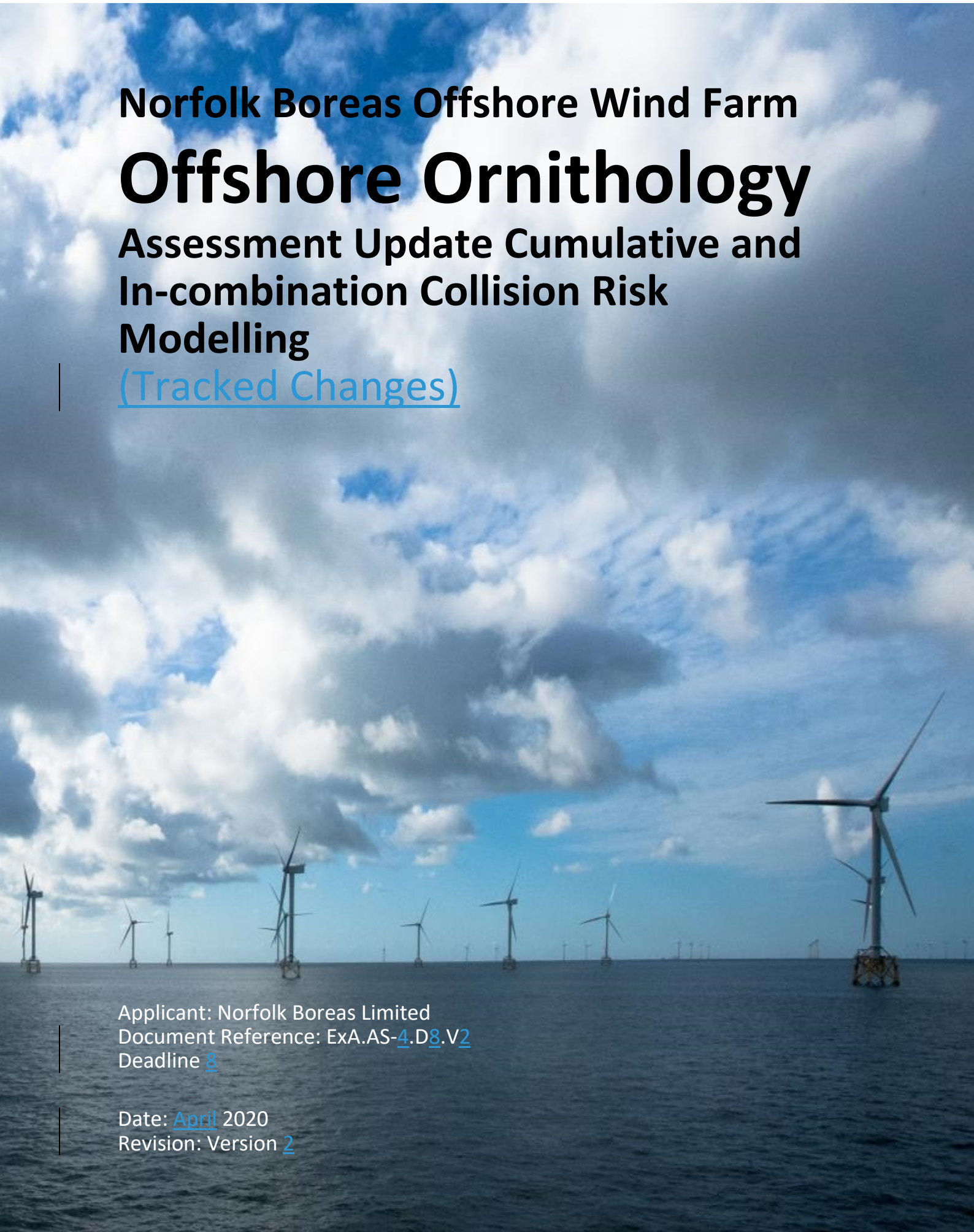

Norfolk Boreas Offshore Wind Farm

Offshore Ornithology

Assessment Update Cumulative and In-combination Collision Risk Modelling

(Tracked Changes)

Applicant: Norfolk Boreas Limited
Document Reference: ExA.AS-4.D8.V2
Deadline 8

Date: April 2020
Revision: Version 2

Executive Summary

Updates to Version 2 of this document

This is an update to the previous version of this document submitted at deadline 6 (REP6-024) with the following two errors (identified by Natural England in REP7-047) corrected:

- The kittiwake cumulative and in-combination collisions for all projects but *excluding* Hornsea Project Three were incorrectly summed. This error has been remedied and this row of the table ('*Total (minus Hornsea Project Three)*') contains the correct cumulative and in-combination totals for all projects *excluding* Hornsea Project Three. Note that this has not affected the figures used in the cumulative and in-combination assessments which are:
  - The totals including all wind farms ('*Total (all projects)*'); and
  - The totals excluding both Hornsea Project Three and Hornsea Project Four ('*Total (minus Hornsea Project Three and Hornsea Project Four)*'),

  both of which were correctly presented in the previous version of this document (REP6-024, ExA.AS-1.D6.V1); and,
- The spring and autumn apportioning rates used to estimate the number of gannet collisions which are assigned to the Flamborough and Filey Coast Special Protection Area (6.2% and 4.8% respectively) were applied the wrong way around for the Norfolk Boreas and Norfolk Vanguard wind farms. This has been corrected for these two wind farms and the in-combination totals updated accordingly. This has reduced the in-combination total in spring by 0.5 and increased the in-combination total in autumn by 0.1 (i.e. a net reduction of 0.4 in the in-combination annual total). This has therefore made no material difference to the assessment of impacts on the SPA.

All other sections of REP6-024 are unchanged from those in version 1.

Following requests from the Examining Authority, Natural England and the Royal Society for the Protection of Birds to consider options for raising draught height to mitigate potential ornithological impacts as far as possible, the Applicant has undertaken a detailed review of a range of mitigation options. This review was not limited to raising draught height, but also considered alternative turbine models as well as the capacity and availability of construction vessels. This has led to a commitment to remove smaller capacity turbines (i.e. less than 11.55MW) from the project design envelope and to increase the draught height (defined here as the gap between the lower rotor tip and the sea surface at Mean High Water Spring (MHWS)) as far as possible within the limit imposed by the installation capacity of available construction vessels.

The previous maximum number of turbines under consideration was 180 x 10MW turbines with a draught height of 22m[1]. This design is no longer being considered and has been replaced with either 158 x 11.55MW turbines with a draught height of 35m (i.e. an increase of 13m) or 124 x 14.7MW turbines with a draught height of 30m (i.e. an increase of 8m). The 11.55MW turbine represents a guaranteed design option as this model is currently commercially available, while the 14.7MW turbine is expected to be available in the project's construction timeframe.

The change in turbine option alone (i.e. without any increase in draught height) would reduce collision risks by approximately 35%. This is equivalent to the reduction in collisions obtained with the original turbine (180 x 10MW) at 27m (i.e. a 5m increase in draught height). Therefore, from a collision risk perspective, since the change in turbine equates to a 5m increase in height, when this is added to the actual height increases of 8m and 13m, the overall reduction in collisions is equivalent to draught height increases of between 13m (14.7MW) and 18m (11.55MW).

The collision risk estimates for the 14.7MW turbine at 30m are slightly higher than those for the 11.55MW turbine at 35m, and therefore the 14.7MW design is the worst case scenario for this impact. The total annual collision predictions for the 14.7MW turbine at 30m draught height, compared with the collision predictions in the DCO application at the point of submission, are reduced by 74% for gannet, 73% for little gull, 72% for kittiwake, 64% for lesser black-backed gull, and 63% for both herring gull and great black-backed gull. The project alone figures were submitted by the Applicant at Deadline 5 (REP5-059) and the design commitments were reflected in the updated draft DCO also submitted at Deadline 5 (REP5-003).

This note provides updated cumulative and in-combination collision estimates which include those for Norfolk Boreas as well as for other projects as follows:

- Norfolk Vanguard, for all species of concern for collision risk (gannet, kittiwake, lesser black-backed gull, herring gull, great black-backed gull and little gull). This revision applies the same design change commitments applied to Norfolk Boreas as detailed above;
- Dogger Bank Creyke Beck A and B, using consented estimates for gannet and kittiwake in place of those in the project's non-material change application, as requested by Natural England (REP4-040); and
- East Anglia ONE North and East Anglia TWO, the addition of estimates for little gull, as requested by Natural England (REP4-040).

[1] This was the worst case scenario for collision risk modelling, CRM, at the time of application submission, June 11, 2019 (APP-226).

In addition, Hornsea Project Three has recently submitted revised collision predictions for kittiwake[2] and these are discussed in this note (as far as the Applicant is aware the update only includes kittiwake). However, following advice from Natural England, these revised figures have not been used in the tabulated estimate of cumulative and in-combination collisions for this species.

In the Applicant's updated ornithology assessment submitted at Deadline 2 (REP2-035) it was concluded there would be no significant impacts due to collision risks for the project alone or cumulatively and there would be no adverse effects on the integrity of any Special Protection Area (SPA) populations due to the project alone or in-combination with other plans and projects. These conclusions remain unchanged following the inclusion of the revised estimates, and furthermore the contribution to the total figures from Norfolk Boreas has been substantially reduced.

Date	Issue No.	Remarks / Reason for Issue	Author	Checked	Approved
05/03/2020	01D	First draft for Deadline 6	MT	EV	JL
06/04/2020	02D	Final version – corrections to Table 2.1 (gannet) and Table 2.2 (kittiwake)	MT	EV	JL

Table of Contents

Table of Tables

Glossary of Acronyms

CRM	Collision Risk Modelling
EIA	Environmental Impact Assessment
HRA	Habitats Regulations Assessment
MHWS	Mean High Water Spring
PEIR	Preliminary Environmental Information Report
PVA	Population Viability Analysis
SPA	Special Protection Area

1 Introduction

1. The Applicant submitted updated project alone collision risk modelling at Deadline 5 (REP5-059) which reflected the following project design updates:

   - Removal of the smallest turbine options from the design envelope, specifically the 10MW and 11MW turbines, with the smallest turbine now included in the design having a capacity of 11.55MW (this turbine is included as it is currently available and is therefore a guaranteed design option). For the purposes of CRM a larger capacity turbine (14.7MW) has also been assessed (this turbine is included as it is expected to be available in the project's construction timeframe); and,
   - An increase in draught height (the minimum distance between the lower rotor tip height and the sea surface) to 30m above Mean High Water Springs (MHWS) for the 14.7MW turbine and 35m for the 11.55MW turbine.

2. These changes have reduced the project's collision risk by between 63% and 74% (REP5-059).

3. This note provides an update of the cumulative and in-combination collision risk tables which include the Norfolk Boreas design change, with the following additional revisions:

   - Revised figures for Norfolk Vanguard (the same design changes have been applied to this project, as detailed in documents submitted to the Planning Inspectorate on the 28th February 2020[2]);
   - Revised figures for gannet and kittiwake for Dogger Bank Creyke Beck A and B wind farms using the consented estimates in place of those in the project's non-material change application (as advised by Natural England); and,
   - Inclusion of little gull collisions for the East Anglia ONE North and East Anglia TWO wind farms.

4. Following Natural England's advice, and as was presented in the submission at Deadline 2 (REP2-035), the summed collision estimates have been presented with and without the inclusion of the figures for Hornsea Project Three and Hornsea Project Four.

5. The figures used for both these wind farms in the cumulative/in-combination tables are unchanged from those used in REP2-035. However, the Applicant notes that following a request for more information from the Secretary of State, Hornsea Project Three submitted revised kittiwake collision estimates to the Planning Inspectorate on the 14th February 2020[2]. These figures have been considered in the text below, with respect to how these would change the totals. However, the

Applicant was advised by Natural England not to use the updated figures in the tables.

6. The figures for Hornsea Project Four remain those presented in that project's Preliminary Environmental Information Report (PEIR).

1.1 Updates to Version 2 of this document

7. This is an update to the previous version of this document submitted at deadline 6 (REP6-024) with the following two errors (identified by Natural England in REP7-047) corrected:

- The kittiwake cumulative and in-combination collisions for all projects but *excluding* Hornsea Project Three were incorrectly summed. This error has been remedied and this row of the table ('*Total (minus Hornsea Project Three)*') contains the correct cumulative and in-combination totals for all projects *excluding* Hornsea Project Three. Note that this has not affected the figures used in the cumulative and in-combination assessments which are:
  - The totals including all wind farms ('*Total (all projects)*'); and~~,~~
  - The totals excluding both Hornsea Project Three and Hornsea Project Four ('*Total (minus Hornsea Project Three and Hornsea Project Four)*'),

  both of which were correctly presented in the previous version of this document (REP6-024, ExA.AS-1.D6.V1); and,
- The spring and autumn apportioning rates used to estimate the number of gannet collisions which are assigned to the Flamborough and Filey Coast Special Protection Area (6.2% and 4.8% respectively) were applied the wrong way around for the Norfolk Boreas and Norfolk Vanguard wind farms. This has been corrected for these two wind farms and the in-combination totals updated accordingly. This has reduced the in-combination total in spring by 0.5 and increased the in-combination total in autumn by 0.1 (i.e. a net reduction of 0.4 in the in-combination annual total). This has therefore made no material difference to the assessment of impacts on the SPA.

~~6.~~8. All other sections of REP6-024 are unchanged from those in version 1.

2 Cumulative and in-combination tables

~~7.~~9. The following tables provide the revised cumulative (Environmental Impact Assessment, EIA) and in-combination (Habitats Regulations Assessment, HRA) collision risks for gannet (Table 2.1), kittiwake (Table 2.2), lesser black-backed gull (Table 2.3), herring gull (Table 2.4), great black-backed gull (Table 2.5) and little gull (Table 2.6).

~~8.~~10. The Applicant considers that Natural England's approach to apportioning kittiwake and lesser black-backed gull impacts to SPAs for Norfolk Boreas (and Norfolk Vanguard) is overly precautionary as Natural England's methods apply the full breeding season and over-estimated apportioning rates. The Applicant presented their preferred, evidence-based, estimates for the number of Norfolk Boreas collisions apportioned to these SPA populations alongside Natural England's in REP5-059.

~~9.~~11. The figures included in the cumulative/in-combination tables in this update follow Natural England's advice. However, the Applicant's estimates for Norfolk Boreas and Norfolk Vanguard have been added as footnotes to the relevant tables below.

~~10.~~12. All the revised figures in the tables below are presented in bold (compared with REP2-035) to assist identification of changes.

Table 2.1 Updated gannet cumulative and in-combination collision risk.

Tier	Wind farm	Breeding season		Autumn migration		Spring migration		Annual	
		Total	FFC SPA	Total	FFC SPA	Total	FFC SPA	Total	FFC SPA
1	Beatrice Demonstrator	0.6	0	0.9	0.04	0.7	0.05	2.2	0.1
1	Greater Gabbard	14	0	8.8	0.42	4.8	0.3	27.5	0.7
1	Gunfleet Sands	-	-	-	-	-	-	-	-
1	Kentish Flats	1.4	0	0.8	0.04	1.1	0.07	3.3	0.1
1	Kentish Flats Extension	-	-	-	-	-	-	-	-
1	Lincs	2.1	2.1	1.3	0.06	1.7	0.1	5	2.3
1	London Array	2.3	0	1.4	0.07	1.8	0.11	5.5	0.2
1	Lynn and Inner Dowsing	0.2	0.2	0.1	0.01	0.2	0.01	0.5	0.2
1	Scroby Sands	-	-	-	-	-	-	-	-
1	Sheringham Shoal	14.1	14.1	3.5	0.17	0	0	17.6	14.3
1	Teesside	4.9	2.4	1.7	0.08	0	0	6.7	2.5
1	Thanet	1.1	0	0	0	0	0	1.1	0
1	Humber Gateway	1.9	1.9	1.1	0.05	1.5	0.09	4.5	2
1	Westermost Rough	0.2	0.2	0.1	0.01	0.2	0.01	0.5	0.2
1	Hywind	5.6	0	0.8	0.04	0.8	0.05	7.2	0.1
2	Kincardine	3	0	0	0	0	0	3	0
2	Beatrice	37.4	0	48.8	2.34	9.5	0.59	95.7	2.9
2	Dudgeon	22.3	22.3	38.9	1.87	19.1	1.18	80.3	25.3
2	Galloper	18.1	0	30.9	1.48	12.6	0.78	61.6	2.3
2	Race Bank	33.7	33.7	11.7	0.56	4.1	0.25	49.5	34.5
2	Rampion	36.2	0	63.5	3.05	2.1	0.13	101.8	3.2
2	Hornsea Project One	11.5	11.5	32	1.54	22.5	1.4	66	14.4
3	Blyth Demonstration Project	3.5	0	2.1	0.1	2.8	0.17	8.4	0.3
3	**Dogger Bank Creyke Beck Projects A and B**	**81.1**	**40.6**	**83.5**	**4.0**	**54.4**	**3.4**	**219.0**	**47.9**
3	East Anglia ONE	3.4	3.4	131	6.29	6.3	0.39	140.7	10.1
3	European Offshore Wind Deployment Centre	4.2	0	5.1	0.25	0.1	0	9.3	0.3
3	Firth of Forth Alpha and Bravo	800.8	0	49.3	2.37	65.8	4.08	915.9	6.4
3	Inch Cape	336.9	0	29.2	1.4	5.2	0.32	371.3	1.7
3	Methil	6	0	0	0	0	0	6	0
3	Moray Firth (EDA)	80.6	0	35.4	1.7	8.9	0.55	124.9	2.3
3	Neart na Gaoithe	143	0	47	2.26	23	1.43	213	3.7
3	Dogger Bank Teesside Projects A and B	14.8	7.4	10.1	0.49	10.8	0.67	35.7	8.5
3	Triton Knoll	26.8	26.8	64.1	3.08	30.1	1.87	121	31.7
3	Hornsea Project Two	7	7	14	0.67	6	0.37	27	8
4	East Anglia THREE	6.1	6.1	33.3	1.6	9.6	0.6	49	8.3
5	Hornsea Project Three	26	26	12	0.58	11	0.68	49	27.3
5	Thanet Extension	0	0	11.1	0.53	22.9	1.42	34	2
5	**Norfolk Vanguard**	**8.2**	**8.2**	**18.6**	**0.89~~1.2~~**	**5.3**	**0.33**	**32.1**	**9.4~~6~~**
6	Moray West	10	0	2	0.1	1	0.06	13	0.2
6	**Norfolk Boreas**	**14.1**	**14.2**	**12.7**	**~~0.8~~0.61**	**3.9**	**0.24**	**30.7**	**15.1**
6	East Anglia TWO	12.7	12.7	28.7	1.38	5.6	0.35	47	14.4
6	East Anglia ONE North	11	11	12.8	0.61	3.4	0.21	27.2	11.8
6	*Hornsea 4 (PEIR)*	43.3	43.3	9.9	0.48	8.1	0.5	61.3	44.3
	Total (all projects)	**1850.1**	**295.1**	**858.2**	**41.2~~7~~**	**366.9**	**22.8~~7~~**	**3075.0**	**359.0~~2~~**
	Total (minus Hornsea Project Three)	**1824.1**	**269.1**	**846.2**	**40.7~~1.2~~**	**355.9**	**22.1~~0~~**	**3026.0**	**331.7~~9~~**
	Total (minus Hornsea Project Four))	**1806.8**	**251.8**	**848.3**	**40.8~~1.3~~**	**358.8**	**22.3~~2~~**	**3013.7**	**314.7~~9~~**

Tier	Wind farm	Breeding season		Autumn migration		Spring migration		Annual	
		Total	FFC SPA	Total	FFC SPA	Total	FFC SPA	Total	FFC SPA
	Total (minus Hornsea Project Three and Hornsea Project Four)	**1780.8**	**225.8**	**836.3**	**40.2~~7~~**	**347.8**	**21.6~~5~~**	**2964.7**	**287.4~~6~~**

~~11.~~13. In response to a request from the Secretary of State to consider additional mitigation, Hornsea Project Three submitted revised kittiwake collisions to the Planning Inspectorate on the 14th February 2020[2]. The Flamborough and Filey Coast SPA kittiwake collision estimate for this project, presented using methods which correspond to Natural England's advice, has been reduced from 181 to 65-73. The Applicant, following advice from Natural England that they have not had time to review the revisions, has continued to use the values presented during the examination (i.e. the annual total of 181, Table 2.2). However, it is worth noting that irrespective of the actual collision estimates, the Hornsea Project Three design changes (an increase in draught height and a reduction in turbine number) will have resulted in reduced collisions, and subject to confirmation by Natural England, this will be potentially by more than 100. Therefore, the in-combination totals in Table 2.2 which include Hornsea Project Three will over-estimate the revised total by the same margin.

Table 2.2 Updated kittiwake cumulative and in-combination collision risk.

Tier	Wind farm	Breeding season		Autumn migration		Spring migration		Annual	
		Total	FFC SPA	Total	FFC SPA	Total	FFC SPA	Total	FFC SPA
1	Beatrice Demonstrator	0.0	0.0	2.1	0.1	1.7	0.1	3.8	0.2
1	Greater Gabbard	1.1	0.0	15.0	0.8	11.4	0.8	27.5	1.6
1	Gunfleet Sands	-	-	-	-	-	-	-	
1	Kentish Flats	0.0	0.0	0.9	0.1	0.7	0.1	1.6	0.1
1	Kentish Flats Extension	0.0	0.0	0.0	0.0	2.7	0.2	2.7	0.2
1	Lincs	0.7	0.7	1.2	0.1	0.7	0.1	2.6	0.8
1	London Array	1.4	0.0	2.3	0.1	1.8	0.1	5.5	0.3
1	Lynn and Inner Dowsing	-	-	-	-	-	-	-	
1	Scroby Sands	-	-	-	-	-	-	-	
1	Sheringham Shoal	-	-	-	-	-	-	-	
1	Teesside	38.4	0.0	24.0	1.3	2.5	0.2	64.9	1.5
1	Thanet	0.2	0.0	0.5	0.0	0.4	0.0	1.1	0.1
1	Humber Gateway	1.9	1.9	3.2	0.2	1.9	0.1	7.0	2.2
1	Westermost Rough	0.1	0.1	0.2	0.0	0.1	0.0	0.5	0.1
1	Hywind	16.6	0.0	0.9	0.1	0.9	0.1	18.3	0.1
2	Kincardine	22.0	0.0	9.0	0.5	1.0	0.1	32.0	0.6
2	Beatrice	94.7	0.0	10.7	0.6	39.8	2.9	145.2	3.5

[2] https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010080/EN010080-003194-HOW03_CON02_Appendix4%20Annexes_Mitigation.EnvelopeModifications.pdf

Tier	Wind farm	Breeding season		Autumn migration		Spring migration		Annual	
		Total	FFC SPA	Total	FFC SPA	Total	FFC SPA	Total	FFC SPA
2	Dudgeon	-	-	-	-	-	-	-	
2	Galloper	6.3	0.0	27.8	1.5	31.8	2.3	65.9	3.8
2	Race Bank	1.9	1.9	23.9	1.3	5.6	0.4	31.4	3.6
2	Rampion	54.4	0.0	37.4	2.0	29.7	2.1	121.5	4.2
2	Hornsea Project One	44.0	36.5	55.9	3.0	20.9	1.5	120.8	41.0
3	Blyth Demonstration Project	1.7	0.0	2.3	0.1	1.4	0.1	5.4	0.2
3	**Dogger Bank Creyke Beck Projects A and B**	**288.6**	**55.8**	**135.0**	**7.3**	**295.4**	**21.3**	**719.0**	**84.3**
3	East Anglia ONE	1.8	0.0	160.4	8.7	46.8	3.4	209.0	12.0
3	European Offshore Wind Deployment Centre	11.8	0.0	5.8	0.3	1.1	0.1	18.7	0.4
3	Firth of Forth Alpha and Bravo	153.1	0.0	313.1	16.9	247.6	17.8	713.8	34.7
3	Inch Cape	13.1	0.0	224.8	12.1	63.5	4.6	301.4	16.7
3	Methil	0.4	0.0	0.0	0.0	0.0	0.0	0.4	0.0
3	Moray Firth (EDA)	43.6	0.0	2.0	0.1	19.3	1.4	64.9	1.5
3	Neart na Gaoithe	32.9	0.0	56.1	3.0	4.4	0.3	93.4	3.4
3	Dogger Bank Teesside Projects A and B	136.9	26.4	90.7	4.9	216.9	15.6	444.5	46.9
3	Triton Knoll	24.6	24.6	139.0	7.5	45.4	3.3	209.0	35.4
3	Hornsea Project Two	16.0	13.3	9.0	0.5	3.0	0.2	28.0	14.0
4	East Anglia THREE	6.1	0.0	69.0	3.7	37.6	2.7	112.7	6.4
5	Hornsea Project Three	187.5	176.3	94.6	5.1	15.0	1.1	297.1	181.0
5	Thanet Extension	2.3	0.0	5.3	0.3	15.3	1.1	22.9	1.4
5	**Norfolk Vanguard***	**21.8**	**18.7**	**16.4**	**0.9**	**19.3**	**1.4**	**57.5**	**21.0**
6	Moray West	79.0	0.0	24.0	1.3	7.0	0.5	110.0	1.8
6	**Norfolk Boreas***	**13.3**	**11.4**	**32.2**	**1.7**	**11.9**	**0.9**	**57.5**	**14.0**
6	East Anglia TWO	19.8	0.0	9.3	0.5	20.9	1.5	50.0	2.0
6	East Anglia ONE North	18.6	0.0	12.1	0.7	27.3	1.9	58.0	2.6
6	*Hornsea 4 (PEIR)*	153.3	153.3	34.7	1.9	9.9	0.7	197.9	155.9
	Total (all projects)	**1509.9**	**520.9**	**1650.8**	**89.1**	**1262.6**	**90.9**	**4423.4**	**699.4**
	Total (minus Hornsea Project Three)	1322.4 ~~1246.9~~	344.62 ~~73.6~~	1556.2 ~~1518.1~~	84.08 ~~2.0~~	1247.6 ~~1241.5~~	89.88 ~~9.4~~	4126.34 ~~006.6~~	518.444 ~~4.9~~
	Total (minus Hornsea Project Four)	**1356.6**	**367.6**	**1616.1**	**87.3**	**1252.7**	**90.2**	**4225.5**	**542.5**
	Total (minus Hornsea Project Three and Hornsea Project Four)	**1169.1**	**191.3**	**1521.5**	**82.2**	**1237.7**	**89.1**	**3928.4**	**362.5**

* Using the Applicant's evidence-based methods the annual HRA estimates for Norfolk Vanguard and Norfolk Boreas are 4.6 and 6.1 respectively (compared with 21 and 14 using Natural England's precautionary apportioning rates).

Table 2.3 Updated lesser black-backed gull cumulative and in-combination collision risk.

Tier	Wind farm	Breeding season		Nonbreeding season		Annual	
		Total	AOE SPA	Total	AOE SPA	Total	AOE SPA (nonbreeding season apportioned plus breeding season for wind farms <141km)*
1	Beatrice Demonstrator	-	-	-	-	-	-
1	Greater Gabbard	12.4	8	49.6	2	62	10
1	Gunfleet Sands	1	0.3	0	0	1	0.3
1	Kentish Flats	-	-	-	-	-	-
1	Kentish Flats Extension	0.3	0.1	1.3	0.1	1.6	0.2
1	Lincs	1.7		6.8	0.3	8.5	0.3
1	London Array	-	-	-	-	-	-
1	Lynn and Inner Dowsing	-	-	-	-	-	-
1	Scroby Sands	-	-	-	-	-	-
1	Sheringham Shoal	1.7	0.3	6.6	0.3	8.3	0.6
1	Teesside	0		0	0	0	0
1	Thanet	3.2	1.4	12.8	0.5	16	1.9
1	Humber Gateway	0.3		1.1	0	1.4	0
1	Westermost Rough	0.1		0.3	0	0.4	0
1	Hywind	0		0	0	0	0
2	Kincardine	0		0	0	0	0
2	Beatrice	0		0	0	0	0
2	Dudgeon	7.7	1.1	30.6	1.2	38.3	2.3
2	Galloper	27.8	18	111	4.4	138.8	22.4
2	Race Bank	43.2		10.8	0.4	54	0.4
2	Rampion	1.6		6.3	0.3	7.9	0.3
2	Hornsea Project One	4.4		17.4	0.7	21.8	0.7
3	Blyth Demonstration Project	0		0	0	0	0
3	Dogger Bank Creyke Beck Projects A and B	2.6		10.4	0.4	13	0.4
3	East Anglia ONE	5.9	2.2	33.8	1.4	39.7	3.6
3	European Offshore Wind Deployment Centre	0		0	0	0	0
3	Firth of Forth Alpha and Bravo	2.1		8.4	0.3	10.5	0.3
3	Inch Cape	0		0	0	0	0
3	Methil	0.5		0	0	0.5	0
3	Moray Firth (EDA)	0		0	0	0	0
3	Neart na Gaoithe	0.3		1.2	0	1.5	0
3	Dogger Bank Teesside Projects A and B	2.4		9.6	0.4	12	0.4
3	Triton Knoll	7.4		29.6	1.2	37	1.2
3	Hornsea Project Two	2		2	0.1	4	0.1
4	East Anglia THREE	1.8	0.4	8.2	0.3	10	0.7
5	Hornsea Project Three	17.3		0	0	17.3	0
5	Thanet Extension	3	1.3	2	0.1	5	1.4
5	**Norfolk Vanguard**	**8.4**	**2.5**	**3.6**	**0.1**	**12**	**2.6[#]**
6	Moray West	0		0	0	0	0
6	**Norfolk Boreas**	**6.2**	**1.9**	**8.1**	**0.2**	**14.3**	**2.1[#]**
6	East Anglia TWO	4.7	1.8	0.5	0	5.2	1.8
6	East Anglia ONE North	1	0.2	0.6	0	1.6	0.2
6	*Hornsea 4 (PEIR)*	1.9		0	0	1.9	0

Tier	Wind farm	Breeding season		Nonbreeding season		Annual	
		Total	AOE SPA	Total	AOE SPA	Total	AOE SPA (nonbreeding season apportioned plus breeding season for wind farms <141km)*
	Total (all projects)	**172.9**	**39.5**	**372.6**	**14.7**	**545.5**	**54.2**
	Total (minus Hornsea Project Three)	**155.6**	**39.5**	**372.6**	**14.7**	**528.2**	**54.2**
	Total (minus Hornsea Project Four)	**171**	**39.5**	**372.6**	**14.7**	**543.6**	**54.2**
	Total (minus Hornsea Project Three and Hornsea Project Four)	**153.7**	**39.5**	**372.6**	**14.7**	**526.3**	**54.2**

* The apportioning of lesser black-backed gull collisions to the Alde Ore Estuary SPA from breeding colonies in Norfolk and Suffolk uses the connectivity rates estimated in Table 7.3 of REP2-035.

Using the Applicant's evidence-based methods the annual HRA estimates for Norfolk Vanguard and Norfolk Boreas are both 1.6 (compared with 2.6 and 2.1 using Natural England's precautionary apportioning rates).

Table 2.4 Herring gull cumulative collision risk.

Tier	Wind farm	Breeding season	Nonbreeding season	Annual
1	Beatrice Demonstrator	0		0
1	Greater Gabbard	0		0
1	Gunfleet Sands	-	-	-
1	Kentish Flats	0	0	0
1	Kentish Flats Extension	0.5	1.7	2.2
1	Lincs	0		0
1	London Array	-	-	-
1	Lynn and Inner Dowsing	0		0
1	Scroby Sands	-	-	-
1	Sheringham Shoal	0		0
1	Teesside	8.7	34.5	43.2
1	Thanet	4.9	19.6	24.5
1	Humber Gateway	0.4	1.1	1.5
1	Westermost Rough	0.1	0	0.1
1	Hywind	0.6	7.8	8.4
2	Kincardine	1	0	1
2	Beatrice	49.4	197.4	246.8
2	Dudgeon	-	-	-
2	Galloper	27.2		27.2
2	Race Bank	0		0
2	Rampion	155		155
2	Hornsea Project One	2.9	11.6	14.5
3	Blyth Demonstration Project	0.5	2.2	2.7
3	Dogger Bank Creyke Beck Projects A and B	0		0
3	East Anglia ONE	0	28	28
3	European Offshore Wind Deployment Centre	4.8		4.8
3	Firth of Forth Alpha and Bravo	10	21	31
3	Inch Cape	0	13.5	13.5
3	Methil	5.8	3.7	9.5
3	Moray Firth (EDA)	52		52
3	Neart na Gaoithe	5	12.5	17.5
3	Dogger Bank Teesside Projects A and B	0		0
3	Triton Knoll	0		0
3	Hornsea Project Two	23.8		23.8
4	East Anglia THREE	0	23	23
5	Hornsea Project Three	1	8.3	9.3
5	Thanet Extension	15	10	25
5	**Norfolk Vanguard**	**0.4**	**7.1**	**7.5**
6	Moray West	12	1	13
6	**Norfolk Boreas**	**1.5**	**5.4**	**6.9**
6	East Anglia TWO	0	0.5	0.5
6	East Anglia ONE North	0	0	0
6	*Hornsea 4 (PEIR)*	1.8	0.8	2.6
	Total (all projects)	**384.3**	**410.7**	**795**
	Total (minus Hornsea Project Three)	**383.3**	**402.4**	**785.7**
	Total (minus Hornsea Project Four)	**382.5**	**409.9**	**792.4**
	Total (minus Hornsea Project Three and Hornsea Project Four)	**381.5**	**401.6**	**783.1**

Table 2.5 Great black-backed gull cumulative collision risk.

Tier	Wind farm	Breeding season	Nonbreeding season	Annual
1	Beatrice Demonstrator	0	0	0
1	Greater Gabbard	15	60	75
1	Gunfleet Sands	-	-	-
1	Kentish Flats	-	-	-
1	Kentish Flats Extension	0.1	0.2	0.3
1	Lincs	0	0	0
1	London Array	-	-	-
1	Lynn and Inner Dowsing	0	0	0
1	Scroby Sands	-	-	-
1	Sheringham Shoal	0	0	0
1	Teesside	8.7	34.8	43.6
1	Thanet	0.1	0.4	0.5
1	Humber Gateway	1.3	5.1	6.3
1	Westermost Rough	0	0	0.1
1	Hywind	0.3	4.5	4.8
2	Kincardine	0	0	0
2	Beatrice	30.2	120.8	151
2	Dudgeon	0	0	0
2	Galloper	4.5	18	22.5
2	Race Bank	0	0	0
2	Rampion	5.2	20.8	26
2	Hornsea Project One	17.2	68.6	85.8
3	Blyth Demonstration Project	1.3	5.1	6.3
3	Dogger Bank Creyke Beck Projects A and B	5.8	23.3	29.1
3	East Anglia ONE	0	46	46
3	European Offshore Wind Deployment Centre	0.6	2.4	3
3	Firth of Forth Alpha and Bravo	13.4	53.4	66.8
3	Inch Cape	0	36.8	36.8
3	Methil	0.8	0.8	1.6
3	Moray Firth (EDA)	9.5	25.5	35
3	Neart na Gaoithe	0.9	3.6	4.5
3	Dogger Bank Teesside Projects A and B	6.4	25.5	31.9
3	Triton Knoll	24.4	97.6	122
3	Hornsea Project Two	3	20	23
4	East Anglia THREE	4.6	34.4	39
5	Hornsea Project Three	19.4	46.6	66
5	Thanet Extension	6.5	35.5	42
5	**Norfolk Vanguard**	**4.5**	**21.5**	**26**
6	Moray West	4	5	9
6	**Norfolk Boreas**	**6.9**	**28.7**	**35.6**
6	East Anglia TWO	3.8	3.7	7.5
6	East Anglia ONE North	3.9	1.3	5.2
6	*Hornsea 4 (PEIR)*	3	13.6	13.6
	Total (all projects)	**205.3**	**863.5**	**1065.8**
	Total (minus Hornsea Project Three)	**185.9**	**816.9**	**999.8**
	Total (minus Hornsea Project Four)	**202.3**	**849.9**	**1052.2**
	Total (minus Hornsea Project Three and Hornsea Project Four)	**182.9**	**803.3**	**986.2**

~~12.~~14. Little gull collisions are only presented in relation to those wind farms with connectivity to the Greater Wash SPA and for which collision estimates have been presented. Table 2.6 provides an update of the in-combination table for this species in REP2-035.

Table 2.6 Assessed collision rates for little gull at offshore wind farm sites with potential connectivity to the Greater Wash SPA.

Wind farm	Annual collisions	Avoidance rate (%)	Assessed wind farm size	Collisions updated for 99.2% avoidance rate	Built or proposed wind farm size	Collisions updated for built or proposed wind farm
Triton Knoll	65	98	288 x 3.6MW	26	90 x 9.5MW	c. 15
Race Bank	52	98	206 x 3MW	21	91 x 6MW	12
Sheringham Shoal	8	98	108 x 3MW	3	88 x 3.6MW	3
Hornsea Project One	10	98	332 x 3.6MW	4	174 x 7MW	2
Hornsea Project Two	1.3	98	360 x 5MW	0.5	N/A	0.5
Hornsea Project Three	0.5	99.2	300 x 6MW	0.5	N/A	0.5
Norfolk Vanguard	**2.5**	**99.2**	**124 x 14.7MW**	**2.5**	**N/A**	**2.5**
Norfolk Boreas	**1.1**	**99.2**	**124 x 14.7MW**	**1.1**	**N/A**	**1.1**
East Anglia ONE North	**1.1**	**99.2**	**53 x 15MW**	**1.1**	**N/A**	**1.1**
East Anglia TWO	**1.7**	**99.2**	**60 x 15MW**	**1.7**	**N/A**	**1.7**
Total	**143.2**			**61.4**		**39.4**

3 Conclusions

~~13.~~15. The cumulative and in-combination collision risk tables in this submission replace those presented in the Applicant's original assessment (APP-226) and the Deadline 2 submission (REP2-035). Following the Applicant's design revisions, the contribution to the totals from Norfolk Boreas has been substantially reduced, by between 62% and 74%, compared with the previous figures.

~~14.~~16. The number of kittiwake collisions apportioned to the Flamborough and Filey Coast SPA at Norfolk Boreas has been reduced by 76%, from 58 to 14 (note that using the Applicant's apportioning rates the equivalent reduction is from 21.4 to 6.1). A similar reduction has also been achieved for Norfolk Vanguard, with SPA kittiwake collisions reduced from 42 (at the close of the examination) to 21, following a commitment to the same design mitigation as Norfolk Boreas (note that using the Applicant's apportioning rates the equivalent reduction is from 9.3 to 4.6).

~~15.~~17. While the contributions from Norfolk Boreas and Norfolk Vanguard have decreased, the total cumulative and in-combination kittiwake collision estimates are slightly higher in Table 2.6 than those submitted at Deadline 2 (an additional 8 collisions apportioned to the Flamborough and Filey Coast SPA, and an additional 26 collisions cumulatively). This is a result of using the Dogger Bank Creyke Beck A and B consented collision estimates rather than those in the project's non-material change application (a change which the Applicant was advised to make by Natural England, REP4-039). However, the assessment conclusions in REP2-035 were based on modelled mortality estimates in the Population Viability Analysis (PVA) that were slightly higher than the cumulative and in-combination totals. Therefore, the conclusions in REP2-035 for kittiwake remain valid and the Applicant considers there is no risk of significant impacts (at the EIA scale) and there will be no adverse effects on integrity of the Flamborough and Filey Coast SPA population due to collision risk impacts at Norfolk Boreas alone or in-combination with other plans and projects.

~~16.~~18. Furthermore, Hornsea Project Three has recently submitted design revisions to the Planning Inspectorate which have presented reduced collision risks for kittiwake[2]. Although the Applicant has followed Natural England's advice and not included these updated figures for Hornsea Project Three, consideration has been given below to how the revised estimates would affect the totals.

~~17.~~19. The reduction in Flamborough and Filey Coast SPA kittiwake collisions at Hornsea Project Three, described as using Natural England's methods, is 108. This is four times greater than the increase of 27 due to using the consented figure for Dogger Bank Creyke Beck (84.3) rather than the non-material change value (57.4). Thus, while the overall total in Table 2.2 is slightly higher than that in REP2-035, once the above revisions (reductions for Norfolk Boreas, Norfolk Vanguard and Hornsea

Project Three and an increase for Dogger Bank Creyke Beck) are taken into account the total (including Hornsea Projects Three and Four) would be reduced from 700 to 592.

~~18.~~20. This further supports the Applicant's position that there will be no significant impacts for kittiwake due to Norfolk Boreas alone or cumulatively (at the EIA scale) and no adverse effects on the integrity of the Flamborough and Filey Coast SPA population due to collision risk impacts at Norfolk Boreas alone or in-combination with other plans and projects.

~~19.~~21. As the updated cumulative and in-combination totals for gannet (Table 2.1), lesser black-backed gull (Table 2.3), herring gull (Table 2.4), great black-backed gull (Table 2.5) and little gull (Table 2.6) are all lower than those in REP2-035, the assessment conclusions for these species presented in REP2-035 remain the same and the Applicant considers that there will be no significant impacts due to Norfolk Boreas alone or cumulatively (at the EIA scale) and no adverse effects on integrity of any SPA population due to collision risk impacts at Norfolk Boreas alone or in-combination with other plans and projects.

~~20.~~22. It is also worth noting that although Hornsea Project Three has not provided collision risk updates for these other species, the design mitigations will also reduce the collision predictions compared to those currently used in the cumulative and in-combination assessments.

~~21.~~23. In addition, the collision estimates for many of the wind farms in the cumulative and in-combination tables have been calculated on the basis of worst case wind farm designs submitted for application, rather than using parameters for the turbines which have actually been built (i.e. the number of turbines and their dimensions). Many wind farms have been built with fewer turbines than the number for which the project was assessed or consented and these changes reduce the collision risk. While Natural England has agreed that these changes reduce collision risks, due to concerns that even after a wind farm has been built (to a different design compared with the consented one) there could be scope for further development, Natural England advises that the figures to be used in cumulative and in-combination assessment should reflect the consented design (as this is legally secured, REP4-040).

~~22.~~24. The Applicant has followed Natural England's advice on this matter and presented the figures advised by Natural England. However, in REP4-014 the Applicant presented legal arguments for why built wind farms can't be extended at a later date and in ~~ExA;AS-4,D6.V1~~REP6-021 the Applicant has also presented revised collision estimates and the difference in collision risk between the consented and built wind farm designs (referred to as 'headroom'). The latter note illustrates the headroom available for kittiwake from the Flamborough and Filey Coast SPA obtained from

updating the collision risk for just two wind farms (Hornsea Project One and Triton Knoll). For these two wind farms the reduction in mortality sums to 39.5, which exceeds the revised kittiwake collision risks (using Natural England methods; Table 2.2) for Norfolk Boreas (14) and Norfolk Vanguard (21) combined. Similar changes in project design have been made for other wind farms included in the cumulative and in-combination totals and therefore application of these methods would further reduce the total collision risks (and increase headroom), and this applies to all species included in the assessment. It is clear therefore that use of collision figures which reflect the consented design rather than the as-built wind farm in the cumulative and in-combination assessment represents another source of over-precaution in the ornithology assessment.