 14MW scenario.
TOTALS FOR CIA		1,584	1,491	1,343	4,419	TOTALS FOR CIA are the numbers used in the CIA, ***THEORETICAL TOTALS*** show the reductions if as-built / as planned (but not consented) numbers are used			

13.2.3.3 Great Black-backed Gull

Table 13.2-8: Cumulative collision risk for great black-backed gull.

Tier	OWF	Predicted Great Black-backed Gull Collisions			Model Parameters			Source and Notes
		Breeding	Non breeding	Annual	Iteration	Option	Avoidance Rate	
1	Aberdeen (EOWDC)	0.6	2.4	1.0	Band (2012)	2	0.995	Macarthur Green (2020b)

Tier	OWF	Predicted Great Black-backed Gull Collisions			Model Parameters			Source and Notes
		Breeding	Non breeding	Annual	Iteration	Option	Avoidance Rate	
1	Beatrice Demonstrator	0	0	0	N/A	N/A	N/A	Royal HaskoningDHV (2016)
1	Beatrice	30.2	120.8	151	Band et al. (2007)	1	0.995	Arcus Consultancy Services (2013), calculated for 140 turbines.
		(26.1)	***(104.5)***	***(130.6)***	Band (2012)	1	0.995	Recalculated for as-built layout of 84 turbines (Macarthur Green and Royal HaskoningDHV, 2019).
1	Blyth Demonstration	1.3	5.1	6.3	Band et al. (2007)	1	0.995	Royal HaskoningDHV (2016)
1	Dudgeon	0	0	0	N/A	N/A	N/A	Royal HaskoningDHV (2016)
1	East Anglia ONE	0	46	46.0	Band (2012)	1	0.995	Macarthur Green (2020b)
1	Galloper	4.5	18	22.5	Band et al. (2007)	1	0.995	Royal HaskoningDHV (2016), calculated for 140 turbines.
		(1.8)	***(7.2)***	***(9.0)***	Band (2012)	1	0.995	Recalculated for as-built layout of 56 turbines (Macarthur Green and Royal HaskoningDHV, 2019).
1	Greater Gabbard	15.0	60.0	75.0	Band (2000)	1	0.9982	Royal HaskoningDHV (2016), from Banks et al., (2006)

Tier	OWF	Predicted Great Black-backed Gull Collisions			Model Parameters			Source and Notes
		Breeding	Non breeding	Annual	Iteration	Option	Avoidance Rate	
		(13.4)	***(53.5)***	***(66.9)***	Band (2012)	1	0.995	Recalculated for change in rotor radius of as-built turbines (Macarthur Green and Royal HaskoningDHV, 2019).
1	Gunfleet Sands	0	0	0	Unknown	Unknown	Unknown	Royal HaskoningDHV (2016), from Smart Wind (2014)
1	Hornsea Project One	17.2	68.6	85.8	Band (2012)	1	0.995	Royal HaskoningDHV (2016) This was calculated for 332 turbines.
		(9.3)	***(37.1)***	***(46.4)***	Band (2012)	1	0.995	Recalculated for as-built turbine parameters (Macarthur Green and Royal HaskoningDHV, 2019).
1	Humber Gateway	1.3	5.1	6.3	Unknown	1	0.995	Royal HaskoningDHV (2016), from Smart Wind (2014)
		(0.6)	***(2.3)***	***(2.9)***	Band (2012)	1	0.995	Recalculated for as-built turbine parameters (Macarthur Green and Royal HaskoningDHV, 2019).
1	Hywind	0.3	4.5	4.8	Band (2012)	1	0.995	Statoil (2014)
1	Kentish Flats and extension	0.1	0.2	0.3	Unknown	Unknown	Unknown	Royal HaskoningDHV (2016), from Smart Wind (2014)
1	Lincs	0	0	0	Unknown	Unknown	Unknown	Royal HaskoningDHV (2016), from Smart Wind (2014)
1	London Array	0	0	0	Unknown	Unknown	Unknown	Royal HaskoningDHV (2016), from Smart Wind (2014)

Tier	OWF	Predicted Great Black-backed Gull Collisions			Model Parameters			Source and Notes
		Breeding	Non breeding	Annual	Iteration	Option	Avoidance Rate	
1	Lynn and Inner Dowsing	0	0	0	Unknown	Unknown	Unknown	Royal HaskoningDHV (2016)
1	Race Bank	0	0	0	N/A	N/A	N/A	Royal HaskoningDHV (2016)
1	Rampion	5.2	20.8	26.0	Band (2012) – draft 2011 version	1	0.995	Royal HaskoningDHV (2016). Calculated for 175 turbines.
		(3.3)	***(13.4)***	***(16.7)***	Band (2012)	1	0.995	Recalculated based on as-built layout of 116 turbines (Macarthur Green and Royal HaskoningDHV, 2019).
1	Scroby Sands	0	0	0	Unknown	Unknown	Unknown	Royal HaskoningDHV (2016)
1	Sheringham Shoal	0	0	0	Unknown	Unknown	Unknown	Royal HaskoningDHV (2016)
1	Teesside	8.7	34.8	43.6	Band (2000)	1	0.995	Royal HaskoningDHV (2016), from Smart Wind (2015c).
		(5.5)	***(22.0)***	***(27.6)***	Band (2012)	1	0.995	Recalculated for as-built layout (Macarthur Green and Royal HaskoningDHV, 2019).
1	Thanet	0.1	0.4	0.5	Band (2000)	1	0.995	Royal HaskoningDHV (2016), from Smart Wind (2014)

Tier	OWF	Predicted Great Black-backed Gull Collisions			Model Parameters			Source and Notes
		Breeding	Non breeding	Annual	Iteration	Option	Avoidance Rate	
1	Westermost Rough	0	0	0.1	Band et al. (2007)	1	0.995	Royal HaskoningDHV (2016), from Smart Wind (2014)
2	Forth (SeaGreen) Alpha and Bravo	13.4	53.4	66.8	Band (2012)	1	0.995	Royal HaskoningDHV (2016)
2	Hornsea Project Two	3	20	23	Band (2012)	1	0.995	Royal HaskoningDHV (2016)
2	Kincardine	0	0	0	N/A	N/A	N/A	Atkins (2016)
2	Moray Firth East	9.5	25.5	35.0	Band (2012)	1	0.995	Royal HaskoningDHV (2016), from Smart Wind (2014)
2	Neart na Gaoithe	0.9	3.6	4.5	Band (2012)	2	0.995	Macarthur Green (2020b)
		(0)	***(3)***	***(3)***	Band (2012)	2	0.995	GoBe Consultants (2018), calculated for a revised layout.
2	Triton Knoll	24.4	97.6	122.0	Band (2012)	1	0.995	Royal HaskoningDHV (2016). Calculated for 288 turbines.
		(8.0)	***(32.1)***	***(40.1)***	Band (2012)	1	0.995	Recalculated for as-built layout of 90 turbines (Macarthur Green and Royal HaskoningDHV, 2019).
3	Dogger Bank Creyke Beck Projects A and B	5.8	23.3	29.1	Band (2012)	1	0.995	Macarthur Green (2020b)

Tier	OWF	Predicted Great Black-backed Gull Collisions			Model Parameters			Source and Notes
		Breeding	Non breeding	Annual	Iteration	Option	Avoidance Rate	
3	Dogger Bank C (formerly Teesside A) and Sofia (formerly Teesside B)	6.4	25.5	31.9	Band (2012)	2	0.995	Macarthur Green (2020b)
3	East Anglia THREE	4.6	34.4	39	Band (2012)	1	0.995	Macarthur Green (2020b)
3	Hornsea Project Three	19.4	46.6	66	Band (2012)	2	0.995	Macarthur Green (2020b)
3	Inch Cape	0	36.8	36.8	Band (2012)	1	0.995	Royal HaskoningDHV (2016)
3	Methil	0.8	0.8	1.6	Unknown	Unknown	Unknown	Macarthur Green (2020b)
3	Moray Firth West	4	5	9	Band (2012)	2	0.995	Moray Offshore Windfarm (West) (2018)
3	Norfolk Vanguard	4.5	21.5	26	Band (2012)	2	0.995	(MacArthur Green 2020b). Revised project design with two turbine scenarios and draft height of 30-35m above Mean High Water Springs.
4	East Anglia TWO	3.5	3.4	6.9	Band (2012)	2	0.995	Macarthur Green and Royal HaskoningDHV (2021)
4	East Anglia ONE North	3.7	1.2	5.0	Band (2012)	2	0.995	Macarthur Green and Royal HaskoningDHV (2021)

Tier	OWF	Predicted Great Black-backed Gull Collisions			Model Parameters			Source and Notes
		Breeding	Non breeding	Annual	Iteration	Option	Avoidance Rate	
4	Norfolk Boreas	6.9	28.7	35.6	Band (2012)	2	0.995	Macarthur Green (2020b)
5	Hornsea Project Four	3.0	13.6	16.6	McGregor et al. (2018)	2	0.995	APEM (2019a). Stochastic CRM based on SNCB-approved parameters.
5	DEP	0.3	1.57	1.87	Band (2012)	2	0.995	This PEIR, mean for 14MW scenario.
5	SEP	0	5.25	5.25	Band (2012)	2	0.995	This PEIR, mean for 14MW scenario.
TOTALS FOR CIA		199	834	1,033	TOTALS FOR CIA are the numbers used in the CIA, ***THEORETICAL TOTALS*** show the reductions if as-built / as planned (but not consented) numbers are used			
THEORETICAL TOTALS		**160**	**684**	**844**				

13.2.3.4 Lesser Black-backed Gull

Table 13.2-9: Cumulative collision risk for lesser black-backed gull.

Tier	OWF	Predicted Lesser Black-backed Gull Collisions			Model Parameters			Source and Notes
		Breeding	Non breeding	Annual	Iteration	Option	Avoidance Rate	
1	Aberdeen (EOWDC)	0	0	0	Band (2012)	2	0.995	Macarthur Green (2020b)
1	Beatrice Demonstrator	0	0	0	N/A	N/A	N/A	Royal HaskoningDHV (2016)

Tier	OWF	Predicted Lesser Black-backed Gull Collisions			Model Parameters			Source and Notes
		Breeding	Non breeding	Annual	Iteration	Option	Avoidance Rate	
1	Beatrice	0	0	0	Band (2012)	1	0.995	Macarthur Green (2020b)
1	Blyth Demonstration	0	0	0	Band et al. (2007)	1	0.995	Royal HaskoningDHV (2016)
1	Dudgeon	7.7	30.6	38.3	N/A	N/A	N/A	Royal HaskoningDHV (2016)
1	East Anglia ONE	5.9	33.8	39.7	Band (2012)	1	0.995	Macarthur Green (2020b)
1	Galloper	27.8	111	138.8	Band et al. (2007)	1	0.995	Royal HaskoningDHV (2016), calculated for 140 turbines.
		(10.5)	***(41.7)***	***(52.2)***	Band (2012)	1	0.995	Recalculated for as-built layout of 56 turbines (Macarthur Green and Royal HaskoningDHV, 2019).
1	Greater Gabbard	12.4	49.6	62.0	Band (2000)	1	0.9982	Royal HaskoningDHV (2016), from Banks et al., (2006)
		(10.5)	***(41.8)***	***(52.3)***	Band (2012)	1	0.995	Recalculated for change in rotor radius of as-built turbines (Macarthur Green and Royal HaskoningDHV, 2019).
1	Gunfleet Sands	1	0.3	1.3	Unknown	Unknown	Unknown	Royal HaskoningDHV (2016)
1	Hornsea Project One	4.4	17.4	21.8	Band (2012)	1	0.995	Royal HaskoningDHV (2016) This was calculated for 332 turbines.

Tier	OWF	Predicted Lesser Black-backed Gull Collisions			Model Parameters			Source and Notes
		Breeding	Non breeding	Annual	Iteration	Option	Avoidance Rate	
		(2.3)	***(8.9)***	***(11.2)***	Band (2012)	1	0.995	Recalculated for as-built turbine parameters (Macarthur Green and Royal HaskoningDHV, 2019).
1	Humber Gateway	0.3	1.1	1.4	Unknown	1	0.995	Royal HaskoningDHV (2016), from Smart Wind (2014)
		(0.1)	***(0.5)***	***(0.6)***	Band (2012)	1	0.995	Recalculated for as-built turbine parameters (Macarthur Green and Royal HaskoningDHV, 2019).
1	Hywind	0	0	0	Band (2012)	1	0.995	Statoil (2014)
1	Kentish Flats and extension	0.3	1.3	1.6	Unknown	Unknown	Unknown	Royal HaskoningDHV (2016), from Smart Wind (2014)
1	Lincs	1.7	6.8	8.5	Unknown	Unknown	Unknown	Royal HaskoningDHV (2016), from Smart Wind (2014)
1	London Array	0	0	0	Unknown	Unknown	Unknown	Royal HaskoningDHV (2016), from Smart Wind (2014)
1	Lynn and Inner Dowsing	0	0	0	Unknown	Unknown	Unknown	Royal HaskoningDHV (2016)
1	Methil	0.5	0	0.5	Unknown	Unknown	Unknown	Macarthur Green (2020b)
1	Race Bank	42.3	10.8	54.0	N/A	N/A	N/A	Royal HaskoningDHV (2016)

Tier	OWF	Predicted Lesser Black-backed Gull Collisions			Model Parameters			Source and Notes
		Breeding	Non breeding	Annual	Iteration	Option	Avoidance Rate	
1	Rampion	1.6	6.3	7.9	Band (2012) – draft 2011 version	1	0.995	Royal HaskoningDHV (2016). Calculated for 175 turbines.
		(1.0)	***(3.8)***	***(4.8)***	Band (2012)	1	0.995	Recalculated based on as-built layout of 116 turbines (Macarthur Green and Royal HaskoningDHV, 2019).
1	Scroby Sands	0	0	0	Unknown	Unknown	Unknown	Royal HaskoningDHV (2016)
1	Sheringham Shoal	1.7	6.6	8.3	Unknown	Unknown	Unknown	Royal HaskoningDHV (2016)
1	Teesside	0	0	0	Band (2000)	1	0.995	Royal HaskoningDHV (2016), from Smart Wind (2015c)
1	Thanet	3.2	12.8	16.0	Band (2000)	1	0.995	Royal HaskoningDHV (2016), from Smart Wind (2014)
1	Westermost Rough	0.1	0.3	0.4	Band et al. (2007)	1	0.995	Royal HaskoningDHV (2016), from Smart Wind (2014)
2	Forth (SeaGreen) Alpha and Bravo	2.1	8.4	10.5	Band (2012)	1	0.995	Macarthur Green (2020b)
2	Hornsea Project Two	2.0	2.0	4.0	Band (2012)	1	0.995	Royal HaskoningDHV (2016)
2	Kincardine	0	0	0	Unknown	Unknown	Unknown	Atkins (2016)

Tier	OWF	Predicted Lesser Black-backed Gull Collisions			Model Parameters			Source and Notes
		Breeding	Non breeding	Annual	Iteration	Option	Avoidance Rate	
2	Moray Firth East	0	0	0	Band (2012)	1	0.995	Royal HaskoningDHV (2016), from Smart Wind (2014)
2	Neart na Gaoithe	0.3	1.2	1.5	Band (2012)	2	0.995	Royal HaskoningDHV (2016), from Smart Wind (2014)
2	Triton Knoll	7.4	29.6	37.0	Band (2012)	1	0.995	Royal HaskoningDHV (2016). Calculated for 288 turbines.
		(2.3)	***(9.3)***	***(11.6)***	Band (2012)	1	0.995	Recalculated for as-built layout of 90 turbines (Macarthur Green and Royal HaskoningDHV, 2019).
3	Dogger Bank Creyke Beck Projects A and B	2.6	10.4	13.0	Band (2012)	1	0.995	Macarthur Green (2020b)
3	Dogger Bank C (formerly Teesside A) and Sofia (formerly Teesside B)	2.4	9.6	12.0	Band (2012)	2	0.995	Macarthur Green (2020b)
3	East Anglia THREE	1.8	8.2	10.0	Band (2012)	1	0.995	Macarthur Green (2020b)
3	Hornsea Project Three	17.3	0	17.3	Band (2012)	2	0.995	Macarthur Green (2020b)

Tier	OWF	Predicted Lesser Black-backed Gull Collisions			Model Parameters			Source and Notes
		Breeding	Non breeding	Annual	Iteration	Option	Avoidance Rate	
3	Inch Cape	0	0	0	Band (2012)	1	0.995	Royal HaskoningDHV (2016)
3	Moray Firth West	0	0	0	Band (2012)	2	0.995	Moray Offshore Windfarm (West) (2018)
3	Norfolk Vanguard	8.4	3.6	12.0	Band (2012)	2	0.995	(MacArthur Green 2020b). Revised project design with two turbine scenarios and draft height of 30-35m above Mean High Water Springs.
4	East Anglia TWO	4.2	0.5	4.7	Band (2012)	2	0.995	Macarthur Green and Royal HaskoningDHV (2021)
4	East Anglia ONE North	0.9	0.6	1.5	Band (2012)	2	0.995	Macarthur Green and Royal HaskoningDHV (2021)
4	Norfolk Boreas	6.2	8.1	14.3	Band (2012)	2	0.995	Macarthur Green (2020b)
5	Hornsea Project Four	1.9	0	1.9	McGregor et al. (2018)	2	0.995	APEM (2019a). Stochastic CRM based on SNCB-approved parameters.
5	DEP	0	0.28	0.28	Band (2012)	2	0.995	This PEIR, mean for 14MW scenario.
5	SEP	0	0	0	Band (2012)	2	0.995	This PEIR, mean for 14MW scenario.
TOTALS FOR CIA		168	371	540	TOTALS FOR CIA are the numbers used in the CIA, ***THEORETICAL TOTALS*** show the reductions if as-built / as planned (but not consented) numbers are used			
THEORETICAL TOTALS		**142**	**263**	**405**				

13.2.3.5 Sandwich Tern

Table 13.2-10: Annual cumulative collision risk for Sandwich tern, using mean flight height distribution data (Johnston et al. 2014).

Tier	OWF	Option	Consented OWF Design			As-built OWF Design		
			0.980 A.R.	0.9883 A.R.	0.993 A.R.	0.980 A.R.	0.9883 A.R.	0.993 A.R.
1	Dudgeon	2	16.6	9.7	5.8	5.7	3.3	2.0
1	Race Bank	2	42.2	24.7	14.8	11.1	6.5	3.9
1	Sheringham Shoal	2	9.9	5.8	3.5	5.1	3.0	1.8
2	Triton Knoll	2	9.1	5.3	3.2	1.3	0.8	0.4
5	DEP (14MW)	2	9.5	5.6	3.3	9.5	5.6	3.3
5	SEP (14MW)	2	2.0	1.2	0.7	2.0	1.2	0.7
TOTALS (Excl. DEP and SEP)			77.8	45.5	27.3	23.2	13.6	8.1
TOTALS (Inc. DEP and SEP)			89.3	52.3	31.3	34.7	20.4	12.1

Table 13.2-11: Annual cumulative collision risk for Sandwich tern, using upper 95% confidence interval flight height distribution data (Johnston et al. 2014).

Tier	OWF	Option	Consented OWF Design			As-built OWF Design		
			0.980 A.R.	0.9883 A.R.	0.993 A.R.	0.980 A.R.	0.9883 A.R.	0.993 A.R.
1	Dudgeon	2	34.8	20.4	12.2	14.9	8.7	5.2
1	Race Bank	2	72.8	42.6	25.5	30.3	17.8	10.6
1	Sheringham Shoal	2	16.6	9.7	5.8	13.4	7.8	4.7
2	Triton Knoll	2	19.1	11.2	6.7	3.4	2.0	1.0

Tier	OWF	Option	Consented OWF Design			As-built OWF Design		
			0.980 A.R.	0.9883 A.R.	0.993 A.R.	0.980 A.R.	0.9883 A.R.	0.993 A.R.
5	DEP (14MW)	2	24.8	14.5	8.7	24.8	14.5	8.7
5	SEP (14MW)	2	5.3	3.1	1.8	5.3	3.1	1.8
TOTALS (Excl. DEP and SEP)			143.3	83.9	50.2	62	36.3	21.5
TOTALS (Inc. DEP and SEP)			173.4	101.5	60.7	92.1	53.9	32.0

13.2.4 Cumulative Displacement Risk

31. In the Tables below, an entry of 'no data' under the column 'source of information and notes' indicates that no information was available on the number of birds of a particular species at risk of displacement in the assessment documentation for a given project. This is the case only for some of the earliest consented OWFs.

13.2.4.1 Gannet

Table 13.2-12: Cumulative number of gannets at risk of displacement.

Tier	OWF	Buffer (km)	Gannets at Risk of Displacement				Source and Notes
			Spring	Breeding	Autumn	Annual	
1	Aberdeen (EOWDC)	2	0	35	5	40	Macarthur Green (2019a)
1	Beatrice Demonstrator	No data	No data	No data	No data	No data	No data
1	Blyth Demonstrator	N/A	0	0	0	0	Macarthur Green (2019a)
1	Dudgeon	1	11	53	25	89	Macarthur Green (2019a)

Tier	OWF	Buffer (km)	Gannets at Risk of Displacement				Source and Notes
			Spring	Breeding	Autumn	Annual	
1	East Anglia ONE	4	76	161	3638	3875	Macarthur Green (2019a)
1	Galloper	4	276	360	907	1543	Macarthur Green (2019a)
1	Greater Gabbard	0	105	252	69	426	Macarthur Green (2019a)
1	Gunfleet Sands	N/A	9	0	12	21	Macarthur Green (2019a)
1	Hornsea Project One	4	250	671	694	1615	Macarthur Green (2019a)
1	Humber Gateway	No data	No data	No data	No data	No data	No data
1	Hywind	1	4	10	0	14	Macarthur Green (2019a)
1	Kentish Flats	No data	No data	No data	No data	No data	No data
1	Kentish Flats ext.	2	0	0	13	13	Macarthur Green (2019a)
1	London Array	No data	No data	No data	No data	No data	No data
1	Lynn and Inner Dowsing & Lincs	No data	No data	No data	No data	No data	No data
1	Race Bank	1	29	92	32	153	Macarthur Green (2019a)
1	Rampion	N/A	0	0	590	590	Macarthur Green (2019a)
1	Scroby Sands	No data	No data	No data	No data	No data	No data
1	Sheringham Shoal	N/A	2	47	31	80	Macarthur Green (2019a)
1	Teeside	N/A	0	1	0	1	Macarthur Green (2019a)
1	Thanet	No data	No data	No data	No data	No data	No data
1	Westermost Rough	No data	No data	No data	No data	No data	No data

Tier	OWF	Buffer (km)	Gannets at Risk of Displacement				Source and Notes
			Spring	Breeding	Autumn	Annual	
2	Beatrice	0.5	0	151	0	151	Macarthur Green (2019a)
2	Forth (Seagreen) Alpha and Bravo	0	332.0	2956.0	664.0	3952.0	Macarthur Green (2019a)
2	Hornsea Project Two	4	124	457	1140	1721	Macarthur Green (2019a)
2	Kincardine	1	0	120	0	120	Macarthur Green (2019a)
2	Moray Firth East	4	27	564	292	883	Macarthur Green (2019a)
2	Neart na Gaoithe	2	281	1987	552	2820	Macarthur Green (2019a)
3	Methil	2	0	23	0	23	Macarthur Green (2019c)
2	Triton Knoll	1	24	211	15	250	Macarthur Green (2019a)
3	Dogger Bank Creyke Beck Projects A and B	2	394	1155	2048	3597	Macarthur Green (2019a)
3	Dogger Bank C (formerly Teesside A) and Sofia (formerly Teesside B)	2	464	2250	887	3601	Macarthur Green (2019a)
3	East Anglia THREE	4	524	412	1269	2205	Macarthur Green (2019a)
3	Hornsea Project Three	4	1099	1203	1494	3796	Macarthur Green (2019a)
3	Inch Cape	4	212	2398	703	3313	Macarthur Green (2019a)
3	Moray Firth West	4	144	2827	439	3410	Macarthur Green (2019a)
3	Norfolk Vanguard	2	437	271	2453	3161	Macarthur Green (2019a)
4	East Anglia TWO	2	192	192	891	1275	Royal HaskoningDHV (2019b)
4	East Anglia ONE North	2	44	149	468	661	Royal HaskoningDHV (2019c)
4	Norfolk Boreas	2	526	1229	1723	3478	Royal HaskoningDHV (2018b)
5	Hornsea Project Four	2	584	1577	1013	2136	APEM (2019a)
5	DEP	2	47	361	343	751	This PEIR

Tier	OWF	Buffer (km)	Gannets at Risk of Displacement				Source and Notes
			Spring	Breeding	Autumn	Annual	
5	SEP	2	0	40	295	335	This PEIR
TOTALS FOR CIA			6217	22215	22705	51137	

13.2.4.2 Guillemot

Table 13.2-13: Cumulative number of guillemots at risk of displacement (based on a 2km buffer).

Tier	OWF	Guillemots at Risk of Displacement		Source and Notes
		Breeding	Non-breeding	
1	Aberdeen (EOWDC)	547	225	Macarthur Green (2019c)
1	Beatrice Demonstrator	-	-	No data
1	Blyth Demonstration	1220	1321	Macarthur Green (2019c)
1	Dudgeon	334	542	Macarthur Green (2019c)
1	East Anglia ONE	274	640	Macarthur Green (2019c)
1	Galloper	305	593	Macarthur Green (2019c)
1	Greater Gabbard	345	548	Macarthur Green (2019c)
1	Gunfleet Sands	0	363	Macarthur Green (2019c)
1	Hornsea Project One	9836	8097	Macarthur Green (2019c)
1	Humber Gateway	99	138	Macarthur Green (2019c)
1	Hywind	249	2136	Macarthur Green (2019c)
1	Kentish Flats and extension	0	7	Macarthur Green (2019c)
1	London Array	192	377	Macarthur Green (2019c)

Tier	OWF	Guillemots at Risk of Displacement		Source and Notes
		Breeding	Non-breeding	
1	Lynn and Inner Dowsing & Lincs	582	814	Macarthur Green (2019c)
1	Race Bank	361	708	Macarthur Green (2019c)
1	Rampion	10887	15536	Macarthur Green (2019c)
1	Scroby Sands	-	-	No data
1	Sheringham Shoal	390	715	Macarthur Green (2019c)
1	Teeside	267	901	Macarthur Green (2019c)
1	Thanet	18	124	Macarthur Green (2019c)
1	Westermost Rough	347	486	Macarthur Green (2019c)
1	Beatrice	13610	2755	Macarthur Green (2019c)
2	Forth (Seagreen) Alpha and Bravo	24724	8800	Macarthur Green (2019c)
2	Hornsea Project Two	7735	13164	Macarthur Green (2019c)
2	Kincardine	632	0	Macarthur Green (2019c)
2	Moray Firth East	9820	547	Macarthur Green (2019c)
2	Neart na Gaoithe	1755	3761	Macarthur Green (2019c)
2	Triton Knoll	425	746	Macarthur Green (2019c)
3	Dogger Bank Creyke Beck Projects A and B	14886	16763	Macarthur Green (2019c)
3	Dogger Bank C (formerly Teesside A) and Sofia (formerly Teesside B)	8494	5969	Macarthur Green (2019c)

Tier	OWF	Guillemots at Risk of Displacement		Source and Notes
		Breeding	Non-breeding	
3	East Anglia THREE	1744	2859	Macarthur Green (2019c)
3	Hornsea Project Three	13374	19174	Macarthur Green (2019c)
3	Inch Cape	8184	3912	Macarthur Green (2019c)
3	Methil	25	0	Macarthur Green (2019c)
3	Moray Firth West	24426	38174	Macarthur Green (2019c)
3	Norfolk Vanguard	4320	4776	Macarthur Green (2019c)
4	East Anglia TWO	2077	1675	Royal HaskoningDHV (2019b)
4	East Anglia ONE North	4183	1888	Royal HaskoningDHV (2019c)
4	Norfolk Boreas	7767	13777	Royal HaskoningDHV (2018b)
5	Hornsea Project Four	9804	58920	APEM (2019b)
5	DEP	8061	2977	This PEIR
5	SEP	610	599	This PEIR
TOTALS FOR CIA		187814	240602	

13.2.4.3 Razorbill

Table 13.2-14: Cumulative number of razorbills at risk of displacement (based on a 2km buffer).

Tier	OWF	Razorbills at Risk of Displacement				Source and Notes
		Breeding	Autumn	Winter	Spring	
1	Aberdeen (EOWDC)	161	64.4	7.3	25.7	Macarthur Green (2019c)
1	Beatrice Demonstrator	-	-	-	-	No data

Tier	OWF	Razorbills at Risk of Displacement				Source and Notes
		Breeding	Autumn	Winter	Spring	
1	Beatrice	873	833	555.3	833	Macarthur Green (2019c)
1	Blyth Demonstration	121	90.9	60.6	90.9	Macarthur Green (2019c)
1	Dudgeon	256	346.1	745.4	346.1	Macarthur Green (2019c)
1	East Anglia ONE	16	26	154.5	336	Macarthur Green (2019c)
1	Galloper	44	43	105.5	394	Macarthur Green (2019c)
1	Greater Gabbard	0	0	387.3	83.8	Macarthur Green (2019c)
1	Gunfleet Sands	0	0	0	0	Macarthur Green (2019c)
1	Hornsea Project One	1109	4812.3	1517.5	1802.8	Macarthur Green (2019c)
1	Humber Gateway	27	20	13.4	20	Macarthur Green (2019c)
1	Hywind	30	719	10	0	Macarthur Green (2019c)
1	Kentish Flats and extension	-	-	-	-	No data
1	London Array	14	20.4	13.6	20.4	Macarthur Green (2019c)
1	Lynn and Inner Dowsing & Lincs	45	33.5	22.3	33.5	Macarthur Green (2019c)
1	Race Bank	28	42	28	42	Macarthur Green (2019c)
1	Rampion	630	66	1244	3327	Macarthur Green (2019c)
1	Scroby Sands	-	-	-	-	No data
1	Sheringham Shoal	106	1343	211.3	30.2	Macarthur Green (2019c)
1	Teesside	16	61.5	1.9	20	Macarthur Green (2019c)
1	Thanet	3	0	13.6	20.9	Macarthur Green (2019c)
1	Westermost Rough	91	121.3	151.6	90.9	Macarthur Green (2019c)

Tier	OWF	Razorbills at Risk of Displacement				Source and Notes
		Breeding	Autumn	Winter	Spring	
2	Forth (Seagreen) Alpha and Bravo	9574	890.6	593.8	890.6	Macarthur Green (2019c). Non-breeding season total of 2375 divided equally by month according to BDMPS seasons (Furness, 2015).
2	Hornsea Project Two	2511	4220.5	719.5	1668	Macarthur Green (2019c)
2	Kincardine	22	0	0	0	Macarthur Green (2019c)
2	Moray Firth East	2423	1102.6	30.2	168.3	Macarthur Green (2019c)
2	Neart na Gaoithe	331	5492	508	-	Macarthur Green (2019c)
2	Triton Knoll	40	253.7	854.5	116.7	Macarthur Green (2019c)
3	Dogger Bank Creyke Beck Projects A and B	2788	3673	3871	9268	Macarthur Green (2019c)
3	Dogger Bank C (formerly Teesside A) and Sofia (formerly Teesside B)	1987	902	2385	4872	Macarthur Green (2019c)
3	East Anglia THREE	1807	1122	1499	1524	Macarthur Green (2019c)
3	Hornsea Project Three	630	2020	3649	1236	Macarthur Green (2019c)
3	Inch Cape	1436	2870	651	-	Macarthur Green (2019c)
3	Methil	4	0	0	0	Macarthur Green (2019c)
3	Moray Firth West	2808	3544	184	3585	Macarthur Green (2019c)
3	Norfolk Vanguard	879	866	839	924	Macarthur Green (2019c)
4	East Anglia TWO	280.9	44.1	136.4	229.9	Royal HaskoningDHV (2019b)
4	East Anglia ONE North	403	85	54	207	Royal HaskoningDHV (2019c)

Tier	OWF	Razorbills at Risk of Displacement				Source and Notes
		Breeding	Autumn	Winter	Spring	
4	Norfolk Boreas	345	630	263	1065	Royal HaskoningDHV (2018b)
5	Hornsea Project Four	508	5428	606	1029	APEM (2019b)
5	DEP	824	3649	576	272	This PEIR
5	SEP	240	646	590	148	This PEIR
TOTALS FOR CIA		33411	46081	23253	34721	

13.2.4.4 Red-throated Diver

13.2.4.4.1 Standard Assessment

Table 13.2-15: Cumulative number of red-throated divers at risk of displacement (based on a 4km buffer), according to quantitative data from other OWF assessments.

Tier	OWF	Red-throated divers at Risk of Mortality (90-100% Displacement, 1-10% Mortality)				Source
		Autumn Mig.	Winter	Spring Mig.	Annual	
1 and 2	All other projects in southern North Sea	N/A	N/A	N/A	6 - 56	Royal HaskoningDHV (2019a)
1	East Anglia ONE	0.4 - 5	1 - 10	1.4 - 15	2.8 - 30	Royal HaskoningDHV (2019a)
3	East Anglia THREE	0.4 - 5	0.2 – 2	2 - 20	2.6 - 27	Royal HaskoningDHV (2019a)
3	Norfolk Vanguard	0.4 - 8	3.2 - 39	3 - 32	6.6 - 79	Royal HaskoningDHV (2019a)
4	Norfolk Boreas	0 - 1	1 - 15	5 - 62	6 – 78	Royal HaskoningDHV (2019a)

Tier	OWF	Red-throated divers at Risk of Mortality (90-100% Displacement, 1-10% Mortality)				Source
		Autumn Mig.	Winter	Spring Mig.	Annual	
4	East Anglia ONE North	0 - 1	1 - 7	3 - 34	4 - 42	Royal HaskoningDHV (2019a)
4	East Anglia TWO	0	0 - 2	2 - 25	3 - 28	Royal HaskoningDHV (2019a)
5	Hornsea Project Four	0	0	0	0	APEM (2019b)
5	DEP	1 - 6	0 - 1	1 - 5	2 - 13	This PEIR
5	SEP	1 - 8	0 - 1	1 - 12	2 - 21	This PEIR
	Totals	3.2 - 34	6.4 - 77	18.4 - 205	28 - 316	

13.2.4.4.2 SeaMAST Data Assessment

Table 13.2-16: Cumulative number of red-throated divers at risk of displacement (based on a 4km buffer), according to Bradbury et al. (2014).

Tier	OWF	% of Reference Population (OWF)	OWF Red-throated Diver Abundance	% of Reference Population (4km Buffer)	4km Buffer Red-throated Diver Abundance	Total Site % Of Reference Population	Total Site Abundance	Notes
1	Aberdeen (EOWDC)	-	-	-	-	-	-	Scottish Territorial Waters - not included
1	Beatrice Demonstrator	-	-	-	-	-	-	Scottish Territorial Waters - not included
1	Beatrice	-	-	-	-	-	-	Scottish Territorial Waters - not included

Tier	OWF	% of Reference Population (OWF)	OWF Red-throated Diver Abundance	% of Reference Population (4km Buffer)	4km Buffer Red-throated Diver Abundance	Total Site % Of Reference Population	Total Site Abundance	Notes
1	Blyth Demonstration	0.000	0.044	0.003	0.534	0.003	0.577	Site consists of three polygons; 4km buffers amalgamated
1	Dudgeon							Beyond extent of viable SeaMAST data - not included
1	East Anglia ONE	0.029	5.752	0.081	16.118	0.109	21.870	4km buffer overlap with East Anglia ONE North; East Anglia ONE buffer prioritised
1	Greater Gabbard & Galloper	0.177	35.404	0.390	77.930	0.567	113.334	4km buffer overlap with East Anglia TWO; Greater Gabbard/Galloper prioritised
1	Gunfleet Sands	0.270	54.038	2.439	487.209	2.709	541.246	-
1	Hornsea Project One	-	-	-	-	-	-	Beyond extent of viable SeaMAST data - not included
1	Humber Gateway	0.000	0.079	0.004	0.744	0.004	0.823	-
1	Hywind	-	-	-	-	-	-	Scottish Territorial Waters - not included
1	Kentish Flats	0.243	48.552	1.721	343.744	1.964	392.296	-

Tier	OWF	% of Reference Population (OWF)	OWF Red-throated Diver Abundance	% of Reference Population (4km Buffer)	4km Buffer Red-throated Diver Abundance	Total Site % Of Reference Population	Total Site Abundance	Notes
1	Lincs, Lynn and Inner Dowsing	0.015	3.075	0.092	18.419	0.108	21.495	-
1	London Array	1.689	337.438	5.832	1165.117	7.521	1502.555	-
1	Methil	-	-	-	-	-	-	Scottish Territorial Waters - not included
1	Race Bank	0.003	0.672	0.014	2.700	0.017	3.372	Northeastern edge of buffer not covered by SeaMAST data
1	Scroby Sands	0.048	9.661	0.400	79.961	0.449	89.622	-
1	Sheringham Shoal	0.000	0.097	0.003	0.588	0.003	0.685	Northern section of OWF and buffer not covered by SeaMAST data
1	Teesside	0.000	0.046	0.004	0.816	0.004	0.863	-
1	Thanet	0.029	5.721	0.174	34.824	0.203	40.545	-
1	Westermost Rough	0.001	0.118	0.004	0.785	0.005	0.903	Northeastern edge of buffer not covered by SeaMAST data
2	Hornsea Project Two	-	-	-	-	-	-	Beyond extent of viable SeaMAST data - not included

Tier	OWF	% of Reference Population (OWF)	OWF Red-throated Diver Abundance	% of Reference Population (4km Buffer)	4km Buffer Red-throated Diver Abundance	Total Site % Of Reference Population	Total Site Abundance	Notes
2	Forth (Seagreen) Alpha and Bravo	-	-	-	-	-	-	Scottish Territorial Waters - not included
2	Kincardine	-	-	-	-	-	-	Scottish Territorial Waters - not included
2	Moray Firth East	-	-	-	-	-	-	Scottish Territorial Waters - not included
2	Neart na Gaoithe	-	-	-	-	-	-	Scottish Territorial Waters - not included
2	Triton Knoll	-	-	-	-	-	-	Beyond extent of viable SeaMAST data - not included
3	Dogger Bank Creyke Beck Projects A and B	-	-	-	-	-	-	Beyond extent of viable SeaMAST data - not included
3	Dogger Bank C (formerly Teesside A) and Sofia (formerly Teesside B)	-	-	-	-	-	-	Beyond extent of viable SeaMAST data - not included

Tier	OWF	% of Reference Population (OWF)	OWF Red-throated Diver Abundance	% of Reference Population (4km Buffer)	4km Buffer Red-throated Diver Abundance	Total Site % Of Reference Population	Total Site Abundance	Notes
3	East Anglia THREE	0.029	5.852	0.066	13.222	0.095	19.074	4km buffer overlap with Norfolk Vanguard East; East Anglia THREE buffer prioritised
3	Hornsea Project Three	-	-	-	-	-	-	Beyond extent of viable SeaMAST data - not included
3	Inch Cape	-	-	-	-	-	-	Scottish Territorial Waters - not included
3	Moray Firth West	-	-	-	-	-	-	Scottish Territorial Waters - not included
3	Norfolk Vanguard	0.047	9.388	0.068	13.514	0.124	24.63	Eastern section of OWF and 4km buffer beyond extent of viable SeaMAST data; 4km buffer overlap with Norfolk Boreas and East Anglia THREE (East Anglia THREE prioritised, Norfolk Vanguard East and Boreas 4km buffer amalgamated)

Tier	OWF	% of Reference Population (OWF)	OWF Red-throated Diver Abundance	% of Reference Population (4km Buffer)	4km Buffer Red-throated Diver Abundance	Total Site % Of Reference Population	Total Site Abundance	Notes
4	Norfolk Boreas	0.015	2.900	0.017	3.455	0.023	4.628	Northern and eastern sections of OWF and 4km buffer beyond extent of viable SeaMAST data; 4km buffer overlap with Norfolk Vanguard East (4km buffers amalgamated)
4	East Anglia ONE North	0.484	96.598	1.053	210.292	1.536	306.890	4km buffer overlap with East Anglia ONE; East Anglia ONE buffer prioritised
4	East Anglia TWO	0.095	18.982	0.358	71.439	0.453	90.421	4km buffer overlap with Greater Gabbard/Galloper; Greater Gabbard/Galloper prioritised
5	Hornsea Project Four	-	-	-	-	-	-	Beyond extent of viable SeaMAST data - not included
5	DEP	-	-	-	-	-	-	Beyond extent of viable SeaMAST data - not included

Tier	OWF	% of Reference Population (OWF)	OWF Red-throated Diver Abundance	% of Reference Population (4km Buffer)	4km Buffer Red-throated Diver Abundance	Total Site % Of Reference Population	Total Site Abundance	Notes
5	SEP	0.000	0.033	0.003	0.576	0.003	0.610	OWF and 4km overlap with Sheringham Shoal OWF. Sheringham Shoal prioritised.
	TOTALS	3.174	634.45	12.726	2541.987	15.9	3176.439	

13.2.4.5 Sandwich Tern

Table 13.2-17: Displacement matrix for Sandwich tern at Dudgeon OWF during the breeding season (April to August), showing the number of birds predicted to die (rounded to the nearest integer) at a given rate of displacement and mortality. Mortality rates used by the assessment are highlighted in red.

Mortality (%)												
Displacement (%)		1	2	3	4	5	10	20	30	50	80	100
	10	0	0	0	0	0	1	1	2	3	5	6
	20	0	0	0	0	1	1	2	3	6	9	12
	30	0	0	1	1	1	2	3	5	9	14	17
	40	0	0	1	1	1	2	5	7	12	18	23
	50	0	1	1	1	1	3	6	9	14	23	29
	60	0	1	1	1	2	3	7	10	17	28	35
	70	0	1	1	2	2	4	8	12	20	32	40
	80	0	1	1	2	2	5	9	14	23	37	46
	90	1	1	2	2	3	5	10	16	26	42	52
	100	1	1	2	2	3	6	12	17	29	46	58

Table 13.2-18: Displacement matrix for Sandwich tern at Race Bank OWF during the breeding season (April to August), showing the number of birds predicted to die (rounded to the nearest integer) at a given rate of displacement and mortality. Mortality rates used by the assessment are highlighted in red.

Mortality (%)												
Displacement (%)		1	2	3	4	5	10	20	30	50	80	100
	10	0	0	0	0	0	1	1	2	3	5	6
	20	0	0	0	0	1	1	2	4	6	10	12
	30	0	0	1	1	1	2	4	6	9	15	19
	40	0	0	1	1	1	2	5	7	12	20	25
	50	0	1	1	1	2	3	6	9	16	25	31
	60	0	1	1	1	2	4	7	11	19	30	37
	70	0	1	1	2	2	4	9	13	22	35	43
	80	0	1	1	2	2	5	10	15	25	40	50
	90	1	1	2	2	3	6	11	17	28	45	56
	100	1	1	2	2	3	6	12	19	31	50	62

Table 13.2-19: Displacement matrix for Sandwich tern at Sheringham Shoal OWF during the breeding season (April to August),, showing the number of birds predicted to die (rounded to the nearest integer) at a given rate of displacement and mortality. Mortality rates used by the assessment are highlighted in red.

Mortality (%)												
Displacement (%)		1	2	3	4	5	10	20	30	50	80	100
	10	0	0	0	0	0	0	0	0	1	1	1
	20	0	0	0	0	0	0	0	1	1	2	2
	30	0	0	0	0	0	0	1	1	2	3	4
	40	0	0	0	0	0	0	1	1	2	4	5
	50	0	0	0	0	0	1	1	2	3	5	6
	60	0	0	0	0	0	1	1	2	4	6	7
	70	0	0	0	0	0	1	2	3	4	7	8
	80	0	0	0	0	0	1	2	3	5	8	10
	90	0	0	0	0	1	1	2	3	5	9	11
	100	0	0	0	0	1	1	2	4	6	10	12

Table 13.2-20: Displacement matrix for Sandwich tern at Triton Knoll OWF during the breeding season (April to August),, showing the number of birds predicted to die (rounded to the nearest integer) at a given rate of displacement and mortality. Mortality rates used by the assessment are highlighted in red.

Mortality (%)												
Displacement (%)		1	2	3	4	5	10	20	30	50	80	100
	10	0	0	0	0	0	0	0	0	1	1	1
	20	0	0	0	0	0	0	0	1	1	2	2
	30	0	0	0	0	0	0	1	1	2	3	4
	40	0	0	0	0	0	0	1	1	2	4	5
	50	0	0	0	0	0	1	1	2	3	5	6
	60	0	0	0	0	0	1	1	2	4	6	7
	70	0	0	0	0	0	1	2	3	4	7	8
	80	0	0	0	0	0	1	2	3	5	8	10
	90	0	0	0	0	1	1	2	3	5	9	11
	100	0	0	0	0	1	1	2	4	6	10	12

Table 13.2-21: Cumulative number of Sandwich terns at risk of displacement.

Tier	OWF	Buffer (km)	No. Sandwich terns at risk of displacement				Source and Notes
			Spring	Breeding	Autumn	Annual	
1	Dudgeon	0	0	0 - 1	0	0 - 1	This assessment
1	Race Bank	0	0	0 - 2	0	0 - 2	This assessment
1	Sheringham Shoal	0	0	0	0	0	This assessment
2	Triton Knoll	0	0	0	0	0	This assessment
5	DEP	0	0	1 - 4	0 - 1	1 - 5	This assessment

Tier	OWF	Buffer (km)	No. Sandwich terns at risk of displacement				Source and Notes
			Spring	Breeding	Autumn	Annual	
5	SEP	0	0	0 - 2	0	0 - 2	This assessment
TOTALS FOR CIA			0	1 - 9	0 - 1	1 - 10	

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