Hornsea Offshore Wind Farm

Project Two

Clarification Note – Apportioning of predicted kittiwake mortality to the Flamborough and Filey Coast pSPA population

Appendix P to the Response submitted for Deadline IIA

Application Reference: EN010053

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1. Apportioning and assessment of predicted kittiwake mortality of the Flamborough and Filey Coast pSPA population

1.1 Introduction

1.1.1 This clarification note has been prepared in respect of the application for a development consent order (DCO) to the Secretary of State under the Planning Act 2008 ('the Application') by SMartWind Ltd on behalf of Optimus Wind Ltd and Breesea Ltd (the 'Applicant') for the Hornsea Project Two Offshore Wind Farm (the 'Project').

1.1.2 This note has been prepared in response to queries raised by Natural England in their Relevant and Written Representations regarding the apportioning of kittiwakes present within the Project site to the Flamborough and Filey Coast (FFC) pSPA during the breeding season. Specifically this note explores the assumptions made regarding the spatial and numerical distribution of non-breeding (including immature) birds during the breeding season and the foraging ranges of breeding adults from the FFC pSPA.

1.1.3 The note provides details of the applicants considered position (and deemed implications for FFC pSPA) in addition to the position of Natural England. Where differences between the Applicant and Natural England occur, these are explored to provide appropriate clarity.

1.1.4 Natural England have not raised any queries about the methodologies used to apportion birds in any other seasons (i.e. pre-breeding and post-breeding) and as such, there has been no exploration of alternative approaches during these seasons.

1.1.5 The report is structured to include the following sections:

- A description of consultation with Natural England from Section 42 submission to final submission and consultation that has taken place as part of the examination process (Section **Error! Reference source not found.**);
- Kittiwake phenology – definition of seasonal extents (Section **Error! Reference source not found.**);
- Breeding season apportioning – Project Two alone (Section **Error! Reference source not found.**);
- Annual predicted mortality apportioning to FFC pSPA – Project Two alone Section **Error! Reference source not found.**); and
- Conclusions – implications for FFC pSPA (Section **Error! Reference source not found.**).

1.2 Consultation timeline

1.2.1 This section outlines the evolution of the assessment on kittiwake originating from the FFC pSPA, including; the consultation and development of the Biologically Defined Minimum Population Scale (BDMPS) and finally the apportioning

methodologies incorporated into assessment for kittiwake from the Section 42 submission to Deadline II of the Project examination. During this time there has been ongoing discussions with Natural England that have informed the BDMPS and apportioning methodologies presented in the submitted application and within this clarification note. The remaining text in Section 1.2 of this note details queries raised by Natural England at various stages of the application and which are clarified within this note.

Section 42 and application submission

1.2.2 In the Section 42 submission, it was determined that there was no potential for Likely Significant Effect (LSE) on kittiwake during the breeding season as the mean-maximum foraging range as stated in Thaxter *et al.* (2012), indicates there would be no connectivity between FFC pSPA and the Project site. Natural England did not agree with the exclusion of the kittiwake from the assessment based on this published mean-maximum foraging range and instead suggested the maximum foraging range and tracking data from the pSPA colony be used to inform the analysis of potential connectivity (determined to be 231 km).

1.2.3 Within the HRA Report (Doc ref. No. 12.6), the Applicant presented two scenarios first assuming that the Project lies outside of foraging range and secondly applying the range of 231 km. The HRA Report applied BDMPS information as presented in Furness (2015) and also aligned with the apportioning methodology used in the examination of Dogger Bank Creyke Beck and Dogger Bank Teesside A and B Offshore Wind Farms.

Natural England's Relevant Representation

1.2.4 Natural England's Relevant Representation includes a number of queries (paragraphs 45 to 58) in relation to the methodology used to apportion impacts to the FFC pSPA kittiwake population.

1.2.5 The first query was in relation the breeding season where Natural England state that they do not agree with the application of figures from Furness (2015), which represent the distribution and abundance of birds in the non-breeding season, to the assessment of the breeding season.

1.2.6 Natural England also raised queries in relation to the foraging range used for kittiwake during the breeding season in order to calculate the proportion of birds that may exhibit connectivity with the Project site. Natural England suggest the use of a 156 km range which they have calculated using tracking data from the pSPA colony collected as part of the FAME project (paragraph 51 of Natural England's Relevant Representation).

1.2.7 The Applicant applied the seasonal definitions described in Furness (2015) within the HRA and EIA (Doc refs 12.6 and 7.2.5). However, as part of their Relevant Representations, Natural England suggest that the definition of seasonal extents should be colony specific where possible, with there being potential evidence to

support the inclusion of March and April as core breeding season months for kittiwake.

1.2.8 Natural England also state that within the in-combination assessment, a breeding adult proportion of 100% should be applied to the Humber Gateway and Westermost Rough projects in breeding season as these projects are both within mean-maximum foraging range of kittiwake from the pSPA, as defined by Thaxter *et al.* (2012).

Pre-examination and examination consultation

1.2.9 During a consultation meeting on the 3rd June 2015, the apportioning of impacts to the FFC pSPA kittiwake population was discussed. The implications of these discussions are applied to the positions of the Applicant and Natural England in the remainder of this note.

1.3 Kittiwake phenology – seasonal definitions

1.3.1 Following consultation with Natural England at Section 42, three seasons were defined for kittiwake based on information presented in Furness (2015); these are presented in Table 1-1.

Table 1-1: Seasonal extents used for kittiwake throughout the assessment of Hornsea Project Two.

Season	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Pre-breeding												
Breeding												
Post-breeding												

1.3.2 As detailed in Section 1.2, Natural England recommended the inclusion of March and April as part of the breeding season for kittiwake. This advice was updated by Natural England on 20th August 2015 based on colony specific information to a recommended breeding season definition of April – July. It is the Applicant's view that the breeding season defined in Table 1-1 for kittiwake represents the core period during which impacts may disproportionately affect the breeding population at FFC pSPA. During this period the foraging range of breeding kittiwake at the colony will be constrained due to the necessity to provision young.

1.3.3 When considering the possibility of including March and April as part of the breeding season for kittiwake it is important to investigate the wider movements of kittiwake in the North Sea, and the destination of these birds. A proportion of these birds will be returning to the pSPA, however a larger proportion will be migrating through the North Sea to colonies further north. Spring migration through UK waters is known to be completed by May (Furness, 2015; Forrester *et al.,* 2007)

with migration peaking during April. In England, the majority of birds do return to breeding colonies between March and April (Brown and Grice, 2005), and although birds may be present at breeding colonies, breeding behaviour does not begin until late April at the earliest (Forrester *et al.,* 2007). It is highly unlikely that birds will be attending eggs or provisioning young during March and April meaning that birds will not be restricted in terms of foraging range. This indicates two important factors that inform definition of biological seasons with respect to the assessment of Project Two:

- Not all breeding adult kittiwake would be expected to be present at the pSPA during April; and
- A substantial proportion of kittiwakes present in the North Sea at distinctly offshore localities during April are likely to be migrating birds from colonies further north than the pSPA.

1.3.4 The Applicants therefore disagrees with Natural England and considers that April is more accurately described as a pre-breeding month. This is noted in Furness (2015), which describes May-July as the "migration-free" core breeding period.

1.3.5 This difference in position between the Applicant and Natural England is highlighted further in this note where it has clear implications for the apportioning of predicted collision mortality.

1.4 Breeding season apportioning – Project Two alone

Foraging range

1.4.1 The Application of a 231 km foraging range in the HRA Report (Doc. ref. 12.6) as an alternative to the published foraging range in Thaxter *et al.,* (2012) was considered by the Applicant to be highly precautionary. It is based on the foraging behaviour of a single tracked kittiwake from a colony (Colonsay) with low breeding success and so foraging behaviour from FFC pSPA will likely differ. Natural England have since expressed the same reservations on the application of this foraging range and have suggested the use of a foraging range of 156 km which is derived based on tracks of birds from the FFC pSPA breeding colony.

1.4.2 This revised foraging range leads to the exclusion in the assessment of kittiwakes from all colonies in Tyne and Wear and Cleveland (9,729 Apparently Occupied Nests (AON)).

1.4.3 The data that informs the 156 km foraging range have been collected as part of the FAME and STAR projects which have tracked seabirds using GPS tags to determine the foraging movements of these birds. There is a lack of a supporting detailed explanation of the methodology used, both in terms of the calculation of the foraging range and the approach used to obtain data representative of the behaviour of adult kittiwake breeding at the FFC pSPA. It is also important to ensure the tracks obtained represent foraging behaviour and not a response caused by the stress of being tagged, with effects due to 'instrument-induced

behaviours' well documented in the literature (see Vandenabeele *et al.,* 2011). This does not necessarily undermine the figures presented but these data should be treated with the appropriate caution.

1.4.4 Notwithstanding these concerns, the Applicant agrees with Natural England that based on current knowledge a kittiwake foraging range of 156 km is appropriate to inform the assessment of Project Two. This does of course assume that the generic mean-maximum foraging range published by Thaxter *et al*. (2012) (which would lead to the conclusion that Project Two is not reached by FFC pSPA birds in the breeding season) is not considered appropriate in this case.

Population age structure

1.4.5 Within Appendix B of the HRA Report (Doc ref No. 12.6), although some consideration is given to the proportion of the population at the Project site that may be represented by immature and non-breeding adult birds, this proportion was not applied to the collision or displacement figures. The proportion was however used to determine the number of immatures associated with the colonies incorporated into the BDMPS, consistent with the approach in Furness (2015).

1.4.6 Data collected during baseline boat-based surveys appear to indicate that the majority of birds at the Project site are adult birds. Of 22,870 birds for which age was recorded, 94.6% were recorded as adult birds. Natural England's position is that this value could be applied in order to determine the proportion of breeding adults present at the Project site.

1.4.7 However, whilst one year old kittiwakes can be easily identified due to differences in plumage, second and third year birds, which have not yet reached the age of first breeding, defined as four years old by Horswill and Robinson (2015), cannot (Coulson, 2011; Olsen and Larsson, 2003). Further to this, it is not possible to identify adult birds which may be non-breeders from those that are breeding at FFC pSPA. Therefore data collected during boat-based surveys will potentially represent a considerable overestimate of the proportion of breeding adults present at the Project site. Coulson (2011) provides further evidence indicating that immature birds often visit colonies in the year before first breeding.

1.4.8 The information presented in Furness (2015) allows the calculation of the proportion of immature birds present in the North Sea during the non-breeding season and there is the potential to apply these proportions to the breeding season assessment. The use of this approach for kittiwake is considered precautionary as the population of immatures present in the North Sea during the non-breeding season is likely to be lower than that present in the breeding season (Coulson, 1966; Wernham *et al.,* 2002).

1.4.9 The Applicant considers that the application of data from Furness (2015) is more biologically relevant to the assessment of Project Two during the breeding season than compared to site specific data. When applying Furness (2015), the scope of potential source colonies to inform the age structure needs to be determined. All

North Sea colonies represent 362,218 individual kittiwakes, while North Sea colonies on the UK coast only, represent 234,090 individuals. Whilst, Coulson (1966) suggests that the former may be a more accurate representation of the birds intermixing within the North Sea, on a precautionary basis the Applicant applies the latter to this assessment. This leads to an estimated breeding adult proportion of 38% in the breeding season at Project Two (Table 1.2).

Table 1.2: Applicant and Natural England's position regarding apportioning of -breeding adult birds at the Project site during the breeding season.

Position	Description	Proportion (%)	
		Proportion of adult birds from FFC pSPA	Immature/non-breeding proportion
Applicant	Foraging range of 156 km; age structure from Furness (2015) based on UK north Sea colonies	38.0	62.0
Natural England	Foraging range of 156 km; site specific age structure data	94.6	5.4

Apportioned mortality - summary of the Applicant and Natural England positions

1.4.10 The Applicant and Natural England agree on the application of a 156 km foraging range from FFC pSPA in the breeding season. With regards to age structure, Natural England's position is that the use of a 94.6% proportion of breeding adult birds derived from Project Two specific data should be used to determine the number of adults within the Project site originating from the FFC pSPA. The Applicant disagrees that this value should be applied and favours data based on Furness (2015) which suggest a proportion of 38% based on the precautionary assumption that only kittiwakes associated with UK North Sea colonies will be present in the Project Two vicinity.

1.4.11 Apportioned predicted collision mortality to FFC pSPA is shown in Table 1.3. The table applies breeding season collision estimates based on the different views on the seasonal extent by the Applicant (May – July) and Natural England (April – July).

Table 1.3: Breeding season kittiwake collision results apportioned to FFC pSPA from Project Two alone.

Position	Collisions (no apportioning)		Age structure proportions (%)		Apportioned collisions to FFC pSPA	
	Option 2 (98.9%)	Option 4 (98%)	Proportion of adult birds from FFC pSPA	Immature/non-breeding proportion	Option 2 (98.9%)	Option 4 (98%)
Applicant	80.3	**13.5**	38.0	62.0	30.2	**5.1**
Natural England	**106.2**	16.66	94.6	3.4	**100.5**	15.8

1.4.12 The Applicant and Natural England disagree on the application of Options (and avoidance rates) within the Band (2012) Collision Risk Model, as detailed in the HRA Report (Doc. ref. 12.6) and within the Statement of Common Ground submitted by the Applicant in their second response (Appendix R). When applying a breeding adult proportion of 94.6% at Option 2 (98.9% AR) Natural England's position is that 100.5 collisions are apportioned to FFC pSPA in the breeding season (April to July) from Project Two alone.

1.4.13 When applying Option 4 of Band (2012) as favoured by the Applicant, 5.1 collisions are apportioned to the pSPA with an adult proportion of 38% in a breeding season of May – July.

1.5 Annual predicted mortality apportioning to FFC pSPA – Project Two alone

1.5.1 Using the apportioned breeding collision risk estimates presented in Table 1.3, the annual collision risk attributable to the FFC pSPA kittiwake population can be calculated.

1.5.2 There have been no queries in relation to the apportioning of impacts to the kittiwake population at FFC pSPA during the post-breeding season and therefore the apportioning approach presented in Appendix C of the HRA Report (Doc ref No. 12.6) is considered to be appropriate. This applied a 6.3% breeding adults proportion resulting in 0.6 collisions using Option 4 and 3.3 collisions at Option 2 respectively (Table 1.4).

1.5.3 Although there have been no specific queries in relation to the apportioning approach used to attribute impacts to the kittiwake population at FFC pSPA during the pre-breeding season, Natural England have queried the extent of the breeding season defined for kittiwake, which has direct consequences for the pre-breeding season. Natural England's position is that the month of April is best represented as part of the breeding season as detailed in Table 1.3. Natural England's position for the pre-breeding season (where it is assumed that 8.4% of birds are breeding adults) is that 0.8 collisions at Option 2 are apportioned to the pSPA. The Applicant's position using Option 4 results in 0.5 collisions apportioned to the pSPA (Table 1.4).

1.5.4 Using Option 2 (i.e. Natural England's Position) this equates to 104.6 total kittiwake collisions per annum. When using Option 4 (i.e. the Applicant's position) this equates to 6.2 total collisions per annum (Table 1.4).

Table 1.4: Annual kittiwake collision risk attributable to FFC pSPA for Project Two alone.

Season	Collision risk (no. of birds)	
	Option 2	Option 4
Breeding	100.5	5.1
Post-breeding	3.3	0.6
Pre-breeding	0.8	0.5
Total	**104.6**	**6.2**

1.6 Assessment of impacts attributable to the FFC pSPA – In-combination

Consented capacity of projects considered in-combination

1.6.1 In their Relevant and Written Representations, Natural England state that changes to collision risk estimates due to a reduction in the capacity at projects considered in-combination should be applied only where the reduction in project capacity is reflected in the consent granted for the project. Therefore the corrections made to the collision in-combination assessment presented in the HRA (Doc Ref No 12.6) have been reviewed and are further discussed below.

1.6.2 The EIA consent decision for Beatrice Offshore Wind Farm states that the project will have "*not more than 140 wind turbines*" (Marine Scotland, 2014a). However, the collision risk modelling for kittiwake was actually calculated using 142 turbines (Arcus Consultancy Services, 2013). However, due to the small difference between the modelled and consented turbine numbers no correction factor will be applied to the collision outputs for Beatrice.

1.6.3 The consent for Dudgeon Offshore Wind Farm was originally for a 168 turbine scenario, however the developer for the project applied for a variation to the Marine Licence in which the number of turbines proposed at the project was reduced to a maximum of 77 (Dudgeon Offshore Wind Farm, no date). A correction factor to take account of this reduction has been previously applied by Forewind (2014) during the examination of Dogger Bank Creyke Beck. As such, an identical correction factor is applied to the collision risk estimates for kittiwake calculated for Dudgeon with respect to Project Two.

1.6.4 Collision risk modelling for kittiwake at EA ONE was undertaken using a 325 turbine scenario (APEM, 2013). However, the Development Consent Order for the project was for up to 240 turbines (Infrastructure Planning, 2014). Therefore a correction factor of 26.2% is applied to the collision risk estimates for EA ONE. This correction factor has been previously applied by Forewind (2014) during the examination of Dogger Bank Creyke Beck.

1.6.5 The Moray Firth Offshore Wind Farm, which is composed of the Telford, Stevenson and MacColl wind farms, calculated collision risk modelling within the Environmental Statement using a 283 turbine scenario (139:72:72 turbines for the respective wind farms) (Moray Offshore Renewables, 2012). However, as part of

further submissions to Marine Scotland it was stated that the ES had erroneously specified that 139 rather than 72 turbines had been modelled for two of the wind farms (Natural Power, 2013). Further to this the final consent decision for all three of the constituent wind farms stated that each project will have a maximum of 62 turbines. Therefore a correction factor of 55.4% has been applied to the collision risk estimates for the Moray Firth Offshore Wind Farm.

1.6.6 Galloper Offshore Wind Farm received consent for 504MW, in 2014 the developer committed to building a capacity of only 304MW. Triton Knoll Offshore Wind Farm received consent for a capacity of 1.2GW and in 2014 committed to reducing the capacity to between 600MW-900MW. As these projects could still legally build out to their fully to their consented capacity no reductions have been applied to the collision risk results for these projects. However, it should be noted that these projects have publically announced their commitment not to build out to full capacity and are therefore unlikely to apply CfD for the full consented capacity.

1.6.7 Table 1.5 summarises the capacity correction factors applied within the in-combination assessment presented in this report and any differences compared to the HRA Report (Doc ref No. 12.6).

Table 1.5: Review of capacity correction factors for offshore wind farms considered in-combination with Project Two.

Project	HRA capacity reduction applied (%)	Updated capacity reduction applied (%)	No. of turbines	
			Assessment	Consented capacity
Beatrice	25	60	277 (Arcus Consultancy Services, 2013)	140 (Marine Scotland, 2014a)
Dudgeon	54.2	54.2	168 (Dudgeon Offshore Wind Farm, no date)	77 (Dudgeon Offshore Wind Farm, no date)
EA ONE	26.2	26.2	325 (APEM, 2013)	240 (Infrastructure Planning, 2014)
Galloper	30	N/A	140 (Royal Haskoning, 2011)	140 (Infrastructure Planning, 2013a)
Moray	25	55.4	283 (Moray Offshore Renewables, 2012)	186 (Marine Scotland, 2014b, 2014c, 2014d)
Triton Knoll	25	N/A	333 (RWE npower renewables, 2011)	288 (Infrastructure Planning, 2013b)

Status of operational projects considered in-combination

1.6.8 Natural England have also queried the exclusion of projects from the in-combination assessment that are considered by the Applicant to have been operational for a period long enough for impacts associated with a project to now be incorporated into the baseline. This refers to the Beatrice Demonstrator project and Scroby Sands Offshore Wind Farm only. There are no estimates of collisions for Scroby Sands (Natural England, 2013) and it has been agreed with Natural England that any contribution from Scroby Sands to in-combination collision mortality is negligible (SoCG with Natural England, Appendix R of the Applicant's second response). With regard to the Beatrice Demonstrator project, collision risk estimates presented in Natural England (2013) are used to inform the in-combination assessment within this Note.

Projects considered in-combination

1.6.9 A mean-maximum foraging range of 156km has been used to determine which projects are included within the in-combination assessment during the breeding season (as recommended by Natural England). For those projects within mean-maximum foraging range it has been assumed that 100% of birds within the project sites originate from the pSPA during the breeding season. However, for the Dogger Bank Creyke Beck project it has been assumed that 19.3% of birds present within the project site are adult birds from that pSPA, as agreed during examination of this project and consented by the Secretary of State. This approach has been agreed with Natural England.

1.6.10 Table 1.6 and Table 1.7 present collision risk estimates for all projects considered in-combination across all seasons for kittiwake.

1.6.11 Table 1.6 presents collision risk estimates from the Extended model (Options 3 or 4) of Band (2012) where available. Table 1.7 presents collision estimates using the Basic (Options 1 or 2) model of Band (2012). Table 1.6 represents the Applicant's position and Table 1.7 represents Natural England's position.

1.6.12 Both tables present a breakdown of collisions across seasons, the apportioning value applied to each project in each season and the resulting collision estimates apportioned to FFC pSPA.

Table 1.6: Seasonal breakdown of predicted total in-combination collision mortality for kittiwake using results from the Extended Band model, where available (Applicant's position).

Offshore wind farm	Band Model	Option	Avoidance rate (%)	Annual collisions	Breeding	% Apportioning	pSPA breeding collisions	Post-breeding	% Apportioning	pSPA post breeding collisions	Pre-breeding	% Apportioning	pSPA pre breeding collisions
Aberdeen European Offshore Wind Deployment Centre	Band (2012)	2	99.2	13.6				4.3	6.3	0.3	0.8	8.4	0.1
Beatrice	Band (2012)	3	98	17.6				1.3	6.3	0.1	4.8	8.4	0.4
Beatrice Demonstrator	Band (2000)	1	99.2	3.6				1.5	6.3	0.1	1.2	8.4	0.1
Blyth Demonstration Project	Band (2011)	1	99.2	3.9	1.0	100.0	1.0	1.6	6.3	0.1	1.3	8.4	0.1
Dogger Bank Creyke Beck Projects A and B	Band (2012)	3	98	218.0	67.0	19.3	12.9	41.0	6.3	2.6	110.0	8.4	9.2
Dogger Bank Teesside Projects A and B	Band (2012)	3	98	135.0	87.0		0.0	26.7	6.3	1.7	21.3	8.4	1.8
Dudgeon	Band (2000)	1	99.2	0.0	0.0	100.0	0.0	0.0	6.3	0.0	0.0	8.4	0.0
East Anglia One	Band (2012)	3	98	24.4			0.0	16.8	6.3	1.1	5.9	8.4	0.5
Galloper	Band et al. (2007)	1	99.2	47.9			0.0	20.2	6.3	1.3	23.2	8.4	1.9
Greater Gabbard	Band (2000)	1	99.2	20.0			0.0	10.9	6.3	0.7	8.3	8.4	0.7
Hornsea Project One	Band (2012)	4	98	20.7	7.4	100.0	7.4	9.1	6.3	0.6	4.2	8.4	0.4
Hornsea Project Two	Band (2012)	4	98	28.1	13.5	38.0	5.1	8.7	6.3	0.5	5.9	8.4	0.5
Humber Gateway	Not available	1	99.2	5.6	1.4	100.0	1.4	2.3	6.3	0.1	1.9	8.4	0.2
Inch Cape	Band (2012)	1	99.2	219.2			0.0	163.5	6.3	10.3	46.2	8.4	3.9
Kentish Flats	Band (2012)	1	98.9	1.6			0.0	0.7	6.3	0.0	0.5	8.4	0.0
Lincs	Band (2000)	1	99.2	2.0	0.5	100.0	0.5	0.8	6.3	0.1	0.7	8.4	0.1
London Array	Band (2000)	1	99.2	4.0			0.0	1.7	6.3	0.1	1.3	8.4	0.1
Moray Firth Project One (MORL)	Band (2012)	3	98	43.3			0.0	2.0	6.3	0.1	18.4	8.4	1.5
Neart na Gaoithe	Band (2012)	1	99.2	67.9			0.0	40.8	6.3	2.6	3.2	8.4	0.3

Offshore wind farm	Band Model	Option	Avoidance rate (%)	Annual collisions	Breeding	% Apportioning	pSPA breeding collisions	Post-breeding	% Apportioning	pSPA post breeding collisions	Pre-breeding	% Apportioning	pSPA pre breeding collisions
Race Bank	Band (2000)	1	99.2	22.8	1.3	100.0	1.3	17.4	6.3	1.1	4.1	8.4	0.3
Seagreen Alpha	Band (2012)	3	98	172.0			0.0	79.3	6.3	5.0	62.0	8.4	5.2
Seagreen Bravo	Band (2012)	3	98	121.0			0.0	50.2	6.3	3.2	40.2	8.4	3.4
Teesside	Band (2000)	1	99.2	56.1	27.8	100.0	27.8	17.4	6.3	1.1	10.9	8.4	0.9
Thanet	Band (2000)	1	99.2	0.8			0.0	0.3	6.3	0.0	0.3	8.4	0.0
Triton Knoll	Band (2000)	1	99.2	152.0	14.4	100.0	14.4	101.0	6.3	6.4	36.5	8.4	3.1
Westermost Rough	Band et al. (2007)	1	99.2	0.4	0.1	100.0	0.1	0.2	6.3	0.0	0.1	8.4	0.0
TOTAL							**72.1**			**39.0**			**34.7**

Table 1.7: Seasonal breakdown of predicted total in-combination collision mortality using the Basic Band model at 98.9% for kittiwake (Natural England's position).

Offshore wind farm	Band Model	Option	Avoidance rate (%)	Annual collisions	Breeding	% Apportioning	pSPA breeding collisions	Post-breeding	% Apportioning	pSPA post breeding collisions	Pre-breeding	% apportioning	pSPA pre breeding collisions
Aberdeen European Offshore Wind Deployment Centre	Band (2012)	2	98.9	18.70				5.8	6.3	0.4	1.1	8.4	0.1
Beatrice	Band (2012)	1	98.9	57.86				4.3	6.3	0.3	15.9	8.4	1.3
Beatrice Demonstrator	Band (2000)	1	99.2	4.95				2.1	6.3	0.1	1.7	8.4	0.1
Blyth Demonstration Project	Band (2011)	1	98.9	5.39	1.3	100.0	1.3	2.2	6.3	0.1	1.8	8.4	0.2
Dogger Bank Creyke Beck Projects A and B	Band (2012)	2	98.9	718.85	221.0	19.3	42.7	135.2	6.3	8.5	362.7	8.4	30.5
Dogger Bank Teesside Projects A and B	Band (2012)	2	98.9	444.40	287.0	19.3	55.4	78.7	6.3	5.0	78.7	8.4	6.6
Dudgeon	Band (2000)	1	98.9	0.00	0.0	100.0	0.0	0.0	6.3	0.0	0.0	8.4	0.0
East Anglia One	Band (2012)	2	98.9	316.96			0.0	217.9	6.3	13.7	77.3	8.4	6.5
Galloper	Band et al. (2007)	1	98.9	65.89			0.0	27.8	6.3	1.7	31.8	8.4	2.7
Greater Gabbard	Band (2000)	1	98.9	27.50			0.0	15.0	6.3	0.9	11.4	8.4	1.0
Hornsea Project One	Band (2012)	1	98.9	122.00	44.0	100.0	44.0	54.0	6.3	3.4	25.0	8.4	2.1
Hornsea Project Two	Band (2012)	2	98.9	230.00	106.2	95.0	100.9	71.0	6.3	4.5	48.0	8.4	4.0
Humber Gateway	Not available	1	98.9	7.70	1.9	100.0	1.9	3.2	6.3	0.2	2.6	8.4	0.2
Inch Cape	Band (2012)	1	98.9	301.42			0.0	224.8	6.3	14.2	63.5	8.4	5.3
Kentish Flats	Band (2012)	1	98.9	2.20			0.0	0.9	6.3	0.1	0.7	8.4	0.1
Lincs	Band (2000)	1	98.9	2.75	0.7	100.0	0.7	1.1	6.3	0.1	0.9	8.4	0.1
London Array	Band (2000)	1	98.9	5.50			0.0	2.3	6.3	0.1	1.8	8.4	0.2
Moray Firth Project One (MORL)	Band (2012)	1	98.9	36.80			0.0	1.7	6.3	0.1	15.6	8.4	1.3
Neart na Gaoithe	Band (2012)	1	98.9	93.39			0.0	56.1	6.3	3.5	4.4	8.4	0.4
Race Bank	Band (2000)	1	98.9	31.35	1.9	100.0	1.9	23.9	6.3	1.5	5.6	8.4	0.5
Seagreen Alpha	Band (2012)	1	98.9	371.25			0.0	171.1	6.3	10.8	133.8	8.4	11.2

Offshore wind farm	Band Model	Option	Avoidance rate (%)	Annual collisions	Breeding	% Apportioning	pSPA breeding collisions	Post-breeding	% Apportioning	pSPA post breeding collisions	Pre-breeding	% apportioning	pSPA pre breeding collisions
Seagreen Bravo	Band (2012)	1	98.9	343.20			0.0	142.4	6.3	9.0	114.0	8.4	9.6
Teesside	Band (2000)	1	98.9	77.08	38.3	100.0	38.3	23.9	6.3	1.5	14.9	8.4	1.3
Thanet	Band (2000)	1	98.9	1.10			0.0	0.5	6.3	0.0	0.4	8.4	0.0
Triton Knoll	Band (2000)	1	98.9	209.00	19.8	100.0	19.8	138.9	6.3	8.8	50.3	8.4	4.2
Westermost Rough	Band et al. (2007)	1	98.9	0.55	0.1	100.0	0.1	0.2	6.3	0.0	0.2	8.4	0.0
TOTAL							**307.0**			**88.5**			**89.4**

Annual In-combination collision risk

1.6.13 The annual in-combination collision risk applying the Extended Model where available (i.e. the Applicant's position), is predicted to be 146 kittiwake (Table 1.8).

1.6.14 The annual in-combination collision risk using the Basic Band Model (i.e. Natural England's position) ranges is predicted to be 484 kittiwake (Table 1.8).

Table 1.8: Annual in-combination kittiwake collision risk attributable to FFC pSPA.

Season	Collision risk (no. of birds)	
	Natural England (Basic Band model)	Applicant (Extended Band model)
Breeding	307	72.1
Post-breeding	88.5	39
Pre-breeding	89.4	34.7
Total	**484.9**	**145.8**

1.7 Summary and conclusions

Summary

1.7.1 When applying the apportioning approach for Project Two as advocated by the Applicant, the annual in-combination collision risk estimate using the Extended Model (where available) is 146 collisions. Using the Basic Model, the annual in-combination collision risk is 485 collisions applying the apportioning for Project Two as advocated by Natural England. Both of these annual in-combination estimates surpass the 1% threshold of baseline mortality for kittiwake and therefore further modelling has been undertaken using Population Viability Analysis (PVA).

1.7.2 PVA modelling (MacArthur Green 2015) indicates that the kittiwake population at FFC pSPA has been relatively stable. This modelling indicates that the additional collision mortality predicted to arise from Project Two in-combination with other projects (at the level predicted by the Applicant, 146 individuals per annum or at the level predicted by Natural England, 485 birds) would not result in a decline of this population below the pSPA citation of 44,502 pairs.

Conclusion

1.7.3 PVA modelling indicates that the resulting levels of mortality predicted by the Applicant to arise when applying these approaches to apportioning would not be sufficient for the population to decline below the FFC pSPA citation for this species.

1.7.4 There is some uncertainty about how the kittiwake population at Bempton has changed since the 1970s (http://jncc.defra.gov.uk/page-2889) and it has been

argued that the population may have been somewhat higher than it is now. It has, however, been assumed for the purposes of modelling that the population has recently been relatively stable. A maximum growth rate of 13.3% has been calculated for kittiwake (following Niel and Lebreton 2005), but PVA modelling (MacArthur Green 2015) predicts a conservative growth rate of 3.9% (density independent and excluding any immigration). If additional mortality of 150 birds annum is assumed (the Applicant predicts that this will be no more than 146 in-combination) then the model predicts a very slight reduction of 0.16 – 0.19%. Under this scenario, the predicted median impacted population size after 25 years would be approximately 96% of that which the model predicts would occur in the in the absence of any additional impact from the Project. This is a relative reduction in population size (compared to that which might otherwise have arisen). The model predicts a positive growth rate, and so the impacted population after 25 years would still be larger than that which was assumed for the initiation of the modelling exercise.

1.7.5 MacArthur Green (2015) argues that it is likely that the population has remained around 40,000 pairs because strong competition for resources may be limiting colony size through density-dependence (Jovani et al. 2012). A density dependent model was, therefore, also run and this model predicts a very small change in growth rate, approximately 0.03 – 0.06% and consequently a considerably higher ratio of impacted to unimpacted median population size after 25 years (approximately 98-99%).

1.7.6 On this basis, there is no indication that, at the level of mortality predicted to arise from the Project, that the population is likely to decline, over a period of 25 years, to an extent that would mean that the breeding kittiwake population of the FFC pSPA would no longer be considered to be in favourable condition. Furthermore, if it is not the case that density-dependence is limiting population size to approximately 40,000 pairs, there is no indication that the level of mortality predicted by the Applicant would inhibit further growth in the breeding population

1.8 References

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