

Date: 21 October 2021
Our ref: Case ref 10570/Consultation ref 369229



Gareth Leigh
Department for Business, Energy & Industrial
Strategy
1 Victoria Street
London
SW1H
0ET

BY EMAIL ONLY

Dear Gareth,

**Norfolk Boreas – 2nd Consultation on Applicant’s response to the Secretary of State’s
Additional Information Request**

Natural England’s remit is to ensure sustainable stewardship of the land and sea so that people and nature can thrive. We are working to achieve a healthy and biodiverse marine environment which can enable a truly sustainable UK offshore wind sector, to support the achievement of ‘net zero’ and address the climate change emergency. This is underpinned by our vision for thriving marine and coastal nature alongside low impact offshore wind energy, tackling both climate and biodiversity emergencies as set out in our [Approach to Offshore Wind](#). Aligned to the four aims of our Approach, we use our expertise to help facilitate offshore windfarms that are sensitively located and constructed, whilst protecting marine ecosystems from proposals with significant environmental impacts through our statutory advice. This, coupled with mechanisms for nature enhancement, will allow marine nature recovery and help mitigate the negative impacts of climate change.

Having reviewed the documents submitted by the Project on 20 August 2021, Natural England provides the following statutory advice to the SoS and BEIS for consideration. This advice considers the updated Population Viability Analyses (PVAs), evidence presented in relation to sandwave levelling and updated DCO/dML conditions.

Further technical ornithological advice is enclosed in the following Appendices:

Appendix 1: Updated Population Visibility Analyses (PVAs) and implications for in-combination

assessments for Flamborough and Filey Coast Special Protection Area (FFC SPA)

Appendix 2: Cumulative and in-combination effects with the Dudgeon and Sheringham Shoal Extension projects

Unless specifically considered as part of this response, all other advice provided by Natural England during the Boreas Examination remains unchanged.

1. Summary of Natural England's Advice on the Additional Information

Natural England continues to advise that adverse effects cannot be ruled out on several SAC and SPA qualifying features as a result of the Boreas proposal. Whilst we consider that there is merit in the compensatory measures brought forward by the Applicant to address these impacts, there is still insufficient detail regarding several important aspects of the measures. In some instances, it has not been satisfactorily demonstrated that the measures are deliverable. Consequently, we consider that the Secretary of State has not been afforded sufficient confidence that the measures can be secured. We are also concerned that the DCO schedule as drafted will not result in compensatory measures being in place in appropriate timescales with respect to the impacts arising.

2. Update on Natural England advice regarding CRM Avoidance Rates

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) (<https://www.bto.org/our-science/publications/research-reports/additional-analysis-inform-sncb-recommendations-regarding>).

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).

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 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 Applicant's consultant for promptly drawing our attention to these concerns.

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 Boreas examination i.e. that collision risk modelling (CRM) should use the ARs previously advised by SNCBs, as presented in SNCBs Avoidance Rate Note (2014). We have alerted the Applicant to this. We also note that Natural England's advice may not necessarily reflect the views of other interested parties regarding this matter.

Natural England sincerely apologise for any inconvenience or additional work caused by our previous advice. 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.

Natural England therefore provides our statutory advice below on the basis of avoidance rates recommended in the SNCBs Avoidance Rate Note (2014), based on the documents submitted by the Applicant for the 25th June 2021 and subsequent 20th August 2021 consultation deadlines. We have supplemented this by carrying our own additional analyses of the 20th August 2021 material in order to provide our detailed advice, as presented in Appendix 1.

We highlight that Natural England's conclusions regarding the significance of the impacts on kittiwake from FFC SPA and lesser black-backed gull from A-OE SPA remain the same irrespective of whether the rates from SNCBs Avoidance Rate Note (2014) or Cook (2021) are used.

3. Updated advice on Habitats Regulations Assessment (HRA) in-combination impacts

Natural England has reviewed the evidence presented in the updated assessments submitted by the Applicant in their updated FFC SPA PVAs and in-combination assessments document (MacArthur Green 2021). We agree with the updated in-combination totals presented by the Applicant in Tables 0.1-0.5 of Appendix 1 of MacArthur Green (2021).

A summary of our advice regarding in-combination impacts to the qualifying features of gannet, kittiwake, guillemot and razorbill of the Flamborough and Filey Coast (FFC) SPA is presented in Table. Detailed advice around how these conclusions were reached are set out in Appendix 1. For completeness, Table 1 presents our previous advice regarding all other HRA in-combination issues relating to offshore ornithology and Norfolk Boreas (e.g. Alde-Ore Estuary SPA lesser black-backed gulls, Greater Wash SPA red-throated diver, common scoter and little gull, and Outer Thames

Estuary SPA red-throated diver). 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 Boreas with other plans and projects

HRA species & site	Norfolk Boreas 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

* Based on updated information provided by the Applicant in MacArthur Green (2021)

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

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

**** Please see Appendix 2 of this letter for our advice on DEP and SEP

***** Our advice for in-combination collision of lesser black-backed gull from the Alde-Ore Estuary SPA is based on the Applicant's in-combination collision totals presented at Deadline 6 [REP6-024], which is based on predicted impacts using an avoidance rate of 99.5% and the PVA undertaken during the Norfolk Vanguard examination.

With regard to lesser black-backed gulls from the Alde-Ore Estuary SPA, we note the request from BEIS for the Applicant to provide updated in-combination collision risk and PVA for lesser black-backed gull at the Alde-Ore Estuary SPA based on the recommended avoidance rate of 98.6% for this species in Cook (2021). Please see our advice at Point 1 of this letter regarding this matter.

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 (e.g. at Hornsea 2, Hornsea 3 and Norfolk Vanguard) and Alde-Ore Estuary SPA lesser black-backed gulls (e.g. at Norfolk Vanguard). These concerns have intensified given the three further offshore wind farm NSIPs currently in the planning system (Norfolk Boreas, East Anglia One North, East Anglia Two), with three further projects planned to submit in the next 12 months (Hornsea 4, 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.

4. Updated Population Viability Analyses (PVAs)

Natural England welcomes the updated PVAs for the qualifying features of the FFC SPA as submitted by the Applicant in MacArthur Green (2021). Whilst Natural England believes the PVAs are broadly sufficient to inform the impact assessments; we have some residual concerns which are set out in detail within the enclosed Appendix 1. Within Appendix 1 we also address points raised by the Applicant regarding the Natural England PVA tool.

5. Sandwave Levelling within Haisborough Hammond and Winterton Special Area of Conservation (HHW SAC)

Natural England has considered the further evidence provided by the Applicant in support of their conclusion that there will be no Adverse Effect on Integrity of Haisborough Hammond and Winterton SAC Annex I Sandbanks from sandwave levelling/sweeping. We consider that the Larsen et al. 2019 paper provides useful evidence from the Race Bank Offshore Windfarm (OWF) to indicate that complete natural regeneration of different types of sandbanks will be achieved within 3 years after

levelling. Natural England highlights that there remains a gap in the evidence to demonstrate that this has fully occurred, due to the lack of further monitoring of the recovery trajectory at Race Bank OWF after the 303 days of monitoring.

Even though there remains some uncertainty as to the exact timeframes for sandbank regeneration, Natural England's experience suggests that complete regeneration is likely to occur on dynamic sandbank systems. Natural England highlights that there is a lack of evidence to suggest that this would be the case in more static sandbank systems. Therefore, we believe that there is a low risk of adverse effects arising due to the proposed sandwave levelling/sweeping by the Norfolk Boreas and/or Norfolk Vanguard projects. This would not be the case for potential alternative options i.e. should additional external cable protection be progressed in the absence of sandwave levelling/sweeping. Please note that Natural England's position in relation to use of external cable protection remains unchanged.

Given the need for evidence to improve our understanding of the timescales for recovery and address this outstanding uncertainty, Natural England advises that monitoring similar in scope to the Larsen et al. 2019 surveys is undertaken of all areas where sandwave sweeping/levelling occurs with HHW SAC and is secured in the Boreas In Principle Monitoring Plan. The initial survey of the impacts should be repeated until such time that the sandbanks are considered by the regulator (in consultation with Natural England) to have satisfactorily regenerated and are providing the same structure and function as to the surrounding sandbanks.

6. Compensation measures with HHW SAC

Since the Applicant's submission for the 25th June 2021 consultation deadline on the proposed compensation measures for HHW SAC, no further information has been submitted to the Secretary of State for consideration. Therefore, our statutory advice provided on 20th August 2021 remains unchanged. We continue to advise that from an ecological perspective there is suitable evidence available to support the potential extension of this particular SAC. We continue to advise that there is ecological potential to be achieved from removing anthropogenic pressures for which there is no existing mechanism for removal. We understand that the feasibility of removing decommissioned Oil and Gas (O&G) pipelines within the site has been put in doubt due to; timeframes, liability concerns and O&G companies indicating their existing commitments to remove any surface laid pipes. However, Natural England is not aware of any commitments to remove surface-laid infrastructure being secured by the O&G companies, and therefore there remains considerable uncertainty given the legislative requirements that removal as opposed to other decommissioning measures e.g. 'making safe' will actually occur.

In addition, Natural England notes there may also be some confusion between stakeholders as to what is meant by 'surface laid'. Natural England considers that any infrastructure that is located on top of/protruding from the seabed, whether or not it has external protection, to be surface laid. However, it is likely that O&G companies only consider exposed pipelines with no protection to be surface laid. It would be helpful going forwards if this could be clarified in discussions with O&G stakeholders to better understand any potential 'additionality' the offshore windfarm industry would bring from removing decommissioned pipelines.

Natural England recommends that BEIS liaise with OPRED in order to fully understand the viability or otherwise of this compensatory measure.

7. DCO/DML

Natural England has reviewed the updated DCO Schedule 19 that the Applicant provided for the consultation deadline on 20th August 2021, and except where explicitly stated in Table 2 below, all issues raised in our advice provided in Annex 4 20th August 2021 remains unchanged.

Table 2: Response to Norfolk Boreas updated Schedule 19 Draft DCO Compensation

Page	Condition	Natural England Comments	RAG
1	Part 1 Condition 2	Natural England notes that this condition has been amended and now contains a time period of 18 months prior to operation. As per Annex 4 of our advice on 23 August 2021 we note that there is still no requirement for the compensation to be in place and functioning, only for the compensation plan to be approved prior to generation. Our comments made on 23 rd August remain and should be considered.	Red
1	Part 1 Condition 3	Natural England notes that the document has been updated to refer to the principles identified within the compensation plan. As noted in our advice on 23 rd August 2021 Annex 4 this amendment provides satisfactory drafting. However, we reiterate that this list was compiled with a view to informing submission of appropriately well-developed compensatory measures into the Examination (or as is the case with current projects, prior to determination), rather than to inform the development of compensatory measures in the post-consent period. It is Natural England's view that sufficient clarify on all these matters is needed prior to determination.	Yellow
2	Part 2 Condition 2	As per comment on Part 1 Condition 2.	Red
2	Part 2 Condition 3	As per comment on Part 1 Condition 3.	Yellow
4	Part 3 Condition 2	Natural England notes that the wording has been amended to note <i>as soon as reasonably practicable and no later than 3 months</i> as per our advice. We accept this change, however, note that this only addresses a minor point of our comments and	Red

		that our outstanding concerns regarding the approach of compensating after impact remain unchanged from our advice of 23 rd August 2021.	
4	Part 3 Condition 5	Natural England notes the changes to address both compensation options within separate conditions and to include monitoring for the removal of anthropogenic material option. We also note the addition of condition 9 regarding the end of life sign off for the compensation and accept this resolves our 'end of life' concerns. However, all other issues raised with regard to these conditions on 23 rd August 2021 remain as per Annex 4 of our advice.	
5	Part 4 Condition 2	As per comment on Part 1 Condition 2.	
5	Part 4 Condition 3	As per comment on Part 1 Condition 3.	
6	Part 4 Condition 8	Natural England notes the inclusion of a close out condition and the need to submit a report for approval with appropriate consultation. We consider this addresses our concerns regarding the need for an end of life sign off report for works with no physical assets to decommission.	
7	Part 5 Condition 2	As per comment on Part 1 Condition 2.	
7	Part 5 Condition 3	As per comment on Part 1 Condition 3.	
8	Part 5 Condition 8	As per comment on Part 4 condition 8.	

8. Dillington Hall Estate

Dillington Hall Estate is a key part of the Wendling Beck Nature Recovery Project (NRP). This is a collaborative, landscape-scale nature recovery project supported by Natural England and various environmental NGOs. This project has been in the planning phase for the past 2 years and will form a strategic project for pioneering the concept of taking land out of intensive production to deliver 'nature based solutions'. The Dillington Hall Estate part of this project will be impacted by a section of the Vattenfall Boreas and Vanguard cable routes which will ultimately occupy the same working corridor.

The project has been aware of the Vattenfall cable route since before the Wendling Beck project was conceived, and as such built the cable path into the design of the project. In the long-term it is envisaged that the cable route will form a huge 'green lane' that will be used to move livestock across the project area. It will also form an important connected corridor for wildlife with high hedges blending into scrub and woodland. However, during the extended timeframe for the determination of the Vattenfall projects, the Wendling Beck NRP has been accelerated. As such the landowners and Natural England will now need to work closely with Vattenfall to ensure that this accelerated program

and associated change in the underlying land use is fully considered as part of any future construction. Natural England notes that the Outline Code of Construction Practice (OCoCP) and the Outline Landscape Environmental Management Scheme (OLEMS) have a range of consultation and mitigations already secured that should be sufficient to ensure that the mitigation needed is consulted upon and approved prior to the works. This also includes consultation with the landowners.

Additionally, Natural England has highlighted to the Applicant that Biodiversity Net Gain credits can be obtained from this project and that, while there is no current legal requirement to provide net gain for NSIP projects, participation could help future proof the developments against any legislative changes as well as help demonstrate and enhance the positive effect of the projects to local stakeholders and residents.

If there are any aspects of our advice that require clarification, please do not hesitate to get in touch.

Yours sincerely

Martin Kerby
Offshore Wind Principal Adviser

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

NORFOLK BOREAS OFFSHORE WIND FARM

Planning Inspectorate Reference: EN010087

Secretary of State Additional Information Request

**Appendix 1: Updated Population Visibility Analyses (PVAs) and
implications for in-combination assessments for Flamborough and
Filey Coast Special Protection Area (FFC SPA)**

21st October 2021

APPENDIX 1: Updated Population Visibility Analyses (PVAs) and implications for in-combination assessments for Flamborough and Filey Coast Special Protection Area (FFC SPA)

Summary

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 Boreas on designated site features, as summarised within each section.

This advice is based on the updated in-combination totals for the FFC SPA features and updated FFC SPA PVAs undertaken by the Applicant in response to the Secretary of State letter dated 9 July 2021 and presented in MacArthur Green (2021). Therefore, this advice updates that previously provided during the Norfolk Boreas examination and at Deadline 12 [REP12-090] of the East Anglia Two examination regarding in-combination collision and displacement impacts for the features of the FFC. 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, Dudgeon extension (DEP) and Sheringham extension (SEP) projects, where the figures are from the PEIRs and hence subject to change.

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.

Detailed Comments

1) Updated PVAs

1. We welcome the updated PVAs for the qualifying features of the FFC SPA as submitted by the Applicant in MacArthur Green (2021).
2. 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).

3. The reasons that only one method for specifying density dependence was included in the online 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 contractors (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.
4. 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.
5. 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.
6. Natural England has 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.
7. 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 MacArthur Green (2021). CPS and CGR will be considered. We note our previous advice during the Norfolk Boreas examination regarding use of both counterfactuals and

around use of density dependent vs density independent PVA models [REP4-040, REP4-043]. The counterfactual metrics are relative measures, the use of the 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.

8. Natural England has identified some issues regarding the Applicant's updated PVAs in MacArthur Green (2021), including relating to the demographic parameters used for all four species and the auk starting populations used and range of impact scenarios assessed. These issues are set out below:

1.1 Productivity rates used in the updated PVAs

9. Natural England does not agree with the productivity rates the Applicant has used for any of the species in the updated PVAs. Boreas have used the pre-populated productivity rates in the PVA tool from selecting 'Country' as the region and 'England' as the sector to use for breeding success. We do not consider these pre-populated productivity values to be suitable for modelling impacts on FFC SPA, due to the age of some of the data used to calculate the productivity rates and hence not being reflective of current productivity levels. In addition, SPA-specific data should be used for HRA-related PVAs where it is available and suitably robust.
10. For example, for FFC SPA gannet, the PVA tool pre-populated value that the Applicant has used (productivity rate of 0.7975, SD 0.0663) is the mean productivity rate for all the England gannet productivity data in the Seabird Monitoring Programme (SMP) database and goes back to the 1980s. Instead, we would advise that average productivity rates and SD for the gannet, guillemot, and razorbill features of the FFC SPA are calculated using the data provided in the FFC SPA Seabird Monitoring Programme reports from 2009 – 2019 (Aitken et al. 2017; Babcock et al. 2014, 2015, 2016, 2018 & Lloyd et al. 2020 – noting that 2009 data should be excluded for razorbill due to only 5 of the 8 plots being monitored in 2009).
11. As a result, we would advise the following productivity rates should have been used in the FFC SPA PVAs for these species:

- gannet – 0.823 (SD 0.038)
- guillemot – 0.716 (SD 0.076)
- razorbill – 0.641 (SD 0.068)

12. For kittiwake, productivity data for Filey is only available since 2012. Productivity for the FFC SPA as a whole for 2012-2019 is 0.580 (SD 0.096). We therefore advise that this rate should have been used in the PVA.

13. In order to provide our final advice to BEIS Natural England has run selected impact scenarios for gannet and kittiwake through the PVA tool using the revised productivity rates (with all of the other input parameters as used by the Applicant) and note that this does not materially alter the outputs and hence our advice. This is perhaps unsurprising as the CGR and CPS that are recommended for use by Natural England in interpretation of PVA outputs are the two metrics that are, in Natural England's opinion, least sensitive to mis-specification of the population trend and demographic rates used in the PVA model. Therefore, in our detailed advice in Annex 1 we have utilised the CGRs and CPSs presented by the Applicant from their updated PVAs for FFC SPA gannet and kittiwake 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.

1.2 Guillemot and razorbill starting populations and impact scenarios

14. In addition to Natural England not agreeing with the productivity rates used by the Applicant (see Section 1.1), we do not agree with the starting populations used by the Applicant for guillemot and razorbill in their updated FFC SPA PVAs. The starting populations used by the Applicant (90,861 guillemot and 30,228 razorbill) are the counts of individuals reported in Aitken et al. (2017). However, as we have previously highlighted to the Applicant, a conversion factor of 0.67 (Birkhead 1978; Harris 1989) is applied to the numbers of individuals recorded in the report to convert into pairs, which are then multiplied by 2 to give the numbers of breeding individuals within the SPA. So, for guillemot, the total number counted on the cliffs = 90,861 individuals, using a conversion factor of 0.67 translates to 60,877 pairs or 121,754 breeding individuals. For razorbill, the total number counted on the cliffs = 30,228 individuals, using a conversion factor of 0.67 translates to 20,253 pairs or 40,506 breeding individuals (Aitken et al.

2017). The appropriate starting populations to use in the PVAs are therefore 121,754 breeding individual/adult guillemot and 40,506 breeding individual/adult razorbill.

15. Furthermore, the Applicant has not presented, either in their updated PVAs or updated in-combination assessment, the full range of predicted displacement impacts to guillemot and razorbill as advised by Natural England. Their updated assessment has focused solely on predicted impacts at 70% displacement and 2% mortality rather than the full range of 30-70% displacement and 1-10% mortality.
16. In order to provide our final advice to BEIS Natural England have re-run the density independent PVAs for FFC SPA guillemot and razorbill to consider the predicted counterfactual metrics for selected scenarios across the full range of predicted impacts across 30-70% displacement and 1-10% mortality, using our preferred productivity rate, starting population sizes and setting the output to be for the whole population. We have also rounded predicted impact levels up to the nearest 10 birds, rather than modelling precise impact levels to 1 or 0.1 of a bird. We have based our advice in this Appendix on the output metrics from our updated PVAs for these species.

1.3 Model outputs set as breeding pairs

17. We highlight that the Applicant has set all the FFC SPA PVA model outputs as breeding pairs. This does not reflect the advice that Natural England gave during the Boreas examination back in REP4-040, 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 Applicant has 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.

1.4 Model outputs run on precise impact levels from in-combination impacts

18. The Applicant has run the PVA models 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.

2) Flamborough and Filey Coast (FFC) SPA in-combination impacts detailed comments/conclusions

2.1 FFC SPA Gannet - impacts from Norfolk Boreas in-combination with other plans and projects

19. 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 MacArthur Green (2021).
20. Natural England does 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, we have run selected impact scenarios for gannet through the PVA tool using this revised productivity rate with all of the other input parameters as used by the Applicant, and note that this does not materially alter the outputs and hence our advice. Therefore, we have utilised the CGRs and CPSs presented by the Applicant from their updated PVA for FFC SPA gannet 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.
21. 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.
22. For the collision impacts in-combination with other plans and projects and using the Applicant's updated PVAs, 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 33.2% 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).
23. For the collision impacts in-combination with other plans and projects and using the Applicant's updated PVAs, 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 37.5% 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)

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)
293 (all prjs excl. PEIR prjs)	13.51	0.6684	0.9871
342 (all prjs incl. PEIR prjs)	15.75	0.6249	0.9849

24. 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.

25. For the displacement impacts in-combination with other plans and projects and using the Applicant’s updated PVAs, 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).

26. For the displacement impacts in-combination with other plans and projects and using the Applicant’s updated PVAs, 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 10.6% 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)

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	0.6684	0.9871
82 (all prjs incl. PEIR prjs)	3.78	0.6249	0.9849

27. 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.

28. 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.

29. 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.

30. For the collision plus displacement impacts in-combination with other plans and projects and using the Applicant's updated PVAs, 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 38.7% 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).

31. For the collision plus displacement impacts in-combination with other plans and projects and using the Applicant's updated PVAs, 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 44.2% 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)

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	0.6684	0.9871
424 (all prjs incl. PEIR prjs)	19.51	0.6249	0.9849

32. 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.

33. As was undertaken during the Norfolk Vanguard examination and used during the Norfolk Boreas 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 Boreas 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.

34. 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.

35. 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.

36. 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 Applicant's updated PVAs, 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 grow slightly above 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.

37. 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 Applicant's updated PVAs, 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.

38. 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 Applicant's updated PVAs, 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.

39. 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.

40. Therefore, based on the above information, an adverse effect on integrity (AEoI) 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 Boreas is excluded from the in-combination totals.

41. As set out in our previous advice during the Norfolk Boreas examination, due to the inevitable uncertainty associated with the figures for Hornsea 4, 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 AEoI 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 FFC SPA Kittiwake - impacts from Norfolk Boreas in-combination with other plans and projects

42. 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 MacArthur Green (2021).

43. As noted in Section 1.1 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, we have run selected impact scenarios for kittiwake through the PVA tool using this revised productivity rate with all of the other input parameters as used by the Applicant, and note that this does not materially alter the outputs and hence our advice. Therefore, we have utilised the CGRs and CPSs presented by the Applicant from their updated PVA for FFC SPA kittiwake 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.
44. 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.
45. Using the Applicant's updated PVAs, 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.

46. 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)

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	0.8801	0.9959
432 (all prjs excl. PEIR prjs, H3=74)	2.87	0.8572	0.9950
533 (all prjs incl. PEIR prjs, H3=0)	3.54	0.8268	0.9939
607 (all prjs incl. PEIR prjs, H3=74)	4.03	0.8051	0.9930

47. 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 colony¹ between 1987 and 2017 (a growth rate of 0.979 per annum). Over the period 2000 to 2017 the population has

¹ 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.

shown a 0.37% per annum increase in numbers (a growth rate of 1.0037 per annum) based on census counts in SMP.

48. 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 2²). 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.

49. 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

50. 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.

51. 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.

² 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>

52. As a result, it is not possible to rule out adverse effect on integrity (AEoI). For the avoidance of doubt, this would also be the case under the presented scenario where Norfolk Boreas 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

53. 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.

54. 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.

55. Again, it is not possible to rule out adverse effect on integrity (AEoI). For the avoidance of doubt, this would also be the case under the presented scenario where Norfolk Boreas 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

56. 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 AEoI.

57. 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.

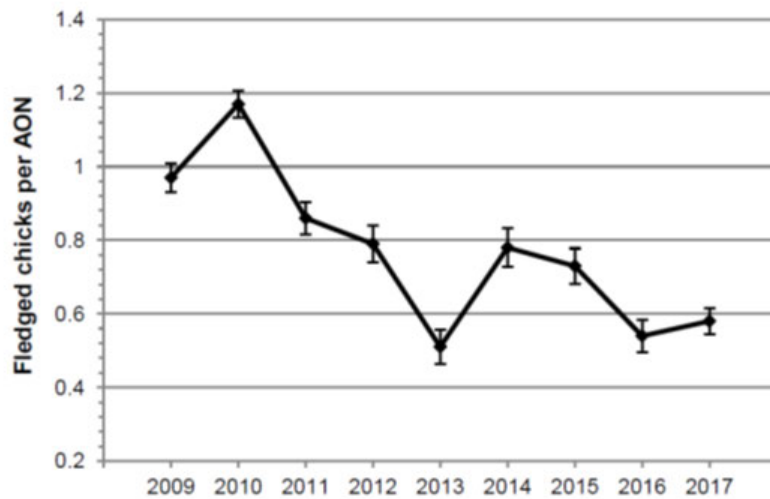


Figure A1.01 Flamborough/Bempton Black-legged kittiwake productivity 2009-2017, mean of plot results +/- SE. From Aitken et al. (2017). Note this does not include productivity data for Filey, where productivity is lower (e.g. in 2017 mean productivity for kittiwake at Filey was 0.39 (SE \pm 0.0742) chicks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

58. 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.**

59. **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 Boreas proposal would therefore be considered adverse.**

2.3 FFC SPA Guillemot - impacts from Norfolk Boreas in-combination with other plans and projects

60. 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 MacArthur Green (2021). However, as noted above, 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 2.1 and 2.5 of our main comments above, we do not agree with the productivity rate or starting population used by the Applicant in their updated PVA. 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. In order to provide our final advice to BEIS Natural England has therefore re-run the PVA for the predicted impacts at 70% displacement and 2% mortality, as submitted by the Applicant, but using our preferred productivity rate and starting population. We have also run PVAs for the predicted impacts at 30% displacement and 1% mortality and for 70% displacement and 10% mortality using these input parameters, to allow a range of potential impacts to be considered.

61. Based on the updated in-combination abundance totals presented by the Applicant in Table 0.4 of Appendix 1 of MacArthur Green (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.

62. 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			
	1	2	5	10
FFC adults mean of population	1	2	5	10
30	75	150	375	749

% displacement	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					
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

* We note that the in-combination predicted mortalities presented here are the same as those presented in our Deadline 12 advice during the East Anglia Two examination³

63. Based on the updated in-combination abundance totals presented by the Applicant in Table 0.4 of Appendix 1 of MacArthur Green (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.

64. 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.

65. As noted above, we have re-run the density independent PVA to consider the predicted counterfactual metrics for selected scenarios across the full range of predicted impacts across 30-70% displacement and 1-10% mortality, using our preferred productivity rate and starting population size (all other relevant input parameters are as used by the Applicant). As the predicted in-combination mortalities are the same as those we

³ Natural England (2021) East Anglia Two Offshore Windfarm: Appendix A16c to the Natural England Deadline 12 submission – Natural England’s Comments on Offshore Ornithology Cumulative and In-Combination Collision Risk and Displacement Update [REP11-027]. Available from: <https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010077/EN010077-005512-Natural%20England%20-%20Appendix%20A16c%20-%20NE%20Comments%20on%20Cumulative%20and%20In-Combination%20Collision%20Risk%20%5bREP11-027%5d%20Deadline%2012.pdf> (DOES THIS NEED PROPER REFERENCING?)

presented in our Deadline 12 response at East Anglia Two, we have focused on re-running the PVAs for the following displacement and mortality rates:

- 30% displacement and 1% mortality, which is the lower end of the Natural England recommended range of rates
- 70% displacement and 2% mortality, as run by the Applicant but with Natural England values used for some parameters.
- 70% displacement and 10% mortality, which is the upper end of the Natural England recommended range of rates.

66. As the predicted impacts will not be accurate to within 1 bird, we have rounded the potential impacts in our PVAs for the different scenarios to the nearest 10 birds.

67. 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.

68. For the in-combination total mortality **excluding** Hornsea 4, SEP and DEP, then if the additional mortality from the windfarm is:

- 80 (for 30% displacement and 1% mortality), then the population of FFC SPA after 30 years will be 2.3% lower than it would have been in the absence of the additional mortality. The population growth rate would be reduced by 0.07%.
- 350 (for 70% displacement and 2% mortality), then the population of FFC SPA after 30 years will be 9.6% lower than it would have been in the absence of the additional mortality. The population growth rate would be reduced by 0.3%.
- 1,750 (for 70% displacement and 10% mortality), then the population of FFC SPA after 30 years will be 39.7% lower than it would have been in the absence of the additional mortality. The population growth rate would be reduced by 1.6% (Table A1.06).

69. For the in-combination total mortality **including** Hornsea 4, SEP and DEP, then if the additional mortality from the windfarm is:

- 140 (for 30% displacement and 1% mortality), then the population of FFC SPA after 30 years will be 3.9% lower than it would have been in the absence of the additional mortality. The population growth rate would be reduced by 0.1%.
- 620 (for 70% displacement and 2% mortality), then the population of FFC SPA after 30 years will be 16.3% lower than it would have been in the absence of the additional mortality. The population growth rate would be reduced by 0.6%.
- 3,060 (for 70% displacement and 10% mortality), then the population of FFC SPA after 30 years will be 58.9% lower than it would have been in the absence of the additional mortality. The population growth rate would be reduced by 2.8% (Table A1.06).

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 calculated from the Natural England re-run of the PVA using the PVA tool, based on Natural England’s preferred productivity rate and starting population, with all other input parameters as used by the Applicant.

GUILLEMOT			
EXCLUDING H4, SEP & DEP			
Additional mortality	% Baseline Mortality using 2017 population size (121,754 breeding individuals)	Counterfactual of Final Population Size (CPS)*	Counterfactual of Growth rate (CGR)*
80 (30%D, 1%M)	1.08	0.9773	0.9993
350 (70%D, 2%M)	4.71	0.9044	0.9968
1,750 (70%D, 10%M)	23.56	0.6030	0.9838
INCLUDING H4, SEP & DEP			
Additional mortality	% Baseline Mortality using 2017 population size (121,754 breeding individuals)	Counterfactual of Final Population Size (CPS)*	Counterfactual of Growth rate (CGR)*
140 (30%D, 1%M)	1.89	0.9607	0.9987
620 (70%D, 2%M)	8.35	0.8367	0.9943
3,060	41.20	0.4106	0.9717

(70%D, 10%M)			
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* Guillemot counterfactuals of population size and growth rate after 30 years, produced by Natural England using input data as set out in Annex 1 below

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 to be at the top of the range considered for projects with low/medium densities. In such instances, we do not expect the mortality to exceed a level where the population growth rate would decline by more than approximately 0.5% per annum.

71. Our most recent advice on the most up to date in-combination FFC SPA guillemot displacement assessment (prior to this response for Norfolk Boreas) was submitted at Deadline 12 of the East Anglia One North/East Anglia Two examinations³. The East Anglia One North/East Anglia Two assessment include the same projects within the in-combination assessment as the assessment presented by the Boreas Applicant in MacArthur Green (2021). In our Deadline 12 advice at East Anglia Two³, the in-combination predicted mortality for all projects **excluding** Hornsea 4, SEP and DEP, at 70% displacement and 2% mortality also equalled 350 additional mortalities per annum. This was the point where growth rates were not predicted to decline by more than 0.5% per annum (at any displacement rate and mortality of 5% or more, growth rates were predicted to decline by more than 0.5%) based on the previous FFC SPA guillemot PVA undertaken by Natural England using the Applicant's previous input parameters. From the outputs of the updated PVAs presented in Table A1.06 above, the mortality at 70% displacement and 2% mortality is again predicted to result in a decline in growth rate of less than 0.5% per annum; for this scenario the growth rate is predicted to decline by 0.3%.

72. Therefore, based on the above, the current population trend for the colony and the restore conservation objective, **Natural England's advice remains that an AEoI 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).

73. 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 A1.06. 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.

74. 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 AEol 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 FFC SPA Razorbill - impacts from Norfolk Boreas in-combination with other plans and projects

75. 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 MacArthur Green (2021). However, as noted in Section 2.5 of our main comments

above, 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 2.1 and 2.5 of our main comments above, we do not agree with the productivity rate or starting population used by the Applicant in their updated PVA. 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. In order to provide our final advice to BEIS Natural England has therefore re-run the PVA for the predicted impacts at 70% displacement and 2% mortality, as submitted by the Applicant, but using our preferred productivity rate and starting population. We have also run PVAs for the predicted impacts at 30% displacement and 1% mortality and for 70% displacement and 10% mortality using these input parameters, to allow a range of potential impacts to be considered.

76. Based on the updated in-combination abundance totals presented by the Applicant in Table 0.5 of Appendix 1 of MacArthur Green (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.

77. 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 A1.07). 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 A1.07 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
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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

* We note that the in-combination predicted mortalities presented here are the same as those presented in our Deadline 12 advice during the East Anglia Two examination⁴

78. Based on the updated in-combination abundance totals presented by the Applicant in Table 0.5 of Appendix 1 of MacArthur Green (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.

79. 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 A1.07). 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.

80. As noted above, we have re-run the density independent PVA to consider the predicted counterfactual metrics for selected scenarios across the full range of predicted impacts across 30-70% displacement and 1-10% mortality, using our preferred productivity rate and starting population size (all other relevant input parameters are as used by the

⁴ Natural England (2021) East Anglia Two Offshore Windfarm: Appendix A16c to the Natural England Deadline 12 submission – Natural England’s Comments on Offshore Ornithology Cumulative and In-Combination Collision Risk and Displacement Update [REP11-027]. Available from: <https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010077/EN010077-005512-Natural%20England%20-%20Appendix%20A16c%20-%20NE%20Comments%20on%20Cumulative%20and%20In-Combination%20Collision%20Risk%20%5bREP11-027%5d%20Deadline%2012.pdf>

Applicant). As the predicted in-combination mortalities are the same as those we presented in our Deadline 12 response at East Anglia Two, as with guillemot, we have focused on re-running the PVAs for the following displacement and mortality rates:

- 30% displacement and 1% mortality, which is the lower end of the Natural England recommended range of rates.
- 70% displacement and 2% mortality, as run by the Applicant, but with Natural England values for some parameters.
- 70% displacement and 10% mortality, which is the upper end of the Natural England recommended range of rates.

81. As the predicted impacts will not be accurate to within 1 bird, we have rounded the potential impacts in our PVAs for the different scenarios up to the nearest 10 birds.

82. 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.

83. For the in-combination total mortality **excluding** Hornsea 4, SEP and DEP, then if the additional mortality from the windfarm is:

- 20 (for 30% displacement and 1% mortality) then the population of FFC SPA after 30 years will be 1.8% lower than it would have been in the absence of the additional mortality. The population growth rate would be reduced by 0.06%.
- 90 (for 70% displacement and 2% mortality) then the population of FFC SPA after 30 years will be 7.8% lower than it would have been in the absence of the additional mortality. The population growth rate would be reduced by 0.3%.
- 350 (for 70% displacement and 10% mortality) then the population of FFC SPA after 30 years will be 27.3% lower than it would have been in the absence of the additional mortality. The population growth rate would be reduced by 1.02% (Table A1.08).

84. For the in-combination total mortality **including** Hornsea 4, SEP and DEP, then if the additional mortality from the windfarm is:

- 30 (for 30% displacement and 1% mortality) then the population of FFC SPA after 30 years will be 2.7% lower than it would have been in the absence of the additional mortality. The population growth rate would be reduced by 0.1%.
- 110 (for 70% displacement and 2% mortality) then the population of FFC SPA after 30 years will be 9.5% lower than it would have been in the absence of the additional mortality. The population growth rate would be reduced by 0.3%.
- 510 (for 70% displacement and 10% mortality) then the population of FFC SPA after 30 years will be 37.2% lower than it would have been in the absence of the additional mortality. The population growth rate would be reduced by 1.5% (Table A1.08).

Table A1.08 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 calculated from the Natural England re-run of the PVA using the PVA tool, based on Natural England's preferred productivity rate and starting population, with all other input parameters as used by the Applicant.

RAZORBILL			
EXCLUDING H4, SEP & DEP			
Additional mortality	% Baseline Mortality using 2017 population size (40,506 breeding individuals)	Counterfactual of Final Population Size (CPS)*	Counterfactual of Growth rate (CGR)*
20 (30%D, 1%M)	0.47	0.9822	0.9994
90 (70%D, 2%M)	2.12	0.9218	0.9974
350 (70%D, 10%M)	8.23	0.7269	0.9898
INCLUDING H4, SEP & DEP			
Additional mortality	% Baseline Mortality using 2017 population size (121,754 breeding individuals)	Counterfactual of Final Population Size (CPS)*	Counterfactual of Growth rate (CGR)*
30 (30%D, 1%M)	0.71	0.9730	0.9991
110 (70%D, 2%M)	2.59	0.9049	0.9968
510 (70%D, 10%M)	11.99	0.6277	0.9851

* Razorbill counterfactuals of population size and growth rate after 30 years, produced by Natural England using input data as set out in Annex 1 below.

85. 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 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. In such instances we do not expect the mortality to exceed a level where the population growth rate would decline by more than approximately 0.5% per annum.

86. Our most recent advice on the most up to date in-combination FFC SPA razorbill displacement assessment (prior to this response for Norfolk Boreas) was submitted at Deadline 12 of the East Anglia One North/East Anglia Two examinations⁴. The East Anglia One North/East Anglia Two assessment include the same projects within the in-combination assessment as the assessment presented by the Boreas Applicant in MacArthur Green (2021). In our Deadline 12 advice at East Anglia Two⁵, the in-combination predicted mortality for all projects **excluding** Hornsea 4, SEP and DEP, at 70% displacement and 2% mortality also equalled 90 additional mortalities per annum. This was the point where growth rates were not predicted to decline by more than 0.5% per annum based on the previous FFC SPA razorbill PVA undertaken during the Hornsea 3 examination. From the outputs of the updated PVAs presented in Table A1.08 above, the mortality at 70% displacement and 2% mortality is again predicted to result in a decline in growth rate of less than 0.5% per annum; for this scenario the growth rate is predicted to decline by 0.3%.

87. Therefore, based on the above, the current population trend for the colony and the restore conservation objective, **Natural England advice remains that an AEol 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**

⁵ NE/MMO Seabird Sensitivity Mapping Tool. http://www.gis.naturalengland.org.uk/pubs/gis/GIS_register.asp

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).

88. 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.

89. **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 AEol 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.**

Annex 1: Natural England's FFC SPA guillemot and razorbill in-combination displacement PVA parameter logs

A02.1 Guillemot excluding PEIR projects (Hornsea 4, DEP and SEP)

Set up

The log file was created on: 2021-10-06 11:57:56 using Tool version 2, with R version 3.5.1, PVA package version: 4.17 (with UI version 1.7)

##	Package	Version
## popbio	"popbio"	"2.4.4"
## shiny	"shiny"	"1.1.0"
## shinyjs	"shinyjs"	"1.0"
## shinydashboard	"shinydashboard"	"0.7.1"
## shinyWidgets	"shinyWidgets"	"0.4.5"
## DT	"DT"	"0.5"
## plotly	"plotly"	"4.8.0"
## rmarkdown	"rmarkdown"	"1.10"
## dplyr	"dplyr"	"0.7.6"
## tidyr	"tidyr"	"0.8.1"

Basic information

This run had reference name "GU FFC DI excl PEIR".

PVA model run type: simplescenarios.

Model to use for environmental stochasticity: betagamma.

Model for density dependence: nodd.

Include demographic stochasticity in model?: Yes.

Number of simulations: 5000.

Random seed: 50.

Years for burn-in: 0.

Case study selected: None.

Baseline demographic rates

Species chosen to set initial values: Common Guillemot.

Region type to use for breeding success data: Country.

Available colony-specific survival rate: National. Sector to use within breeding success region: England.

Age at first breeding: 6.

Is there an upper constraint on productivity in the model?: Yes, constrained to 1 per pair.

Number of subpopulations: 1.

Are demographic rates applied separately to each subpopulation?: No.

Units for initial population size: breeding.adults

Are baseline demographic rates specified separately for immatures?: Yes.

Population 1

Initial population values: Initial population 121754 in 2025

Productivity rate per pair: mean: 0.716 , sd: 0.076

Adult survival rate: mean: 0.94 , sd: 0.025

Immatures survival rates:

Age class 0 to 1 - mean: 0.56 , sd: 0.058 , DD: NA

Age class 1 to 2 - mean: 0.792 , sd: 0.152 , DD: NA

Age class 2 to 3 - mean: 0.917 , sd: 0.098 , DD: NA

Age class 3 to 4 - mean: 0.938 , sd: 0.107 , DD: NA

Age class 4 to 5 - mean: 0.94 , sd: 0.025 , DD: NA

Age class 5 to 6 - mean: 0.94 , sd: 0.025 , DD: NA

Impacts

Number of impact scenarios: 3.

Are impacts applied separately to each subpopulation?: No

Are impacts of scenarios specified separately for immatures?: No

Are standard errors of impacts available?: No

Should random seeds be matched for impact scenarios?: No

Are impacts specified as a relative value or absolute harvest?: relative

Years in which impacts are assumed to begin and end: 2026 to 2056

Impact on Demographic Rates

Scenario A - Name: mort 80 (30%D, 1%M)

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.000657063 , se: NA

Scenario B - Name: mort 350 (70%D, 2%M)

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.002874649 , se: NA

Scenario C - Name: mort 1750 (70%D, 10%M)

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.01437324 , se: NA

Output:

First year to include in outputs: 2026

Final year to include in outputs: 2056

How should outputs be produced, in terms of ages?: whole.population

Target population size to use in calculating impact metrics: NA

Quasi-extinction threshold to use in calculating impact metrics: NA

A02.2 Guillemot including PEIR projects (Hornsea 4, DEP and SEP)

Set up

The log file was created on: 2021-10-06 15:07:22 using Tool version 2, with R version 3.5.1, PVA package version: 4.17 (with UI version 1.7)

##	Package	Version
## popbio	"popbio"	"2.4.4"
## shiny	"shiny"	"1.1.0"
## shinyjs	"shinyjs"	"1.0"
## shinydashboard	"shinydashboard"	"0.7.1"
## shinyWidgets	"shinyWidgets"	"0.4.5"
## DT	"DT"	"0.5"
## plotly	"plotly"	"4.8.0"
## rmarkdown	"rmarkdown"	"1.10"
## dplyr	"dplyr"	"0.7.6"
## tidyr	"tidyr"	"0.8.1"

Basic information

This run had reference name "GU FFC DI with PEIR".

PVA model run type: simplescenarios.

Model to use for environmental stochasticity: betagamma.

Model for density dependence: nodd.

Include demographic stochasticity in model?: Yes.

Number of simulations: 5000.

Random seed: 50.

Years for burn-in: 0.

Case study selected: None.

Baseline demographic rates

Species chosen to set initial values: Common Guillemot.

Region type to use for breeding success data: Country.

Available colony-specific survival rate: National. Sector to use within breeding success region: England.

Age at first breeding: 6.

Is there an upper constraint on productivity in the model?: Yes, constrained to 1 per pair.

Number of subpopulations: 1.

Are demographic rates applied separately to each subpopulation?: No.

Units for initial population size: breeding.adults

Are baseline demographic rates specified separately for immatures?: Yes.

Population 1

Initial population values: Initial population 121754 in 2025

Productivity rate per pair: mean: 0.716 , sd: 0.076

Adult survival rate: mean: 0.94 , sd: 0.025

Immatures survival rates:

Age class 0 to 1 - mean: 0.56 , sd: 0.058 , DD: NA

Age class 1 to 2 - mean: 0.792 , sd: 0.152 , DD: NA

Age class 2 to 3 - mean: 0.917 , sd: 0.098 , DD: NA

Age class 3 to 4 - mean: 0.938 , sd: 0.107 , DD: NA

Age class 4 to 5 - mean: 0.94 , sd: 0.025 , DD: NA

Age class 5 to 6 - mean: 0.94 , sd: 0.025 , DD: NA

Impacts

Number of impact scenarios: 3.

Are impacts applied separately to each subpopulation?: No

Are impacts of scenarios specified separately for immatures?: No

Are standard errors of impacts available?: No

Should random seeds be matched for impact scenarios?: No

Are impacts specified as a relative value or absolute harvest?: relative

Years in which impacts are assumed to begin and end: 2026 to 2056

Impact on Demographic Rates

Scenario A - Name: mort 140 (30%D, 1%M)

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.00114986 , se: NA

Scenario B - Name: mort 620 (70%D, 2%M)

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.005092235 , se: NA

Scenario C - Name: mort 3060 (70%D, 10%M)

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.02513264 , se: NA

Output:

First year to include in outputs: 2026

Final year to include in outputs: 2056

How should outputs be produced, in terms of ages?: whole.population

Target population size to use in calculating impact metrics: NA

Quasi-extinction threshold to use in calculating impact metrics: NA

A02.3 Razorbill excluding PEIR projects (Hornsea 4, DEP and SEP)

Set up

The log file was created on: 2021-10-07 09:45:40 using Tool version 2, with R version 3.5.1, PVA package version: 4.17 (with UI version 1.7)

##	Package	Version
## popbio	"popbio"	"2.4.4"
## shiny	"shiny"	"1.1.0"
## shinyjs	"shinyjs"	"1.0"
## shinydashboard	"shinydashboard"	"0.7.1"
## shinyWidgets	"shinyWidgets"	"0.4.5"
## DT	"DT"	"0.5"
## plotly	"plotly"	"4.8.0"
## rmarkdown	"rmarkdown"	"1.10"
## dplyr	"dplyr"	"0.7.6"
## tidyr	"tidyr"	"0.8.1"

Basic information

This run had reference name "RA FFC DI excl PEIR".
PVA model run type: simplescenarios.
Model to use for environmental stochasticity: betagamma.
Model for density dependence: nodd.
Include demographic stochasticity in model?: Yes.
Number of simulations: 5000.
Random seed: 50.
Years for burn-in: 0.
Case study selected: None.

Baseline demographic rates

Species chosen to set initial values: Razorbill.
Region type to use for breeding success data: Country.
Available colony-specific survival rate: National. Sector to use within breeding success region: England.
Age at first breeding: 5.
Is there an upper constraint on productivity in the model?: Yes, constrained to 1 per pair.
Number of subpopulations: 1.
Are demographic rates applied separately to each subpopulation?: No.
Units for initial population size: breeding.adults
Are baseline demographic rates specified separately for immatures?: Yes.

Population 1

Initial population values: Initial population 40506 in 2025

Productivity rate per pair: mean: 0.641 , sd: 0.068

Adult survival rate: mean: 0.895 , sd: 0.067

Immatures survival rates:

Age class 0 to 1 - mean: 0.63 , sd: 0.067 , DD: NA

Age class 1 to 2 - mean: 0.63 , sd: 0.067 , DD: NA

Age class 2 to 3 - mean: 0.895 , sd: 0.067 , DD: NA

Age class 3 to 4 - mean: 0.895 , sd: 0.067 , DD: NA

Age class 4 to 5 - mean: 0.895 , sd: 0.067 , DD: NA

Impacts

Number of impact scenarios: 3.

Are impacts applied separately to each subpopulation?: No

Are impacts of scenarios specified separately for immatures?: No

Are standard errors of impacts available?: No

Should random seeds be matched for impact scenarios?: No

Are impacts specified as a relative value or absolute harvest?: relative

Years in which impacts are assumed to begin and end: 2026 to 2056

Impact on Demographic Rates

Scenario A - Name: mort 20 (30%D, 1%M)

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.000493754 , se: NA

Scenario B - Name: mort 90 (70%D, 2%M)

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.002221893 , se: NA

Scenario C - Name: mort 350 (70%D, 10%M)

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.008640695 , se: NA

Output:

First year to include in outputs: 2026

Final year to include in outputs: 2056

How should outputs be produced, in terms of ages?: whole.population

Target population size to use in calculating impact metrics: NA

Quasi-extinction threshold to use in calculating impact metrics: NA

A02.4 Razorbill including PEIR projects (Hornsea 4, DEP and SEP)

Set up

The log file was created on: 2021-10-07 11:41:13 using Tool version 2, with R version 3.5.1,
PVA package version: 4.17 (with UI version 1.7)

##	Package	Version
## popbio	"popbio"	"2.4.4"
## shiny	"shiny"	"1.1.0"
## shinyjs	"shinyjs"	"1.0"
## shinydashboard	"shinydashboard"	"0.7.1"
## shinyWidgets	"shinyWidgets"	"0.4.5"
## DT	"DT"	"0.5"
## plotly	"plotly"	"4.8.0"
## rmarkdown	"rmarkdown"	"1.10"
## dplyr	"dplyr"	"0.7.6"
## tidyr	"tidyr"	"0.8.1"

Basic information

This run had reference name "RA FFC DI incl PEIR".
PVA model run type: simplescenarios.
Model to use for environmental stochasticity: betagamma.
Model for density dependence: nodd.
Include demographic stochasticity in model?: Yes.
Number of simulations: 5000.
Random seed: 50.
Years for burn-in: 0.
Case study selected: None.

Baseline demographic rates

Species chosen to set initial values: Razorbill.
Region type to use for breeding success data: Country.
Available colony-specific survival rate: National. Sector to use within breeding success region: England.
Age at first breeding: 5.
Is there an upper constraint on productivity in the model?: Yes, constrained to 1 per pair.
Number of subpopulations: 1.
Are demographic rates applied separately to each subpopulation?: No.
Units for initial population size: breeding.adults
Are baseline demographic rates specified separately for immatures?: Yes.

Population 1

Initial population values: Initial population 40506 in 2025

Productivity rate per pair: mean: 0.641 , sd: 0.068

Adult survival rate: mean: 0.895 , sd: 0.067

Immatures survival rates:

Age class 0 to 1 - mean: 0.63 , sd: 0.067 , DD: NA

Age class 1 to 2 - mean: 0.63 , sd: 0.067 , DD: NA

Age class 2 to 3 - mean: 0.895 , sd: 0.067 , DD: NA

Age class 3 to 4 - mean: 0.895 , sd: 0.067 , DD: NA

Age class 4 to 5 - mean: 0.895 , sd: 0.067 , DD: NA

Impacts

Number of impact scenarios: 3.

Are impacts applied separately to each subpopulation?: No

Are impacts of scenarios specified separately for immatures?: No

Are standard errors of impacts available?: No

Should random seeds be matched for impact scenarios?: No

Are impacts specified as a relative value or absolute harvest?: relative

Years in which impacts are assumed to begin and end: 2026 to 2056

Impact on Demographic Rates

Scenario A - Name: mort 30 (30%D, 1%M)

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.000740631 , se: NA

Scenario B - Name: mort 110 (70%D, 2%M)

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.002715647 , se: NA

Scenario C - Name: mort 510 (70%D, 10%M)

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.01259073 , se: NA

Output:

First year to include in outputs: 2026

Final year to include in outputs: 2056

How should outputs be produced, in terms of ages?: whole.population

Target population size to use in calculating impact metrics: NA
Quasi-extinction threshold to use in calculating impact metrics: NA

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

NORFOLK BOREAS OFFSHORE WIND FARM

Planning Inspectorate Reference: EN010087

Secretary of State Additional Information Request

**Appendix 2: Cumulative and in-combination effects with the
Dudgeon and Sheringham Shoal Extension projects**

21st October 2021

APPENDIX 2: Cumulative and in-combination effects with the Dudgeon and Sheringham Shoal Extension projects

Summary Comments

We welcome the information provided by the Norfolk Boreas Applicant on updated cumulative and in-combination effects with the Dudgeon (DEP) and Sheringham Shoal (SEP) Extension projects. However, we note that the figures for these projects currently available in the public domain are those from the PEIR for the projects. These figures are hence subject to ongoing discussions through the Evidence Plan process and hence have an element of uncertainty associated with them and are subject to change (the same applies to figures for Hornsea 4).

Therefore, the inevitable uncertainty around the DEP and SEP (and Hornsea 4) figures means that Natural England is not in a position to advise that a significant adverse impact for cumulative impacts at EIA scale, or that an AEoI for in-combination impacts at HRA, can be ruled out for any relevant species or feature of an SPA when the DEP and SEP (and Hornsea 4) projects are included in the totals.

Hence, we do not agree with the Applicant's conclusions regarding offshore ornithology of:

- No likely significant effects for any receptor for cumulative impacts (collision and/or displacement) at EIA scale; and,
- No Adverse Effect on Integrity (AEoI) for any site and species combination for in-combination impacts (collision and/or displacement).

Detailed Comments

1) Natural England's Advice on Offshore Ornithology EIA Scale Cumulative Impacts including DEP and SEP

1. Natural England has previously provided regulators with our advice regarding our concerns about predicted level of cumulative impacts on North Sea seabirds (e.g. during the Norfolk Vanguard and Boreas and East Anglia One North/East Anglia Two examinations). For EIA we have been unable to rule out a significant adverse effect (i.e. moderate adverse or above) for cumulative operational impacts on:

- Gannet for cumulative collision and cumulative collision plus displacement impacts;
 - Kittiwake and great black-backed gull for cumulative collision impacts;
 - Guillemot and razorbill for cumulative displacement impacts; and,
 - Red-throated diver for cumulative displacement impacts.
2. As the DEP and SEP projects are located within the same Biologically Defined Minimum Population Scales (BDMPs) as Norfolk Boreas for all the above species, the DEP and SEP projects will be adding further affected birds to these totals. **Therefore, our advice above remains irrespective of whether DEP and SEP are included in the cumulative totals or not.**
3. In our final advice during the East Anglia One North/East Anglia Two examination (Natural England 2021¹), where the cumulative assessment included the same OWF projects as the Boreas assessment, we advised that a significant adverse effect could be ruled out for cumulative operational impacts when the PEIR projects (i.e. Hornsea 4 and DEP and SEP) were excluded from the totals:
- Lesser black-backed gull (LBBG), herring gull and little gull cumulative collision.
4. However, due to the inevitable uncertainty associated with the figures for DEP and SEP (and Hornsea 4) being from the PEIRs and are hence subject to change, Natural England therefore is not in a position to advise that significant adverse impact can be ruled out for LBBG, herring gull and little gull for cumulative collision impacts when the DEP and SEP (and Hornsea 4) projects are included in the cumulative totals.

2) Natural England's Advice on Offshore Ornithology HRA Scale In-Combination Impacts including DEP and SEP

5. Natural England has previously provided regulators with our advice regarding our concerns about predicted level of in-combination impacts on North Sea seabirds (e.g. during the Norfolk Vanguard and Boreas and East Anglia One North/East Anglia Two

¹ Natural England (2021) East Anglia Two Offshore Windfarm: Appendix A16c to the Natural England Deadline 12 submission – Natural England's Comments on Offshore Ornithology Cumulative and In-Combination Collision Risk and Displacement Update [REP11-027]. Available from: <https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010077/EN010077-005512-Natural%20England%20-%20Appendix%20A16c%20-%20NE%20Comments%20on%20Cumulative%20and%20In-Combination%20Collision%20Risk%20%5bREP11-027%5d%20Deadline%2012.pdf>

examinations). For HRA we have been unable to rule out AEol for in-combination operational impacts on:

- Kittiwake at the Flamborough and Filey Coast (FFC) SPA due to in-combination collision impacts; and,
 - LBBG at the Alde-Ore Estuary SPA due to in-combination collision impacts.
6. As Norfolk Boreas and the DEP and SEP projects are located within the same Biologically Defined Minimum Population Scales (BDMPs), all of these projects have the potential to add further affected birds to these totals. **Therefore, our advice on the above qualifying features remains irrespective of whether DEP and SEP are included in the in-combination totals or not.**
 7. **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 Boreas, DEP and SEP proposals would therefore be considered adverse.**
 8. For the other **qualifying features of the FFC SPA** (guillemot, razorbill and seabird assemblage), in our final advice during the East Anglia One North/East Anglia Two examination (Natural England 2021¹), where the in-combination assessment included the same OWF projects as the Boreas assessment, we advised that an AEol could be ruled out for these features for operational in-combination displacement for guillemot and razorbill and operational collision and displacement for the seabird assemblage when the PEIR projects (i.e. Hornsea 4 and DEP and SEP) were excluded from the totals. **However, due to the inevitable uncertainty associated with the figures for DEP and SEP (and Hornsea 4) being from the PEIRs and are hence subject to change, Natural England therefore is not in a position to advise that an AEol can be ruled out for in-combination displacement of guillemot and razorbill of the FFC SPA and for in-combination collision and displacement of the seabird assemblage of the FFC SPA when the DEP and SEP (and Hornsea 4) projects are included in the cumulative totals.**
 9. For the **qualifying features of the Greater Wash SPA** considered by the Applicant (red-throated diver, Sandwich tern and common tern), we advise that the Norfolk Boreas site is located outside of the foraging ranges of these features. NB: Both tern species are also features of the North Norfolk Coast SPA for which the same advice applies. In

addition, because common tern and Sandwich tern tend to migrate parallel to the coast in broad bands and tend to concentrate in the zone from 1-10km from the coast, non-breeding impacts the tern features of the Greater Wash SPA were screened out for LSE at Norfolk Boreas. Therefore, **we advise that the Norfolk Boreas site would make no contribution to the in-combination assessment for Sandwich and common tern when DEP and SEP are included.**

10. For red-throated diver (RTD), following discussions with Natural England, the Applicant committed to best practice vessel mitigation for cable laying and for O&M vessel movements, and only one cable laying vessel in the SPA during the winter period. This mitigation allowed Natural England to conclude that an AEoI could be ruled out.
11. Nevertheless, Boreas will have a residual, time-limited contribution to disturbance effects within the Greater Wash SPA that could operate in-combination with other disturbing activities that come forward in the future. Based on their PEIR, the DEP and SEP Applicants have not to date brought forward any mitigation measures to address disturbance/displacement during the cable installation, and that it is presently unclear whether the cable installation phases of Boreas and the DEP & SEP projects could overlap. Accordingly, **we are not currently in a position to rule out an adverse effect on integrity on Greater Wash RTD in-combination when DEP & SEP are included.** We have advised DEP and SEP to consider mitigation measures including seasonal restrictions to cable installation and operation and maintenance activities to address these impacts.