



THE PLANNING ACT 2008
THE INFRASTRUCTURE PLANNING (EXAMINATION PROCEDURE)
RULES 2010

NORFOLK VANGUARD OFFSHORE WIND FARM

Planning Inspectorate Reference: EN010079

Secretary of State Additional Information Request

**Natural England advice on Flamborough and Filey Coast (FFC) SPA
PVAs and in-combination assessments**

19th November 2021

ANNEX 6: NATURAL ENGLAND ADVICE ON FLAMBOROUGH AND FILEY COAST (FFC) SPA PVAS AND IN-COMBINATION ASSESSMENTS

SECTION 1: UPDATED FLAMBOROUGH AND FILEY COAST (FFC) SPA PVAS AND IN-COMBINATION ASSESSMENTS SUBMITTED ON 26TH AUGUST 2021

1) Avoidance rates (ARs)

1. In our advice dated 20th August 2021 regarding the Norfolk Boreas proposal, Natural England highlighted the recent evidence review we commissioned from British Trust for Ornithology (BTO) into the appropriate avoidance rates (ARs) to use in Collision Risk Modelling (CRM) [REDACTED].
[REDACTED].
2. Given the report was published during the determination period for Norfolk Boreas, we felt it prudent to advise BEIS that Natural England was likely to recommend the revised ARs presented in that review, in an effort to ensure any decisions took account of the latest evidence and any future SNCB recommendations. This advice was given with respect to the impact assessment for kittiwake from Flamborough & Filey Coast SPA (FFC SPA) and lesser black-backed gull from Alde-Ore Estuary SPA (A-OE SPA).
3. The data used to inform the BTO report and the R code were made available by the BTO alongside the report, to allow interested parties to review the report and the evidence base for its recommendations. We have been contacted by the Norfolk Boreas Applicant's consultant who has reviewed that material and raised concerns with the inclusion of one of the post-construction studies within the report. We thank the Norfolk Boreas Applicant's consultant for promptly drawing our attention to these concerns.
4. Natural England has reviewed these concerns and discussed them with the author of the report and the other SNCBs. Having carefully considered the issues raised we have concluded that they present reasonable grounds for the exclusion of that study from the findings of the report. Natural England has therefore concluded that it is not appropriate to use the ARs recommended in the BTO report. This being the case, our advice reverts to that previously provided throughout the Norfolk Vanguard examination i.e. that collision risk modelling (CRM) should use the ARs previously advised by SNCBs i.e.

those presented in SNCBs (2014). We also note that Natural England's advice may not necessarily reflect the views of other interested parties regarding this matter.

5. We are working hard to identify a course of action to ensure that any future recommendations regarding avoidance rates are robust and can be adopted with confidence by stakeholders.

6. Natural England therefore provides our statutory advice below on the basis of avoidance rates recommended in SNCBs (2014), based on the material provided by the Applicant on in response to the SoS letter of 11th August 2021 (Royal Haskoning DHV 2021) and in previous submissions. Given that we have highlighted some issues with the updated PVAs undertaken by the Applicant in Royal Haskoning (2021) (see Section 3 below), which we also highlighted in our recent response at Norfolk Boreas (Natural England 2021), we have supplemented this by utilising the outputs from the recently updated Flamborough and Filey Coast (FFC) SPA PVAs undertaken by the Norfolk Boreas Applicant in their '*update at that request of Natural England*' (MacArthur Green 2021) in order to provide our advice.

2) Summary of NE advice on Habitats Regulation Assessment (HRA) in-combination impacts based on updated Population Viability Analysis (PVAs) and assessments

7. Natural England has reviewed the evidence presented in the updated assessments submitted by the Norfolk Vanguard Applicant in their updated Flamborough and Filey Coast (FFC) SPA PVAs and in-combination assessments document (Royal Haskoning DHV 2021) and the further updated FFC PVAs presented by the Norfolk Boreas Applicant in their FFC SPA PVAs update at that request of Natural England (MacArthur Green 2021). We agree with the updated in-combination totals presented by the Norfolk Vanguard Applicant in Tables 0.1-0.5 of Appendix 1 of Royal Haskoning DHV (2021).

8. A summary of our advice regarding in-combination impacts to the qualifying features of gannet, kittiwake, guillemot and razorbill of the FFC SPA is presented in Table. Detailed advice around how these conclusions were reached are set out in Annex 1. Please note we have provided separate advice on the updated PVA provided for Alde-Ore Estuary SPA lesser black-backed gulls in Annex 7 also summarised here. For completeness, Table 1 presents our previous advice regarding all other HRA in-combination issues

relating to offshore ornithology and Norfolk Vanguard (e.g. Outer Thames Estuary SPA red-throated diver and Greater Wash SPA red-throated diver, common scoter and little gull). There have been no further updates from the Applicant regarding these sites and features.

Table 1 Summary of HRA conclusions for assessments of in-combination impacts of Norfolk Vanguard with other plans and projects

HRA species & site	Norfolk Vanguard in-combination with other plans & projects
Gannet, Flamborough & Filey Coast SPA: collision	No AEol excl. H4, DEP & SEP Unable to rule out AEol incl. H4, DEP & SEP
Gannet, Flamborough & Filey Coast SPA: displacement	No AEol excl. H4, DEP & SEP Unable to rule out AEol incl. H4, DEP & SEP
Gannet, Flamborough & Filey Coast SPA: collision + displacement	No AEol excl. H4, DEP & SEP Unable to rule out AEol incl. H4, DEP & SEP
Kittiwake, Flamborough & Filey Coast SPA: collision	Unable to rule out AEol excl. and incl. H4, DEP & SEP irrespective of whether H3's contribution is 0 or 74
Guillemot, Flamborough & Filey Coast SPA: displacement	No AEol excl. H4, DEP & SEP Unable to rule out AEol incl. H4, DEP & SEP
Razorbill, Flamborough & Filey Coast SPA: displacement	No AEol excl. H4, DEP & SEP Unable to rule out AEol incl. H4, DEP & SEP
Assemblage, Flamborough & Filey Coast SPA	No AEol excl. H4, DEP & SEP Unable to rule out AEol incl. H4, DEP & SEP
Lesser black-backed gull, Alde-Ore Estuary SPA: collision	Unable to rule out AEol incl. or excl. H4, DEP & SEP
Little gull, Greater Wash SPA: collision*	No AEol excl. H4, DEP & SEP Unable to rule out AEol incl. H4, DEP & SEP
Red-throated diver, Greater Wash SPA: displacement (cable construction and O&M vessel movements)**	No AEol, based on Applicant's commitment to mitigation. Unable to rule out AEol incl. H4, DEP & SEP.
Common scoter, Greater Wash SPA: displacement**	No AEol
Red-throated diver, Outer Thames Estuary SPA: displacement (O&M vessel movements)*	No AEol, based on Applicant's commitment to mitigation

* As set out in in our Deadline 7 response [REP7-047]

** As set out in our Deadline 4 response [REP4-040]

9. Natural England has previously provided regulators with our advice regarding our concerns about predicted level of in-combination impacts on North Sea seabirds, especially FFC SPA kittiwakes and e.g. at Hornsea 2, Hornsea 3 and Norfolk Boreas and Alde-Ore Estuary SPA lesser black-backed gulls e.g. at Norfolk Boreas. These concerns have intensified given the further offshore wind farm NSIPs currently in the planning system (East Anglia One North, East Anglia Two, Hornsea 4), with further projects planned to submit in the next 12 months (Dudgeon extension and Sheringham extension), and additional Extensions projects and Round 4 to follow. Therefore, Natural

England again considers that without major project-level mitigation being applied to all relevant projects coming forward, there is a significant risk of large-scale impacts on seabird populations.

10. We note that the Hornsea 4 application has now been accepted by PINS and the Environmental Statement (ES) is now in the public domain. Natural England is in the process of reviewing this submission and is not in a position to provide advice to BEIS regarding the robustness of conclusions of the ES as regards FFC SPA. More generally, Natural England highlights that collision and displacement assessments tend to go through multiple iterations during the Examination phase, and therefore are also subject to change. Accordingly, there remains significant uncertainty regarding the contribution of Hornsea 4 to the in-combination totals.

3) Updated PVAs – FFC SPA

11. We welcome the updated PVAs for the qualifying features of the FFC SPA as submitted by the Applicant in Royal Haskoning DHV (2021). Our advice also takes account of the evidence presented by the Norfolk Boreas Applicant in their updated FFC PVAs and in-combination assessments updated at the request of Natural England (MacArthur Green 2021). This is because this information has been submitted since the Norfolk Vanguard Applicant's updated PVAs in Royal Haskoning DHV (2021) and is highly relevant to the Vanguard assessment. Our detailed advice is presented in Annex I.
12. The Applicant is correct that the online version of the PVA Tool only allows selection of one method for including density dependent effects of population size on demographic rates, and that this is set such that whatever percentage point level of change is applied to a demographic rate (the effect is specified by the user) it operates for every 10 fold change in population size (i.e. a linear function of \log_{10} of population size).
13. The reasons that only one method for specifying density dependence was included in the online Shiny version of the tool were:
 1. to simplify the interface and the running of the online version;
 2. because during the expert workshops for the development of the tool there was no agreement regarding the method to use for incorporating density dependence into the models on seabird populations, and the contractor (UK CEH and BiOSS) considered that the one they selected for the online tool was the best option; and,

3. SNCB advice is currently to not include density dependence unless there is robust evidence regarding the existence and nature of any density dependence operating on the population being modelled – therefore the capability to run a density independent model in the online version was prioritised.
14. The underlying R package for the tool includes four different models for applying density dependence to populations. These include the Weibull function which was suggested by MacArthur Green via the development workshops and subsequent discussion with the contractor. It is also possible to add additional models for density dependence to the underlying package (on top of the 4 options available) if required.
15. If there is good evidence to support use of a particular form of density dependence operating on a specific population then that can be presented by Applicants, and the PVA Tool R package can be used to run models and derive outputs with a range of different methods. However, if this were to be done, Natural England would still request that outputs run with a density independent model are presented, and we would also request that all the input parameters used are presented if running the R package with the alternative methods of density dependence being used. We note that currently we have not accepted or endorsed any particular method for incorporation of density dependence into population models for the species and populations that we have advised on.
16. We welcome that the Applicant has presented both the counterfactuals of population size (CPS) and counterfactuals of growth rate (CGR) metrics from their updated PVAs in Royal Haskoning DHV (2021). CPS and CGR will be considered. We note our advice provided at Deadline 4 during the Norfolk Boreas examination regarding use of both counterfactuals and around use of density dependent vs density independent PVA models^{1,2}. The counterfactual metrics are relative measures, the use of the

¹ Natural England (2020) Norfolk Boreas Offshore Wind Farm Deadline 4: Updated Ornithology Advice – Natural England’s comments in relation to the Norfolk Boreas updated offshore ornithological assessment, submitted at Deadline 2 [REP2-035]. Available from: <https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010087/EN010087-001629-DL4%20-%20Natural%20England%20-%20Updated%20Ornithology%20Advice.pdf>

² Natural England (2020) Norfolk Boreas Offshore Wind Farm: Natural England’s Written Summary of Oral Representations made at Issue Specific Hearing 4 on offshore effects including the Draft Development Consent Order. Available from: <https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010087/EN010087-001630-DL4%20-%20Natural%20England%20-%20Written%20Representation%20of%20Oral%20Case.pdf>

counterfactual metrics does make the metrics less sensitive to mis-specifying density dependence or density independence etc. Without having good evidence to support what form and strength of density dependence to add to a model there is no way of knowing whether the predictions from a density dependent model are robust or accurate, which is why Natural England advise use of the density independent models, or at least inclusion of a density independent option.

17. We note that there are some issues regarding the Applicant's updated PVAs in Royal Haskoning DHV (2021), including relating to the demographic parameters used for all four species and the auk starting populations used and range of impact scenarios assessed. However, we note that since the Royal Haskoning DHV (2021) PVAs were submitted by the Norfolk Vanguard Applicant, the Norfolk Boreas Applicant has submitted further updated FFC PVAs and in-combination assessments in their document titled '*Updated FFC SPA PVAs and in-combination assessments updated at the request of Natural England*' in MacArthur Green (2021). These updated PVAs have now addressed the above issues and hence are highly relevant to our updated advice on in-combination impacts to FFC SPA features at Norfolk Vanguard. Therefore, in our detailed advice in Annex 1 we have utilised the CGRs and CPSs presented by the Norfolk Boreas Applicant from their updated PVAs for the FFC SPA features presented in MacArthur Green (2021) as these represent the best available evidence on which to base an assessment.

18. However, there remain a couple of minor issues with the updated FFC SPA PVAs that have not been addressed by the Applicants in either the Vanguard PVA document (Royal Haskoning DHV 2021) or the more recent Norfolk Boreas update document (MacArthur Green 2021):
 - In Royal Haskoning (2021) and MacArthur Green (2021) all the FFC SPA PVA model outputs have been set as breeding pairs. This does not reflect the advice that Natural England gave during the Norfolk Boreas examination in our Deadline 4 response¹, where we requested that any revised assessments (and hence PVAs) present the metrics calculated across the whole population. The new version of the tool that the Norfolk Vanguard and Norfolk Boreas Applicants have used allows this to be selected as an output type. Whilst in some ways this does not matter, Natural England highlights we would prefer the outputs to be presented as the whole population, and this is consistent with our advice to other developers.

- In both Royal Haskoning DHV (2021) and MacArthur Green (2021), the PVA models have been run based on the precise impact levels from the in-combination assessments (e.g. for collision impacts these have been run to an impact level 0.1 of a bird and for displacement to levels of 1 bird). It would have been beneficial to also present some tables with the counterfactuals for a wider range of figures e.g. for the gannet in-combination collision assessment to present outputs against impacts of 270 and 280 birds, rather than 277.9 only as has been done currently.

SECTION 2: FLAMBOROUGH AND FILEY COAST (FFC) SPA IN-COMBINATION IMPACTS - DETAILED COMMENTS/CONCLUSIONS

19. This document is a technical document submitted to the Secretary of State to provide scientific justification for Natural England's advice regarding the potential impacts of Norfolk Vanguard on designated site features, as summarised within each section.
20. This advice is based on the updated in-combination totals for the FFC SPA features submitted by the Norfolk Vanguard Applicant in response to the Secretary of State letter dated 11 August 2021 and presented in Royal Haskoning DHV (2021) and on the more recently updated FFC SPA PVAs presented by the Norfolk Boreas Applicant in their document titled '*Updated FFC SPA PVAs and in-combination assessments updated at the request of Natural England*' in MacArthur Green (2021). Therefore, this advice updates that previously provided during the Norfolk Vanguard examination, at Deadline 12 [REP12-090] of the East Anglia Two examination and in our recent advice on Norfolk Boreas dated 21st October 2021 regarding in-combination collision and displacement impacts for the features of the FFC SPA. Our advice considers all projects up to and including Hornsea 3, Norfolk Vanguard, Norfolk Boreas, East Anglia One North and East Anglia Two, and both excluding and including the Hornsea 4, and Dudgeon and Sheringham extension projects (DEP & SEP) where the figures are from the application to PINS and PEIRs respectively, and hence subject to change.
21. Our advice is based on best available evidence at the time of writing and is subject to change in the future should further evidence be presented.

2.1 Flamborough and Filey Coast (FFC) SPA: Gannet – impacts from Vanguard in-combination with other plans and projects: Operational collision risk, displacement and collision and displacement.

22. We agree with the updated in-combination totals for all projects including and excluding the PEIR projects presented by the Applicant in Table 3.1 for collisions and Table 3.2 for displacement of Royal Haskoning DHV (2021).
23. As noted in Section 3.1 of our main comments above, we do not agree with the productivity rate used by the Applicant in their updated PVA and advise that a productivity rate of 0.823 (SD 0.038) is used for FFC SPA gannets. However, as set out in Section 3.1 of our main comments above, the more recent updated FFC SPA

PVA run by the Norfolk Boreas Applicant in MacArthur Green (2021) has used the productivity rate recommended by Natural England. Therefore, we have utilised the CGRs and CPSs presented by the Norfolk Boreas Applicant from their updated PVA for FFC SPA gannet in MacArthur Green (2021) as these represent the best available evidence on which to base an assessment, though this should not be taken as an endorsement or 'acceptance' of the model outputs.

24. The Applicant's updated in-combination collision totals for FFC SPA gannet is 293 gannets from the FFC SPA per annum for all projects excluding Hornsea 4, SEP and DEP and 342 for all projects including Hornsea 4, SEP and DEP (predicted total impacts rounded to whole birds). These predicted in-combination collision impacts equate to more than 1% of baseline mortality of the colony.
25. For the collision impacts in-combination with other plans and projects and using the Norfolk Boreas Applicant's more recently updated PVAs in MacArthur Green (2021), if the additional mortality from the offshore wind farms is 293 per annum (in-combination collision total excluding Hornsea 4, SEP and DEP) then the population of FFC SPA after 30 years will be 33.4% lower than it would have been in the absence of the additional mortality. The population growth rate would be reduced by 1.3% (Table A1.01 below).
26. For the collision impacts in-combination with other plans and projects and using the Norfolk Boreas Applicant's more recently updated PVAs in MacArthur Green (2021), if the additional mortality from the offshore wind farms is 342 per annum (in-combination collision total including Hornsea 4, SEP and DEP) then the population of FFC SPA after 30 years will be 37.8% lower than it would have been in the absence of the additional mortality. The population growth rate would be reduced by 1.5% (Table A1.01 below).

Table A1.01 Predicted population impacts on the gannet population of FFC SPA for the range of mortality impacts predicted for in-combination collision. PVA impact metrics are as provided in Table 3.3 of MacArthur Green (2021) for the Natural England requested parameters

GANNET	FFC SPA		
	% Baseline Mortality using mean 2017 census data (26,782 adults)	Counterfactual of Final Population Size (CPS)	Counterfactual of Growth rate (CGR)
293 (all prjs excl. PEIR prjs)	13.51	0.6659	0.9870
342 (all prjs incl. PEIR prjs)	15.75	0.6221	0.9848

27. The Applicant's updated in-combination displacement totals for FFC SPA gannet for the worst-case scenario of 80% displacement and 1% mortality is 62 gannets from the FFC SPA per annum for all projects excluding Hornsea 4, SEP and DEP and 82 for all projects including Hornsea 4, SEP and DEP (predicted total impacts rounded to whole birds). These predicted in-combination collision impacts equate to more than 1% of baseline mortality of the colony. Note only the predicted additional impacts at 80% displacement and 1% mortality have been run through the PVA by the Applicant, no consideration was given to the range of impacts from 60-80% displacement and 1% mortality.
28. For the displacement impacts in-combination with other plans and projects and using the Norfolk Boreas Applicant's more recently updated PVAs in MacArthur Green (2021), if the additional mortality from the offshore wind farms is 62 per annum (in-combination displacement mortality figure for 80% displacement and 1% mortality excluding Hornsea 4, SEP and DEP) then the population of FFC SPA after 30 years will be 8.2% lower than it would have been in the absence of the additional mortality. The population growth rate would be reduced by 0.3% (Table A1.02 below).
29. For the displacement impacts in-combination with other plans and projects and using the Norfolk Boreas Applicant's more recently updated PVAs in MacArthur Green (2021), if the additional mortality from the offshore wind farms is 82 per annum (in-combination displacement mortality figure for 80% displacement and 1% mortality including Hornsea 4, SEP and DEP) then the population of FFC SPA after 30 years will be 10.7% lower than it would have been in the absence of the additional mortality. The population growth rate would be reduced by 0.4% (Table A1.02 below).

Table A1.02 Predicted population impacts on the gannet population of FFC SPA for the range of mortality impacts predicted for in-combination displacement at 80% displacement and 1% mortality. PVA impact metrics are as provided in Table 3.3 of MacArthur Green (2021) for the Natural England requested parameters

GANNET	FFC SPA		
Additional mortality	% Baseline Mortality using mean 2017 census data (26,782 adults)	Counterfactual of Final Population Size (CPS)	Counterfactual of Growth rate (CGR)
62 (all prjs excl. PEIR prjs)	2.86	0.9178	0.9972
82 (all prjs incl. PEIR prjs)	3.78	0.8932	0.9964

30. The combined in-combination impact for all projects excluding Hornsea 4, SEP and DEP of collision plus displacement to gannet from the FFC SPA equals:

- 293 mortalities per annum from collisions plus up to 62 mortalities per annum from displacement = up to 355 mortalities from the FFC SPA.
31. The combined in-combination impact for all projects including Hornsea 4, SEP and DEP of collision plus displacement to gannet from the FFC SPA equals:
- 342 mortalities per annum from collisions plus up to 82 mortalities per annum from displacement = up to 424 mortalities from the FFC SPA.
32. These combined in-combination impacts again equate to over 1% of baseline mortality of the colony. Therefore, the potential combined impacts from in-combination collision plus displacement on the SPA requires further consideration.
33. For the collision plus displacement impacts in-combination with other plans and projects and using the Norfolk Boreas Applicant's more recently updated PVAs in MacArthur Green (2021), if the additional mortality from the offshore wind farms is 355 per annum (in-combination collision plus displacement mortality figure for all projects excluding Hornsea 4, SEP and DEP) then the population of FFC SPA after 30 years will be 38.9% lower than it would have been in the absence of the additional mortality. The population growth rate would be reduced by 1.6% (Table A1.03 below).
34. For the collision plus displacement impacts in-combination with other plans and projects and using the Norfolk Boreas Applicant's more recently updated PVAs in MacArthur Green (2021), if the additional mortality from the offshore wind farms is 424 per annum (in-combination collision plus displacement mortality figure for all projects including Hornsea 4, SEP and DEP) then the population of FFC SPA after 30 years will be 44.5% lower than it would have been in the absence of the additional mortality. The population growth rate would be reduced by 1.9% (Table A1.03 below).

Table A1.03 Predicted population impacts on the gannet population of FFC SPA for the range of mortality impacts predicted for in-combination collision plus displacement mortality. PVA impact metrics are as provided in Table 3.3 of MacArthur Green (2021) for the Natural England requested parameters

GANNET	FFC SPA		
Additional mortality	% Baseline Mortality using mean 2017 census data (26,782 adults)	Counterfactual of Final Population Size (CPS)	Counterfactual of Growth rate (CGR)
355 (all prjs excl. PEIR prjs)	16.38	0.6106	0.9842
424 (all prjs incl. PEIR prjs)	19.51	0.5547	0.9812

35. The gannet population of FFC SPA increased at 11.1% per annum (between 2003/4 and 2015, JNCC Seabird Monitoring Programme SMP data). Using FFC SPA census data 2002-2017 the growth rate was 9.4% per annum. However, it is not known what the growth rate of the colony will be over the next 30 years and this should therefore be considered when judging the significance of predicted impacts against the conservation objectives for the feature.
36. As was undertaken during the Norfolk Vanguard examination, Natural England has reviewed growth rates for the 22 gannet colonies across Britain, Channel Islands and Ireland with repeated census data (Cramp et al. 1974, Lloyd et al. 1991, Mitchell et al. 2004, plus more recent count data from the SMP). The Flamborough/Bempton gannet colony was founded in the late 1930s (Cramp et al. 1974) and so has been in existence now for about 80 years. Thus, by the end of the lifespan of the Norfolk Vanguard project it will be about 110 years in age. Given the analysis of trends in gannet colony growth rates amongst a suite of long-established colonies, it is highly likely that its annual growth rate averaged over the whole period since founding will drop from its current average of c 11% over the first 80 years. The highest annual colony growth rate calculated over a period of >100 years is 4.5% at Grassholm. The Flamborough colony is unlikely to achieve a higher annual growth rate than this. The average annual growth rate calculated over a period of >90 years across the 8 gannet colonies with records exceeding 90 years is 1.8%. Amongst these colonies the mean annual growth rate over the most recent years of their records (80+ years) has been just 1.2% per annum (or 1.3% excluding Sula Sgeir (as the growth rate here may be influenced adversely by an annual licenced harvest of young birds)) compared to an average rate of 2.0% per annum during the first 80 or so years of their existence. Therefore, Natural England has considered the counterfactuals of final population size for the predicted levels of in-combination additional mortality for a range of plausible future growth rate scenarios for FFC of 1, 1.3, 2, 3, 4 and 5% per annum.
37. The Conservation Objective for the gannet population of the FFC SPA is to maintain the size of the breeding population at a level which is above 8,469 pairs (16,938 adults), whilst avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent. The latest mean count is 24,594 adults based on the mean of the 2012, 2015 and 2017 counts.

38. For the predicted in-combination collision mortality to FFC SPA gannets of 293 mortalities per year for all projects excluding Hornsea 4, SEP and DEP, from the Norfolk Boreas Applicant's more recently updated PVAs in MacArthur Green (2021), the colony would be predicted to reduce from its current size of 24,594 adults for a growth rate of 1% but would still be above the size of the 8,469 pairs or 16,938 adults. The colony would be predicted to remain at approximately the mean current population of 24,594 adults under a growth rate scenario of 1.3% and would be predicted to continue to grow above the current mean population of 24,594 adults under any growth rate scenario from 2% to up to 5% per annum.
39. For the predicted in-combination displacement mortality for 80% displacement and 1% mortality to FFC SPA gannets of 62 mortalities per year for all projects excluding Hornsea 4, SEP and DEP, from the Norfolk Boreas Applicant's more recently updated PVAs in MacArthur Green (2021), the colony would still be predicted to grow above the current mean population of 24,594 adults under any growth rate scenario from 1% to up to 5%. This would allow the conservation objective to be met.
40. For the predicted in-combination collision plus displacement mortality to FFC SPA gannets of 355 mortalities per year for all projects excluding Hornsea 4, SEP and DEP, from the Norfolk Boreas Applicant's more recently updated PVAs in MacArthur Green (2021), the colony would be predicted to reduce from its current size of 24,594 adults for a growth rate of 1% and 1.3% but would still be above the size of the 8,469 pairs or 16,938 adults. The colony would be predicted to continue to grow above the current mean population of 24,594 adults under any growth rate scenario from 2% to up to 5% per annum.
41. If the colony were to experience an annual growth rate of 2% or more per annum over the next 30 or so years, then the integrity of the site for this feature is high, with high rates for self-repair, and self-renewal under dynamic conditions with minimal external management. Therefore, the FFC gannet population is believed to be robust enough to allow the conservation objective to maintain the population at (or above) designation levels and sustain

additional alone and in-combination mortalities from the offshore wind farms. Our justification for this position is that we consider it to be highly unlikely that the FFC annual growth rate would be as low as 1%, and from the analysis of gannet colony growth rates we have conducted the current annual growth rate of c 11% appears to be relatively high for a colony of this age and so the colony is likely to do better than a 1.3 % annual growth rate in the foreseeable future.

42. Therefore, based on the above information, an adverse effect on integrity (AEol) of the gannet feature of the FFC SPA can be ruled out for in-combination collision impacts, in-combination displacement impacts and in-combination collision plus displacement impacts when all projects up to and including Hornsea 3, Norfolk Vanguard, Norfolk Boreas, East Anglia One North and East Anglia Two are included in the in-combination totals (i.e. if the Hornsea 4, DEP and SEP projects are excluded from the in-combination totals). For the avoidance of doubt, this is also our advice for a similar scenario presented by the Applicant where Norfolk Vanguard is excluded from the in-combination totals.

43. As set out in our most advice at Norfolk Boreas (Natural England 2021), due to the inevitable uncertainty associated with the figures for Hornsea 4 being from a recently submitted application, and those from DEP and SEP being from the PEIRs and are hence subject to change, Natural England therefore is again not in a position to advise that an AEol can be ruled out for the gannet feature of the FFC SPA for in-combination collision impacts, in-combination displacement impacts and in-combination collision plus displacement impacts when the Hornsea 4, DEP and SEP projects are included in the in-combination totals.

2.2. Flamborough and Filey Coast (FFC) SPA: Kittiwake – impacts from Norfolk Vanguard in-combination with other plans and projects: Operational collision risk

44. We agree with the updated in-combination totals for all projects including and excluding the PEIR projects presented by the Applicant in Table 3.4 of Royal Haskoning DHV (2021).
45. As noted in Section 3.1 of our main comments above, we do not agree with the productivity rate used by the Applicant in their updated PVA and advise that a productivity rate of 0.580 (SD 0.096) is used for FFC SPA kittiwakes. However, as set out in Section 3.1 of our main comments above, the more recent updated FFC SPA PVA run by the Norfolk Boreas Applicant in MacArthur Green (2021) has used the productivity rate recommended by Natural England. Therefore, we have utilised the CGRs and CPSs presented by the Norfolk Boreas Applicant from their updated PVA for FFC SPA kittiwake in MacArthur Green (2021) as these nevertheless represent the best available evidence on which to base an assessment, though this should not be taken as an endorsement or 'acceptance' of the model outputs.
46. The Applicant's updated in-combination collision totals for FFC SPA kittiwake if the Hornsea 3 contribution is assumed to be fully compensated for and set to 0 is 358 kittiwakes from the FFC SPA per annum for all projects excluding Hornsea 4, SEP and DEP, and 533 for all projects including Hornsea 4, SEP and DEP (predicted total impacts rounded to whole birds). Whilst if the Hornsea 3 contribution is not compensated for and its contribution of 74 kittiwakes is included, then the totals are 432 kittiwakes from the FFC SPA per annum for all projects excluding Hornsea 4, SEP and DEP and 607 for all projects including Hornsea 4, SEP and DEP. All of these predicted in-combination collision impacts equate to more than 1% of baseline mortality of the colony.
47. Using the Norfolk Boreas Applicant's more recently updated PVAs in MacArthur Green (2021), if the additional mortality from the windfarm is 358 adults per annum (in-combination total excluding Hornsea 4, DEP and SEP, with Hornsea 3 set at 0) then the population of FFC SPA after 30 years will be 12.0% lower than it would have been in the absence of the additional mortality. The population growth rate would be reduced by 0.4% (Table A1.04). If it is assumed that the FFC SPA kittiwake population is stable, then this would mean that the population would be 12.0% lower than the current population size. Whilst if the additional mortality from the windfarm is 432 adults per annum (in-combination total excluding Hornsea 4, DEP and SEP, with Hornsea 3 set at 74) then the population of FFC SPA after 30 years will be 14.3% lower than it would have been in the absence of the additional mortality. The population growth rate would

be reduced by 0.5% (Table A1.04). If it is assumed that the FFC SPA kittiwake population is stable, then this would mean that the population would be 14.3% lower than the current population size. Both scenarios would be counter to the restore conservation objective for this feature at the site and would result in an adverse effect on the integrity of the site.

48. If the additional mortality from the windfarm is 533 adults per annum (in-combination total including Hornsea 4, DEP and SEP, with Hornsea 3 set at 0) then the population of FFC SPA after 30 years will be 17.3% lower than it would have been in the absence of the additional mortality. The population growth rate would be reduced by 0.6% (Table A1.04). If it is assumed that the FFC SPA kittiwake population is stable, then this would mean that the population would be 17.3% lower than the current population size. Whilst if the additional mortality from the windfarm is 607 adults per annum (in-combination total including Hornsea 4, DEP and SEP, with Hornsea 3 set at 74) then the population of FFC SPA after 30 years will be 19.5% lower than it would have been in the absence of the additional mortality. The population growth rate would be reduced by 0.70% (Table A1.04). If it is assumed that the FFC SPA kittiwake population is stable, then this would mean that the population would be 19.5% lower than the current population size. Both scenarios would be counter to the restore conservation objective for this feature at the site and would result in an adverse effect on the integrity of the site.

Table A1.04 Predicted population impacts on the kittiwake population of FFC SPA for the range of mortality impacts predicted for in-combination collision. PVA impact metrics are as provided in Table 3.5 of MacArthur Green (2021) for the Natural England requested parameters

KITTIWAKE	FFC SPA		
Additional mortality	% Baseline Mortality using mean 2017 census data (103,070 adults)	Counterfactual of Final Population Size (CPS)	Counterfactual of Growth rate (CGR)
358 (all prjs excl. PEIR prjs, H3=0)	2.38	0.8802	0.9959
432 (all prjs excl. PEIR prjs, H3=74)	2.87	0.8571	0.9950
533 (all prjs incl. PEIR prjs, H3=0)	3.54	0.8269	0.9939
607 (all prjs incl. PEIR prjs, H3=74)	4.03	0.8051	0.9930

49. It is not known what the growth rate of the colony will be over the next 30 years and this should be considered when judging the significance of predicted impacts against the conservation objectives for the feature. There has been a 2.2% per annum decline

in numbers for Flamborough Head and Bempton Cliffs colony³ between 1987 and 2017 (a growth rate of 0.979 per annum). Over the period 2000 to 2017 the population has shown a 0.37% per annum increase in numbers (a growth rate of 1.0037 per annum) based on census counts in SMP.

50. Across colonies in the UK the kittiwake population declined by 44% between 1998/2000 and 2015. Between the SCR Census (1985–88) and Seabird 2000 (1998–2002) for major colonies in Britain, no sites showed a per annum increase that exceeded 4.5% (see Section B of Natural England’s Deadline 4 submission for Hornsea Project 2⁴). The growth rate of the colony at Bempton/Flamborough between 2000 and 2017 was 0.37% per annum, following declines from 1987. So, it seems reasonable to assume that the FFC SPA kittiwake colony growth rate is <1% per annum. Therefore, Natural England has again considered the counterfactuals of final population size for the predicted levels of in-combination additional mortality for a range of potential future growth rate scenarios for FFC of stable, 0.37, 1, and 3% per annum, as per our previous advice during the Norfolk Vanguard and Norfolk Boreas examinations.
51. The Conservation Objective for the kittiwake population of the FFC SPA is to restore the size of the breeding population at a level which is above 83,700 breeding pairs, whilst avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent.

2.2.1 Consideration of in-combination impacts excluding the PEIR projects

52. If we assume a 1% per annum growth rate, then 358 additional mortalities per annum (total for all projects excluding the PEIR projects and with Hornsea 3 set to 0) would result in the population being approximately 15,000-16,000 birds lower than without the additional mortality after 30 years, and it would take over an additional 30 years to reach the target population compared to the no windfarm mortality scenario.

³ It should be noted that the new Flamborough and Filey Coast SPA includes additional cliff areas at Filey which support kittiwake but were not previously monitored as part of the SPA, hence the reference to Flamborough Head and Bempton Cliffs.

⁴ Natural England (2015) Hornsea Project Two Offshore Wind Farm – Written Submission for Deadline 4. Available from: <https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010053/EN010053-001163-Natural%20England.pdf>

53. Even under an optimistic growth rate of 3% per annum over the next 30 years, a trajectory for which there is limited evidence to support, then 358 additional mortalities per annum (total for all projects excluding the PEIR projects and with Hornsea 3 set to 0) would result in the population being approximately 25,000-30,000 birds lower than without the additional mortality after 30 years and it would take over an additional 2 years to reach the target population compared to the no windfarm mortality scenario.
54. As a result, it is not possible to rule out adverse effect on integrity (AEol). For the avoidance of doubt, this would also be the case under the presented scenario where Norfolk Vanguard is excluded from the in-combination totals (and would also be the case if Hornsea 3's contribution was set to 74 rather than 0).

2.2.2 Consideration of in-combination impacts including the PEIR projects

55. If we assume a 1% per annum growth rate, then 533 additional mortalities per annum (total for all projects including the PEIR projects and with Hornsea 3 set to 0) would result in the population being around 20,000-25,000 birds lower than without the additional mortality after 30 years and it would take over an additional 70 years to reach the target population compared to the no windfarm mortality scenario.
56. Even under an optimistic growth rate of 3% per annum over the next 30 years, a trajectory for which there is limited evidence to support, then 533 additional mortalities per annum (total for all projects including the PEIR projects and with Hornsea 3 set to 0) would result in the population being approximately 40,000 birds lower than without the additional mortality after 30 years and it would take over an additional 4 years to reach the target population compared to the no windfarm mortality scenario.
57. Again, it is not possible to rule out adverse effect on integrity (AEol). For the avoidance of doubt, this would also be the case under the presented scenario where Norfolk Vanguard is excluded from the in-combination totals (and would also be the case if Hornsea 3's contribution was set to 74 rather than 0).

2.2.3 Conclusions

58. In the context of a population trajectory that is currently stable or increasing at <1% per annum an additional mortality of 348-432 adults per annum (all projects excl. PEIR projects) over 30 years causing a reduction in growth rate of 0.4-0.5%, or of 533-607

adults per annum (all projects incl. PEIR projects) over 30 years causing a reduction in growth rate of 0.6-0.7%, would further harm the population and make it more difficult to restore the population to a favourable condition. Natural England is therefore currently unable to advise beyond reasonable scientific doubt that this level of impact would not be an AEol.

59. There is no evidence to suggest that the future population trend will be significantly different from the current trend of 0.37% per annum (2000-2017), for example productivity at the colony has not been increasing in recent years (see Figure A2.01) (Aitken et al. 2017). So, based on the review of growth rates above, it seems reasonable to assume that the FFC SPA colony growth rate will be <1% per annum.

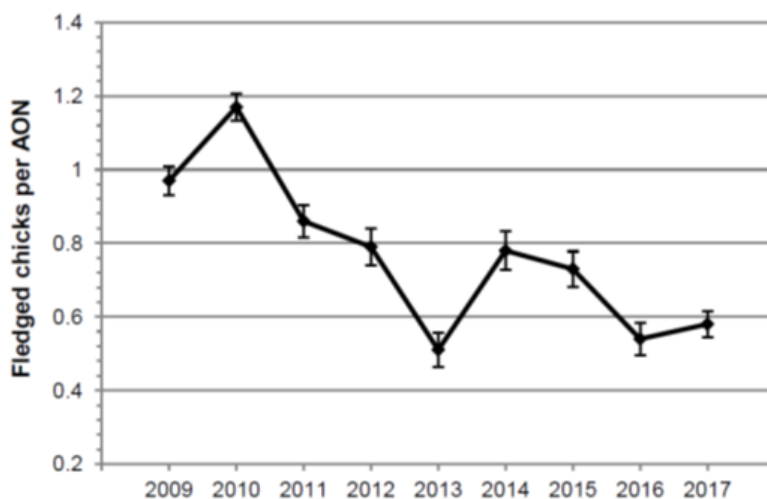


Figure A1.01 Flamborough/Bempton Black-legged kittiwake productivity 2009-2017, mean of plot results +/- SE. From Aitken et al. (2017). Note this does not include productivity data for Filey, where productivity is lower (e.g. in 2017 mean productivity for kittiwake at Filey was 0.39 (SE ± 0.0742) chicks per AON).

60. Therefore, as this feature has a restore conservation objective, and because there are indications that the predicted level of mortality would mean the population could decline from current levels should it currently be stable, **it is not possible to rule out AEol of the kittiwake feature of the FFC SPA for collision impacts from in-combination with other plans and projects, for all projects up to and including Hornsea 3, Norfolk Vanguard, Norfolk Boreas, East Anglia One North and East Anglia Two, irrespective of whether Hornsea 4, DEP and SEP are included in the totals or not.**

61. **We again highlight that the in-combination total of collision mortality across consented plans/projects has already exceeded levels which are considered to be of an AEol to kittiwake at FFC SPA, and that any additional mortality arising from the Norfolk Vanguard proposal would therefore be considered adverse.**

2.3 Flamborough and Filey Coast (FFC) SPA: Guillemot – impacts from Norfolk Vanguard in-combination with other plans and projects: Operational displacement

62. We agree with the updated in-combination guillemot abundances for all projects including and excluding the PEIR projects presented by the Applicant in Table 0.4 in Appendix 1 of Royal Haskoning DHV (2021). However, as noted in Section 3.2 of our main comments above, in Royal Haskoning DHV (2021) the Applicant has not considered predicted impacts covering the whole range of possible impacts advised by Natural England (i.e. a range of displacement rates of 30-70% and a range of mortality rates of 1-10%) and has only considered potential impacts for 70% displacement and 2% mortality. Additionally, as noted in Sections 3.1 and 3.2 of our main comments above, we do not agree with the productivity rate or starting population used by the Applicant in their updated PVA in Royal Haskoning DHV (2021). We advise that a productivity rate of 0.716 (SD 0.076) and a starting population of 121,754 breeding individuals (from Aitken et al. 2017) is used for FFC SPA guillemots. However, as set out in Sections 3.1 and 3.2 of our main comments above, the more recent updated FFC SPA PVA run by the Norfolk Boreas Applicant in MacArthur Green (2021) has used the productivity rate and starting population as recommended by Natural England and has run PVAs covering the predicted impacts across the full range of scenarios of 30-70% displacement and 1-10% mortality. Therefore, we have utilised the CGRs and CPSs presented by the Norfolk Boreas Applicant from their updated PVA for FFC SPA guillemot in MacArthur Green (2021) as these represent the best available evidence on which to base an assessment, though this should not be taken as an endorsement or 'acceptance' of the model outputs.
63. Based on the updated in-combination abundance totals presented by the Applicant in Table 0.4 of Appendix 1 of Royal Haskoning DHV (2021), the annual in-combination total number of guillemots to be at risk of displacement for all projects (**excluding** from Hornsea 4, SEP and DEP) is estimated to be 24,975.

64. For the Natural England recommended rates of 30-70% displacement and 1-10% mortality, the number of predicted additional in-combination mortalities **excluding** Hornsea 4, SEP and DEP is between 75 (30% displacement and 1% mortality) and 1,748 (70% displacement and 10% mortality) guillemots from the FFC SPA. This equates to 1.01-23.54% of baseline mortality for the colony (Table A1.05). This is significant and therefore requires further consideration.

Table A1.05 Predicted annual displacement mortalities for in-combination impact levels for excluding and including Hornsea 4 (H4), Sheringham extension (SEP) and Dudgeon extension (DEP) for guillemot for FFC SPA. Pink shaded cells indicate predicted mortalities that exceed 1% of baseline (Aitken et al. 2017) mortality – baseline mortality calculated using colony starting size of 121,754 breeding individuals and adult mortality rate (6.1% from Horswill & Robinson 2015) – 1% baseline mortality = 74 birds.

Guillemot in-combination mortality figures, EXCLUDING H4, SEP & DEP		% mortality			
FFC adults mean of population		1	2	5	10
% displacement	30	75	150	375	749
	40	100	200	499	999
	50	125	250	624	1,249
	60	150	300	749	1,498
	70	175	350	874	1,748
Guillemot in-combination mortality figures, INCLUDING H4, SEP & DEP		% mortality			
FFC adults mean of population		1	2	5	10
% displacement	30	131	262	655	1,310
	40	175	349	873	1,746
	50	218	437	1,092	2,183
	60	262	524	1,310	2,620
	70	306	611	1,528	3,056

65. Based on the updated in-combination abundance totals presented by the Applicant in Table 0.4 of Appendix 1 of Royal Haskoning DHV (2021), the annual in-combination total number of guillemots to be at risk of displacement for all projects (**including** from Hornsea 4, SEP and DEP) is estimated to be 43,663.
66. For the Natural England recommended rates of 30-70% displacement and 1-10% mortality, the number of predicted additional in-combination mortalities **including** Hornsea 4, SEP and DEP is between 131 (30% displacement and 1% mortality) and 3,056 (70% displacement and 10% mortality) guillemots from the FFC SPA. This equates to 1.76-41.15% of baseline mortality for the colony (Table A1.05). Again, this is significant and therefore requires further consideration.

67. As noted above, we have utilised the more recently updated PVA counterfactual metrics presented by the Norfolk Boreas Applicant in MacArthur Green (2021).
68. The FFC SPA guillemot colony increased by 2.8% per annum between 1987-2008 and the designated population size is 83,214 breeding adults. The 2017 colony count indicated approximately 121,754 breeding adults across the site (Aitken et al. 2017). It is not clear whether the colony will continue to grow at the current rate for the next 30 years, and this should be considered when judging the significance of predicted impacts against the conservation objectives for the feature. The Conservation Objective for the guillemot population of the FFC SPA is to maintain the size of the breeding population at a level which is above 41,607 breeding pairs, whilst avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent.
69. Using the CPSs and CGRs from the most recently updated PVAs undertaken by the Norfolk Boreas Applicant and presented in Table A3.3-A3.6 of MacArthur Green (2021), if the additional mortality from the windfarms is 1,748-3,056 birds per annum (predicted mortalities for the in-combination totals for excluding and including Hornsea 4, SEP and DEP at 70% displacement and 10% mortality) then the population of FFC SPA after 30 years will be 39.7-58.9% lower (based on CPSs presented in Tables A3.5 and A3.6 of MacArthur Green 2021) than it would have been in the absence of the additional mortality. The population growth rate would be reduced by 1.6-2.8% (based on CGRs presented in Tables A3.3 and A3.4 of MacArthur Green 2021), see Table A1.06. This level of impact would be considered significant in the context of the current colony population trend.

Table A1.06 Predicted population impacts on the guillemot population of FFC SPA for the range of mortality impacts predicted for in-combination displacement. PVA impact metrics are those presented by the Norfolk Boreas Applicant in Tables A3.3-A3.6 of MacArthur Green (2021)

GUILLEMOT			
Additional mortality (70% displacement, 10% mortality)	% Baseline Mortality using 2017 population size (121,754 breeding individuals)	Counterfactual of Final Population Size (CPS)	Counterfactual of Growth rate (CGR)
1748 (excl. PEIR prjs)	23.54	0.6032	0.9838
3056 (incl. PEIR prjs)	41.15	0.4110	0.9717

70. While there is some empirical evidence to support the displacement levels for auks, we do not know what the likely mortality impacts of displacement are. We therefore

consider it appropriate to consider a range of mortalities from 1-10%. However, on the basis that the majority of the projects that have been scoped into the assessment lie in areas of the North Sea that represent low to medium levels of guillemot density during both the breeding (where relevant) and non-breeding seasons (Seabird Sensitivity Mapping Tool), it is assumed that areas of low/medium density will be less important/desirable feeding areas and therefore mortality impacts of displacement from lower quality areas would be lower than displacement from optimal/important areas. Therefore, we do not anticipate that mortality rates will be at the top of the range considered for projects with low/medium densities. When Hornsea 4 and DEP and SEP are excluded, Table A1.07 indicates that the mortality is unlikely to exceed a level where the population growth rate would decline by more than approximately 0.5% per annum.

Table A1.07 Predicted % reductions in population growth rates from Norfolk Vanguard in-combination with other plans and projects for excluding and including Hornsea 4 (H4), Sheringham extension (SEP) and Dudgeon extension (DEP). Shaded cells are those where the reduction in growth rate exceeds 0.5%, 1% or 2%.

Guillemot growth rate figures*, EXCLUDING H4, SEP & DEP		% mortality			
FFC adults in-combination		1	2	5	10
% displacement	30	0.07	0.14	0.35	0.69
	40	0.09	0.18	0.46	0.92
	50	0.12	0.23	0.58	1.16
	60	0.14	0.28	0.69	1.39
	70	0.16	0.32	0.81	1.62
Guillemot growth rate figures*, INCLUDING H4, SEP & DEP		% mortality			
FFC adults in-combination		1	2	5	10
% displacement	30	0.12	0.24	0.61	1.21
	40	0.16	0.32	0.81	1.62
	50	0.2	0.4	1.01	2.02
	60	0.24	0.48	1.21	2.42
	70	0.28	0.57	1.41	2.83

* Guillemot CGRs presented in Tables A3.3 and A3.4 of MacArthur Green (2021) - Norfolk Boreas Applicant's most recently updated PVAs using Natural England recommended productivity rates and starting population

71. Therefore, based on the above, the current population trend for the colony and the restore conservation objective, **Natural England's advice remains that an AEol on the guillemot feature of the FFC SPA can be ruled out from displacement in-combination with other plans and projects when all projects up to and including Hornsea 3, Norfolk Vanguard, Norfolk Boreas, East Anglia One North and East**

Anglia Two are included in the in-combination totals (i.e. if the Hornsea 4, DEP and SEP projects are excluded from the in-combination totals).

72. However, the Hornsea 4 PEIR data indicates that there are high densities of guillemot present at the Hornsea 4 site compared to other projects and therefore it may be an important area for guillemot, particularly as Hornsea 4 is significantly closer to FFC SPA compared to other Round 3 projects. As a result, Hornsea 4 is likely to have a higher importance for guillemot from the colony during the breeding season and the immediate post-breeding period. For both these reasons, Natural England considers that the consequences of displacement for guillemot are likely to be significantly higher for this project, and therefore it cannot be assumed that mortality will be at the lower end of the range at Hornsea 4. We also note that when Hornsea 4, DEP and SEP are included in the in-combination totals there is a higher risk of a more substantial reduction in the CGR, as shown in Table A1.07. Therefore, it should not be considered for future projects that Natural England's advice regarding guillemot displacement is that a displacement rate of 70% and mortality rate of 2% is appropriate for use in displacement assessments and we continue to advise that a range of displacement rates of 30-70% and mortality rates of 1-10% should be considered in impact assessments.

73. **Due to the issues identified above regarding the numbers of guillemot in Hornsea 4 array area and its proximity to FFC SPA, the increased risk of reductions in growth rate and population size when Hornsea 4, DEP and SEP are included, and the inevitable uncertainty associated with the figures for these projects due to them being from the PEIRs and hence subject to change, Natural England is again not in a position to advise that an AEoI can be ruled out for the guillemot feature of the FFC SPA for in-combination displacement impacts when the Hornsea 4, DEP and SEP projects are included in the in-combination totals.**

2.4 Flamborough and Filey Coast (FFC) SPA: Razorbill – impacts from Norfolk Vanguard in-combination with other plans and projects: Operational displacement

74. We agree with the updated in-combination razorbill abundances for all projects including and excluding the PEIR projects presented by the Applicant in Table 0.5 in Appendix 1 of Royal Haskoning DHV (2021). However, as noted in Section 3.2 of our main comments above, in Royal Haskoning DHV (2021) the Applicant has not

considered predicted impacts covering the whole range of possible impacts advised by Natural England (i.e. a range of displacement rates of 30-70% and a range of mortality rates of 1-10%) and has only considered potential impacts for 70% displacement and 2% mortality. Additionally, as noted in Section 3.1 and 3.2 of our main comments above, we do not agree with the productivity rate or starting population used by the Applicant in their updated PVA in Royal Haskoning DHV (2021). We advise that a productivity rate of 0.641 (SD 0.068) and a starting population of 40,506 breeding individuals (from Aitken et al. 2017) is used for FFC SPA razorbills. However, as set out in Sections 3.1 and 3.2 of our main comments above, the more recent updated FFC SPA PVA run by the Norfolk Boreas Applicant in MacArthur Green (2021) has used the productivity rate and starting population as recommended by Natural England and has run PVAs covering the predicted impacts across the full range of scenarios of 30-70% displacement and 1-10% mortality. Therefore, we have utilised the CGRs and CPSs presented by the Norfolk Boreas Applicant from their updated PVA for FFC SPA razorbill in MacArthur Green (2021) as these represent the best available evidence on which to base an assessment, though this should not be taken as an endorsement or 'acceptance' of the model outputs.

75. Based on the updated in-combination abundance totals presented by the Applicant in Table 0.5 of Appendix 1 of Royal Haskoning DHV (2021), the annual in-combination total number of razorbills to be at risk of displacement for all projects (**excluding** from Hornsea 4, SEP and DEP) is estimated to be 6,620.
76. For the Natural England recommended rates of 30-70% displacement and 1-10% mortality, the number of predicted additional in-combination mortalities **excluding** Hornsea 4, SEP and DEP is between 19 (30% displacement and 1% mortality) and 435 (70% displacement and 10% mortality) razorbills from the FFC SPA. This equates to 0.44-10.24% of baseline mortality for the colony (Table A1.08). This is significant at the upper level of the displacement/mortality range that the SNCBs advise for auks (70% displacement and 10% mortality) and therefore requires further consideration.

Table A1.08 Predicted annual displacement mortalities for in-combination impact levels for excluding and including Hornsea 4 (H4), Sheringham extension (SEP) and Dudgeon extension (DEP) for razorbill for FFC SPA. Pink shaded cells indicate predicted mortalities that exceed 1% of baseline mortality – baseline mortality calculated using colony starting size of 40,506 breeding individuals (Aitken et al. 2017) and adult mortality rate (10.5% from Horswill & Robinson 2015) – 1% baseline mortality = 43 birds.

Razorbill in-combination mortality figures, EXCLUDING H4, SEP & DEP		% mortality			
FFC adults mean of population		1	2	5	10
% displacement	30	19	37	93	187
	40	25	50	124	249
	50	31	62	155	311
	60	37	75	187	373
	70	44	87	218	345
Razorbill in-combination mortality figures, INCLUDING H4, SEP & DEP		% mortality			
FFC adults mean of population		1	2	5	10
% displacement	30	22	44	109	218
	40	29	58	145	290
	50	36	73	182	363
	60	44	87	218	436
	70	51	102	254	508

77. Based on the updated in-combination abundance totals presented by the Applicant in Table 0.5 of Appendix 1 of Royal Haskoning DHV (2021), the annual in-combination total number of razorbills to be at risk of displacement for all projects (**including** from Hornsea 4, SEP and DEP) is estimated to be 7,262.
78. For the Natural England recommended rates of 30-70% displacement and 1-10% mortality, the number of predicted additional in-combination mortalities **including** Hornsea 4, SEP and DEP is between 22 (30% displacement and 1% mortality) and 508 (70% displacement and 10% mortality) razorbills from the FFC SPA. This equates to 0.51-11.95% of baseline mortality for the colony (Table A1.08). Again, this is significant at the upper level of the displacement/mortality range that the SNCBs advise for auks (70% displacement and 10% mortality) and therefore requires further consideration.
79. As noted above, we have utilised the more recently updated PVA counterfactual metrics presented by the Norfolk Boreas Applicant in MacArthur Green (2021).
80. The FFC SPA razorbill colony increased by 3% per annum 1987-2008 and the designated population size is 21,140 breeding adults. The 2017 colony count indicated approximately 40,506 breeding adults across the site, indicating continued increases (Aitken et al. 2017). It is not clear whether the colony will continue to grow at the current rate for the next 25 years and this should be considered when judging the

significance of predicted impacts against the conservation objectives for the feature. However, colony productivity is higher than the national average. The Conservation Objective for the razorbill population of the FFC SPA is to maintain the size of the breeding population at a level which is above 10,570 breeding pairs whilst avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent.

81. Using the CPSs and CGRs from the most recently updated PVAs undertaken by the Norfolk Boreas Applicant and presented in Tables A3.9-A3.12 of MacArthur Green (2021), if the additional mortality from the windfarms is 435-508 birds per annum (predicted mortalities for the in-combination totals for excluding and including Hornsea 4, SEP and DEP at 70% displacement and 10% mortality) then the population of FFC SPA after 30 years will be 32.8-37.2% lower (based on CPSs presented in Tables A3.11 and A3.12 of MacArthur Green 2021) than it would have been in the absence of the additional mortality. The population growth rate would be reduced by 1.3-1.5% (based on CGRs presented in Tables A3.9 and A3.10 of MacArthur Green 2021), see Table A1.06. This level of impact would be considered significant in the context of the current colony population trend.

Table A1.09 Predicted population impacts on the razorbill population of FFC SPA for the range of mortality impacts predicted for in-combination displacement. PVA impact metrics are those presented by the Norfolk Boreas Applicant in Tables A3.9-A3.12 of MacArthur Green (2021)

RAZORBILL			
Additional mortality (70% displacement, 10% mortality)	% Baseline Mortality using 2017 population size (40,506 breeding individuals)	Counterfactual of Final Population Size (CPS)	Counterfactual of Growth rate (CGR)
435 (excl. PEIR prjs)	10.24	0.6723	0.9873
508 (incl. PEIR prjs)	11.95	0.6284	0.9851

82. Whilst there is some empirical evidence to support the displacement levels for auks, we do not know what the likely mortality impacts of displacement are. We therefore consider it appropriate to consider a range of mortalities from 1-10%. However, on the basis that the majority of the projects that have been scoped into the assessment lie in areas of the North Sea that represent low to medium levels of razorbill density during both the breeding (where relevant) and non-breeding seasons⁵, it is assumed that areas of low/medium density will be less important/desirable feeding areas and

⁵ NE/MMO Seabird Sensitivity Mapping Tool.

therefore mortality impacts of displacement from lower quality areas would be lower than displacement from optimal/important areas. Therefore, we do not anticipate razorbill mortality rates to be at the top of the range considered for projects with low/medium densities. When Hornsea 4 and DEP and SEP are excluded, Table A1.10 indicates that the mortality is unlikely to exceed a level where the population growth rate would decline by more than approximately 0.5% per annum.

Table A1.10 Predicted % reductions in population growth rates from Norfolk Vanguard in-combination with other plans and projects for excluding and including Hornsea 4 (H4), Sheringham extension (SEP) and Dudgeon extension (DEP). Shaded cells are those where the reduction in growth rate exceeds 0.5%, 1% or 2%).

Razorbill growth rate figures*, EXCLUDING H4, SEP & DEP		% mortality			
FFC adults in-combination		1	2	5	10
% displacement	30	0.05	0.11	0.27	0.55
	40	0.07	0.14	0.36	0.73
	50	0.09	0.18	0.45	0.91
	60	0.11	0.22	0.55	1.09
	70	0.13	0.26	0.64	1.27
Razorbill growth rate figures*, INCLUDING H4, SEP & DEP		% mortality			
FFC adults in-combination		1	2	5	10
% displacement	30	0.06	0.13	0.32	0.64
	40	0.08	0.17	0.42	0.85
	50	0.10	0.21	0.53	1.06
	60	0.13	0.26	0.64	1.27
	70	0.15	0.30	0.74	1.49

* Razorbill CGRs presented in Tables A3.9 and A3.10 of MacArthur Green (2021) - Norfolk Boreas Applicant's most recently updated PVAs using Natural England recommended productivity rates and starting population

83. Therefore, based on the above, the current population trend for the colony and the restore conservation objective, **Natural England advice remains that an AEoI on the razorbill feature of the FFC SPA can be ruled out from displacement in-combination with other plans and projects when all projects up to and including Hornsea 3, Norfolk Vanguard, Norfolk Boreas, East Anglia One North and East Anglia Two are included in the in-combination totals (i.e. if the Hornsea 4, DEP and SEP projects are excluded from the in-combination totals).**

84. However, Hornsea 4 is located significantly closer to the FFC SPA compared to other Round 3 projects, and as a result is potentially of a higher importance for razorbill during the breeding season and the immediate post-breeding period. For this reason, Natural England considers that the consequences of displacement for razorbill is likely

to be higher for this project, and therefore higher mortality rates are more likely to be appropriate at Hornsea 4 and it cannot be assumed that mortality will be at the lower end of the range. Therefore, it should not be considered for future projects that Natural England's advice regarding razorbill displacement is that a displacement rate of 70% and mortality rate of 2% is appropriate for use in displacement assessments and we continue to advise that a range of displacement rates of 30-70% and mortality rates of 1-10% should be considered in impact assessments.

- 85. Due to the issues identified above regarding the proximity of Hornsea 4 to FFC SPA and the implications for displacement effects, and the inevitable uncertainty associated with the figures for Hornsea 4, DEP and SEP being from the PEIRs and hence being subject to change, Natural England therefore is not in a position to advise that an AEoI can be ruled out for the razorbill feature of the FFC SPA for in-combination displacement impacts when the Hornsea 4, DEP and SEP projects are included in the in-combination totals.**

REFERENCES

Cramp, S., Bourne, W.R.P. & Sanders, D. (1974) *The Seabirds of Britain and Ireland*. Collins, London.

Horswill, C. & Robinson R. A. (2015) *Review of seabird demographic rates and density dependence*. JNCC Report No. 552. Joint Nature Conservation Committee, Peterborough.

Lloyd, C., Tasker, M.L. & Partridge, K. (1991) *The status of seabirds in Britain and Ireland*. Poyser, London

MacArthur Green (2021) *Norfolk Boreas Offshore Wind Farm Updated Population Viability Analysis: Flamborough and Filey Coast SPA – updated at the request of Natural England*.

Available from: <https://infrastructure.planninginspectorate.gov.uk/wp-content/uploads/projects/EN010087/EN010087-002896-SoS%20Deadline%20-%20Applicant%20-%20Updated%20Population%20Viability%20Analysis%20Flamborough%20and%20Filey%20Coast%20SPA%20-%20Updated%20at%20the%20request%20of%20Natural%20England.pdf>

Mitchell, P.I., Newton, S.F., Ratcliffe, N. & Dunn, T. E. (2004) *Seabird Populations of Britain and Ireland*. T and A.D. Poyser, London.

Natural England (2021) *Norfolk Boreas Offshore Wind Farm 2nd Consultation on Applicant's response to the Secretary of State's Additional Information Request: Appendix 1: Updated Population Viability Analyses (PVAs) and implications for in-combination assessments for Flamborough and Filey Coast Special Protection Area (FFC SPA)*. Available from:

<https://infrastructure.planninginspectorate.gov.uk/wp-content/uploads/projects/EN010087/EN010087-002883-SoS%20Deadline%20-%20Natural%20England.pdf>

Royal Haskoning DHV (2021) *Norfolk Vanguard Offshore Wind Farm Updated Population Viability Analysis: Flamborough and Filey Coast SPA*. Available from:

<https://infrastructure.planninginspectorate.gov.uk/wp-content/uploads/projects/EN010079/EN010079-004399-Updated%20Population%20Viability%20Analysis%20Flamborough%20and%20Filey%20Coast%20SPA.pdf>

SNCBs (JNCC, NE, NIEA, NRW, SNH) (2014). *Joint Response from the Statutory Nature Conservation Bodies to the Marine Scotland Science Avoidance Rate Review*. Available from: [REDACTED]

[REDACTED]