RWE Renewables UK Dogger Bank South (West) Limited

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Dogger Bank South Offshore Wind Farms

Report to Inform Appropriate Assessment

Habitats Regulations Assessment

Volume 6

Part 4 of 4 – Marine Ornithological Features (Revision 3)

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Revision Change Log			
Rev No.	**Page**	**Section**	**Description**
01	N/A	N/A	Submitted for DCO Application
02	All	1	The Guide to the Application has been updated to account for the addition of the Pre-Examination Procedural Deadline documents and the updates of documents previously submitted as part of the DCO Submission
03	24	9.1	Section 9.1 - Update to Assessment – Natural England Advice and Responses section added, including Table 9-2 Summary of Changes to Assessment of Designated Sites and Features Screened In.
03	51	9.2.2	Table 9-4 Construction Seasonal Displacement Mortality in the Array Areas and Table 9 5 Operation Seasonal Displacement in the Array Areas updated
03	56	9.2.4	Information added following NE's request that guillemot from Flamborough and Filey Coast (FFC) SPA should be assessed with an additional post-breeding/chick rearing period in August and September.
03	58	9.2.5	Average mortality rates as advised by NE added to Table 9-7.
03	62	9.2.5	Additional details on the apportioning calculations (requested by NE) have been added to Tables 9-8 and 9-9.
03	76 – 641	9.5 – 9.26	Assessment sections updated based on NE Relevant Representations.
03	647 – 675	Annex A	Annex A updated based on NE Relevant Representations.

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Annex A – SPA PVA Results

Glossary

Term	Definition
Array Areas	The DBS East and DBS West offshore Array Areas, where the wind turbines, offshore platforms and array cables will be located. The Array Areas do not include the Offshore Export Cable Corridor or the Inter-Platform Cable Corridor within which no wind turbines are proposed. Each area is referred to separately as an Array Area.
Array cables	Offshore cables which link the wind turbines to the Offshore Converter Platform(s).
Collision	The act or process of colliding (crashing) between two moving objects.
Collision Risk Model (CRM)	Quantitative means to estimate the number of predicted collisions between seabirds recorded in the Array Areas and rotating wind turbines.
Concurrent Scenario	A potential construction scenario for the Projects where DBS East and DBS West are both constructed at the same time.
Cumulative effects	The combined effect of the Projects in combination with the effects of a number of different (defined cumulative) schemes, on the same single receptor / resource.
Cumulative Effects Assessment (CEA)	The assessment of the combined effect of the Projects in combination with the effects of a number of different (defined cumulative) schemes, on the same single receptor/resource.
Cumulative impact	The combined impact of the Projects in combination with the effects of a number of different (defined cumulative) schemes, on the same single receptor / resource.
Development Consent Order (DCO)	An order made under the Planning Act 2008 granting development consent for one or more Nationally Significant Infrastructure Project (NSIP).
Development Scenario	Description of how the DBS East and/or DBS West Projects would be constructed either in-isolation, sequentially or concurrently.
Dogger Bank South (DBS) Offshore Wind Farms	The collective name for the two Projects, DBS East and DBS West.

Term	Definition
Effect	Term used to express the consequence of an impact. The significance of an effect is determined by correlating the magnitude of the impact with the value, or sensitivity, of the receptor or resource in accordance with defined significance criteria.
Electrical Switching Platform (ESP)	The Electrical Switching Platform (ESP), if required would be located either within one of the Array Areas (alongside an Offshore Converter Platform (OCP)) or the Export Cable Platform Search Area.
Environmental Impact Assessment (EIA)	A statutory process by which certain planned projects must be assessed before a formal decision to proceed can be made. It involves the collection and consideration of environmental information, which fulfils the assessment requirements of the EIA Directive and EIA Regulations, including the publication of an Environmental Statement (ES).
Environmental Statement (ES)	A document reporting the findings of the EIA and produced in accordance with the EIA Directive as transposed into UK law by the EIA Regulations.
Evidence Plan Process (EPP)	A voluntary consultation process with specialist stakeholders to agree the approach, and information to support, the Environmental Impact Assessment (EIA) and Habitats Regulations Assessment (HRA) for certain topics.
Expert Topic Group (ETG)	A forum for targeted engagement with regulators and interested stakeholders through the EPP.
Export Cable Platform Search Area	The Export Cable Platform Search Area is located mid-way along the Offshore Export Cable Corridor and is the area of search for the Electrical Switching Platform (ESP).
Habitats Regulations	Conservation of Habitats and Species Regulations 2017 and Conservation of Offshore Marine Habitats and Species Regulations 2017.
Habitats Regulations Assessment (HRA)	The process that determines whether or not a plan or project many have an adverse effect on the integrity of a European Site or European Offshore Marine Site.

Term	Definition
Impact	Used to describe a change resulting from an activity via the Projects, i.e. increased suspended sediments / increased noise.
In Isolation Scenario	A potential construction scenario for one Project which includes either the DBS East or DBS West array, associated offshore and onshore cabling and only the eastern Onshore Converter Station within the Onshore Substation Zone and only the northern route of the onward cable route to the proposed Birkhill Wood National Grid Substation.
Inter-Platform Cable Corridor	The area where Inter-Platform Cables would route between platforms within the DBS East and DBS West Array Areas, should both Projects be constructed.
Inter-Platform Cables	Buried offshore cables which link offshore platforms.
Intertidal	Area on a shore that lies between Mean High Water Springs (MHWS) and Mean Low Water Springs (MLWS).
Landfall	The point on the coastline at which the Offshore Export Cables are brought onshore, connecting to the onshore cables at the Transition Joint Bay (TJB) above mean high water.
Mean Sea Level	The average level of the sea surface over a defined period (usually a year or longer), taking account of all tidal effects and surge events.
National Site Network	The National Site Network comprises National Site Network sites (formerly referred to as European) in the UK that already existed (i.e., were established under the Nature Directives) on 31 December 2020 (or proposed to the EC before that date) and any new sites designated under the Habitats Regulations under an amended designation process.
National Site Network sites	Sites designated for nature conservation under the Habitats Directive and Birds Directive. This includes candidate Special Areas of Conservation, Sites of Community Importance, Special Areas of Conservation and Special Protection Areas, and is defined in regulation 8 of the Conservation of Habitats and Species Regulations 2017.

Term	Definition
Offshore Development Area	The Offshore Development Area for ES encompasses both the DBS East and West Array Areas, the Inter-Platform Cable Corridor, the Offshore Export Cable Corridor, plus the associated Construction Buffer Zones.
Offshore Export Cable Corridor	This is the area which will contain the Offshore Export Cables (and potentially the ESP) between the offshore substation / converter platforms and Transition Joint Bays at the landfall.
Offshore Export Cables	The cables which would bring electricity from the offshore platforms to the Transition Joint Bays (TJBs).
Projects Design (or Rochdale) Envelope	A concept that ensures the EIA is based on assessing the realistic worst-case scenario where flexibility or a range of options is sought as part of the consent application.
Sequential Scenario	A potential construction scenario for the Projects where DBS East and DBS West are constructed with a lag between the commencement of construction activities. Either Project could be built first.
Special Protection Area (SPA)	Strictly protected sites designated pursuant to Article 4 of the Birds Directive (via the Habitats Regulations) for species listed on Annex I of the Directive and for regularly occurring migratory species
The Applicants	The Applicants for the Projects are RWE Renewables UK Dogger Bank South (East) Limited and RWE Renewables UK Dogger Bank South (West) Limited. The Applicants are themselves jointly owned by the RWE Group of companies (51% stake) and Masdar (49% stake).
The Projects	DBS East and DBS West (collectively referred to as the Dogger Bank South offshore wind farms).
Wind turbine	Power generating device that is driven by the kinetic energy of the wind.

Acronyms

Term	Definition
AEoI	Adverse Effect on [Site] Integrity
CGR	Counterfactuals of Growth Rate
CRM	Collision Risk Modelling
DBS	Dogger Bank South
DCO	Development Consent Order
EIA	Environmental Impact Assessment
ES	Environmental Statement
ESP	Electrical Switching Platform
FFC	Flamborough and Filey Coast
HVAC	High Voltage Alternating Current
HVDC	High Voltage Direct Current
MCA	Maximum Curvature Analysis
PCH	Potential Collision Height
PVA	Population Viability Analyses
RIAA	Report to Inform Appropriate Assessment
SPA	Special Protection Area

9 Sites Designated for Marine Ornithological Features

9.1 Update to Assessment – Natural England Advice and Responses

1. This document updates the submitted ornithology RIAA, addressing comments received from Natural England [RR-039]. **Table 9-1** provides the comments received, the Applicants' responses and the sections in the RIAA where the comment has been addressed. While this this updated assessment has been provided as requested in order to facilitate full engagement with stakeholders, it remains the case that the Applicants' consider the original assessment, produced following the guidance and information available at the time, is a robust and accurate consideration of the Projects' impacts.

2. It should also be noted that Natural England comments which related in the first instance to the EIA have been addressed and discussed within the update to the Offshore Ornithology Assessment (REF), and where relevant methodological updates have been applied through this RIAA update (e.g. summing of East and West abundances for the combined assessment).

Table 9-1 Post-Submission Comments from Natural England and The Applicant's Responses

Comment number	Natural England Relevant Representation [RR-039]	Natural England's Recommendations to Resolve Issues	Applicant's Response	Section
G9	**Characterisation of Natural England/SNCB advice** Whilst we welcome that the Applicant has at times sought to provide analysis that aligns with Natural England's advice, we note that this and wider SNCB advice on both methodology and interpretation of results is frequently referred to as "overly precautionary" or not based in evidence, whilst the Applicant's preferred methods are characterised as "evidence-based". The SNCB approach is no less evidence-led than that of the Applicant. It is simply a different interpretation of the same evidence, and one which takes account of the evidence-poor, high-uncertainty environment within which the assessments are carried out, as well as the requirements of the Habitats Regulations. Ultimately this is a matter of ecological judgment and given Natural England's role as the appropriate national conservation body, considerable weight ought to be given to its advice and there should be cogent and compelling reasons for departing from it	To note.	The Applicants' acknowledge Natural England's position on this matter. However, by way of illustration of the Applicants' concern that the SNCB approach to assessment, which combines individual elements of precaution to arrive at highly precautionary conclusions, it is informative to consider the Flamborough and Filey Coast (FFC) SPA in-combination assessment of guillemot. The estimated total number of guillemots at risk of displacement from all OWFs within the UK North Sea BDMPS combined is 647,032 (**Table 9-28**). Using Natural England advised methods, the estimated number of these that are adults from FFC SPA is 110,084, from an SPA population of 149,978. This suggests that over 73% of the FFC SPA guillemot population is apparently present on all UK wind farms through the course of the year and at risk of displacement, despite the fact that offshore wind farms actually make up approximately 6% of the area within 300km of the FFC SPA, 12 times less than the in-combination assessment indicates (and a considerably smaller proportion across the UK North Sea as a whole). It is not difficult to envisage that, with the addition of a small number of wind farms the current assessment methods could predict more birds are at risk of displacement than are present in the population.	9.6.2.3.5.1
G31	**Breeding season apportioning** Insufficient detail has been provided on the methods and parameters used to determine apportioning proportions during the breeding season. There are also inconsistencies in the Applicant's description of the approach taken, with paragraph 28 stating that SPA populations were obtained from SPA citations, whilst Tables 9.6 and 9.7 indicate that more recent SPA population sizes were used.	Natural England advise that further detail and clarity is provided on the foraging ranges and SPA populations used to calculate breeding season apportioning proportions. We advise that the more up-to-date and contemporaneous SPA populations from Seabirds Count data (Burnell *et al* 2023) should be used to determine proportions for apportioning during the breeding season, rather than SPA citation populations, unless more recent counts are available.	Additional information has been provided. Note also that the apparent discrepancy between paragraph 28 and tables 9.6 and 9.7 actually reflects that these two sections refer to nonbreeding and breeding season apportioning respectively. This has been clarified in paragraph 35 (which related to nonbreeding season methods where use of SPA citation populations is appropriate since these correspond to the values used to derive the BDMPS).	9.2.5
G32	**Calculation of adult baseline mortality of gannet at FFC SPA**	Natural England advise that the adult baseline mortality for FFC	This update has been made to the relevant section.	Paragraph 111 and

Comment number	Natural England Relevant Representation [RR-039]	Natural England's Recommendations to Resolve Issues	Applicant's Response	Section
	The Applicant has used an adult mortality rate for gannet of 8.8%, cited as being from the recommended demographic rates published in Horswill & Robinson (2015). However, the adult mortality rate from that source is 8.1%. When combined with the 2022 population estimate, this gives an adult baseline mortality of 2126 birds, not 2310.	SPA gannet is recalculated using the 8.1% mortality rate from Horswill and Robinson (2015), and the rest of the assessment of impacts on this population adjusted accordingly.	The slightly smaller background mortality for the FFC SPA population (2,126, cf. 2,310) results in slightly elevated estimated impacts (from an increase in mortality of 0.58-0.94% to 0.62-1.0%; **Table 9-16**). PVA modelling predicts the upper end of this range could reduce the population growth rate by 0.06% (**Table 9-20**), reducing the population's trend from 2.9% per year to 2.84%. This does not change the original conclusion that the Projects alone will not result in an AEoI for the FFC SPA gannet population. The updated adult mortality rate has also been used in the in-combination assessment (section 9.6.2.1.5), the conclusion of which remains that there will be no AEoI for the FFC SPA gannet population as a result of the Projects in-combination with other plan and projects.	throughout Section 9.6.2.1
G33	**Calculation of adult baseline mortality of kittiwake at FFC SPA** The Applicant has referred to the FFC SPA Kittiwake count from Burnell *et al* (2023) as being more recent than the FFC SPA colony count from Clarkson *et al* (2022). However, Burnell *et al* (2023) covers the time period 2015 – 2021 and uses the kittiwake count for FFC SPA from the 2017 SPA census. We consider that the Clarkson *et al* (2022) count is more contemporaneous with the baseline surveys for the Dogger Bank South projects, and we note that the Applicant has used this population size when calculating breeding season apportioning (Table 9.5). We therefore recommend that the Clarkson *et al* (2022) counts be used for calculating baseline mortality of kittiwakes at FFC SPA and note that this would give a baseline mortality of 13,016 breeding adult birds per year, not 13,287 (paragraph 144).	Natural England advise that the Applicant recalculate adult baseline mortality for the FFC SPA kittiwake using the 2022 population estimate and adjust the rest of their assessment of impacts on this population accordingly.	This update has been made to the assessment. The slightly smaller background mortality for the FFC SPA population (13,016, cf.13,287) results in slightly elevated estimated impacts (from an increase in mortality of 0.75-1.37% to 0.80-1.47%; **Table 9-22***Table 9-16*). PVA modelling predicts the upper end of this range could reduce the population growth rate by 0.14% (from 2.1% per year to 1.96%; **Table 9-24**). This does not change the original conclusion that the Projects alone will not result in an AEoI for the FFC SPA kittiwake population. The updated adult mortality rate has also been used in the in-combination assessment (section 9.6.2.2.5), the conclusion of which remains that there will be no AEoI for the FFC SPA kittiwake population as a result of the Projects in-combination with other plan and projects. However, the Applicants do not consider it worthwhile to contest this point and on this basis concede in-combination AEoI on the Flamborough and Filey Coast SPA.	9.6.2.2
G34	**Calculation of adult baseline mortality of puffin at FFC SPA** The Applicant has used a population estimate for puffin at FFC SPA of 4279 apparently occupied nests, equating to 8558 individuals, taken from Burnell *et al* (2023). We note that this figure is not presented in Burnell *et al* (2023) as an accurate count for the SPA, and that the authors state "the change to a less accurate survey method has	Natural England advise that the Applicant recalculate adult baseline mortality and breeding season apportioning for FFC SPA puffin using the 2022 count and adjust the rest of their assessment of impacts on this population accordingly.	This update has been made to the assessment. Following review of Natural England's advice the Applicants' have estimated the FFC SPA population to be 4,107 (see section 9.6.2.4.1 for details). The smaller background mortality for the FFC SPA population (386, cf. 804), combined with revised apportioning to FFC SPA (due to the smaller population size, **Table 9-9**) results in almost identical estimated impacts (from an increase in mortality of 0.2-0.35% to 0.21-0.36%; **Table**	9.6.2.4

Comment number	Natural England Relevant Representation [RR-039]	Natural England's Recommendations to Resolve Issues	Applicant's Response	Section
	introduced some uncertainty in this trend." Further, this figure is more than double the highest most recent count of individuals at the SPA. Natural England advise the most recent count undertaken at the SPA is used, which was of 3080 individuals (Clarkson *et al* 2022). This would give an adult baseline mortality for the population of 290 per year, not 804 as presented by the Applicant. We further note that the Applicant has given the 2022 population as 4929 (Table 9.7) and used this figure for breeding season apportioning rates.		**9-32***Table 9-16*). This does not change the original conclusion that the Projects alone will not result in an AEoI for the FFC SPA puffin population. Following these updates the Projects' impacts are now less (maximum of 1.4) than those for the Dudgeon and Sheringham Extensions (2.4) for which Natural England stated: "*…there would be no measurable contribution to an in-combination assessment of puffin mortality due to displacement from SEP and DEP*". Therefore, these updates do not change the original conclusion that the Projects will not result in an AEoI for the FFC SPA puffin population in-combination with other plan and projects.	
G35	**Calculation of adult baseline mortality of razorbill at FFC SPA** The Applicant has used a count for FFC SPA razorbill of 55,934 individuals from 2017 and have stated that this is the most recent count. Natural England note that the most recent count for razorbill at FFC SPA is the 2022 count of 45,780 individuals, which when corrected according to standard methodology gives 61,345 individuals (Clarkson *et al* 2022). This gives an adult baseline mortality for the razorbill population at FFC SPA of 6441, not 5873 as presented by the Applicant.	Natural England advise that the Applicant recalculates adult baseline mortality for FFC SPA razorbill using the 2022 count and adjust the rest of their assessment of impacts on this population accordingly.	This update has been made to the assessment. The slightly higher background mortality for the FFC SPA population (6,441, cf. 5,873) reduces the estimated impacts. However, other changes made to the razorbill assessment (see Comment Number G40 in this table) have also altered the assessment as discussed under G40 and in section 9.6.2.5.4.	9.6.2.5
G38	**Guillemot apportioning to FFC SPA - seasonality** Natural England do not support the approach taken to seasonality when assessing impacts on guillemot. Natural England recognise and welcome that the Applicant has considered the need for a bespoke approach to apportioning guillemot to FFC SPA in August and September. However, we consider that the approach taken by the Applicant, of including August and September within an extended breeding season, under-represents impacts on guillemot breeding at FFC SPA. Given the peaks in density and abundance of guillemot in the array areas plus 2km buffer during August and September, the proximity of the arrays to FFC SPA, and the ecological sensitivity of guillemot to impacts during these months, Natural England advise that August and September be treated as a separate 'chick rearing and moult'	Natural England advise that for apportioning of guillemot impacts to FFC SPA, August and September be treated as a separate 'chick rearing and moult' season, with seasonal mean peaks and impacts calculated accordingly. See Annex G1 for our detailed advice on apportioning of guillemot impacts to FFC SPA.	This update has been made to the assessment. The addition of an extra season (post-breeding) to the guillemot assessment has increased the annual impact. Hence the worst case impact (at 70% displaced and 10% mortality) has increased from 639-1107 to 1721-2279. However, the Applicant has also considered new evidence on seabird displacement (e.g. Trinder et al. 2024) and provided additional impact rates (e.g. 70% displaced and 2% mortality, as accepted in the decision for the consented Sheringham and Dudgeon Extensions projects[1]). Assessment of the mortality obtained using these displacement rates in PVA results in reductions in the population growth rate by up to 0.21% (i.e. a reduction in the FFC SPA population growth rate from 3.6% to 3.39%). This does not change the original conclusion that the Projects alone will not result in an AEoI for the FFC SPA guillemot population. The same approach has been applied to the in-combination assessment (section 9.6.2.3.5), the conclusion of which remains that there will be no AEoI for the FFC SPA guillemot population as a result of the Projects in-combination with other plan and projects. However, the Applicants do not consider it worthwhile to contest this point and on this	9.6.2.3

Comment number	Natural England Relevant Representation [RR-039]	Natural England's Recommendations to Resolve Issues	Applicant's Response	Section
	season, with seasonal mean peaks and impacts calculated accordingly. Detailed advice on apportioning of guillemot impacts to FFC SPA is provided in Annex G1.		basis concede in-combination AEoI on the Flamborough and Filey Coast SPA.	
G39	**Guillemot apportioning to FFC SPA – adult proportions in August and September** The Applicant has assumed that up to 70% of guillemot in August and September could be breeding adults from FFC SPA, however insufficient detail has been provided as to how this proportion has been calculated. Natural England advise that the likely adult proportions during August and September should be calculated based on the published productivity data for guillemot at FFC SPA during the years that the baseline surveys were undertaken (Cope *et al* 2021, Cope *et al* 2022). This data indicates that 75.75% of guillemot during August and September would be breeding adults. Due to the possibility of some degree of dilution by adults from other colonies to North, it is precautionary to assume that around 90% of these adults come from FFC SPA. This would result in an apportioning rate during August and September of 68.2%. Natural England note that this is close to the 70% rate used by the Applicant (notwithstanding Natural England's position on the treatment of August and September as a separate season, see previous comment).	The Applicant should clarify their apportioning method. Natural England advice is that adult proportions of guillemot during August and September be calculated according to the published productivity data for guillemot at FFC SPA during the years that the baseline surveys were undertaken (Cope *et al* 2021, Cope *et al* 2022), as detailed in Annex G1.	This update has been made to the assessment. See above comment for Comment G38 for details.	9.6.2.3
G40	**Razorbill apportioning to FFC SPA** Natural England do not agree with the use of the Biologically Defined Minimum Population Scale (BDMPS) method for apportioning razorbill impacts to FFC SPA in the post-breeding migration season. Given the peaks in density and abundance of razorbill in the array areas plus 2km buffer during August and September, the proximity of the arrays to FFC SPA, and the ecological sensitivity of razorbill to impacts during these months, we consider the Applicant's approach under-represents impacts on razorbill breeding at FFC SPA.	Based on the published productivity data for razorbill at FFC SPA during the years that the baseline surveys were undertaken (Cope *et al* 2021, Cope *et al* 2022), and allowing for the possibility of some degree of dilution by adults from other colonies to North, Natural England advise that 69.93% of razorbill are apportioned as breeding adults	This update has been made to the assessment. The updated post-breeding apportioning rate provided by Natural England [RR-039] has been applied to the razorbill assessment which has increased the annual impact. Hence the worst case impact (at 70% displaced and 10% mortality) has increased from 155-232 to 625-702. However, the Applicant has also considered new evidence on seabird displacement (e.g. Trinder *et al.* 2024) and provided additional impact rates (e.g. 70% displaced and 2% mortality, as accepted in the decision for the consented Sheringham and Dudgeon Extensions projects[1]). Assessment of the mortality obtained using these displacement rates in PVA results in reductions in the population growth rate by up to 0.15% (i.e. a reduction in the FFC SPA population growth rate from 8.0% to 7.85%).	9.6.2.5

Comment number	Natural England Relevant Representation [RR-039]	Natural England's Recommendations to Resolve Issues	Applicant's Response	Section
		at FFC SPA during the post-breeding migration season, as detailed in Annex G1.	This does not change the original conclusion that the Projects alone will not result in an AEoI for the FFC SPA razorbill population. The same approach has been applied to the in-combination assessment (section 9.6.2.5.5), the conclusion of which remains that there will be no AEoI for the FFC SPA razorbill population as a result of the Projects in-combination with other plan and projects.	
G41	**Kittiwake apportioning in the breeding season** Table 9.6 states that the minimum distance from FFC SPA to DBS is 125.29 km. Natural England note that this is the minimum distance from FFC SPA to DBS East, whilst the minimum distance from FFC SPA to DBS West (and thus to the arrays combined) is 103 km (Table 9.7).	Natural England advise that the Applicant check that the correct minimum distance between FFC SPA and the arrays has been applied when considering apportioning rates to FFC SPA for kittiwake.	This update has been made to the assessment. The breeding season apportioning for kittiwake has been updated using this distance (**Table 9-8**). This has increased the breeding season kittiwake percentage for FFC SPA from 95.2% to 96.6%, and reduced the percentages for the Farne Islands SPA from 2.6% to 1.8% and for St Abbs Head to Fast Castle SPA from 2.2% to 1.6%. Overall this update does not change the original conclusions that the Projects alone will not result in an AEoI for the FFC SPA kittiwake population.	9.6.2.2 9.2.5
G42	**Impacts on gannet at FFC SPA** Natural England note that the combined impacts of collision and displacement on FFC SPA gannet in the Applicant's assessment for the arrays combined results in an increase in mortality rate of 0.9%. This is very close to the 1% detectability threshold. If Natural England's advised approach to calculating seasonal mean peaks for the arrays combined, collision impacts, and baseline mortality were used, impacts may well exceed the 1% threshold.	Natural England advise that if when calculated according to Natural England's advised approach the impacts of the arrays combined on FFC SPA gannet exceed the 1% threshold, then PVA should be undertaken for impacts of the projects alone.	This update has been made to the assessment. Following the update to the adult mortality rate (G32) the impact of combined collisions and displacement has increased from 0.58-0.94% to 0.62-1.0%. The upper level of impact has been assessed using PVA and results in a reduction in the growth rate of 0.06%, which would reduce the population trend from 2.9% per year to 2.84% per year. Overall this update does not change the original conclusions that the Projects alone will not result in an AEoI for the FFC SPA gannet population.	9.6.2.1
G43	**Lack of PVA for impacts on guillemot and razorbill at FFC SPA** The Applicant has assessed displacement impacts on guillemot and razorbill at FFC SPA using NE's recommended range of mortality and displacement rates and age apportioning. The results of this assessment show an increase in the adult mortality rate for the arrays combined of up to 12.1% and 7.9% for guillemot and razorbill respectively, well above the 1% threshold above which it is recommended PVA is undertaken. Further, if Natural England's advised approach was taken for calculating seasonal mean peaks and apportioning guillemot and razorbill impacts to FFC SPA, the displacement impacts would be even higher	Natural England advise that PVAs are carried out for the impacts of the projects alone (i.e. DBS East and West combined) on guillemot and razorbill at FFC SPA.	This update has been made to the assessment. PVA for both species for project alone impacts have been provided (guillemot: **Table 9-30**; razorbill: **Table 9-38**). The PVA results reveal that the project alone impacts will have very small effects on each species' population growth rates. For guillemot a maximum reduction of 0.21% (reducing the SPA population trend from 3.8% to 3.59%) and for razorbill a maximum reduction of 0.15% (reducing the SPA population trend from 8% to 7.85%). Furthermore, these are still based on precuationary assumptions about disaplcement (70%) and mortality (2%), since a recent study designed specifically to estimate displacement rates from an operational wind farm found no evidence that these species avoided turbines (i.e. 0% displacement; Trinder *et al.* 2024). While this result stands in contrast with those from other studies (e.g. Peschko *et al.* 2024), the latter have all	9.6.2.3 9.6.2.5

Comment number	Natural England Relevant Representation [RR-039]	Natural England's Recommendations to Resolve Issues	Applicant's Response	Section
	than those currently presented by the Applicant for Natural England's advised range of displacement and mortality rates. The high densities of guillemot and razorbill in the area between the two arrays and without the 2km buffer are also not included in the Applicant's assessment, which we consider are likely to be vulnerable to cumulative effects of displacement from the two arrays. However, the Applicant has not undertaken a PVA for displacement impacts on razorbill or guillemot for the projects alone (i.e. DBS East and West combined), on the basis that applying their own preferred displacement and mortality rates reduces the increase in adult mortality to below 1%, and therefore no further assessment is required. Natural England do not agree that a 50% displacement rate and 1% mortality rate are more appropriate for displacement assessments of guillemot or razorbill (see G27). We also note that the Applicant's assessment using NE's advised displacement and mortality rates results in an increase in adult mortality rate above 1% for DBS East (7.3% guillemot; 2.1% razorbill) and DBS West (7.1%; 6.3% razorbill) alone. These values would likely be higher were the full assessment conducted in line with SNCB advice. In other words, each project would normally trigger the need for a PVA.		been based on comparisons of seabird distributions before and after wind farm construction. Such studies all share a fundamental weakness: they cannot distinguish between natural variations and wind farm effects, and it is very apparent from all seabird surveys (including the baseline surveys for DBS) that from one year to the next seabird distributions can show wide differences. Overall these do not change the original conclusions that the Projects alone will not result in an AEoI for either the FFC SPA guillemot or razorbill populations.	
G44	**Impacts on kittiwake at FFC SPA** The Applicant's assessment of collision impacts on FFC SPA kittiwake for the arrays combined, using Natural England's advised age-apportioning, results in an increase in the adult mortality rate of 1.37%. By the Applicant's own admission, this exceeds the 1% threshold above which Natural England advise that PVA be undertaken. However, the Applicant has not undertaken a PVA, and no explanation has been provided for this omission. Given the large numbers of kittiwake recorded during baseline surveys, Natural England considers there is potential for AEOI alone conclusions.	Natural England advise that a PVA is carried out for the impacts of the projects alone (i.e. DBS East and West combined) on kittiwake at FFC SPA.	This update has been made to the assessment. PVA for kittiwake for project alone impacts has been provided (**Table 9-24**). The PVA results reveal that the project alone impacts will have a very small effect on the species' population growth rate with a maximum reduction of 0.14% (reducing the SPA population trend from 2.5% to 2.36%). This does not change the original conclusion that the Projects alone will not result in an AEoI for the FFC SPA kittiwake population.	9.6.2.2

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G45	**Displacement impacts on gannet at FFC SPA** There appears to be a discrepancy between the annual operational displacement impacts of the arrays combined on FFC SPA gannet presented in Table 9.12 (13.17) compared to the text in paragraph 109 (12.5). We note that the latter value has been used to calculate the annual operational impacts of displacement and collision on gannet at FFC SPA, as presented in paragraph 121.	Natural England advise that the annual operational impacts on gannet at FFC SPA for the arrays combined are checked, and the appropriate values are used to calculate the impacts of displacement and collision combined.	The figures in paragraph 109 are incorrect as these refer to the breeding season only, however paragraph 110 uses the correct annual values to estimate the change in mortality rate expected. Furthermore paragraph 121 states that the 12.5 value only relates to the breeding season, which is correct - to this are added 0.6 (autumn) and 0.08 (spring) to give an annual total of 13.18, which is the correct value, and this is used as the basis for assessment. In conclusion, this error is only in paragraph 109 and the correct values have been used in the assessment.	
G46	**Combined displacement and collision impacts on gannet at FFC SPA** The annual combined impacts of displacement and mortality on FFC SPA gannet presented in Table 9.14 (21.6) are not consistent with those presented in the text (21.9).	Natural England advise that the figures for displacement and collision impacts on FFC SPA gannet are checked and updated as needed.	The collision values in Table 9-14 (now **Table 9-16**) are correct, and correspond to those in table 9-13 (now **Table 9-15**). The combined impact value is therefore 21.6 as stated in the table, not the slightly higher value of 21.9 erroneously~~in~~ presented in the text. The correct assessment (with this error amended) is provided in this document.	
G47	**Inconsistency between approach taken with respect to red-throated diver densities in the Greater Wash SPA** The descriptions of red-throated diver densities in the area of the Greater Wash SPA crossed by the cable corridor given in Chapter 7.12 and in Chapter 6.1 do not correspond. In Chapter 7.12 they are given as 0.68 and 0.87 birds per km^2, whilst in Chapter 6.1 the density is given as 0.5 birds per km^2.	Natural England advise that the Applicant clearly presents the calculated densities of red-throated diver for the area of the cable corridor that overlaps with the Greater Wash SPA and ensures that these are used in all relevant parts of the assessment.	This update has been made to the assessment. The values used in the RIAA have been updated to those used in the EIA (0.68 to 0.87/km^2). This has not affected the conclusions of the assessment and the Applicants consider there to be no risk that the Projects will have any detectable effects on red-throated diver in the Greater Wash SPA and there will be no adverse effects on the Greater Wash SPA due to DBS East and DBS West.	9.5.2.1
G48	**Red-throated diver at the Greater Wash SPA** The assessment of impacts on red-throated diver in the Greater Wash SPA does not consider impacts of the reduction in habitat resulting from disturbance/displacement during cable installation. Given the proposed duration of the cable installation phase, Natural England consider this aspect needs to be properly assessed. We highlight that the DEP&SEP projects committed to a seasonal restriction of cable installation within the Greater Wash SPA and advise that sufficient assessment of effective habitat loss is needed to determine whether a similar restriction will be needed here.	Natural England advise that implications of cable installation on extent of available habitat for red-throated diver in the Greater Wash SPA is assessed and robust mitigation be brought forward.	This comment has been given detailed consideration in the assessment (section 9.5.2.1.3.1.2). In summary, the Applicant's consider that cable laying installation will have only a temporary effect on red-throated diver (resulting from vessel displacement) since this species preys on fish in the water column and is not therefore at risk of effects (however minimal) on the seabed caused by cable installation. Therefore the Applicants' consider the assessment has already covered the sources of possible impact and assessed them. There is therefore no change to the conclusion that predicted red-throated diver mortality due to construction phase displacement within the export cable corridor of DBS East and DBS West together would not adversely affect the integrity of the Greater Wash SPA.	9.5.2.1
G49	**PVA population size** The initial population sizes used in the PVA for kittiwake and razorbill at FFC SPA are 91,008 and	Natural England advise that PVAs for kittiwake and razorbill at FFC SPA be re-run using the	This update has been made to the assessment. The conclusions of the kittiwake and razorbill assessments are unaffected by these updates.	9.6.2.2 9.6.2.5

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	30,673 respectively. We advise that the appropriate population sizes to use are the 2022 count figures of 89,148 (kittiwake) and 61,345 (razorbill) (Clarkson *et al* 2022).	appropriate initial population sizes (Clarkson *et al* 2022).		
G50	**In-combination assessments** In-combination assessments have not been carried out for a number of SPA features, including guillemot and puffins at Farne Islands SPA, puffins at FFC SPA and Red-throated diver at the Greater Wash SPA. The Applicant consistently explains the lack of in-combination assessment by stating that the impacts of the projects alone cause no "measurable increase" in mortality. This is not in line with SNCB Best Practice Guidance (Parker, 2022), which is clear that: "Species should not be scoped out of cumulative / in-combination assessments because the project alone level impacts are deemed to be small (e.g. less than 1% of baseline mortality), as the combined impacts have to be assessed across projects within the spatial scale". Natural England highlights that a small alone impact may still contribute to an adverse effect on integrity (AEoI). In any event, there are several SPA features for which the increase in adult mortality for the projects alone, when calculated using NE's advised approach, is assessed to be above the 1% detectability threshold used by the Applicant, and yet for which no in-combination assessments have been carried out. We also highlight that BEIS (now DESNZ) have used the following text in such circumstances in their HRAs: "The contribution from the Project to the in-combination collision total will be small, but the Secretary of State notes that the Habitats Regulations do not include any reference to the exclusion of small-scale effects, or to treating effects as de minimis. The relevant test in Regulation 63 of the Habitats Regulations is whether there would be effects from a project alone or in-combination with other projects. This implies that however small an	Natural England advise that it would be best practice for the Applicant carry out in-combination assessments for all SPA features that have been screened in for assessment. As a minimum, we consider that in-combination assessments should be carried out for all species that meet the 1% baseline mortality threshold (calculated according to SNCB guidance), specifically guillemot at Farne Islands SPA, and Red-throated diver at the Greater Wash SPA. We consider there would also be merit in in-combination assessments being carried out for puffins at Farne Islands SPA and FFC SPA.	This update has been made to the assessment. The Applicants' considered that the magnitude of impacts and increases in background mortality attributable to the worst case impact predictions from the Projects were of a scale that these would make undetectably small contributions to in-combination totals. This is line with Natural England's conclusion for the Dudgeon and Sheringham Extension wind farms for which a puffin mortality of 2.4 apportioned to FFC SPA (compared to 1.4 for DBS East and DBS West to FFC SPA) which stated that "*…there would be no measurable contribution to an in-combination assessment of puffin mortality due to displacement from SEP and DEP*". Hence, the Applicants' do not consider an in-combination assessment for puffin from FFC SPA is required. The above notwithstanding, the Applicants' have provided in-combination assessment for: • Red-throated diver at the Greater Wash SPA (section 9.5.2.1.5), for which no in-combination AEoI is concluded, • Guillemot at the Farne Islands SPA (section 9.8.2.2.5), for which no in-combination AEoI is concluded, and • Puffin at the Farne Islands SPA (section 9.8.2.3.5), for which no in-combination AEoI is concluded.	9.6.2.4 9.6.2.3 9.8.2.3 9.5.2.1

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	effect is, it may still contribute to an adverse effect on integrity."			
G51	**Projects included in the in-combination assessment** The impacts of several relevant Tier 4 projects have been left out of the in-combination assessments, including Outer Dowsing, Five Estuaries and North Falls offshore wind farms (OWF). These Projects have all recently submitted applications and there is therefore information on predicted impacts in the public domain that should be included by the Applicant. Dogger Bank D OWF should also be included as a Tier 6 project.	Natural England advise that the in-combination assessment should be updated to include all relevant projects.	The information was not available at the time of writing of the submitted assessment. This update has been made to the assessment. No changes to the original assessment conclusions have occurred as a result of incorporating this additional data. No quantitative information on impacts is available for Dogger Bank D, therefore there is no update with respect to this project.	9.6
G52	**Exclusion of 'compensated for' projects from in-combination assessment for FFC SPA kittiwake** The Applicant has excluded projects for which kittiwake compensation measures are required (Hornsea Three, Norfolk Boreas, Norfolk Vanguard, East Anglia Two, East Anglia One North, Hornsea Four, SEP&DEP) from their in-combination assessment, which substantially reduces the in-combination totals. We highlight that recent DESNZ appropriate assessments have considered in-combination totals both including and excluding compensated-for projects, and therefore it would be appropriate for the Applicant to present both in any in-combination assessment updated.	Natural England advise that the Applicant should present in-combination assessments that both include and exclude compensated-for projects.	This update has been made to the assessment. Where relevant, the in-combination assessments now consider impacts both with and without compensated projects included. No changes to the original assessment conclusions have occurred as a result of incorporating this additional data.	9.6.2.2
G53	**Exclusion of Hornsea Project 4 guillemot totals from in-combination assessment for FFC SPA** The Applicant has excluded the impacts of Hornsea Project 4 from their in-combination assessment of impacts on guillemot at FFC SPA "as this project's impacts are subject to compensation". Natural England do not support Hornsea 4 guillemot impacts being excluded from in-combination totals, as a high degree of uncertainty remains regarding the likely effectiveness of available measures to fully compensate for their impacts.	Natural England advise that in-combination totals should be presented both with and without the impacts of compensated-for projects due to the current uncertainty regarding the effectiveness of compensatory measures for auks.	This update has been made to the assessment. The Applicants' have now provided in-combination assessment with and without the inclusion of projects that have committed to provide compensation for their impacts. The Applicants' consider it more appropriate that these projects are omitted since their impacts are required to be compensated for as part of their DCOs, however by providing both versions of the assessment this request from Natural England has been addressed.	9.6.2.3
G54	**In-combination impacts on FFC SPA features** The in-combination totals calculated for impacts on kittiwake, guillemot razorbill and gannet at FFC SPA	Natural England advise that the in-combination totals for impacts on kittiwake, guillemot,	This update has been made to the assessment. Where there were differences between the in-combination totals presented in the DEP&SEP application and that in the original DBS	9.6

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	do not appear to reflect the combined impacts of the arrays with other relevant projects. Natural England note that the most recent agreed in-combination totals are for DEP&SEP and that the Appropriate Assessment for those projects referred to those values in making integrity judgements. Accordingly, NE advised during the EPP that these figures be used by DBS. The in-combination impacts for DBS should necessarily be higher than those presented for DEP&SEP, as they will include the impacts of the DBS arrays and those of other more recent projects (see G51&52). However, the in-combination totals presented by the Applicant are often lower than those presented for DEP&SEP, or lower that would be expected based on the DBS alone impacts. This casts major doubt over the value of the Applicant's in-combination assessment.	razorbill and gannet at FFC SPA be recalculated, taking into account the impacts of all relevant projects (see G51&52) and any updated assessments resulting from advice within this Representation.	application these are expected to have been the result of changes in how impacts have been assessed (e.g. collision avoidance rates) for which it is standard practice to update the values for other projects, or due to the omission of compensated projects, as discussed above. The in-combination totals have been updated in the current document following a review of recent wind farm applications.	
G55	**Presentation of in-combination totals for displacement impacts** For the in-combination assessment of displacement impacts, the Applicant has presented apportioned abundance estimates for other projects, and then presented minimum (30% displacement and 1% mortality for auks, 60% displacement and 1% mortality for gannet) and maximum (70% displacement and 10% mortality for auks, 80% displacement and 1% mortality for gannets) displacement impacts in the text. The full methods and displacement matrices for these assessments have not been provided, and it is therefore not possible for us to evaluate the methods or the potential range of predicted impacts. We note that the approach taken does not allow consideration of other displacement and mortality rate combinations which have previously been considered as appropriate indications of predicted impacts for other projects, such as 70% displacement and 2% mortality (SEP&DEP) and 70% displacement and 5% mortality (Hornsea 4). Nor does the approach taken by the Applicant allow for	Natural England advise that the Applicant presents the details of the in-combination displacement assessment in full to allow the methods used and full range of predicted impacts to be evaluated.	This update has been made to the assessment. The Applicants' have now provided additional matrices for key impacts throughout the assessment. However, since calculating displacement is a very simple task of multiplying a species abundance by two values, the displacement rate and the mortality rate, the absence of any particular combination of values should not be an impediment to Natural England being able to quickly derive these independently. Furthermore, to obtain a displacement estimate for the 70% x 2% combination from the 70% x 10% values provided it is only necessary to divide by 5. Thus the Applicants' consider that alternative displacement combinations can be quickly derived if those are required.	9.6.2.1 9.6.2.3 9.6.2.4 9.6.2.5

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	variation in the methods used for other projects, e.g. the bespoke apportioning methods for auks recently advised for other North Sea projects.			
G56	**Displacement and mortality rate range represented in PVAs for guillemot and razorbill** While Natural England appreciate the Applicant presenting PVA results for guillemot and razorbill considering both ends of Natural England's advised range for displacement and mortality rates (i.e. from 30% displacement and 1% mortality to 70% displacement and 10% mortality) as well as Natural England's advised adult apportioning rates, we note that only a limited number of results are presented from within this range. We note that it may be necessary to assess impacts on populations at different combinations of displacement and mortality rates not presented, e.g. 70% displacement and 2% mortality.	Natural England advise the Applicant to present the results of the full range of displacement impacts on guillemot and razorbill in the PVA modelling.	This update has been made to the assessment. The Applicant has presented combinations of 70% and 2% for guillemot and razorbill assessments, and included additional matrices containing a wide range of values. However, as noted in response to comment G55, estimating displacement does not require any modelling since it is simply the product of three values: the abundance, the displacement rate and the mortality rate. Therefore, if other values are required by Natural England these can be readily obtained from the information presented in this assessment.	9.6.2.3 9.6.2.5
G62	**Interpretation of PVA results for FFC SPA gannet, kittiwake, guillemot and razorbill** In the Applicant's interpretation of the PVA results for in-combination impacts on gannet, kittiwake, guillemot and razorbill at FFC SPA, they cite recent population growth at the SPA as a reason for concluding no AEoI is likely. Whilst we do not dispute the evidence of population growth at the colony in past years, we do not consider it appropriate to assume the same growth rate will continue over the next 30 years. It is highly likely that the populations will experience density-dependent mechanisms over the lifetime of the Project, and there are uncertainties about the long-term population impacts of HPAI and a wide range of other environmental pressures. We note that the Applicant has acknowledged the importance of considering density dependence and other pressures including HPAI and climate change elsewhere in the Application, but they have not considered these in their interpretation of the PVA results.	Natural England advise that the Applicant considers realistic assessments of current and future population trends, considering all relevant evidence, when interpreting the results of updated PVAs.	The Applicants are surprised that Natural England is criticising the Applicant's assessment for failing to take density dependence into account in the PVA since Natural England's long-standing advice on this matter has been that PVA should not include density dependence and when such models have been included in assessments Natural England has been very clear that they do not support their use for this purpose. It is therefore unclear how the Applicant should take density dependent effects into account while also being advised to omit this from PVA. While there was considerable and justifiable concern that HPAI would have large impacts on seabird populations, the reality appears to have been much less significant than feared and (with some exceptions) this appears to have resulted in temporary impacts on growth trends rather than any long lasting effects.	Section 12.5.2 of 7.12 ES Chapter 12 - Offshore Ornithology (Revision 2) [document reference 7.12]

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	Further, recent surveys have shown that UK gannet, kittiwake and guillemot populations declined by 25%, 18% and 20% respectively between the results of the last seabird census which covered the period between 2015 and 2021 (Burnell *et al* 2023), and the summer of 2023 (Tremlett *et al* 2024) and that neither this significant recent population decline nor the uncertainties regarding longer-term population impacts have been referred to.			

3. The following table provides a summary of the changes made in the original assessment and how (if at all) this has changed the conclusions.

Table 9-2 Summary of Changes to Assessment of Designated Sites and Features Screened In

SPA / Ramsar site	Features	Change	Change in conclusions (Y/ N)
Greater Wash SPA	Red-throated diver, non-breeding	Update of density within Offshore Export Cable Corridor Addition of in-combination information	N
	Common scoter, nonbreeding	none	n/a
Flamborough and Filey Coast SPA	Kittiwake, breeding	Update of FFC population estimate Update of in-combination totals (submitted applications) Inclusion of Project alone PVA & PVA update	N
	Gannet, breeding	Update of baseline mortality rate Update of E+W totals (displacement only) Update of in-combination totals (submitted applications) Inclusion of Project alone PVA & PVA update	N

SPA / Ramsar site	Features	Change	Change in conclusions (Y/ N)
	Guillemot, breeding	Addition of post-breeding season & updated apportioning Update of E+W totals Update of displacement / mortality to 70%/2% (approved SEP & DEP rates) Update of in-combination totals (submitted applications) Inclusion of Project alone PVA & PVA update	N
	Razorbill, breeding	Update of FFC population estimate & apportionment Update of E+W totals Update of displacement / mortality to 70%/2% (approved SEP & DEP rates) Update of in-combination totals (submitted applications) Inclusion of Project alone PVA & PVA update	N
	Puffin, breeding	Update of FFC population estimate & apportionment Update of E+W totals Update of in-combination text	N
Coquet Island SPA	Puffin, breeding	Update of apportionment Update of E+W totals	N
Farne Islands SPA	Guillemot, breeding	Update of E+W totals Update of displacement / mortality to 70%/2% (approved SEP & DEP rates) In-combination PVA update	N

SPA / Ramsar site	Features	Change	Change in conclusions (Y/ N)
	Kittiwake, breeding	none	n/a
	Puffin, breeding	Update of apportionment Update of E+W totals Inclusion of in-combination PVA	N
St Abbs Head to Fast Castle SPA	Kittiwake, breeding	none	n/a
	Guillemot, breeding	Update of E+W totals Update of displacement / mortality to 70%/2% (approved SEP & DEP rates)	N
	Razorbill, breeding	Update of E+W totals Update of displacement / mortality to 70%/2% (approved SEP & DEP rates)	N
Forth Islands SPA	Kittiwake, breeding	none	n/a
	Gannet, breeding	none	n/a
	Guillemot, breeding	Update of E+W totals Update of displacement / mortality to 70%/2% (approved SEP & DEP rates)	N
	Razorbill, breeding	Update of E+W totals Update of displacement / mortality to 70%/2% (approved SEP & DEP rates)	N
	Puffin, breeding	Update of E+W totals	N
Fowlsheugh SPA	Kittiwake, breeding	none	n/a

SPA / Ramsar site	Features	Change	Change in conclusions (Y/ N)
	Guillemot, breeding	Update of E+W totals Update of displacement / mortality to 70%/2% (approved SEP & DEP rates)	N
	Razorbill, breeding	Update of E+W totals Update of displacement / mortality to 70%/2% (approved SEP & DEP rates)	N
Buchan Ness to Collieston Coast SPA	Kittiwake, breeding	none	n/a
	Guillemot, breeding	Update of E+W totals Update of displacement / mortality to 70%/2% (approved SEP & DEP rates)	N
Troup, Pennan and Lion's Heads SPA	Kittiwake, breeding	none	n/a
	Guillemot, breeding	Update of E+W totals Update of displacement / mortality to 70%/2% (approved SEP & DEP rates)	N
	Razorbill, breeding	Update of E+W totals Update of displacement / mortality to 70%/2% (approved SEP & DEP rates)	N
East Caithness Cliffs SPA	Kittiwake, breeding	none	n/a
	Guillemot, breeding	Update of E+W totals Update of displacement / mortality to 70%/2% (approved SEP & DEP rates)	N
	Razorbill, breeding	Update of E+W totals Update of displacement / mortality to 70%/2% (approved SEP & DEP rates)	N

SPA / Ramsar site	Features	Change	Change in conclusions (Y/ N)
North Caithness Cliffs SPA	Guillemot, breeding	Update of E+W totals Update of displacement / mortality to 70%/2% (approved SEP & DEP rates)	N
	Kittiwake, breeding	none	n/a
	Razorbill, breeding	Update of E+W totals Update of displacement / mortality to 70%/2% (approved SEP & DEP rates)	N
	Puffin, breeding	Update of E+W totals Update of displacement / mortality to 70%/2% (approved SEP & DEP rates)	N
Copinsay SPA	Kittiwake, breeding	none	n/a
	Guillemot, breeding	Update of E+W totals Update of displacement / mortality to 70%/2% (approved SEP & DEP rates)	N
Hoy SPA	Kittiwake, breeding	none	n/a
	Guillemot, breeding	Update of E+W totals Update of displacement / mortality to 70%/2% (approved SEP & DEP rates)	N
	Puffin, breeding	Update of E+W totals	N
Rousay SPA	Kittiwake, breeding	none	n/a
	Guillemot, breeding	Update of E+W totals	N

SPA / Ramsar site	Features	Change	Change in conclusions (Y/ N)
		Update of displacement / mortality to 70%/2% (approved SEP & DEP rates)	
Calf of Eday SPA	Kittiwake, breeding	none	n/a
	Guillemot, breeding	Update of E+W totals Update of displacement / mortality to 70%/2% (approved SEP & DEP rates)	N
Marwick Head SPA	Guillemot, breeding	Update of E+W totals Update of displacement / mortality to 70%/2% (approved SEP & DEP rates)	N
	Kittiwake, breeding	none	n/a
West Westray SPA	Guillemot, breeding	Update of E+W totals Update of displacement / mortality to 70%/2% (approved SEP & DEP rates)	N
	Kittiwake, breeding	none	n/a
	Razorbill, breeding	Update of E+W totals Update of displacement / mortality to 70%/2% (approved SEP & DEP rates)	N
Fair Isle SPA	Guillemot, breeding	Update of E+W totals Update of displacement / mortality to 70%/2% (approved SEP & DEP rates)	N
	Kittiwake, breeding	none	n/a
	Razorbill, breeding	Update of E+W totals	N

SPA / Ramsar site	Features	Change	Change in conclusions (Y/ N)
		Update of displacement / mortality to 70%/2% (approved SEP & DEP rates)	
	Puffin, breeding	Update of E+W totals	N
	Gannet, breeding	none	n/a
Sumburgh Head SPA	Kittiwake, breeding	none	n/a
	Guillemot, breeding	Update of E+W totals Update of displacement / mortality to 70%/2% (approved SEP & DEP rates)	N
Noss SPA	Gannet, breeding	none	n/a
	Guillemot, breeding	Update of E+W totals Update of displacement / mortality to 70%/2% (approved SEP & DEP rates)	N
	Kittiwake, breeding	none	n/a
	Puffin, breeding	Update of E+W totals	N
Foula SPA	Guillemot, breeding	Update of E+W totals Update of displacement / mortality to 70%/2% (approved SEP & DEP rates)	N
	Puffin, breeding	Update of E+W totals	N
	Kittiwake, breeding	none	n/a

SPA / Ramsar site	Features	Change	Change in conclusions (Y/ N)
	Razorbill, breeding	Update of E+W totals Update of displacement / mortality to 70%/2% (approved SEP & DEP rates)	N
Hermaness, Saxa Vord and Valla Field SPA	Gannet, breeding	none	n/a
	Puffin, breeding	Update of E+W totals	N
	Kittiwake, breeding	none	n/a
	Guillemot, breeding	Update of E+W totals Update of displacement / mortality to 70%/2% (approved SEP & DEP rates)	N

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~~1.~~5.

~~9.1~~9.2 Approach to Assessment

~~2.~~6. The assessment of predicted impacts from the Projects alone on the qualifying features of Special Protection Areas (SPAs) draws on the impact assessment completed for the EIA (**Volume 7, Chapter 12 Offshore Ornithology (application ref: 7.12)**). Species assessed for impacts are those which were recorded during baseline aerial surveys and which are considered to be at potential risk either due to their abundance, potential sensitivity to wind farm impacts or due to biological characteristics which make them potentially susceptible (e.g. the species commonly flies at rotor heights).

~~3.~~7. Estimates of predicted collisions and predicted displacement impacts from the Environmental Impact Assessment were used as the basis for the assessment of impacts on the qualifying feature of SPAs in this report. These were then apportioned to demographic unit (i.e. breeding adult population size) and appropriate SPA as described in section 9.2.5.

~~4.~~8. Impacts from the different pathways, seasons and other reasonably foreseeable plans and projects were collated to provide a single, reasonable worst case, predicted impact. Where this impact was of a sufficiently high level (e.g. the increase in background mortality was estimated to be >1%), Population Viability Analyses (PVA) was undertaken to understand in more detail the potential impact on the population of the relevant SPA qualifying feature.

~~5.~~9. If the increase in background mortality for a particular feature was less than 1% then it has been concluded there is no risk of an Adverse Effect on Site Integrity (AEoI). Where the increase was greater than 1% and a PVA has been used, the counterfactual metrics (of population growth rate and population size) have been considered with respect to population trends (where available) to determine whether the effect on the feature population could result in an AEoI. Both forms of assessment (the 1% mortality test and PVA) have been conducted for Project alone, and in-combination effects (with other reasonably foreseeable plans and projects).

~~6.~~10. The assessment of potential impacts used in this report follows Natural England (Parker *et al*. 2022) guidance and specific advice provided though consultation on the Project.

~~9.1.1~~9.2.1 Collision risk

~~7.~~11. Collision risk modelling (CRM) results from the EIA were used to inform the Report to Inform Appropriate Assessment (RIAA), these results have been used to produce predictions of mortality for key seabird species at risk of collision across biological seasons and annually (refer to **Volume 7, Chapter 12 Offshore Ornithology (application ref: 7.12), Volume 7, Appendix 12-9 Offshore Ornithology Collision Risk Modelling (application ref: 7.12.12.9)**).

~~8.~~12. The assessment is based on collision risk predictions obtained using the Band CRM Option 2. This option uses generic estimates of flight height for each species based on the percentage of birds flying at Potential Collision Height (PCH) derived from data from a number of offshore array areas, presented in Johnston *et al*. (2014).

~~9.~~13. As with the EIA, the assessment was based on the results from outputs of the stochastic Band model (Band, 2012; Caneco *et al*. 2022), incorporating uncertainty in flight densities, flight height, bird dimensions (wingspan, body length, flight speed), avoidance rates and nocturnal activity. Input parameters used for the CRM were those advised by Natural England (**Volume 7, Appendix 12-9 Offshore Ornithology Collision Risk Modelling (application ref: 7.12.12.9)**); and proportions at collision height (based on the generic dataset in Johnston *et al*. 2014).

~~10.~~14. For all species scoped into the EIA, the worst-case collision risk design was identified as being the 200 small wind turbines (100 in each of DBS East and DBS West) scenario (see turbine parameter set 1, **Volume 7, Appendix 12-9 Offshore Ornithology Collision Risk Modelling (application ref: 7.12.12.9)** and section 2.1.2 of this report for further details regarding wind turbine parameters and definitions). This turbine scenario was also used for the RIAA.

~~11.~~15. The predicted collisions per season in relation to worst case design scenario for each species that were qualifying features of SPAs requiring assessment are summarised in **Table 9-3**.

Table 9-3 Total Seasonal Collision Risk Estimates for the Worst Case Scenario Wind Turbine (the 200 Small wind turbines scenario) for all birds. Values are the Mean Number of Predicted Collisions and 95% Confidence Intervals Derived From 5,000 stochastic simulations.
Note that none of these values have changed from the original revision of this report

Species	Array	Breeding season	Autumn migration	Non-breeding/ Winter	Spring Migration	Annual
Gannet	East	3.44 (0.76-7.78)	1.61 (0.34-3.81)	0 (0-0)	0.11 (0-0.55)	5.16 (1.15-11.44)
	West	4.81 (1.02-11.39)	2.11 (0.31-5.92)	0 (0-0)	0.14 (0-0.63)	7.06 (1.37-17.77)
	East+West	8.25 (2.71-16.09)	3.72 (1.12-8.13)	0 (0-0)	0.25 (0-0.88)	12.22 (3.97-24.48)
Great black-backed gull	East	0.92 (0-4.42)	0.33 (0-2.05)	2.76 (0-7.66)	2.43 (0-7.35)	3.68 (0.58-9.83)
	West	0 (0-0)	0.82 (0-3.81)	1.16 (0-4.92)	0.34 (0-1.99)	1.16 (0-4.92)
	East+West	0.92 (0-4.42)	1.15 (0-4.43)	3.92 (0-9.76)	2.77 (0-7.95)	4.84 (0.74-11.5)
Herring gull	East	0 (0-0)	0.29 (0-1.79)	0.57 (0-2.08)	0.28 (0-1.78)	0.57 (0-2.08)
	West	0.76 (0-2.62)	0.55 (0-2.72)	0.85 (0-2.81)	0.3 (0-1.82)	1.61 (0-4.22)
	East+West	0.76 (0-2.62)	0.84 (0-3.26)	1.42 (0-3.78)	0.58 (0-2.43)	2.18 (0-5.18)
Kittiwake	East	83.31 (42.28-168.51)	41.39 (14.65-82.93)	0 (0-0)	14.59 (6.83-28.02)	139.3 (66.87-261.27)
	West	107.83 (36.94-280.76)	37.92 (9.54-81.91)	0 (0-0)	14.88 (7.07-26.47)	160.64 (55.88-372.05)
	East+West	191.14 (96.22-378.38)	79.32 (30.47-143.14)	0 (0-0)	29.48 (16.89-47.35)	299.94 (150.92-540.51)
Lesser black-backed gull	East	0.93 (0-3.82)	0 (0-0)	0 (0-0)	0 (0-0)	0.93 (0-3.82)
	West	0.28 (0-1.7)	0 (0-0)	0 (0-0)	0 (0-0)	0.28 (0-1.7)
	East+West	1.21 (0-4.37)	0 (0-0)	0 (0-0)	0 (0-0)	1.21 (0-4.37)

~~9.1.2~~9.2.2 Displacement

~~12.~~16. The recommended SNCB (2022) matrix approach was used to calculate the predicted number of birds that would be killed as a result of being displaced from DBS East and DBS West and a suitable buffer area around it. The buffer area can vary between species: for divers, the assessment used all data recorded within the 4km buffer, for all other species the assessment used all data recorded within the 2km buffer.

~~13.~~17. It is important to note that the seasonal total for the sum of DBS East and DBS West may not be the sum of the seasonal peak on each individual site since the peak may have occurred in different months within any given season. The combined (DBS East + DBS West) seasonal peak was estimated as the highest of the summed monthly values (e.g. the highest breeding season value might have been recorded in May on DBS East and July in DBS West, but the highest sum across both sites could have been recorded in June). Using the approach avoids double counting.

~~14.~~18. The matrix approach uses the range of predicted losses, in association with the scientific evidence available from post-construction monitoring studies, to quantify the level of displacement and the potential losses as a consequence of the Projects. These losses are then placed in the context of the relevant population (e.g. SPA or BDMPS) to determine the magnitude of impact.

~~15.~~19. The matrix approach was used in the EIA to provide an estimate of the total impact on birds of all ages occurring within the Projects and 2km buffer (4km for divers; **Volume 7, Chapter 12 Offshore Ornithology (application ref: 7.12), Volume 7, Appendix 12-12 – Displacement matrices for upper/lower 95% confidence interval abundance estimates (application ref: 7.12.12.12)**). Predicted impacts on relevant species at risk of displacement that were recorded in DBS East and DBS West (plus 2km buffer) during baseline surveys are summarised in **Table 9-4** and for operational impacts in **Table 9-5**.

~~16.~~20. Construction displacement impacts resulting from construction vessels plus 50% installed turbines (i.e. the worst case scenario) has been assessed in the RIAA. Additional breakdown of construction displacement impacts from construction vessels or 50% installed turbines has been presented in **Volume 7, Chapter 12 Offshore Ornithology (application ref: 7.12)**.

Table 9-4 Construction Seasonal Displacement Mortality in the Array Areas (construction vessels plus 50% installed turbines). Impact for birds of all ages. Values are the Maximum displacement mortality in the Project and 2km buffer and evidence based rates for auks (from MacArthur Green 2019).

Species	Array	Breeding season	Autumn migration/Chick-rearing	Non-breeding/ Winter	Spring Migration	Annual
Gannet	East	3.~~56~~58	3.~~57~~67	-	0.~~56~~36	7.~~69~~61
(80% displaced +	West	3.~~58~~80	3.~~58~~77	-	0.~~56~~40	~~8.22~~7.99
1% mortality)	East+West	~~6.64~~7.38	7.~~65~~45	-	0.~~62~~76	~~14.41~~15.60
Guillemot	East	382.~~7~~8	~~-~~325.5	532.~~3~~1	-	~~915~~1240.4
(70% displaced +	West	371.~~3~~2	~~-~~528.1	~~528.2~~418.1	-	~~899~~1317.5
10% mortality)	East+West	~~653~~754.0	~~-~~853.7	~~888.5~~950.3	-	~~1541~~2557.9
Guillemot	East	76.6	65.1	106.4		248.1
(70% displaced +	West	74.2	105.6	83.6		263.5
2% mortality)	East+West	150.8	170.7	190.1		451.6
Guillemot	East	27.3	~~-~~23.2	38.0	-	~~65.4~~88.6
(50% displaced +	West	26.5	~~-~~37.7	~~37.7~~29.9	-	~~64.3~~94.1
1% mortality)	East+West	~~46.6~~53.8	~~-~~61.0	~~63.5~~67.9	-	~~110.1~~182.7
Puffin	East	2.~~5~~7	-	7.~~8~~6	-	10.3
(70% displaced +	West	4.~~8~~6	-	8.~~4~~3	-	12.~~7~~9
10% mortality)	East+West	~~6~~7.3	-	15.~~7~~9	-	~~22~~23.2
Puffin	East	0.5	-	1.5	-	2.1
(70% displaced +	West	1.0	-	1.7	-	2.6
2% mortality)	East+West	1.5	-	3.2	-	4.7
Puffin	East	0.2	-	0.6	-	0.7
(50% displaced +	West	0.3	-	0.6	-	0.9

Species	Array	Breeding season	Autumn migration/Chick-rearing	Non-breeding/ Winter	Spring Migration	Annual
1% mortality)	East+West	0.5	-	1.~~1~~2	-	1.6
Razorbill (70% displaced + 10% mortality)	East	23.6	198.6	142.9	152	517.1
	West	96.5	206.5	40.5	188.3	531.5
	East+West	~~119.6~~120.1	~~292.6~~405.1	~~187.9~~183.4	~~279~~340.3	~~878~~1048.6
Razorbill (70% displaced + 2% mortality)	East	4.7	39.7	28.6	30.4	103.4
	West	19.3	41.3	8.1	37.7	106.3
	East+West	24.0	81.0	36.7	68.1	209.7
Razorbill (50% displaced + 1% mortality)	East	1.7	14.2	10.2	10.9	36.9
	West	6.9	14.8	2.9	13.5	38.0
	East+West	8.~~5~~6	~~20.9~~29.0	13.~~4~~1	~~20.0~~24.4	~~62.8~~74.9

Table 9-5 Operation Seasonal Displacement in the Array Areas. Impact for birds of all ages. Values are the Maximum displacement mortality in the Project and 2km buffer and evidence based rates for auks (from MacArthur Green 2019).

Species	Array	Breeding season	Autumn migration	Non-breeding/ Winter	Spring Migration	Annual
Gannet (80% displaced + 1% mortality)	East	6	6	-	1	13
	West	6	6	-	1	14
	East+West	~~11~~12	13	-	1	~~24~~26
Guillemot (70% displaced + 10% mortality)	East	632	~~-~~535	~~879~~880	-	~~1,511~~2050
	West	615	~~-~~875	~~875~~695	-	~~1,490~~2180
	East+West	~~1045~~1244	1410~~-~~	1570~~1410~~	-	~~2,454~~4230
Guillemot	East	126	107	176	-	410

Species	Array	Breeding season	Autumn migration	Non-breeding/ Winter	Spring Migration	Annual
(70% displaced + 2% mortality)	West	123	175	139	-	436
	East+West	249	282	314	-	846
Guillemot (50% displaced + 1% mortality)	East	45.1	~~-~~38.2	62.8	-	~~107.9~~146.4
	West	43.9	~~-~~62.5	~~62.5~~49.6	-	~~106.4~~155.7
	East+West	~~74.6~~89.0	~~-~~100.7	~~100.7~~112.1	-	~~175.3~~302.1
Puffin (70% displaced + 10% mortality)	East	4	-	13	-	17
	West	8	-	14	-	21
	East+West	10	-	26	-	36
Puffin (70% displaced + 2% mortality)	East	0.8	-	2.6	-	3.4
	West	1.6	-	2.8	-	4.8
	East+West	2.4	-	5.4	-	7.2
Puffin (50% displaced + 1% mortality)	East	0.3	-	0.9	-	1.2
	West	0.6	-	1.0	-	1.5
	East+West	0.~~7~~9	-	1.9	-	2.~~6~~7
Razorbill (70% displaced + 10% mortality)	East	39	328	236	251	845
	West	160	342	67	312	881
	East+West	~~198~~199	~~445~~670	~~312~~303	~~441~~563	~~1,395~~1726
Razorbill (70% displaced + 2% mortality)	East	7.8	65.6	47.2	50.2	169
	West	32	68.4	13.4	62.4	176.2
	East+West	39.8	134.0	60.6	112.6	345.2
Razorbill (50% displaced + 1% mortality)	East	2.8	23.4	16.9	17.9	60.4
	West	11.4	24.4	4.8	22.3	62.9
	East+West	14.~~1~~2	~~31~~47.8	~~22.3~~21.6	~~31.5~~40.2	~~99.6~~123.3

~~9.1.2.1~~9.2.2.1 Barrier effects

~~17.~~21. The small risk of impact to migrating birds resulting from flying around rather than through, the array area of an offshore windfarm is considered a potential barrier effect. The assessment on direct disturbance and displacement effects is based on the SNCB (Parker *et al*. 2022) Advice Note which in turn is based on the work of Furness *et al*. (2013) and Bradbury *et al*. (2014). Displacement is defined as 'a reduced number of birds occurring within or immediately adjacent to an offshore windfarm' (Furness *et al*., 2013) and involves birds present in the air and on the water (Parker *et al*. 2022). Birds that do not intend to utilise a windfarm area but would have previously flown through the area on the way to a feeding, resting or nesting area, and which either stop short or detour around a development, are subject to barrier effects (Parker *et al*. 2022). For the purposes of assessment of displacement for resident birds, it is usually not possible to distinguish between displacement and barrier effects - for example to define where individual birds may have intended to travel to, or beyond an offshore windfarm, even when tracking data are available. Therefore, in this assessment the effects of displacement and barrier effects on the key resident species are considered together.

~~9.1.3~~9.2.3 Indirect effects through effects on habitats and prey species

~~18.~~22. Indirect disturbance and displacement of birds may occur during the construction stage if there are impacts on prey species and the habitats of prey species. These indirect effects include those resulting from the production of underwater noise (e.g. during piling), temporary habitat loss and disturbance (e.g. during preparation of the seabed for foundations and cable installation) that may alter the behaviour or availability of bird prey species.

~~19.~~23. With regard to changes to the seabed and to suspended sediment levels, **Volume 7, Chapter 8 Marine Physical Environment (application ref: 7.8)** and **Volume 7, Chapter 9 Benthic and Intertidal Ecology (application ref: 7.9)** of the ES discuss the nature of any change and impacts on the seabed and benthic habitats. The impact on benthic habitats was predicted to be minor adverse due to the limited spatial extent (i.e. restricted to discrete areas within the Projects), the relatively short-term duration (as it is limited to the duration of construction activities), intermittent and with high reversibility nature of the effect. The consequent indirect impact is considered to be minor, and this is also likely to be the case for species such as herring, sprat and sandeel which are the main prey items of seabirds such as gannet and auks. As outlined in **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)**, sandeel and herring are potentially vulnerable to seabed disturbance and increases in local suspended sediments as these species are demersal spawners with specific habitat requirements. However, considering the temporary, intermittent, and localised nature of this impact, it is considered to be a minor adverse effect.

~~20.~~24. Therefore, since these effects were ruled out as sources of potential impacts on seabirds at the EIA scale the same conclusion has been reached for designated sites and it is concluded there are no risks of AEoI for any SPA.

~~9.1.4~~9.2.4 Seasonal definitions

~~21.~~25. Impacts have been assessed in relation to relevant biological seasons, as defined by Furness (2015). Seasonal definitions for impacted species identified in the EIA (**Volume 7, Chapter 12 Offshore Ornithology (application ref: 7.12)**) are presented in **Table 9-6.**

~~22.~~26. The seasonal definitions in Furness (2015) include overlapping months in some instances due to variation in the timing of migration for birds which breed at different latitudes (i.e. individuals from breeding sites in the north of the species' range may still be on spring migration when individuals farther south have already commenced breeding). However, as a precautionary assumption, the full breeding season has been applied, with the adjacent non-breeding months reduced to remove overlaps (i.e. if March was identified as a spring migration month and also a breeding season month, it was assigned only to the latter).

27. Natural England [REP-039] requested that guillemot from Flamborough and Filey Coast (FFC) SPA should be assessed with an additional post-breeding/chick rearing period in August and September, and also provided their estimate of the percentage of the guillemots on the Projects' sites that could originate from the FFC SPA. A similar request was made for razorbill from FFC SPA, although this species already has this season defined (~~A~~as autumn migration) so in this case the only change was to use the Natural England advised percentage from the SPA. Assessment for both features of the FFC SPA has been undertaken following the Natural England guidance.

Table 9-6 Species Specific Seasonal Definitions and Biologically Defined Minimum Population Sizes (In Brackets) Have Been Taken from Furness (2015). Shaded Cells Indicate the Appropriate Non-Breeding Season Periods Used in the Assessment for Each Species. An additional post-breeding season has been used for guillemot(*) with reference to the FFC SPA following Natural England guidance (RR-039).

Species	Breeding	Migration-free breeding	Migration ~~-~~- autumn (& post-breeding)*	Winter	Migration - spring	Non-breeding
Gannet	Mar-Sep	Apr-Aug	Sep-Nov (456,298)	-	Dec-Mar (248,385)	Sep-Mar
Puffin	Apr-Aug (868,689)	May-Jun	Jul-Aug	Sep-Feb	Mar-Apr	Mid-Aug-Mar (231,957)
Razorbill	Apr-Jul	Apr-Jun	Aug-Oct (591,874)	Nov-Dec (218,622)	Jan-Mar (591,874)	-
Guillemot	Mar-Jul (2,045,078)	Mar-Jun	~~Jul-Oct~~Aug-Sep	Nov	Dec-Feb	~~Aug~~Oct-Feb (1,617,306)
Kittiwake	Mar-Aug (839,456)	May-Jul	Aug-Dec (829,937)	-	Jan-Apr (627,816)	-
Lesser black-backed gull	Apr-Aug	May-Jul	Aug-Oct (209,007)	Nov-Feb (39,314)	Mar-Apr (197,483)	-
Herring gull	Mar-Aug	May-Jul	Aug-Nov	Dec	Jan-Apr	Sep-Feb (466,511)
Great black-backed gull	Mar-Aug	May-Jul	Aug-Nov	Dec	Jan-Apr	Sep-Mar (91,399)

~~9.1.5~~9.2.5 Apportioning of predicted impacts to SPAs

~~23.~~28. Predicted impacts on birds of all ages within the Projects (and a 2km buffer for displacement impacts) were calculated in the EIA (**Volume 7, Chapter 12 Offshore Ornithology (application ref: 7.12)**).

~~24.~~29. The first stage in the RIAA was to adjust the displacement and collision risk impacts predicted in the EIA (**Table 9-3, Table 9-4 and Table 9-5**) to account for the proportion of impacts on adults only.

~~25.~~30. To calculate the adult proportion for each species screened into assessment, demographic rates were taken from Horswill and Robinson (2015) and entered into a matrix population model. This was used to calculate the expected stable proportions in each age class (note, to obtain robust stable age class distributions for less well studied species such as divers it was necessary to adjust the rates in order to obtain a stable population size). Each age class survival rate was multiplied by its stable age proportion and the total for all ages summed to give the weighted average survival rate for all ages. Taking this value from 1 gives the average mortality rate. The demographic rates and the age class proportions, and average mortality rates calculated from them are presented in **Table 9-7**. For SPAs with breeding season connectivity to the Projects, as well as the demographic rate based estimate of the adult proportion outlined above, a precautionary '100% adult' apportioning was applied. This followed advice from Natural England (at the ETG of 6th February 2024) that, in the absence of evidence to the contrary, this was their preferred option (note Natural England also advised consideration of age ratios derived from observations of plumage features in the survey data, however this is approach is quite limited for most species as it is not feasible to reliably distinguish most sub-adult age classes birds from adults).

31. Natural England also advised (REP-039) on average mortality rates to be used for all age-class assessments, although as seabird features of SPAs are typically defined in terms of adult breeding birds (or pairs), the assessment presented here primarily uses adult survival rates.

Table 9-7 Average Mortality Across All Age Classes. Average Mortality Calculated Using Age Specific Demographic Rates and Age Class Proportions. Additional average mortality rates advised by Natural England are also provided, and these have been used in this assessment.

Species	Parameter	Survival (age class)						Productivity	Adult mortality	Average mortality	Natural England advised average mortality
		0-10-1	1-2	2-3	3-4	4-5	Adult				
Gannet	Demo-graphic rate	0.424	0.829	0.891	0.895	-	0.~~912~~919	0.7	0.~~088~~081	0.191	0.1866
	Population age ratio	0.191	0.081	0.067	0.06	-	0.6	-			
Guil-lemot	Demo-graphic rate	0.56	0.792	0.917	0.939	0.939	0.939	0.672	0.061	0.14	0.1405
	Population age ratio	0.168	0.091	0.069	0.062	0.056	0.552	-			
Razorbill	Demo-graphic rate	0.63	0.63	0.895	0.895	-	0.895	0.57	0.105	0.174	0.1302
	Population age ratio	0.159	0.102	0.065	0.059	-	0.613	-			
Puffin	Demo-graphic rate	0.709	0.709	0.709	0.760	0.805	0.906	0.617	0.094	0.176	0.1190

Species	Parameter	Survival (age class)						Productivity	Adult mortality	Average mortality	Natural England advised average mortality
		0-10-1	1-2	2-3	3-4	4-5	Adult				
	Population age ratio	0.156	0.113	0.082	0.060	0.047	0.543	-			
Kitti-wake	Demo-graphic rate	0.79	0.854	0.854	0.854		0.854	0.69	0.146	0.156	0.1577
	Population age ratio	0.155	0.123	0.105	0.089		0.53	-			
Great black-backed gull[1]	Demo-graphic rate	0.815	0.815	0.815	0.815		0.885	0.53	0.115	0.144	0.0969
	Population age ratio	0.137	0.112	0.093	0.076		0.581	-			

1 – Great black-backed gull survival rates were taken from EATL (2016) which provided compelling reasons for the representativeness of these rates rather than those in Horswill and Robinson (2015).

~~26.~~32. These predicted impacts were apportioned to individual SPAs so that the total effect of the Projects alone and in-combination could be assessed for each SPA qualifying feature for which LSE could not be rule out.

~~27.~~33. In the breeding season apportioning was based on hypothetical connectivity between the Project (and buffer) based on existing information on species specific foraging ranges (Woodward *et al*. 2019) as recommended by Natural England (Parker *et al*. 2022) guidance. The NatureScot distance-decay approach was used, which considers relative population sizes, distances and areas of sea to estimate colony proportions as follows:

Colony i weight = (Colony Population i / Sum of Candidate Populations i-n) x (Sum of Candidate Colony i-n Distances^2 / Colony i Distance^2) x (1/Colony i Sea Proportion / Sum of 1/Colony i-n Sea Proportions)

~~28.~~34. Where *i* indicates values for the focal colony from a sample of values for *n* candidate colonies (i.e. those within foraging range).

~~29.~~35. The apportioning of impacts in non-breeding seasons to each designated site was calculated for each qualifying feature by dividing the impact (number of collisions and/or displacement mortality) calculated at the national level in the EIA (**Volume 7, Chapter 12 Offshore Ornithology (application ref: 7.12)**) by the proportion of the national population that were members of the designated site population at citation. Designated site populations were obtained from the SPA citation, or the Ramsar site population if the SPA citation did not include a population estimate (although in some cases more recent colony counts are available, it is important that all counts used in the apportioning calculation are contemporaneous; assuming the relative population sizes for all colonies are comparable this has no effect on the estimated SPA proportions). It should also be noted that, in practice, as very few SPAs were within foraging range of the Projects, this calculation had little bearing on the assessment.

~~30.~~36. During the nonbreeding season the proportion of the relevant BDMPS represented by the SPA population in question was used on the assumption that individuals from all candidate SPAs are equally likely to be present throughout the defined BDMPS region.

~~31.~~37. For the non-breeding period, the relevant population sizes for Biologically Defined Minimum Population Scales (BDMPS) were taken from Furness (2015, Appendix A) for each SPA.

~~32.~~38. SPA populations and apportioning percentages are summarised in ~~**Table 9-6**~~**Table 9-8** and **Table 9-9**. For species with breeding season connectivity limited to only one SPA it has been assumed that all individuals present in the breeding season originate from that SPA.

39. Natural England (RR-039) requested additional details on the apportioning calculations, which have been added to **Table 9-8**.

Table 9-8 Breeding season apportioning for kittiwake SPAs.

SPA	Most recent count (AON)	Year of most recent count	Minimum distance from SPA to DBS (km)	Minimum distance from SPA to DBS [2] (km)	Marine proportion of foraging range	1/ Marine proportion of foraging range	Colony weight	Apportioned estimate
Flamborough and Filey Coast	44574	2022	103.8	10774.4	0.74	1.35	3.77	0.966
Farne Island	4402	2019	247.02	61018.9	0.69	1.45	0.07	0.018
St Abbs Head to Fast Castle	5150	2018-2021	290.36	84308.9	0.68	1.47	0.06	0.016
Sum	54,126			156102.3		4.27	3.91	

Table 9-9 Breeding season apportioning for puffin SPAs.

SPA	Most recent count (AOB)	Year of most recent count	Minimum distance from SPA to DBS (km)	Minimum distance from SPA to DBS [2] (km)	Marine proportion of foraging range	1/ Marine proportion of foraging range	Colony weight	Apportioned estimate
Flamborough and Filey Coast	2053	2022	103.08	10774.4	0.70	1.43	0.25	0.13
Farne Island	43752	2019	247.02	61018.9	0.66	1.52	0.41	0.52
Coquet	25029	2019	229.60	52716.2	0.65	1.54	0.28	0.35
Sum	70834			124509.5		4.48	0.93	

~~9.2~~9.3 Consultation

~~33.~~41. Consultation with regard to offshore ornithology has been undertaken in line with the general process described in section 2 (see Part 1 of the RIAA). The key elements to date have included scoping and the HRA screening.

~~34.~~42. The feedback received throughout this process has been considered in preparing the offshore ornithology sections of the RIAA. Stakeholder comments relevant to the RIAA are included in **Table 9-10**.

Table 9-10 Consultation Responses Relevant to Marine Ornithological Features

Comment	Project Response
Responses to Draft HRA Screening Report	
Natural England, 20/02/2023	
<u>Sites designated for marine ornithological features (Section 4.4)</u> Whilst Natural England are content with the sites screened in and out of the HRA assessment we would like to see more consideration of seabird features outside the breeding season. Distant SPAs screened in should not be limited to those determined solely by the breeding season/foraging ranges of their ornithological features, but also account for the potential for the project to interact with birds from much more distant SPAs during the migration and non-breeding seasons. Furness (2015) provides information for many species of seabird on the suite of colonies that may have connectivity with the southern North Sea outside the breeding season. Natural England recommend that impacts on breeding seabird features outside the breeding season be considered and that details of how they are considered be clearly presented.	We welcome Natural England's confirmation of the sites screened in and out. Further details regarding SPA's screened in for assessment following the publication of the HRA Screening Report are detailed in section 5.4.4 of this report.
Natural England would also like to see greater clarity on which SPA features have been screened in for which SPAs. Both Table 4-10 and 4-11 could be made clearer if the 'species/feature' column listed individual features.	Further detail regarding which SPA features have been screened in for which SPAs are provided throughout this report.

Comment	Project Response
No information has been provided on which impact pathways the relevant SPA features are being screened in for, Natural England therefore cannot comment on this at this stage. Likewise, no detail has been provided on seasonal definitions for different features.	Details of the impact pathways assessed for each SPA feature are provided in section 9.1 of this report.
Responses to Final HRA Screening Report	
Natural England, 17/07/2023	
We do not agree with the Applicant's approach of only screening in SPAs within mean max foraging range +1s.d. for potential effects on non-breeding seabirds. We advise that the screening process be revised, considering the information presented in Furness (2015) on potential connectivity of seabird features of SPAs outside the breeding season.	Further SPAs that are potentially connected with the Projects during the non-breeding season (Furness, 2015), but are beyond mean maximum + 1SD foraging range for designated seabirds to the Projects have now been screened in for further assessment, see section 5.4.4 for further details.
Section 4.4.4.2. Table 4-10, Table 4-11 Non-breeding and migratory seabirds: Natural England do not agree with the Applicant's approach of only screening in SPAs within mean max foraging range +1s.d. for potential effects on non-breeding seabirds. SPAs screened in should not be limited to those determined solely by the breeding season/foraging ranges of their ornithological features,	Further SPAs that are potentially connected with the Projects during the non-breeding season (Furness, 2015), but are beyond mean maximum + 1SD foraging range for designated seabirds to the Projects have now been screened in for further assessment, see section 5.4.4 for further details.

Comment	Project Response
but also account for the potential for the projects to interact with birds from much more distant SPAs during the migration and non-breeding seasons. Furness (2015) provides information for many of the relevant seabird species on the suite of SPAs with potential connectivity to the relevant area outside of the breeding season. This information should be considered when screening in SPAs for impacts on seabird species outside of the breeding season. Natural England advise that the screening process be revised, taking into account the information presented in Furness (2015) on potential connectivity of seabird features of SPAs outside the breeding season.	
Section 4.4.4.4, Table 4-10, Table 4-11 Transboundary considerations: Natural England does not agree with screening out non-UK SPAs that are within foraging range (mean max + 1sd) for breeding features or that might have connectivity with features during the non-breeding season (see comment above re information in Furness 2015). Non-UK SPAs should be treated the same as for UK SPAs and screened in for assessment where appropriate. Natural England advise that the screening process be revised to include all SPAs that are within foraging range (mean max + 1sd) for breeding features.	Further details on transboundary considerations are provided in section 5.4.3 of this report.
Table 4-10, Table 4-11 FFC SPA: "There is potential for disturbance to breeding cormorant, shag and herring gull from operation & maintenance vessels."	The operational displacement assessment encompasses potential displacement due to both the presence of turbines and also O&M vessels. Any

Comment	Project Response
Natural England notes that disturbance from operation & maintenance vessels may also affect guillemot, razorbill, and puffin, and advises that these species be screened in for assessment of impacts from operation and maintenance vehicles. Please include consideration of disturbance impacts from operation & maintenance vessels to FFC guillemot, razorbill, and puffin.	additional effects due to birds avoiding vessels outside the wind farm would be small and short-lived, with birds rapidly relocating following vessel passage. Against the baseline of vessel traffic in the region the additional O&M vessel movements will make an insignificant contribution to this potential source of disturbance.
Table 1-1 Natural England note that no detail has been provided on the impact pathways to be considered for each SPA feature, but note that it is stated that this information will be provided in the RIAA. Please provide details of the impact pathways to be assessed for each SPA feature in the RIAA, as stated.	Details of the impact pathways assessed for each SPA feature are provided in section 9.1 of this report.

~~9.3~~9.4 Assessment of Potential Effects

~~35.~~43. The assessment of potential effects at each SPA are presented in sections 9.5 to 9.26.

~~9.3.1~~9.4.1 Embedded Mitigation

~~36.~~44. Certain measures have been adopted as part of the Project development process in order to reduce the potential for impacts to the environment, as presented in **Table 9-11**. These have been accounted for in the assessment presented below. General mitigation measures, which would apply to all parts of the Project, are set out first. Thereafter mitigation measures that would apply specifically to offshore ornithology issues associated with the OAA and offshore export cable corridor, are described separately.

Table 9-11 Embedded Mitigation Measures

Parameter	Embedded Mitigation Measures	Where commitment is secured?
Site Selection	The Crown Estate conducted a detailed site selection exercise, considering a range of sensitivities which included ornithological impacts. The Projects' Array Areas are located at least 100km from the nearest seabird breeding colony at Flamborough and Filey Coast Special Protection Area (FFC SPA) and as such connectivity for most species will be relatively low. The Array Areas have been refined following review of site-specific survey information.	**Volume 7, Chapter 4 Site Selection and Assessment of Alternatives (application ref: 7.4)**
Wind turbine design	There would be a minimum blade tip clearance (air draft height) of at least 34m above MSL. Project parameters would be secured within **Volume 3, Draft DCO (application ref: 3.1)**.	Deemed Marine Licence (DML) 1 & 2 - Condition 2
Vessel traffic	Potential impacts on red throated diver in the Greater Wash SPA during construction, operation and maintenance works will be mitigated through measures such as: • Existing shipping lanes will be utilised for any vessels crossing the Greater Wash SPA and up to 2km beyond the SPA boundary to limit potential disturbance of red-throated diver;	Pollution Environmental Management Plan (PEMP) DML 1 & 2 - Conditions 15 & 21 DML 3 & 4-Conditions 13 & 19

Parameter	Embedded Mitigation Measures	Where commitment is secured?
	• Vessels may deviate from the existing shipping lanes to avoid disturbance of red-throated diver should they be located within the existing shipping lane; • Selecting routes that avoid known aggregations of birds; • Restricting vessel movements to existing navigation routes (where the densities of red-throated divers are typically relatively low); • Maintaining direct transit routes (to minimise transit distances through areas used by red-throated diver); • Considering the potential for crew transfer vessels to travel in convoy en route to the wind farm sites and seeking to do so where it is considered practicable; • Avoidance of over-revving of engines (to minimise noise disturbance); and • Briefing of vessel crew on the purpose and implications of these vessel management practices (through, for example, tool-box talks). These measures are set out in **Volume 8, Outline Project Environmental Management Plan (application ref: 8.21).**	DML 5 - Conditions 11 & 15

~~9.3.2~~9.4.2 Realistic Worst Case Scenario

~~9.3.2.1~~9.4.2.1 General Approach

~~37.~~45. The realistic worst case design parameters for likely significant effects scoped into the RIAA for the Offshore Ornithology assessment are summarised in **Table 9-12**. These are based on the project parameters described in the ES **Volume 7, Chapter 5 Project Description (application ref: 7.5)**, which provides further details regarding specific activities and their durations.

Table 9-12 Realistic Worst Case Design Parameters for Offshore Ornithology

	Parameter			
	DBS East or DBS West in isolation	**DBS West and DBS East concurrently**	**DBS West and DBS East sequentially**	**Notes and rationale**
Construction				
Array areas	Pin piling (4 pins per wind turbine) for largest number of wind turbines (up to 100 in either DBS East or DBS West) 3 piling vessels operating at same time	Pin piling (4 pins per wind turbine) for largest number of wind turbines (up to 200 across the two Projects) 3 piling vessels operating at same time	Pin piling (4 pins per wind turbine) for largest number of wind turbines (up to 200 across the two Projects) 3 piling vessels operating at same time	Assumed a 2km buffer around each construction location.
Offshore Export Cable Corridor	Two cables, assume each laid independently. Assessment has been based on a 2km buffer around each independently operating cable laying vessel. Pin piling / monopiling for one Electrical Switching Platform (ESP) along the Offshore Export Cable Corridor.	Four cables– assume each laid independently. Assessment will be based on a 2km buffer around each independently operating cable laying vessel. Pin piling / monopiling for one ESP along the Offshore Export Cable Corridor.	Four cables– assume each laid independently. Assessment will be based on a 2km buffer around each independently operating cable laying vessel. Pin piling / monopiling for one ESP along the Offshore Export Cable Corridor.	

	Parameter			
	DBS East or DBS West in isolation	**DBS West and DBS East concurrently**	**DBS West and DBS East sequentially**	**Notes and rationale**
Operation				
Array areas	100 smaller wind turbines in either DBS East or DBS West	200 smaller wind turbines (100 in DBS East and 100 in DBS West) for the same operational period i.e. 30 years.	200 smaller wind turbines (100 in DBS East and 100 in DBS West) for the overlapping operational period i.e. 32 years.	Larger number of smaller wind turbines gives highest collision risk
	Complete development of areas within the Array Area boundaries assessed.	Complete development of areas within the Array Area boundaries assessed.	Complete development of areas within the Array Area boundaries assessed.	Greatest area from which birds could be displaced
Decommissioning				
No final decision regarding the final decommissioning policy for the offshore project infrastructure including landfall, has yet been made. It is also recognised that legislation and industry best practice change over time. It is likely that offshore project infrastructure will be removed above the seabed and reused or recycled where practicable. The detail and scope of the decommissioning works will be determined by the relevant legislation and guidance at the time of decommissioning and will be agreed with the regulator. It is anticipated that for the worst case scenario, the impacts will be no greater than those identified for the construction phase. A decommissioning plan for the offshore works would be submitted prior to any decommissioning commencing.				

~~9.3.2.2~~9.4.2.2 Development Scenarios

~~38.~~46. Following Statutory Consultation High Voltage Alternating Current (HVAC) technology (previously assessed in PEIR) was removed from the Projects' Design Envelope (see ES **Volume 7, Chapter 4 Site Selection and Assessment of Alternatives (application ref: 7.4)** for further information). As a result, only High Voltage Direct Current (HVDC) technology has been taken forward for assessment purposes. This assessment considers the following development scenarios:

- Either DBS East or DBS West is built In Isolation (the In Isolation Scenario);
- DBS East and DBS West are developed concurrently (the Concurrent Scenario); or
- Both DBS East and DBS West are developed sequentially (the Sequential Scenario).

~~39.~~47. An In Isolation scenario has been assessed on the basis that theoretically one Project could be taken forward without the other being built out. If an In Isolation project is taken forward, either DBS East or DBS West may be constructed. As such the offshore assessment considers both DBS East and DBS West in isolation.

~~40.~~48. In order to ensure that a robust assessment has been undertaken, all development scenarios and options have been considered to ensure the realistic worst case scenario for each topic has been assessed. Further details are provided in ES **Volume 7, Chapter 5 Project Description (application ref: 7.5)**.

~~41.~~49. The three development scenarios to be considered for assessment purposes are outlined in **Table 9-13.**

Table 9-13 Development Scenarios and Construction Durations

Development scenario	Description	Overall Construction Duration (Years)	Maximum construction Duration Offshore (Years)	Maximum construction Duration Onshore (Years)
In Isolation	Either DBS East or DBS West is built In Isolation	Five	Five	Four
Sequential	DBS East and DBS West are both built Sequentially, either Project could commence construction first with staggered / overlapping construction	Seven	A five year period of construction for each project with a lag of up to two years in the start of construction of the second project (excluding landfall duct installation) – reflecting the maximum duration of effects of seven years.	Construction works (i.e. onshore cable civil works, including duct installation) to be completed for both Projects simultaneously in the first four years, with additional works at the Landfall Zone, Onshore Substation Zone and cable joint bays in the following two years. Maximum duration of effects of six years.
Concurrent	DBS East and DBS West are both built Concurrent reflecting the maximum peak effects	Five	Five	Four

~~42.~~50. The In Isolation, Concurrent and Sequential Development Scenarios all allow for flexibility to build out either or both Projects using a phased approach offshore. Under a phased approach the maximum timescales for individual elements of the construction are assessed.

~~9.3.2.3~~9.4.2.3 Operation Scenarios

~~43.~~51. Operation scenarios are described in detail in the ES **Volume 7, Chapter 5 Project Description (application ref: 7.5)**. The assessment considers the following scenarios:

- Only DBS East in operation;
- Only DBS West in operation; and
- The two projects operating concurrently, with a lag of two years between each Project commencing operation.

~~44.~~52. If the Projects are built out using a phased approach, there would also be a phased approach to starting the operational stage. The worst case scenario for the operational phases for the Projects have been assessed. See the ES **Volume 7, Chapter 5 Project Description (application ref: 7.5)** for further information on phasing scenarios for the Projects.

~~45.~~53. The operational lifetime of each Project is expected to be 30 years.

~~9.3.2.4~~9.4.2.4 Decommissioning Scenarios

~~46.~~54. Decommissioning scenarios are described in **Volume 7, Chapter 5 Project Description (application ref: 7.5)**. Decommissioning arrangements will be agreed through the submission of a Decommissioning Programme prior to construction, however for the purpose of this assessment it is assumed that decommissioning of the Projects could be conducted separately, or at the same time.

~~9.4~~9.5 Greater Wash SPA

~~9.4.1~~9.5.1 Site Description

~~47.~~55. The Greater Wash SPA is a marine SPA located in the southern North Sea. The SPA boundary encompasses offshore areas identified as containing high densities of the qualifying bird species (Natural England and JNCC, 2016). The offshore export cable corridor crosses the Greater Wash SPA prior to making landfall.

~~48.~~56. To the north, off the Holderness coast in Yorkshire, seabed habitats primarily comprise coarse sediments, with occasional areas of sand, mud and mixed sediments. Subtidal sandbanks occur at the mouth of the Humber Estuary, primarily comprising sand and coarse sediments. Offshore, soft sediments dominate, with extensive areas of subtidal sandbanks off The Wash as well as north and east Norfolk coasts. Closer inshore at The Wash and north Norfolk coast, sediments comprise a mosaic of sand, muddy sand, mixed sediments and coarse sediments, as well as occasional Annex I reefs. The area off the Suffolk coast continues the mosaic habitats mostly dominated by soft sediment.

~~49.~~57. The landward boundary of the SPA covers the coastline from Bridlington Bay in the north (at the village of Barmston), to the existing boundary of the Outer Thames Estuary SPA in the south. Across the mouth of the Humber Estuary, the boundary abuts the boundary of the Humber Estuary SPA, except where neither the little tern foraging zone nor the red-throated diver Maximum Curvature Analysis (MCA) density threshold reaches the SPA. The landward boundary abuts the seaward boundary of The Wash SPA except where the former overlaps the latter to encompass habitats used by breeding Sandwich tern.

~~9.4.1.1~~9.5.1.1 Qualifying Features

~~50.~~58. The qualifying features of this SPA screened into the assessment are listed in Table 4-7 of **RIAA HRA Part 1 of 4 – Introduction and Terrestrial Ecology (application ref: 6.1)**. These are non-breeding red-throated diver and common scoter.

~~9.4.1.2~~9.5.1.2 Conservation Objectives

~~51.~~59. The SPA's over-arching conservation objectives are to ensure that, subject to natural change, the integrity of the site is maintained or restored as appropriate, and that the site contributes to achieving the aims of the Wild Birds Directive, by maintaining or restoring:

- The extent and distribution of the habitats of the qualifying features.
- The structure and function of the habitats of the qualifying features.
- The supporting processes on which the habitats of the qualifying features rely.
- The populations of each of the qualifying features.
- The distribution of qualifying features within the site.

~~9.4.2~~9.5.2 Assessment: Offshore Export Cable Corridor

~~9.4.2.1~~9.5.2.1 Red-throated diver

~~52.~~60. Red-throated diver has been screened into the assessment to assess impacts from disturbance / displacement from construction activity in the Offshore Export Cable Corridor and increased vessel activity during the construction and operation phase.

~~9.4.2.1.1~~9.5.2.1.1 Status

~~53.~~61. At citation, the population of red-throated diver was 1,407 non-breeding individuals (Natural England, 2018a). This was calculated using a five year peak mean population estimate derived from distance-corrected visual aerial surveys of the Greater Wash in 2002/03, 2004/05, 2005/06, 2006/07 and 2007/08.

~~54.~~62. The annual baseline mortality of this population, assuming that the published all age class mortality rate of 22.8% applies (Horswill and Robinson 2015), is 321 birds.

~~9.4.2.1.2~~9.5.2.1.2 Connectivity to the Projects

~~55.~~63. The export cable route will pass through the northern most end of the Greater Wash SPA, therefore the presence of vessels undertaking the installation of the export cable could result in the direct disturbance and displacement of red-throated diver.

~~9.4.2.1.3~~9.5.2.1.3 Assessment of Potential Effects of the Projects alone and Together

~~9.4.2.1.3.1~~9.5.2.1.3.1 Potential Effects During Construction: Direct Disturbance and Displacement from Export Cable construction vessels

~~9.4.2.1.3.1.1~~9.5.2.1.3.1.1 DBS East or DBS West in Isolation

~~56.~~64. The region of the SPA which the export cable route crosses had low densities of red-throated diver recorded, and the nearshore sections were not identified as within the species' distribution (Natural England and JNCC 2016). The peak density of red-throated diver within the overlap of the cable route and the SPA was between 0.~~5~~68 and 0.87 birds/km^2.

~~57.~~65. The magnitude of disturbance to red-throated diver from construction vessels has been estimated on a worst case basis. This assumes that there would be 100% displacement of birds within a 2km buffer surrounding the source, in this case around a maximum of two cable laying vessels (one main cable vessel and one support vessel). This approach is the same as that applied for this potential impact in other wind farm applications (e.g. East Anglia TWO (SPR, 2019). This 100% displacement from vessels is consistent with Garthe and Hüppop (2004) and Schwemmer *et al*. (2011) since they suggested that all red-throated divers present fly away from approaching vessels at a distance of often more than 1km.

~~58.~~66. The worst case area from which birds could be displaced was defined as a circle with a 2km radius around each cable laying vessel, which is 25.2km^2 (2 x 12.6km^2). If 100% displacement is assumed to occur within this area, then within the density range of 0.~~5~~68 to 0.87 birds/km^2, ~~a peak of 13~~17 to 22 divers could be displaced at any given time. This would lead to a 0.7% increase in diver density in the remaining areas of the SPA assuming that displaced birds all remain within the SPA. As the vessels move it is assumed that displaced birds return and therefore any individual will be subjected to a brief period of impact. Consequently, for the purposes of this assessment it has been assumed that the estimated number displaced at any one time represents the total number displaced over the course of a single winter (i.e. rather than many individuals for a short duration each, the same individuals for the duration of a single winter).

~~59.~~67. Definitive mortality rates associated with displacement for red-throated divers, or for any other seabird species, are not known and precautionary estimates have to be used. There is no evidence that birds displaced from wind farms suffer any mortality as a consequence of displacement; any mortality due to displacement would be most likely a result of increased density in areas outside the affected area, resulting in increased competition for food where density was elevated (Dierschke *et al*., 2017). Such impacts are most likely to be negligible, and below levels that could be quantified, as the available evidence suggests that red-throated divers are unlikely to be affected by density-dependent competition for resources during the nonbreeding period (Dierschke *et al*., 2017).

~~60.~~68. Impacts of displacement are also likely to be context-dependent. In years when food supply has been severely depleted, as for example by unsustainably high fishing mortality of sandeel stocks as has occurred several times in recent decades (ICES, 2013), displacement of sandeel-dependent seabirds from optimal habitat may increase mortality. In years when food supply is good, displacement is unlikely to have any negative effect on seabird populations. Red-throated divers may feed on sandeels, but take a wide diversity of small fish prey, so would be buffered to an extent from fluctuations in abundance of individual fish species. It is not possible for the Projects to predict future fishing effort.

~~61.~~69. For recent wind farm assessments Natural England has advised that an unconfirmed 10% mortality rate should be used for birds displaced by cable laying vessels. This magnitude of impact is not supported in the literature and equates to more than half the natural adult annual mortality (16%) from a single occasion of disturbance (as described above). Furthermore, given the high levels of background shipping within the species' wintering range (the southern North Sea) and the undoubtably high rate of interaction with existing vessel traffic, it seems highly improbable that such a large effect would occur.

~~62.~~70. Indeed, disturbance from vessels in the southern North Sea must have been ongoing for decades since there are designated shipping lanes located throughout the areas where this species is present. With this in mind, additional mortality of 10% of the population due to single instances of vessel disturbance during the course of the winter, as proposed by Natural England, would reduce the population of 1,407 (i.e. the Greater Wash SPA population) to fewer than 100 within 10 years (alternatively the SPA population would need to have been 16 times larger 10 years prior to the SPA designation surveys in order to have been reduced to 1,407). Neither of these scenarios is supported by the evidence.

~~63.~~71. A review of available evidence for red-throated diver displacement was submitted for the Norfolk Vanguard assessment (MacArthur Green 2019a) and this concluded that there would be little or no effect of displacement on diver survival. Consequently, a maximum, and hence precautionary, displacement caused mortality rate of 1% was identified as appropriate for this assessment.

~~64.~~72. At this level of additional mortality, only a maximum of 0.~~1~~2 individuals would be expected to die across the entire winter period (September to April) as a result of any potential displacement effects from the offshore cable installation activities, which would be restricted to a maximum of one nonbreeding seasons. This highly precautionary assessment will have no discernible effect on the Greater Wash SPA red-throated diver population, and therefore will not adversely affect the integrity of the Greater Wash SPA.

~~9.4.2.1.3.1.2~~9.5.2.1.3.1.2 *DBS East and West Together*

~~65.~~73. If both wind farms are constructed the potential effect on red-throated diver within the overlap of the export cable route and the Greater Wash SPA will be the same as that described for DBS East or DBS West in isolation, but over a period of two nonbreeding seasons rather than one. This would not materially change the conclusions for one project in isolation and therefore it is concluded that predicted red-throated diver mortality due to construction phase displacement within the export cable corridor of DBS East and DBS West together would **not adversely affect the integrity of the Greater Wash SPA**.

74. Natural England (REP-039) commented that the assessment of construction impacts on red-throated diver did not:

> *"...consider impacts of the reduction in habitat resulting from disturbance/ displacement during cable installation"*

75. Since this species preys on fish in the water column, and not on benthic organisms, the assessment explicitly assesses the area from which red-throated divers may be completely displaced (i.e. around cable laying vessels) and this captures the habitat reduction aspect of cable installation identified by Natural England. Therefore, the Applicants disagree~~s~~ with Natural England's comment and consider~~s~~ the approach to assessment (which also corresponds to previous assessments of cable installation through red-throated diver SPAs) has included all the important aspects of concern.

~~9.4.2.1.3.2~~9.5.2.1.3.2 *Potential Effects During Operation: Disturbance and Displacement from maintenance vessel activity.*

~~9.4.2.1.3.2.1~~9.5.2.1.3.2.1 *DBS East or DBS West in Isolation*

~~66.~~76. The Operations and Maintenance port has not been determined, however this may be located such that vessels accessing the Array area will need to cross the Greater Wash SPA. Therefore, it is appropriate to assess the potential effects on red-throated diver of additional vessel movements.

~~67.~~77. It is estimated that as a worst case up to five vessels may pass through the SPA each week travelling between the Operations and Maintenance Port and the Array Area. These vessels would travel within designated shipping lanes whilst in proximity to the port and, while steaming through the SPA, would be subject to best practice guidance on minimising disturbance to red-throated divers (see section 9.4.1). Thus, when these factors are taken into account Operation and Maintenance vessel movements would not adversely affect the integrity of the Greater Wash SPA.

~~9.4.2.1.3.2.2~~9.5.2.1.3.2.2 DBS East and West Together

~~68.~~78. The Operations and Maintenance port has not been determined, however this may be located such that vessels accessing the Array Areas will need to cross the Greater Wash SPA. Therefore it is appropriate to assess the potential effects on red-throated diver of additional vessel movements.

~~69.~~79. It is estimated that as a worst case up to nine vessels may pass through the SPA each week travelling between the Operations and Maintenance Port and the Array Area. These vessels would travel within designated shipping lanes whilst in proximity to the port, and while steaming through the SPA would be subject to best practice guidance on minimising disturbance to red-throated divers (as has been agreed with Natural England for previous projects). Thus, when these factors are taken into account Operation and Maintenance vessel movements would not adversely affect the integrity of the Greater Wash SPA.

~~9.4.2.1.4~~9.5.2.1.4 Summary

~~70.~~80. It is concluded that any potential effects on red-throated diver due to construction of the export cable through the Greater Wash SPA for either DBS East or DBS West in isolation or for both together would not adversely affect the integrity of the Greater Wash SPA.

~~71.~~81. It is concluded that any potential effects on red-throated diver due to disturbance from operational and maintenance vessels for either DBS East or DBS West in isolation or for both together, and on the assumption that these vessels would need to cross the SPA (noting that the Operations and Maintenance Port has not yet been finalised) would not adversely affect the integrity of the Greater Wash SPA. Therefore the Applicants consider there to be no risk that the Projects will have any detectable effects on red-throated diver in the Greater Wash SPA and **there will be no adverse effects on the Greater Wash SPA due to DBS East and DBS West alone**.

~~9.4.2.1.5~~9.5.2.1.5 *Assessment of potential effects of the Projects in combination with other plans and projects*

~~72.~~82. Given the extremely low mortality predicted for construction (a maximum of 0.~~1~~2 mortalities per year during construction), and the commitment to adopt best practice management for project vessels crossing the SPA (including travelling within existing shipping lanes where possible) the Applicants consider there ~~is~~to be no risk that the Projects will make any material contribution to impacts on red-throated diver in the Greater Wash SPA ~~and therefore~~ ~~**there will be no adverse effects on the Greater Wash SPA due to DBS East and DBS West alone and in-combination with other projects**~~.

83. Nonetheless, Natural England (REP-039) advised that an in-combination assessment of red-throated diver impacts at the Greater Wash SPA should be provided.

9.5.2.1.5.1 Potential Effects During Construction: Direct Disturbance and Displacement from Export Cable construction vessels

84. The Greater Wash is already subject to high levels of vessel traffic and this is a situation which has persisted for many years and long before the SPA was designated. It is reasonable therefore to assume that the locations favoured by the birds are those beyond established shipping routes. Thus, while there is a theoretical risk that any increase in shipping activity levels will result in an in-combination effect on red-throated divers belonging to the Greater Wash SPA, this risk is almost certainly so small as to be undetectable for the magnitude of increase in vessel numbers anticipated for cable installation for the Projects.

85. The displacement impacts on red-throated diver that will occur due to cable installation for the Projects within the Greater Wash SPA will be temporary and once the vessels have left the area the birds will be expected to return.

86. Very low numbers (0.2) were estimated to be at risk in any given winter period due to the Projects. Consequently, the likelihood of an in-combination displacement effect is extremely small. Therefore, the Applicants consider there to be no risk that the Projects will make any material contribution to in-combination impacts on red-throated diver in the Greater Wash SPA due to construction effects and therefore **there will be no adverse effects on the Greater Wash SPA due to DBS East and DBS West in-combination with other projects.**

9.5.2.1.5.2 Potential Effects During Operation: Disturbance and Displacement from maintenance vessel activity.

87. It is apparent from the mapped red-throated diver distribution used to define the SPA (Natural England and JNCC, 2016) that the mouth of the Humber is already an area of low diver density (to the extent that there is a 'pinch-point' in the modelled density surface indicating that this area was almost below the threshold for inclusion in the SPA). This is very likely to be predominantly due to the existing shipping traffic through this part of the SPA. Thus, it is reasonable to assume that the existing extensive shipping traffic passing through the SPA to and from ports on the Humber has already contributed to the placement of the SPA and can be assumed to be part of the baseline.

88. Hence, the consideration for the Projects is whether the additional operational vessel movements through this part of the SPA (up to nine vessel movements per week, or slightly more than one per day, on average) would make any material, or indeed, detectable difference to this existing baseline. Shipping data from 2012 (MMO 2014) derived from AIS (Automated Identification System) identify the approaches to the Humber Estuary within the range of 500 to 1,000 vessel movements per week (71 to 143 per day; note this also omits smaller vessels, and therefore was estimated to account for around 84% of actual vessels).

89. Red-throated divers respond to vessels by moving away and then return afterwards following the removal of the source of disturbance. However, with an average frequency of at least 3 vessels per hour, it seems very unlikely that there is sufficient time for birds to move in and out of the shipping lanes between the passage of vessels. Therefore, the impact on red-throated divers from existing shipping must already have been accounted for within the SPA (i.e. the routes are effectively free of divers) and the addition of up to 1.3 vessels per day due to the Projects will have no additional effect.

90. Therefore, the Applicants consider there to be no risk that the Projects will make any material contribution to in-combination impacts on red-throated diver in the Greater Wash SPA due to operational and maintenance vessel movements and **there will be no adverse effects on the Greater Wash SPA due to DBS East and DBS West in-combination with other projects.**

91. The above conclusion notwithstanding, the Applicants will implement the best-practice measures listed in **Table 9-11** to minimise the potential effects on red-throated divers.

~~9.4.2.2~~9.5.2.2 Common scoter

~~9.4.2.2.1~~9.5.2.2.1 Status

~~73.~~92. At citation, the population of common scoter was 3,449 non-breeding individuals (Natural England, 2018a). This was calculated using a five year peak mean population estimate derived from distance-corrected visual aerial surveys of the Greater Wash in 2002/03 to 2007/08.

~~9.4.2.3~~9.5.2.3 Connectivity to the Projects

~~74.~~93. The export cable route will pass through the northern most end of the Greater Wash SPA, therefore the presence of vessels undertaking the installation of the export cable could result in the direct disturbance and displacement of common scoter.

~~9.4.2.3.1~~9.5.2.3.1 Assessment of Potential Effects of the Projects alone and Together

~~9.4.2.3.1.1~~9.5.2.3.1.1 Potential Effects During Construction: Direct Disturbance and Displacement from Export Cable construction vessels

~~75.~~94. Although common scoter are a designated feature of the Greater Wash SPA, and the export cable will be installed through the northern most tip of the SPA, it is clear from the data used for the SPA's designation (Natural England and JNCC, 2016) that this species was present in, at most, very low numbers in this part of the SPA. Indeed, the only identified higher density areas were in The Wash itself off the east coast of Norfolk. Therefore, it can be concluded that the risk of an adverse effect on the SPA as a result of disturbance to common scoter is extremely low and can be ruled out.

~~76.~~95. This conclusion applies to all development scenarios.

~~9.4.2.3.1.2~~9.5.2.3.1.2 Potential Effects During Operation: Disturbance and Displacement from maintenance vessel activity.

~~9.4.2.3.1.2.1~~9.5.2.3.1.2.1 DBS East or DBS West in Isolation and DBS East and West Together

~~77.~~96. The Operations and Maintenance port has not been finalised, however this may be located such that vessels accessing the Array area will need to cross the Greater Wash SPA. Therefore, it is appropriate to assess the potential effects on common scoter of additional vessel movements.

~~78.~~97. It is estimated that as a worst case up to five vessels may pass through the SPA each week travelling between the Operations and Maintenance Port and the Array Area. These vessels would travel within designated shipping lanes whilst in proximity to the port and while steaming through the SPA would be subject to best practice guidance on minimising disturbance to red-throated divers (as per previous projects: need to include details of this), and this would also reduce the risk of disturbance to other species including common scoter. Furthermore, common scoter were primarily recorded in the region of The Wash, which is not located between the Array Areas and any Ports under consideration. Therefore, the likelihood of encountering any concentrations of common scoter is extremely low.

~~79.~~98. Thus, when these factors are taken into account Operation and Maintenance vessel movements would not adversely affect the integrity of the Greater Wash SPA.

~~9.4.2.3.2~~9.5.2.3.2 *Summary*

~~80.~~99. It is concluded that any potential effects on common scoter due to construction of the export cable through the Greater Wash SPA for either DBS East or DBS West in isolation or for both together would not adversely affect the integrity of the Greater Wash SPA.

~~81.~~100. It is concluded that any potential effects on common scoter due to disturbance from operational and maintenance vessels for either DBS East or DBS West in isolation or for both together, and on the assumption that these vessels would need to cross the SPA (noting that the Operations and Maintenance Port has not yet been finalised) would not adversely affect the integrity of the Greater Wash SPA.

~~9.4.2.3.3~~9.5.2.3.3 *Assessment of potential effects of the Projects in combination with other plans and projects*

~~82.~~101. Given the near absence of common scoter in the cable construction corridor and hence negligible to zero mortality predicted for construction, and the commitment to adopt best practice management for project vessels crossing the SPA (including travelling within existing shipping lanes where possible) there is no risk that the project will make any material contribution to impacts on common scoter in the Greater Wash SPA and therefore **there will be no adverse effects on the Greater Wash SPA due to DBS East and DBS West alone and in-combination with other projects**.

~~9.5~~9.6 Flamborough and Filey Coast SPA

~~9.5.1~~9.6.1 Site Description

~~83.~~102. The Flamborough and Filey Coast SPA was designated in 2018. It is a geographical extension to the former Flamborough Head and Bempton Cliffs SPA, which was designated in 1993 (Natural England, 2018b).

~~84.~~103. The SPA is located on the Yorkshire coast between Bridlington and Scarborough, and is composed of two sections. The northern section runs from Cunstone Nab to Filey Brigg, and the southern section from Speeton, around Flamborough Head, to South Landing. The seaward boundary extends 2km offshore and applies to both sections of the SPA.

~~85.~~104. The predominantly chalk cliffs of Flamborough Head rise to 135m and have been eroded into a series of bays, arches, pinnacles and gullies. The cliffs from Filey Brigg to Cunstone Nab are formed from various sedimentary rocks including shales and sandstones. The adjacent sea out to 2km off Flamborough Head as well as Filey Brigg to Cunstone Nab is characterised by reefs supporting kelp forest communities in the shallow subtidal, and faunal turf communities in deeper water. The southern side of Filey Brigg shelves off gently from the rocks to the sandy bottom of Filey Bay. This site does not support any priority habitats or species (Natural England, 2018b).

~~86.~~105. The coastal areas of the SPA cover cliffs supporting internationally important breeding populations of seabirds, the marine extension includes areas close to the colony used by seabirds for maintenance behaviours (loafing, preening etc).

~~9.5.1.1~~9.6.1.1 Qualifying Features and Condition Assessment

~~87.~~106. The qualifying features of the Flamborough and Filey Coast SPA screened into the assessment are listed in Table 4-7 of **RIAA HRA Part 1 of 4 – Introduction and Terrestrial Ecology (application ref: 6.1)**. These are breeding gannet, kittiwake and guillemot, razorbill and one named component of the breeding seabird assemblage (puffin).

~~9.5.1.2~~9.6.1.2 Conservation Objectives

~~88.~~107. The site's over-arching conservation objectives are to ensure that, subject to natural change, the integrity of the site is maintained or restored as appropriate, and that the site contributes to achieving the aims of the Wild Birds Directive, by maintaining or restoring:

- The extent and distribution of the habitats of the qualifying features;
- The structure and function of the habitats of the qualifying features;

- The supporting processes on which the habitats of the qualifying features rely;
- The populations of each of the qualifying features; and
- The distribution of qualifying features within the site.

~~89.~~108. Of relevance to the requirement to maintain the supporting habitats for qualifying features, in January 2024 Defra announced that the UK government had decided to prohibit the fishing of sandeels within English waters of ICES Area 4 (North Sea) effective from 26th March 2024 (Defra, 2024). This measure will go a considerable way towards ensuring greater resilience for species which rely upon sandeels, which in particular includes the seabird qualifying features from Flamborough and Filey Coast SPA assessed in this section.

~~9.5.2~~9.6.2 Assessment: Array Areas

~~9.5.2.1~~9.6.2.1 Gannet

~~90.~~109. Gannet has been screened in to assess the impacts from disturbance / displacement and collision risk in the construction and operation phase.

~~9.5.2.1.1~~9.6.2.1.1 Status

~~91.~~110. Gannet is listed as a designated species of the Flamborough and Filey Coast SPA.

~~92.~~111. The SPA breeding population at classification was cited as 8,469 pairs or 16,938 breeding adults, for the period 2008 to 2012 (Natural England, 2018b). The most recent count is 15,223 apparently occupied nests, or 30,446 breeding adults in 2023 (Butcher *et al*. 2023), however the closest to the period when the surveys were conducted was 13,125 in 2022 (Clarkson *et al*. 2022). The baseline mortality of this population is 2,~~310~~126 breeding adult birds per year based on the published adult mortality rate of 8.~~8~~1% (Horswill and Robinson, 2015).

~~93.~~112. Supplementary advice on the conservation objectives were added for qualifying features of the Flamborough and Filey Coast SPA in 2020 (Natural England, 2020). For gannet, these are:

- Maintain the size of the breeding population at a level which is above 8,469 pairs, whilst avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent;
- Maintain safe passage of birds moving between nesting and feeding areas;

- Restrict the frequency, duration and / or intensity of disturbance affecting roosting, nesting, foraging, feeding, moulting and/or loafing birds so that they are not significantly disturbed;
- Restrict predation and disturbance caused by native and non-native predators;
- Maintain concentrations and deposition of air pollutants at below the site-relevant Critical Load or Level values given for this feature of the site on the Air Pollution Information System;
- Maintain the structure, function and supporting processes associated with the feature and its supporting habitat through management or other measures (whether within and/or outside the site boundary as appropriate) and ensure these measures are not being undermined or compromised;
- Maintain the extent, distribution and availability of suitable breeding habitat which supports the feature for all necessary stages of its breeding cycle (courtship, nesting, feeding) at: current extent;
- Maintain the distribution, abundance and availability of key food and prey items (e.g. herring, mackerel, sprat, sandeel – see section 9.6.1.2) at preferred sizes;
- Restrict aqueous contaminants to levels equating to High Status according to Annex VIII and Good Status according to Annex X of the Water Framework Directive, avoiding deterioration from existing levels;
- Maintain the dissolved oxygen (DO) concentration at levels equating to High Ecological Status (specifically ≥5.7mg per litre (at 35 salinity) for 95% of the year), avoiding deterioration from existing levels;
- Maintain water quality and specifically mean winter dissolved inorganic nitrogen (DIN) at a concentration equating to High Ecological Status (specifically mean winter DIN is <12μM for coastal waters), avoiding deterioration from existing levels; and
- Maintain natural levels of turbidity (e.g. concentrations of suspended sediment, plankton and other material) across the habitat.

~~9.5.2.1.2~~9.6.2.1.2 *Connectivity to the Projects*

~~94.~~113. DBS East and DBS West are at least 125km and 103km respectively from the Flamborough and Filey Coast SPA. The mean maximum foraging range of gannet is 509.4km (315.2 + 194.2km, Woodward *et al.*, 2019). Therefore, DBS East and DBS West are both within potential foraging range for breeding gannet from the Flamborough and Filey Coast SPA.

~~95.~~114. Although the gannets which breed at the Bass Rock, part of the Forth Islands SPA, are also within this mean maximum foraging distance (c. minimum of 290km to the Projects), Wakefield *et al*. (2013) found very little overlap in colony foraging areas, so connectivity with that SPA is considered very unlikely during the breeding season. Therefore, a precautionary assumption has been made that all of the gannets recorded at the Projects during the breeding season could be breeding adult birds from the Flamborough and Filey Coast SPA.

~~96.~~115. Outside the breeding season, breeding gannets, including those from the Flamborough and Filey Coast SPA, are not constrained by requirements to visit nests to incubate eggs or provision chicks. At this time, they range more widely and mix with gannets of all age classes from breeding colonies in the UK and further afield. The background population during these seasons is the UK North Sea BDMPS. This consists of 456,298 individuals during autumn migration (September to November), and 248,385 individuals during spring migration (December to March; Furness, 2015).

~~97.~~116. During the autumn migration and spring migration seasons it is estimated that 4.8% and 6.2% of birds respectively present in the Project Array Areas are breeding adults from the Flamborough and Filey Coast SPA. Note, these percentages have been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

~~9.5.2.1.3~~9.6.2.1.3 *Assessment of Potential Effects of the Projects alone and Together*

~~9.5.2.1.3.1~~9.6.2.1.3.1 *Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines*

~~98.~~117. The seasonal peak total number of gannets recorded in DBS East and DBS West and the number apportioned to the Flamborough and Filey Coast SPA is provided in **Table 9-14**.

~~99.~~118. Construction displacement has been estimated on the basis this operates across half the wind farm. Thus, gannet displacement was calculated using 30% and 40% displacement rates (i.e. half the operational values) and 1% mortality. These were then added to the number of birds expected to be displaced by up to three construction vessels (assuming 100% displacement within 2km of each vessel and 1% mortality), calculated from the seasonal densities (**Table 9-14**).

Table 9-14 Summary of gannet density and abundance estimates and SPA apportioning rates used in the operation and construction displacement assessment for Flamborough and Filey Coast SPA. Note that displacement from the wind farm during construction has been estimated as 30%-40%, half the operational rates. Note that breeding season impacts have been estimated assuming 60% of birds present were adults (demographic) and also 100% (shaded cells).

Site	Season	Peak no. (mean)	SPA %	Adult %	No. apportioned to SPA	Wind farm operation displacement mortality to SPA		Wind farm construction displacement mortality to SPA		Peak density (birds/ km^2)	Total vessel displacement mortality (2km around 3 vessels, 1% mortality)	Vessel mortality to SPA	Total construction displacement mortality to SPA	
						60-1	80-1	30-1	40-1				30-1 & vessel	40-1 & vessel
DBS East	Breeding	754.9	100	60	452.9	2.72	3.62	1.36	1.81	1.48	0.56	0.36	1.72	2.17
				100	754.9	4.53	6.04	2.26	3.02			0.56	2.83	3.58
	Autumn	776.1	4.8	100	37.2	0.22	0.30	0.11	0.15	1.52	0.57	0.03	0.14	0.18
	Spring	75.1	6.2	100	4.6	0.03	0.04	0.01	0.02	0.15	0.06	0.006	0.02	0.03
	Annual (60% adult & 100% adult)				494.7	2.97	3.96	1.48	1.98		1.19	0.40	1.88	2.38
					796.7	4.78	6.38	2.38	3.19			0.60	2.99	3.79
DBS West	Breeding	805.3	100	60	483.2	2.90	3.87	1.45	1.93	1.55	0.58	0.36	1.81	2.29
				100	805.3	4.83	6.44	2.42	3.22			0.58	2.77	3.57
	Autumn	797.5	4.8	100	38.3	0.23	0.31	0.11	0.15	1.54	0.58	0.03	0.14	0.18
	Spring	86.2	6.2	100	5.3	0.03	0.04	0.02	0.02	0.17	0.06	0.006	0.03	0.03
	Annual (60% adult & 100% adult)				526.8	3.16	4.22	1.58	2.1		1.22	0.40	1.98	2.50
					848.9	5.09	6.79	2.55	3.39			0.62	2.94	3.78
DBS East + DBS West	Breeding	1560.2	100	60	936.1	5.62	7.49	2.81	3.74	-	1.14	0.72	3.53	4.46
				100	1560.2	9.36	12.48	4.68	6.24			1.14	5.03	6.59
	Autumn	1573.6	4.8	100	75.5	0.45	0.61	0.22	0.3	-	1.15	0.06	0.28	0.36
	Spring	161.3	6.2	100	9.9	0.06	0.08	0.03	0.04	-	0.12	0.012	0.05	0.06
	Annual (60% adult & 100% adult)				1021.5	6.13	8.18	3.06	4.08			0.79	3.86	4.88
					1645.6	9.87	13.17	4.93	6.58			1.21	5.36	7.01

~~9.5.2.1.3.1.1~~9.6.2.1.3.1.1 DBS East in Isolation

~~100.~~119. The wind farm construction displacement from DBS East in the breeding, autumn and spring seasons were up to 1.8 (60% adults) and 3.0 (100% adults), 0.1 and 0, respectively (**Table 9-14**). Displacement mortalities due to construction vessels were 0.36 (60% adults) and 0.56 (100% adults), 0.03 and <0.01 in each season respectively. Thus the maximum total combined seasonal construction displacement mortalities apportioned to the SPA were 2.1 (60% adults) and 3.6 (100% adults), 0.18 and 0.03 birds during the breeding, autumn and spring.

~~101.~~120. At the baseline mortality rate for adult gannet of 0.~~088~~081 (**Table 9-7**) the number of adults from the Flamborough and Filey Coast SPA population expected to die per year is 2,~~310~~126 (26,250 x 0.~~088~~081). The predicted annual construction mortality impacts from DBS East alone on the breeding gannet population is 2.4 to 3.8 birds per annum. These result in a predicted change in adult mortality rate of 0.1% to 0.~~16~~18% which are below the 1% threshold for detectability and therefore no further assessment is required.

~~9.5.2.1.3.1.2~~9.6.2.1.3.1.2 DBS West in Isolation

~~102.~~121. The wind farm construction displacement from DBS West in the breeding, autumn and spring seasons were up to 1.9 (60% adults) and 3.2 (100% adults), 0.1 and 0, respectively (**Table 9-14**). Displacement mortalities due to construction vessels were 0.36 (60% adults) and 0.58 (100% adults), 0.03 and <0.01 in each season respectively. Thus the maximum total combined seasonal construction displacement mortalities apportioned to the SPA were 2.3 (60% adults) and 3.6 (100% adults), 0.18 and 0.03 birds during the breeding, autumn and spring.

~~103.~~122. At the baseline mortality rate for adult gannet of 0.~~088~~081 (**Table 9-7**) the number of adults from the Flamborough and Filey Coast SPA population expected to die per year is 2,~~310~~126 (26,250 x 0.~~088~~081). The predicted annual construction mortality impacts from DBS East alone on the breeding gannet population is 2.5 to 3.8 birds per annum. These result in a predicted change in adult mortality rate of 0.1% to 0.~~16~~18% which are below the 1% threshold for detectability and therefore no further assessment is required.

~~9.5.2.1.3.1.3~~9.6.2.1.3.1.3 DBS East and West Together

~~104.~~123. The wind farm construction displacement from DBS East and DBS West in the breeding, autumn and spring seasons were up to 3.7 (60% adults) and 6.2 (100% adults), 0.3 and 0.04, respectively. Displacement mortalities due to construction vessels were 0.72 (60% adults) and 1.14 (100% adults), 0.06 and 0.01 in each season respectively. Thus the maximum total combined seasonal construction displacement mortalities apportioned to the SPA were 4.4 (60% adults) and 6.6 (100% adults), 0.36 and 0.05 birds during the breeding, autumn and spring.

~~105.~~124. At the baseline mortality rate for adult gannet of 0.~~088~~081 (**Table 9-7**) the number of adults from the Flamborough and Filey Coast SPA population expected to die per year is 2,~~310~~126 (26,250 x 0.~~088~~081). The predicted annual construction mortality impacts from DBS East alone on the breeding gannet population is 4.8 to 7.0 birds per annum. These result in a predicted change in adult mortality rate of 0.~~21~~22% to 0.~~30~~33% which are below the 1% threshold for detectability and therefore no further assessment is required.

~~9.5.2.1.3.2~~9.6.2.1.3.2 Potential Effects During Operation: Disturbance and Displacement

~~9.5.2.1.3.2.1~~9.6.2.1.3.2.1 DBS East in Isolation

~~106.~~125. The wind farm operation displacement from DBS East apportioned to the SPA in the breeding, autumn and spring seasons were up to 3.6 (60% adults) and 6.0 (100% adults), 0.3 and 0.04, respectively (**Table 9-14**).

~~107.~~126. At the baseline mortality rate for adult gannet of 0.~~088~~081 (**Table 9-7**) the number of individuals from the Flamborough and Filey Coast SPA population expected to die per year is 2,~~310~~126 (26,250 x 0.~~088~~081). The predicted annual impacts from DBS East alone on the breeding gannet population is 3.96 to 6.3 birds per annum. These result in a predicted change in adult mortality rate of 0.~~17~~19% to 0.~~27~~29% which are below the 1% threshold for detectability and therefore no further assessment is required.

~~9.5.2.1.3.2.2~~9.6.2.1.3.2.2 DBS West in Isolation

~~108.~~127. The wind farm operation displacement from DBS West apportioned to the SPA in the breeding, autumn and spring seasons were up to 3.9 (60% adults) and 6.4 (100% adults), 0.3 and 0.04, respectively (**Table 9-14**).

~~109.~~128. At the baseline mortality rate for adult gannet of 0.~~088~~081 (**Table 9-7**) the number of individuals from the Flamborough and Filey Coast SPA population expected to die per year is 2,~~310~~126 (26,250 x 0.~~088~~081). The predicted annual (breeding and non-breeding periods combined) impacts from DBS West alone on the breeding gannet population is 4.2 to 6.7 birds per annum. These result in a predicted change in adult mortality rate of 0.~~18~~20% to 0.~~29~~31% which are below the 1% threshold for detectability and therefore no further assessment is required.

~~9.5.2.1.3.2.3~~9.6.2.1.3.2.3 DBS East and West Together

~~110.~~129. The wind farm operation displacement from DBS East and DBS West apportioned to the SPA in the breeding, autumn and spring seasons were up to 7.5 (60% adults) and 12.5 (100% adults), 0.6 and 0.08, respectively (**Table 9-14**).

~~111.~~130. At the baseline mortality rate for adult gannet of 0.~~088~~081 (**Table 9-7**) the number of individuals from the Flamborough and Filey Coast SPA population expected to die per year is 2,~~310~~126 (26,250 x 0.~~088~~081). The predicted annual (breeding and non-breeding periods combined) impacts from DBS East and DBS West alone on the breeding gannet population is 8.2 to 13.2 birds per annum. These result in a predicted change in adult mortality rate of 0.~~35~~38% to 0.~~57~~62% which are below the 1% threshold for detectability and therefore no further assessment was required (**Table 9-16).**

~~9.5.2.1.3.3~~9.6.2.1.3.3 Potential Effects During Operation: Collision Risk

Table 9-15 Summary of gannet total collisions and apportioned to the Flamborough and Filey Coast SPA. Note that breeding season impacts have been estimated assuming 60% of birds present were adults (demographic) and also 100% (shaded cells).

Site	Season	Collision mortality			SPA %	Adult %	Collisions apportioned to SPA		
		Lower 95% c.i.	Mean	Upper 95% c.i.			Lower 95% c.i.	Mean	Upper 95% c.i.
DBS East	Breeding	0.7	3.4	7.8	100	60	0.44	2.04	4.68
						100	0.74	3.40	7.80
	Autumn	0.3	1.6	3.8	4.8	100	0.02	0.08	0.18
	Spring	0.0	0.1	0.6	6.2	100	0.00	0.01	0.03
	Annual	1.1	5.1	12.2	-	60	0.46	2.12	4.90
						100	0.76	3.48	8.02

Site	Season	Collision mortality			SPA %	Adult %	Collisions apportioned to SPA		
		Lower 95% c.i.	Mean	Upper 95% c.i.			Lower 95% c.i.	Mean	Upper 95% c.i.
DBS West	Breeding	1.0	4.8	11.4	100	60	0.60	2.89	6.84
						100	1.00	4.81	11.40
	Autumn	0.3	2.1	5.9	4.8	100	0.01	0.10	0.28
	Spring	0.0	0.1	0.6	6.2	100	0.00	0.01	0.04
	Annual	1.3	7.1	17.9	-	60	0.61	3.00	7.16
						100	1.01	4.92	11.72
DBS East + DBS West	Breeding	2.7	8.2	16.1	100	60	1.63	4.93	9.66
						100	2.71	8.21	16.10
	Autumn	1.1	3.7	8.1	4.8	100	0.05	0.18	0.39
	Spring	0.0	0.2	0.9	6.2	100	0.00	0.01	0.05
	Annual	3.8	12.2	25.1	-	60	1.68	5.12	10.10
						100	2.76	8.40	16.54

~~9.5.2.1.3.3.1~~9.6.2.1.3.3.1 DBS East in Isolation

~~112.~~131. Based on adult gannet proportions of 60% and 100% (**Table 9-7**) applied to the breeding season impact and the proportions of birds recorded at the Projects predicted to be adult birds from the Flamborough and Filey Coast SPA (100%, 4.8% and 6.2% in the breeding, autumn and spring respectively), the predicted mean (lower c.i. and upper c.i.) collision risk impact from DBS East alone on the breeding gannet population is 2.0 (0.4 to 4.7 at 60% adults) and 3.4 (0.7 to 7.8 at 100% adults) birds in the breeding season, 0.08 (0.02 to 0.18) birds during autumn migration and 0.01 (0 to 0.03) birds during spring migration (**Table 9-15**).

~~113.~~132. At the baseline mortality rate for adult gannet of 0.~~088~~081 (**Table 9-7**) the number of individuals from the Flamborough and Filey Coast SPA population expected to die is 2,~~310~~126 (26,250 x 0.~~088~~081) adults per annum. The predicted annual (breeding and non-breeding periods combined) impacts from DBS East alone on the breeding gannet population is 2.1 (0.5 to 4.9) to 3.5 (0.8 to 8.0) birds per annum. These result in a predicted change in adult mortality rate of 0.~~09~~10% to 0.~~15~~16% which are below the 1% threshold for detectability and therefore no further assessment was required.

~~9.5.2.1.3.3.2~~9.6.2.1.3.3.2 DBS West in Isolation

~~114.~~133. Based on adult gannet proportions of 60% and 100% (**Table 9-7**) applied to the breeding season impact and the proportions of birds recorded at the Projects predicted to be adult birds from the Flamborough and Filey Coast SPA (100%, 4.8% and 6.2% in the breeding, autumn and spring respectively), the predicted mean (lower c.i. and upper c.i.) collision risk impact from DBS West alone on the breeding gannet population is 2.9 (0.6 to 6.8 at 60% adults) and 4.8 (1.0 to 11.4 at 100% adults) birds in the breeding season, 0.10 (0.01 to 0.28) birds during autumn migration and 0.01 (0 to 0.04) birds during spring migration (**Table 9-15**).

~~115.~~134. At the baseline mortality rate for adult gannet of 0.~~088~~081 (**Table 9-7**) the number of individuals from the Flamborough and Filey Coast SPA population expected to die is 2,~~310~~126 (26,250 x 0.~~088~~081) adults per annum. The predicted annual (breeding and non-breeding periods combined) impacts from DBS West alone on the breeding gannet population is 3.0 (0.61 to 7.2) to 4.9 (1.0 to 11.7) birds per annum. These result in a predicted change in adult mortality rate of 0.~~13~~14% to 0.~~21~~23% which are below the 1% threshold for detectability and therefore no further assessment was required.

~~9.5.2.1.3.3.3~~9.6.2.1.3.3.3 DBS East and West Together

~~116.~~135. Based on an adult gannet proportions of 60% and 100% (**Table 9-7**) applied to the breeding season impact and the proportions of birds recorded at the Projects predicted to be adult birds from the Flamborough and Filey Coast SPA (100%, 4.8% and 6.2% in the breeding, autumn and spring respectively), the predicted mean (lower c.i. and upper c.i.) collision risk impact from DBS East and DBS West alone on the breeding gannet population is 4.9 (1.6 to 9.7 at 60% adults) and 8.2 (2.7 to 16.1 at 100% adults) birds in the breeding season, 0.18 (0.05 to 0.39) birds during autumn migration and 0.01 (0 to 0.05) birds during spring migration (**Table 9-15**).

~~117.~~136. At the baseline mortality rate for adult gannet of 0.~~088~~081 (**Table 9-7**) the number of individuals from the Flamborough and Filey Coast SPA population expected to die is 2,~~310~~126 (26,250 x 0.~~088~~081) adults per annum. The predicted annual (breeding and non-breeding periods combined) impacts from DBS East and DBS West alone on the breeding gannet population is 5.1 (1.7 to 10.1) to 8.4 (2.8 to 16.5) birds per annum. These result in a predicted change in adult mortality rate of 0.~~22~~24% to 0.~~36~~39% which are below the 1% threshold for detectability and therefore no further assessment was required (**Table 9-16**).

~~9.5.2.1.3.4~~9.6.2.1.3.4 *Potential Effects During Operation: Combined Operational Displacement and Collision Risk*

~~9.5.2.1.3.4.1~~9.6.2.1.3.4.1 *DBS East in Isolation*

~~118.~~137. The predicted mean displacement and collision risk mortality combined on the breeding gannet population from the Flamborough and Filey Coast SPA due to DBS East alone is up to 7.0 (3.6 + 3.4) birds in the breeding season, 1.9 (0.3 + 1.6) birds during autumn migration and 0.14 (0.04 + 0.1) birds during spring migration.

~~119.~~138. At the baseline mortality rate for adult gannet of 0.~~088~~081 (**Table 9-7**) the number of individuals from the Flamborough and Filey Coast SPA population expected to die is 2,~~310~~126 (26,250 x 0.~~088~~081) adults per annum. The predicted annual (breeding and non-breeding periods combined) impacts from DBS East alone on the breeding gannet population is 9.0 birds per annum. This results in a predicted change in adult mortality rate of 0.~~39~~42% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.5.2.1.3.4.2~~9.6.2.1.3.4.2 *DBS West in Isolation*

~~120.~~139. The predicted mean displacement and collision risk mortality combined on the breeding gannet population from the Flamborough and Filey Coast SPA due to DBS West alone is 11.2 (6.4 + 4.8) birds in the breeding season, 2.4 (0.3 + 2.1) birds during autumn migration and 0.14 (0.04 + 0.1) birds during spring migration.

~~121.~~140. At the baseline mortality rate for adult gannet of 0.~~088~~081 (**Table 9-7**) the number of individuals from the Flamborough and Filey Coast SPA population expected to die is 2,~~310~~126 (26,250 x 0.~~088~~081) adults per annum. The predicted annual (breeding and non-breeding periods combined) impacts from DBS West alone on the breeding gannet population is 13.7 birds per annum. This results in a predicted change in adult mortality rate of 0.~~59~~64% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.5.2.1.3.4.3~~9.6.2.1.3.4.3 *DBS East and West Together*

~~122.~~141. The predicted mean displacement and collision risk mortality combined on the breeding gannet population from the Flamborough and Filey Coast SPA due to DBS East and DBS West together is 20.7 (12.5 + 8.2) birds in the breeding season, 0.97 (0.6 + 0.37) birds during autumn migration and 0.28 (0.08 + 0.2) birds during spring migration.

~~123.~~142. At the baseline mortality rate for adult gannet of 0.~~088~~081 (**Table 9-7**) the number of individuals from the Flamborough and Filey Coast SPA population expected to die is 2,~~310~~126 (26,250 x 0.~~088~~081) adults per annum. The predicted annual (breeding and non-breeding periods combined) impacts from DBS East and DBS West alone on the breeding gannet population is 21.9 birds per annum. This results in a predicted change in adult mortality rate of 1.0~~.9~~% which is ~~below the 1%~~at threshold for detectability. This has therefore ~~no further assessment was required (**Table 9-14**).~~been assessed using PVA. After a period of 30 years, project alone displacement and collisions reduced the population growth rate by up to 0.06% (0.9994). See section 9.6.2.1.5.4 for full discussion of the results including the precautionary assumptions about the impact level have been made (e.g. apportioning of 100% breeding season impacts to FFC SPA adults, summing displacement and collision risk).

~~9.5.2.1.4~~9.6.2.1.4 Summary of DBS alone

~~124.~~143. A table summarising the gannet construction and operational disturbance / displacement, as well as operational collision risk and finally the combination of operational disturbance and displacement with collision risk assessment for DBS East and DBS West together is provided below (**Table 9-16**).

~~125.~~144. It is concluded that predicted gannet mortality due to construction and operational phase displacement, as well as operational collision risk and finally the combination of operational disturbance and displacement with collision risk impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the Flamborough and Filey Coast SPA**.

Table 9-16 Summary of predicted gannet construction and operational displacement and operational collision risk mortality from Flamborough and Filey Coast SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.

Gannet		
Potential Effects During Construction: Disturbance and Displacement		
Displacement mortality (40% + 1%)		Mean
Breeding season (60-100% adults)		4.46-6.59
Autumn		0.36
Spring		0.05
Annual		4.88-7.0
Effect	Reference population	26,250
	Increase in background mortality (%)	0.~~21~~23-0.~~30~~33
Potential Effects During Operation: Disturbance and Displacement		

Gannet				
Displacement mortality (80% + 1%)		Mean		
Breeding season (60-100% adults)		7.5-12.5		
Autumn		0.61		
Spring		0.08		
Annual		8.18-13.2		
Effect	Reference population	26,250		
	Increase in background mortality (%)	0.~~35~~38-0.~~57~~62		
Potential Effects During Operation: Collision Risk				
Collision mortality		Lower c.i.	Mean	Upper c.i.
Breeding season (60-100% adults)		1.6-2.7	4.9-8.2	9.7-16.1
Autumn		0.05	0.18	0.39
Spring		0.00	0.01	0.05
Annual		1.68-2.76	5.12-8.4	10.1-16.5
Effect	Reference population	26,250		
	Increase in background mortality (%)	0.01-0.~~12~~13	0.~~2~~24-0.~~36~~39	0.~~43~~47-0.~~7~~78
Potential Effects During Operation: Combined Disturbance and Displacement and Collision Risk				
Combined Displacement and Collision mortality		Mean		
Breeding season		12.4-20.7		
Autumn		0.79		
Spring		0.10		
Annual		13.3-21.6		
Effect	Reference population	26,250		
	Increase in background mortality (%)	0.~~58-~~62-1.0~~.94~~		

~~9.5.2.1.5~~9.6.2.1.5 Assessment of potential effects of the Projects in combination with other plans and projects

~~9.5.2.1.5.1~~9.6.2.1.5.1 Potential Effects During Operation: Disturbance and Displacement

~~126.~~145. Seasonal and annual abundance estimates of gannets, both total values and apportioned to Flamborough and Filey Coast SPA, reported for all OWFs included in the in-combination assessment are presented in **Table 9-17**~~. This information was taken from the DCO Application and Examination for the Dudgeon and Sheringham Extension projects (Royal HaskoningDHV 2022, 2023).~~.

~~127.~~146. The estimated total number of gannets at risk of displacement from all OWFs within the UK North Sea BDMPS combined is ~~59,359~~62,167 of which ~~10,243~~11,051 to ~~10,867~~11,675 are estimated to be breeding adults from Flamborough and Filey Coast SPA (**Table 9-17**). Using displacement rates of 60% to 80% and a maximum mortality rate of 1% for displaced birds, the number of Flamborough and Filey Coast SPA birds predicted to die each year would be between ~~61~~66 to ~~87~~93.

~~128.~~147. At the baseline mortality rate for adult gannet of 0.~~088~~081 (**Table 9-7**) the number of individuals from the Flamborough and Filey Coast SPA population expected to die is 2,~~310~~126 (26,250 x 0.~~088~~081) adults per annum. The predicted annual in-combination mortality on the breeding gannet population would result in a predicted change in adult mortality rate of between ~~2.6~~3.1% and ~~3.7~~4.4%. These are above the 1% threshold below which effects are considered undetectable, therefore PVA was undertaken to investigate further. The results of the PVA are considered below (paragraph 154).

148. A matrix of the range of in-combination mortalities is provided in **Table 9-18**.

Table 9-17 Total in-combination gannet abundance on North Sea and English Channel Wind Farms and apportioned to Flamborough and Filey Coast SPA adult population.

Tier	Wind Farm	Breeding		Autumn		Spring		Annual	
		Total	FFC	Total	FFC	Total	FFC	Total	FFC
1	Beatrice	151	0	0	0	0	0	151	0
1	Beatrice Demonstrator	-	-	-	-	-	-	-	-
1	Blyth Demonstration Project	-	-	-	-	-	-	-	-
1	Dudgeon	53	53	25	1.2	11	0.7	89	54.9
1	East Anglia ONE	161	161	3638	174.6	76	4.7	3875	340.3
1	European Offshore Wind Deployment Centre	35	0	5	0.2	0	0	40	0.2
1	Galloper	360	0	907	43.5	276	17.1	1543	60.6
1	Greater Gabbard	252	0	69	3.3	105	6.5	426	9.8
1	Gunfleet Sands	0	0	12	0.6	9	0.6	21	1.2
1	Hornsea Project One	671	671	694	33.3	250	15.5	1615	719.8
1	Humber Gateway	-	-	-	-	-	-	-	-
1	Hywind	10	0	0	0	4	0.2	14	0.2
1	Kentish Flats	-	-	-	-	-	-	-	-
1	Kentish Flats Extension	0	0	13	0.6	0	0	13	0.6
1	Kincardine	120	0	0	0	0	0	120	0
1	Lincs	-	-	-	-	-	-	-	-
1	London Array	-	-	-	-	-	-	-	-
1	Race Bank	92	92	32	1.5	29	1.8	153	95.3
1	Rampion	0	0	590	28.3	0	0	590	28.3
1	Scroby Sands	-	-	-	-	-	-	-	-
1	Sheringham Shoal	47	47	31	1.5	2	0.1	80	48.6
1	Teesside	1	0.5	0	0	0	0	1	0.5
1	Thanet	-	-	-	-	-	-	-	-
1	Westermost Rough	-	-	-	-	-	-	-	-
2	Triton Knoll	211	211	15	0.7	24	1.5	250	213.2
3	Dogger Bank Creyke Beck Projects A and B	1155	577.5	2048	98.3	394	24.4	3597	700.2
3	Dogger Bank Teesside Projects A and B	2250	1125	887	42.6	464	28.8	3601	1196.4
3	East Anglia ONE North	149	149	468	22.5	44	2.7	661	174.2
3	East Anglia THREE	412	412	1269	60.9	524	32.5	2205	505.4
3	East Anglia TWO	192	192	891	42.8	192	11.9	1275	246.7
3	Firth of Forth Alpha and Bravo	2956	0	664	31.9	332	20.6	3952	52.5
3	Hornsea Project Three	1333	844	984	47	524	32.5	2841	924
3	Hornsea Project Two	457	457	1140	54.7	124	7.7	1721	519.4
3	Inch Cape	2398	0	703	33.7	212	13.1	3313	46.8
3	Methil	23	0	0	0	0	0	23	0
3	Moray Firth (EDA)	564	0	292	14	27	1.7	883	15.7
3	Moray West	2827	0	439	21.1	144	8.9	3410	30

Tier	Wind Farm	Breeding		Autumn		Spring		Annual	
		Total	FFC	Total	FFC	Total	FFC	Total	FFC
3	Neart na Gaoithe	1987	0	552	26.5	281	17.4	2820	43.9
3	Norfolk Boreas	1229	1229	1723	82.7	526	32.6	3478	1344.3
3	Norfolk Vanguard	271	271	2453	117.7	437	27.1	3161	415.8
3	Hornsea Project Four	976	883.1	790	38.3	401	25	2167	946.4
4	Rampion 2	111	0	102	4.9	123	7.6	336	12.5
4	DEP	417	319.8	343	16.5	47	2.9	807	339.2
4	SEP	23	17.6	295	14.1	11	0.7	328	32.4
4	Berwick Bank	4735	61	1500	30	269	11	6504	102
4	North Falls (ES)	69	48	287	14	290	18	646	80
4	Five Estuaries (ES)	233	78	640	31	67	4	940	113
4	Outer Dowsing (ES)	635	584	496	30	91	1	1222	615
Total without DBS		**~~2662~~9 27566**	**~~7773.5~~8483**	**~~2357~~4 24997**	**~~1089~~1164.5**	**~~5862~~6310**	**~~357.83~~381**	**~~5606~~4 58872**	**~~9221.3~~10029**
5	DBS East	755	452.9	776	37.6	75	4.7	1606	495
5	DBS West	805	483.2	798	38.7	86	5.4	1689	527
5a	DBS East+West (60% adults in breeding season)	1560	936	1574	76	161	10	3295	1022
5b	DBS East+West (100% adults in breeding season)		1560						1646
5a Total (all projects)		**~~28189~~29126**	**~~8710~~9419**	**~~25148~~26571**	**~~1165~~1240**	**~~6023~~6471**	**~~368~~391**	**~~59359~~62167**	**~~10243~~11501**
5b Total (all projects)			**~~9334~~10044**						**~~10867~~11675**

Table 9-18 Gannet in-combination displacement matrix for Flamborough and Filey Coast SPA.

Mortality %	**Displacement %**									
	10	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**
1	12	23	35	47	58	70	82	93	105	117
2	23	47	70	93	117	140	163	187	210	234
3	35	70	105	140	175	210	245	280	315	350
4	47	93	140	187	234	280	327	374	420	467
5	58	117	175	234	292	350	409	467	525	584
6	70	140	210	280	350	420	490	560	630	701
7	82	163	245	327	409	490	572	654	736	817
8	93	187	280	374	467	560	654	747	841	934
9	105	210	315	420	525	630	736	841	946	1051
10	117	234	350	467	584	701	817	934	1051	1168
20	234	467	701	934	1168	1401	1635	1868	2102	2335
30	350	701	1051	1401	1751	2102	2452	2802	3152	3503
50	584	1168	1751	2335	2919	3503	4086	4670	5254	5838
75	876	1751	2627	3503	4378	5254	6129	7005	7881	8756
100	1168	2335	3503	4670	5838	7005	8173	9340	10508	11675

~~9.5.2.1.5.2~~9.6.2.1.5.2 Potential Effects During Operation: Collision Risk

~~129.~~149. Seasonal and annual collision mortality estimates of gannets, both total values and apportioned to Flamborough and Filey Coast SPA, reported for all OWFs included in the in-combination assessment are presented in **Table 9-19**. This information was taken from the DCO Application and Examination for the Dudgeon and Sheringham Extension projects (Royal HaskoningDHV 2022, 2023).

~~130.~~150. The estimated total number of gannets at risk of collision from all OWFs within the UK North Sea BDMPS combined is ~~665~~710.5 of which between ~~73~~75 and ~~76.4~~79 are estimated to be breeding adults from Flamborough and Filey Coast SPA (**Table 9-19**).

~~131.~~151. At the baseline mortality rate for adult gannet of 0.~~088~~081 (**Table 9-7**) the number of individuals from the Flamborough and Filey Coast SPA population expected to die is 2,~~310~~126 (26,250 x 0.~~088~~081) adults per annum. The predicted annual in-combination collision mortality would result in a predicted change in adult mortality rate of 3.~~1~~5% to 3.~~3~~7%. These are above the 1% threshold below which effects are considered undetectable, therefore PVA was undertaken to investigate further. The results of the PVA are considered below (paragraph 154).

Table 9-19 Total in-combination gannet collision risk at North Sea and English Channel Wind Farms and apportioned to Flamborough and Filey Coast SPA adult population. Collisions adjusted to 99.2% micro-avoidance and 70% macro-avoidance.

Tier	Wind Farm	Breeding		Autumn		Spring		Annual	
		Total	FFC	Total	FFC	Total	FFC	Total	FFC
1	Beatrice	8.2	0	10.6	0.5	2.1	0.1	20.9	0.6
1	Beatrice Demonstrator	0.2	0	0.3	0	0.2	0	0.7	0
1	Blyth Demonstration Project	0.8	0	0.5	0	0.6	0	1.8	0.1
1	Dudgeon	4.9	4.9	8.5	0.4	4.2	0.3	17.5	5.5
1	East Anglia ONE	0.7	0.7	28.6	1.4	1.4	0.1	30.8	2.2
1	European Offshore Wind Deployment Centre	0.9	0	1.1	0.1	0	0	2	0.1
1	Galloper	3.9	0	6.7	0.3	2.7	0.2	13.4	0.5
1	Greater Gabbard	3.1	0	1.9	0.1	1	0.1	6	0.2
1	Gunfleet Sands	-	-	-	-	-	-	-	-
1	Hornsea Project One	2.5	2.5	7	0.3	4.9	0.3	14.4	3.1
1	Humber Gateway	0.4	0.4	0.2	0	0.3	0	1	0.4
1	Hywind	1.2	0	0.2	0	0.2	0	1.6	0
1	Kentish Flats	0.3	0	0.2	0	0.2	0	0.7	0
1	Kentish Flats Extension	-	-	-	-	-	-	-	-
1	Kincardine	0.7	0	0	0	0	0	0.7	0
1	Lincs	0.5	0.5	0.3	0	0.4	0	1.1	0.5
1	London Array	0.5	0	0.3	0	0.4	0	1.2	0
1	Lynn and Inner Dowsing	0.1	0.1	0	0	0.1	0	0.2	0.1
1	Race Bank	7.4	7.4	2.6	0.1	0.9	0.1	10.8	7.5
1	Rampion	7.9	0	13.9	0.7	0.5	0	22.2	0.7
1	Scroby Sands	-	-	-	-	-	-	-	-
1	Sheringham Shoal	3.1	3.1	0.8	0	0	0	3.8	3.1
1	Teesside	1.1	0.5	0.4	0	0	0	1.5	0.5
1	Thanet	0.2	0	0	0	0	0	0.2	0
1	Westermost Rough	0	0	0	0	0	0	0.1	0
2	Triton Knoll	5.8	5.8	14	0.7	6.6	0.4	26.4	6.9
3	Dogger Bank Creyke Beck Projects A and B	17.7	8.9	18.2	0.9	11.9	0.7	47.8	10.5
3	Dogger Bank Teesside Projects A and B	3.2	1.6	2.2	0.1	2.4	0.1	7.8	1.9
3	East Anglia THREE	1.3	1.3	7.3	0.3	2.1	0.1	10.7	1.8
3	Firth of Forth Alpha and Bravo	174.7	0	10.8	0.5	14.4	0.9	199.8	1.4
3	Hornsea Project Three	2.2	1.3	1.1	0	0.9	0	4.1	1.5
3	Hornsea Project Two	1.5	1.5	3.1	0.1	1.3	0.1	5.9	1.7
3	Inch Cape	73.5	0	6.4	0.3	1.1	0.1	81	0.4
3	Methil	1.8	0	0	0	0	0	1.8	0
3	Moray Firth (EDA)	17.6	0	7.7	0.4	1.9	0.1	27.3	0.5
3	Moray West	2.2	0	0.4	0	0.2	0	2.8	0
3	Neart na Gaoithe	31.2	0	10.3	0.5	5	0.3	46.5	0.8
3	Norfolk Boreas	3.1	3.1	2.8	0.1	0.9	0.1	6.7	3.3
3	Norfolk Vanguard	1.8	1.8	4.1	0.2	1.2	0.1	7	2.1

Tier	Wind Farm	Breeding		Autumn		Spring		Annual	
		Total	**FFC**	**Total**	**FFC**	**Total**	**FFC**	**Total**	**FFC**
3	East Anglia TWO	2.7	2.7	5	0.2	0.9	0	8.6	3
3	East Anglia ONE North	2.7	2.7	2.4	0.1	0.2	0	5.3	2.8
3	Hornsea Project Four	3.4	3.1	1.1	0.1	0.3	0	4.9	3.2
4	Rampion 2	2.9	0	1.4	0.1	0.6	0.0	4.9	0.1
4	DEP	0.4	0.3	0.5	0	0	0	0.9	0.3
4	SEP	0	0	0.1	0	0	0	0.2	0
4	Berwick Bank	30	0.4	3	0.1	0.4	0	33.4	0.4
4	North Falls (ES)	0.6	0.4	0.9	0.04	0.6	0.04	2.1	0.48
4	Five Estuaries (ES)	2	0.8	2.3	0.1	0.2	0	4.5	0.9
4	Outer Dowsing (ES)	3.6	1	1.2	0.1	0.3	0	5.1	1.1
Total before DBS		**~~428.3~~ 434.5**	**~~54.6~~ 56.8**	**~~186.0~~ 190.4**	**8.~~6~~8**	**~~72.4~~ 73.5**	**4.2**	**~~686.0~~ 698.1**	**~~67.7~~ 70.2**
5	DBS East	3.5	2.1	1.6	0.1	0.1	~~0.~~0	5.3	2.2
5	DBS West	4.9	2.9	2.1	0.1	0.1	~~0.~~0	7.1	3.0
5a	DBS East+West (60% adults in breeding season)	8.2	5.0	3.7	0.2	0.2	0.0	12.4	5.1
5b	DBS East+West (100% adults in breeding season)		8.2						8.4
5a Total (all projects)		**~~407~~442.7**	**~~59~~61.8**	**~~187~~194.1**	**9.0**	**~~72~~73.7**	**4.2**	**~~665~~710.5**	**~~73~~75.3**
5b Total (all projects)			**~~63.4~~65.0**						**~~76.4~~78.6**

~~9.5.2.1.5.3~~9.6.2.1.5.3 *Potential Effects During Operation: Combined Operational Displacement and Collision Risk*

~~132.~~152. The annual displacement and collision mortality estimates of gannets, both total values and apportioned to Flamborough and Filey Coast SPA, reported for all OWFs included in the in-combination assessment are presented in **Table 9-17** and **Table 9-19**. The estimated total number of breeding adult gannets from Flamborough and Filey Coast SPA at risk of both displacement and collision mortality from all OWFs within the UK North Sea BDMPS combined is ~~134~~145 to ~~162~~172.

~~133.~~153. At the baseline mortality rate for adult gannet of 0.~~088~~081 (**Table 9-7**) the number of individuals from the Flamborough and Filey Coast SPA population expected to die is 2,~~310~~126 (26,250 x 0.~~088~~081) adults per annum. The predicted annual in-combination displacement and collision mortality would result in a predicted change in adult mortality rate of ~~5.8~~6.6% to ~~7.0~~8.1%. These are above the 1% threshold below which effects are considered undetectable, therefore Population Viability analysis (PVA) was undertaken to investigate further. The results of the PVA are considered below (paragraph 154).

~~9.5.2.1.5.4~~9.6.2.1.5.4 *Population Viability Analysis Results for gannet*

~~134.~~154. The Natural England commissioned PVA tool was used to examine the effect of the estimated in-combination mortality on the Flamborough and Filey Coast SPA population. The complete input parameters and settings and results are provided in Annex A: SPA PVA Results Annex A: SPA PVA Results. The counterfactuals of growth rate (CGR) and population size (CPS) are presented in **Table 9-20**.

Table 9-20 PVA results for in-combination impacts on FFC SPA gannet after 30 years.

PVA run scenario	Annual mortality	Decrease in adult survival rate	Mean CGR (95% c.i.)	Mean CPS (95% c.i.)
Project alone displacement higher (80% x 1%) + collisions	21.6	0.0008229	0.9994 (0.9986-1.0002)	0.9817 (0.9584-1.0051)
In-combination displacement lower (60% x 1%)	~~61~~66	0.~~0023238~~002514	0.~~9983~~9982 (0.~~9976~~9974-0.~~9991~~9989)	0.~~9492~~9451 (0.~~9265~~9223-0.~~9723~~9677)

PVA run scenario	Annual mortality	Decrease in adult survival rate	Mean CGR (95% c.i.)	Mean CPS (95% c.i.)
In-combination displacement lower (80% x 1%)	~~87~~93	0.~~0033143~~003543	0.~~9976~~9974 (0.~~9968~~9967-0.~~9984~~9982)	0.~~9285~~9235 (0.~~9063~~9016-0.~~9509~~9454)
In-combination collisions	~~76~~79	0.~~0029105~~003010	0.~~9979~~9978 (0.9971-0.~~9987~~9986)	0.~~9369~~9345 (0.~~9153~~9125-0.~~9597~~9568)
In-combination displacement lower (60% x 1%) + collisions	~~137~~145	0.~~0052190~~005524	0.~~9962~~996 (0.~~9955~~9952-0.~~9970~~9968)	0.~~8897~~8832 (0.~~8685~~8616-0.~~9113~~9046)
In-combination displacement lower (80% x 1%) + collisions	~~163~~172	0.~~0062095~~006552	0.~~9955~~9953 (0.~~9947~~9945-0.~~9963~~996)	0.~~8702~~8632 (0.~~8492~~8424-0.~~8916~~8852)

155. After a period of 30 years, project alone displacement and collisions reduced the population growth rate by up to 0.~~24~~06% (0.~~9976~~9994).

156. After a period of 30 years, in-combination displacement reduced the population growth rate by up to 0.26% (0.9974), in-combination collision risk reduced the population growth rate by up to 0.~~21~~22% (0.~~9979~~9978), and displacement and collisions combined reduced the population growth rate by up to 0.~~45~~47% (0.~~9955~~9953).

~~135.~~157. After a period of 30 years, project alone displacement and collisions reduced the population compared to the baseline size by up to 1.8% (0.9817).

~~136.~~158. After a period of 30 years, in-combination displacement reduced the population compared to the baseline size by up to 7.~~1~~6% (0.~~9285~~9235), in-combination collision risk reduced the population size by up to 6.~~3~~5% (0.~~9369~~9345), and displacement and collisions combined reduced the population compared to the baseline size by up to 13.7% (0~~%~~ ~~(0.8702~~.8632).

~~137.~~159. The choice of which counterfactual measure is more appropriate for understanding the potential population consequences of increased mortality is dependent on the model formulation, specifically whether or not the model incorporates realistic density dependent regulation. Natural England advise that PVA for seabird impact assessment should not include density dependence (on the basis that there is insufficient data to parameterise this for specific impacted populations). Density independent population predictions made under this assumption lack the natural feedback mechanisms that prevent natural populations growing indefinitely at an exponential rate. The implication of this for the current PVA is that the baseline population projections (no impact) and the impacted ones will diverge at an increasing rate as the simulated period increases. Therefore, the CPS figures are very sensitive to the duration of the simulation.

~~138.~~160. Furthermore, although the size of the impacted population may be, for example, much smaller than the baseline one, both populations could have increased considerably in size. Indeed, that is the case with the gannet PVA, with a baseline annual average growth rate of 1.7% and a maximum impacted growth rate of 1.~~25~~23%. These result in median populations after 30 years of over 43,000 and 38,000 for baseline and maximum impact respectively. It is clear therefore that the ~~10~~13% 'reduction' in population size is in fact a population which has simply not grown as quickly, but has still grown considerably from the starting size of 26,250 (which has in fact already been exceeded, with the most recent population estimate of 30,446 in 2023).

~~139.~~161. The CPGR for a density independent model is a more consistent measure of population health, since it is much less sensitive to the duration considered. For example, the CPS after 10 years was 0.~~94999~~472 (a 5.3% difference to the baseline) which increased to 0.~~87028~~632 (13.7%) after 30 years, while the CPGR after 10 years was almost exactly the same (0.~~99539~~951) as that after 30 years (0.~~99559~~953). Thus the interpretation of the CPS depends on the timespan, while interpretation of the CPGR is largely insensitive to this aspect.

~~140.~~162. The CPGR also lends itself to consideration against the recent observed trend in the growth rate of the population. For example, the gannet population at Flamborough and Filey Coast SPA has grown at an average rate of 2.9% per year between 2012 (11,061 AON) and 2023 (15,223 AON). Notably this average rate includes the dip recorded in 2022 with a count of 13,125 AON which was a little below the previous count of 13,392 recorded in 2017, and was attributed to the presence of HPAI. However, the positive trend has resumed since with counts of 15,223 and 15,794 in 2023 and 2024 (Butcher *et al*. 2024). The maximum CPGR was 0.~~45~~47% which if realised would only reduce the annual growth rate to 2.~~45~~43%. Thus, the population would continue to grow at a healthy rate even if the worst case in-combination mortality occurred.

~~141.~~163. Furthermore, there are several additive precautionary assumptions baked into the estimated impacts:

- The use of mean peak abundance estimates in the displacement assessment is likely to result in unrealistically high predictions about displaced effects, especially when combined across wind farms;
- The assumption of a 1% mortality rate for displaced birds is not based on any scientific evidence and is highly likely to be an overestimate;
- Most of the impact estimates for other wind farms are based on their consented designs, not the actual built designs, which will over-estimate collision risks;
- The lack of density dependence in the PVA means the CPS values in particular present overly pessimistic outcomes which are very unlikely to occur; and
- The PVA are run as closed populations, with no immigration or emigration, while it is well known that seabird populations operate as metapopulations with considerable levels of exchange. The interconnections in seabird populations will confer a large degree of resilience which is absent from the assessment.

~~142.~~164. Therefore, in conclusion, the combined displacement and collision impacts for gannet predicted at DBS East and DBS West in-combination with other projects, will **not adversely affect the integrity of the Flamborough and Filey Coast SPA**.

~~9.5.2.2~~9.6.2.2 Kittiwake

~~143.~~165. Kittiwake has been screened into the assessment to assess the impacts from collision risk in the operation phase.

~~9.5.2.2.1~~9.6.2.2.1 *Status*

~~144.~~166. Kittiwake is listed as a designated species of the Flamborough and Filey Coast SPA.

~~145.~~167. The SPA breeding population at classification was cited as 44,520 pairs or 89,040 breeding adults, for the period 2008 to 2011 (Natural England, 2018b). Clarkson *et al*. (2022) reported the 2022 population was 44,574 apparently occupied nests (AON), or 89,148 breeding adults, while Burnell *et al*. (2023) reported a small increase to 45,504 AON, 91,008 individuals. The baseline mortality of this population using the most recent figure is 13,287 breeding adult birds per year based on the published adult mortality rate of 14.6% (Horswill and Robinson, 2015). Natural England [REP-039] advised that the earlier population estimate should be used (89,148) which gives a baseline mortality of 13,016.

~~146.~~168. Supplementary advice on the conservation objectives were added for qualifying features of the Flamborough and Filey Coast SPA in 2020 (Natural England, 2020). For kittiwake, these are:

- 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;
- Restore safe passage of birds moving between nesting and feeding areas;
- Restrict the frequency, duration and / or intensity of disturbance affecting roosting, nesting, foraging, feeding, moulting and/or loafing birds so that they are not significantly disturbed;
- Restrict predation and disturbance caused by native and non-native predators;
- Maintain concentrations and deposition of air pollutants at below the site-relevant Critical Load or Level values given for this feature of the site on the Air Pollution Information System;
- Restore the structure, function and supporting processes associated with the feature and its supporting habitat through management or other measures (whether within and/or outside the site boundary as appropriate) and ensure these measures are not being undermined or compromised;
- Maintain the extent, distribution and availability of suitable breeding habitat which supports the feature for all necessary stages of its breeding cycle (courtship, nesting, feeding) at: current extent;

- Restore the distribution, abundance and availability of key food and prey items (e.g. sandeel, sprat, cod, squid, shrimps) at preferred sizes;
- Restrict aqueous contaminants to levels equating to High Status according to Annex VIII and Good Status according to Annex X of the Water Framework Directive, avoiding deterioration from existing levels;
- Maintain the dissolved oxygen (DO) concentration at levels equating to High Ecological Status (specifically ≥5.7mg per litre (at 35 salinity) for 95% of the year), avoiding deterioration from existing levels;
- Maintain water quality and specifically mean winter dissolved inorganic nitrogen (DIN) at a concentration equating to High Ecological Status (specifically mean winter DIN is <12μM for coastal waters), avoiding deterioration from existing levels; and
- Maintain natural levels of turbidity (e.g. concentrations of suspended sediment, plankton and other material) across the habitat.

~~9.5.2.2.2~~9.6.2.2.2 *Connectivity to the Projects*

~~147.~~169. DBS East and DBS West are 125km and 103km respectively from the Flamborough and Filey Coast SPA. The mean maximum foraging range of kittiwake is 300.6km (156.1km + 144.5km, Woodward *et al*., 2019). Therefore, DBS East and DBS West are both within potential foraging range for breeding kittiwake from the Flamborough and Filey Coast SPA. The estimated proportion of the kittiwakes recorded at the Projects during the breeding season that could be breeding adult birds from the Flamborough and Filey Coast SPA (based on the most recent count of ~~91,008~~89,148 breeding adults) is calculated as ~~92~~96.6% (**Table 9-8**).

~~148.~~170. Outside the breeding season breeding kittiwakes, including those from the Flamborough and Filey Coast SPA, are not constrained by requirements to visit nests to incubate eggs or provision chicks. At this time, they are assumed to range more widely and to mix with kittiwakes of all age classes from breeding colonies in the UK and further afield. The background population during these seasons is the UK North Sea BDMPS. This consists of 829,937 individuals during the autumn migration season (August to December), and 627,816 individuals during the spring migration season (January to April) (Furness, 2015).

~~149.~~171. During the autumn migration and spring migration seasons, 60% of the Flamborough and Filey Coast SPA breeding adults are assumed to be present in the BDMPS. It is estimated that 5.4% and 7.2% of birds respectively present in the Project array areas are breeding adults from the Flamborough and Filey Coast SPA. Note, these percentages have been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

~~9.5.2.2.3~~9.6.2.2.3 *Assessment of Potential Effects of the Projects alone and Together*

~~9.5.2.2.3.1~~9.6.2.2.3.1 *Potential Effects During Operation: Collision risk*

Table 9-21 Summary of kittiwake total collisions and apportioned to the Flamborough and Filey Coast SPA. Note that breeding season impacts have been estimated assuming 53% of birds present were adults (demographic) and also 100% (shaded cells).

Site	Season	Collision mortality			SPA %	Adult %	Collisions apportioned to SPA		
		Lower 95% c.i.	Mean	Upper 95% c.i.			Lower 95% c.i.	Mean	Upper 95% c.i.
DBS East	Breed-ing	42.3	83.3	168.5	~~92~~96.6	53	~~20.63~~21.66	~~40.62~~42.65	~~82.16~~86.27
						100	~~38.92~~40.86	~~76.64~~80.47	~~155.02~~162.77
	Autumn	14.6	41.4	82.9	5.4	100	0.79	2.24	4.48
	Spring	6.8	14.6	28.0	7.2	100	0.49	1.05	2.02
	Annual (53% adults)	66.9	139.3	261.3	-	-	~~21.90~~22.93	~~43.90~~45.93	~~88.65~~92.76
	Annual (100% adults)						~~40.19~~42.14	~~79.92~~83.75	~~161.51~~169.26
DBS West	Breed-ing	36.9	107.8	280.8	~~92~~96.6	53	~~17.99~~18.89	~~52.56~~55.19	~~136.92~~143.76
						100	~~33.95~~35.65	~~99.18~~104.13	~~258.34~~271.25
	Autumn	9.5	37.9	81.9	5.4	100	0.51	2.05	4.42
	Spring	7.1	14.9	26.5	7.2	100	0.51	1.07	1.91

Site	Season	Collision mortality			SPA %	Adult %	Collisions apportioned to SPA		
		Lower 95% c.i.	Mean	Upper 95% c.i.			Lower 95% c.i.	Mean	Upper 95% c.i.
	Annual (53% adults)	55.9	160.6	327.0	-	-	19.~~02~~92	~~55.68~~58.31	~~143.25~~150.09
	Annual (100% adults)						~~34.97~~36.67	~~102.3~~107.25	~~264.67~~277.58
DBS East + DBS West	Breed-ing	96.2	191.1	378.4	~~92~~96.6	53	~~46.91~~49.25	~~93.18~~97.84	~~184.51~~193.73
						100	~~88.50~~92.93	~~175.8~~184.60	~~348.13~~365.53
	Autumn	30.5	79.3	143.1	5.4	100	1.65	4.28	7.73
	Spring	16.9	29.5	47.3	7.2	100	1.22	2.12	3.41
	Annual (53% adults)	150.9	299.9	540.5	-	-	~~49.77~~52.12	~~99.59~~104.25	~~195.64~~204.87
	Annual (100% adults)						~~91.37~~95.79	~~182.2~~191.01	~~359.26~~376.67

~~9.5.2.2.3.1.1~~9.6.2.2.3.1.1 DBS East in Isolation

~~150.~~172. Based on adult kittiwake proportions of 53% and 100% (**Table 9-7**) applied to the breeding season impact and the proportions of birds recorded at the Projects predicted to be adult birds from the Flamborough and Filey Coast SPA (~~92~~96.6%, 5.4% and 7.2% in the breeding, autumn and spring respectively), the predicted mean (lower c.i. and upper c.i.) collision risk impact from DBS East alone on the breeding kittiwake population is ~~40~~42.6 (~~20.6~~21.7 to ~~82.2~~86.3 at 53% adults) and ~~76.6 (38~~80.5 (40.9 to ~~155.0~~162.8 at 100% adults) birds in the breeding season, 2.2 (0.8 to 4.5) birds during autumn migration and 1.0 (0.5 to 2.0) birds during spring migration (**Table 9-21**).

~~151.~~173. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-7**) the number of individuals from the Flamborough and Filey Coast SPA population expected to die is 13,~~287 (91,008~~016 (89,148 x 0.146) adults per annum. The predicted annual (breeding, autumn migration and spring migration periods combined) impacts from DBS East alone on the breeding kittiwake population is ~~43~~45.9 (~~21~~22.9 to ~~88.6~~92.8) to ~~79.9 (40.2~~83.8 (42.1 to ~~161.5~~169.3) birds per annum. These result in a predicted change in adult mortality rate of 0.~~33~~35% to 0.~~66~~64% which are below the 1% threshold for detectability and therefore no further assessment was required.

~~9.5.2.2.3.1.2~~9.6.2.2.3.1.2 DBS West in Isolation

~~152.~~174. Based on adult kittiwake proportions of 53% and 100% (**Table 9-7**) applied to the breeding season impact and the and the proportions of birds recorded at the Projects predicted to be adult birds from the Flamborough and Filey Coast SPA (~~92~~96.6%, 5.4% and 7.2% in the breeding, autumn and spring respectively), the predicted mean (lower c.i. and upper c.i.) collision risk impact from DBS West alone on the breeding kittiwake population is ~~52.6~~55.2 (18.~~0~~9 to 143.8~~136.9~~ at 53% adults) and ~~99.2 (33.9~~104.1 (35.6 to ~~258.3~~271.2 at 100% adults) birds in the breeding season, 2.0 (0.5 to 4.4) birds during autumn migration and 1.1 (0.5 to 1.9) birds during spring migration (**Table 9-21**).

~~153.~~175. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-7**) the number of individuals from the Flamborough and Filey Coast SPA population expected to die is 13,~~287 (91,008~~016 (89,148 x 0.146) adults per annum. The predicted annual (breeding, autumn migration and spring migration periods combined) impacts from DBS West alone on the breeding kittiwake population are ~~55.7 (19.0 to 143.2) to 102~~58.3 (~~34~~19.9 to ~~264.7~~150.1) to 107.2 (36.7 to 277.6) birds per annum. These result in a predicted change in adult mortality rate of 0.~~42~~45% to 0.~~77~~82% which are below the 1% threshold for detectability and therefore no further assessment was required.

~~9.5.2.2.3.1.3~~9.6.2.2.3.1.3 DBS East and DBS West Together

~~154.~~176. Based on adult kittiwake proportions of 53% and 100% (**Table 9-7**) applied to the breeding season impact and the ~~and the~~ proportions of birds recorded at the Projects predicted to be adult birds from the Flamborough and Filey Coast SPA (~~92~~96.6%, 5.4% and 7.2% in the breeding, autumn and spring respectively), the predicted mean (lower c.i. and upper c.i.) collision risk impact from the Projects (DBS East and DBS West together) alone on the breeding kittiwake population is ~~93~~97.8 (49.2 ~~(46.9~~ to ~~184.5~~193.7 at 53% adults) and ~~175.8 (88.5~~184.6 (92.9 to ~~348.1~~365.5 at 100% adults) birds in the breeding season, 4.3 (1.6 to 7.7) birds during autumn migration and 2.1 (1.2 to 3.4) birds during spring migration (**Table 9-21**).

~~155.~~177. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-7**) the number of individuals from the Flamborough and Filey Coast SPA population expected to die is 13,~~287 (91,008~~016 (89,148 x 0.146) adults per annum. The predicted annual (breeding, autumn migration and spring migration periods combined) impacts from the Projects alone on the breeding kittiwake population is ~~99.6 (49~~104.2 (52.1 to 204.9) to 191.0 (95.8 to ~~195.6) to 182.2 (91.4 to 359.3~~376.7) birds per annum. These result in predicted changes in adult mortality rate of 0.~~75~~80% to 1.~~37~~47% which at the upper end of the range exceeds the 1% threshold for detectability. Further consideration of kittiwake impacts using PVA is provided in the in-combination section below (paragraph 183~~).~~). After a period of 30 years, project alone collisions reduced the population growth rate by up to 0.14% (0.9986). This would reduce the population's growth trend (since 2000) from 2.5% per year to 2.36% per year (i.e. a small reduction in the positive growth rate). See section 9.6.2.2.5.2 for full discussion of the results including the precautionary assumptions about the impact level have been made (e.g. apportioning of 100% breeding season impacts to FFC SPA adults).

~~9.5.2.2.4~~9.6.2.2.4 Summary of DBS alone

~~156.~~178. A table summarising the kittiwake operational collision risk assessment for DBS East and DBS West together is provided below (**Table 9-22**).

~~157.~~179. It is concluded that predicted kittiwake mortality due to operational collision risk at DBS East, DBS West and the Projects together would, at worst, only reduce population growth by 0.14% (from 2.5% to 2.36%) and that this would **not adversely affect the integrity of the Flamborough and Filey Coast SPA**.

Table 9-22 Summary of predicted Kittiwake collision mortality from the Flamborough and Filey Coast SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations for the Worst Case Wind Turbine Scenario.

Kittiwake		Collisions		
Potential Effects During Operation: Collision Risk				
Collision mortality		Lower c.i.	Mean	Upper c.i.
Breeding season (53-100% adults)		~~46~~49.2-92.9~~-88.5~~	~~93.2-175~~97.8-184.6	~~184~~193.7-365.5~~-348.1~~
Autumn		1.6	4.3	7.7
Spring		1.2	2.1	3.4
Annual		~~49~~52.1-95.8~~-91.4~~	~~99.6-182~~104.2-191.0	~~195.6-359.3~~204.9-376.7
Effect	Reference population	~~91,008~~89,148		
	Increase in background mortality (%)	0.4-0.~~7~~74	0.~~75~~80-1.~~37~~47	1.~~5~~6-2.~~7~~9

~~9.5.2.2.5~~9.6.2.2.5 *Assessment of potential effects of the Projects in combination with other plans and projects*

~~9.5.2.2.5.1~~9.6.2.2.5.1 *Potential Effects During Operation: Collision Risk*

~~158.~~180. Seasonal and annual collision mortality estimates of kittiwake, both total values and apportioned to Flamborough and Filey Coast SPA, reported for all OWFs included in the in-combination assessment are presented in **Table 9-23**. This information was taken from the DCO Application and Examination for the Dudgeon and Sheringham Extension projects (Royal HaskoningDHV 2022, 2023).

~~159.~~181. The estimated total number of kittiwakes at risk of collision from all OWFs within the UK North Sea BDMPS combined is ~~3,995 of~~ 4,071. If projects for which compensation has been agreed are omitted, between ~~351~~380 and ~~434~~466 are estimated to be breeding adults from Flamborough and Filey Coast SPA, while if these projects are retained, the totals are 518 to 605 (~~**Table 9-20**).~~ Table 9-23). It should be noted that the collisions in this table have been adjusted for the most recent guidance on avoidance rates and therefore the wind farm values and totals may not match previous wind farm applications submitted prior to provision of such guidance.

~~160.~~182. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-7**) the number of individuals from the Flamborough and Filey Coast SPA population expected to die is 13,~~287 (91,008~~016 (89,148 x 0.146) adults per annum. The predicted annual in-combination collision mortality would result in a predicted change in adult mortality rate of 2.~~6 – 3.3%. This is~~9% – 4.6%. These are above the 1% threshold below which effects are considered undetectable, therefore Population Viability analysis (PVA) was undertaken to investigate further.

Table 9-23 Total in-combination kittiwake collision risk at North Sea and English Channel Wind Farms and apportioned to Flamborough and Filey Coast SPA adult population.

Tier	Wind Farm	Breeding		Autumn		Spring		Annual	
		Total	FFC	Total	FFC	Total	FFC	Total	FFC
1	Beatrice	68.9	0	7.8	0.4	28.9	2.1	105.6	2.5
1	Beatrice Demonstrator	0	0	2.1	0.1	1.7	0.1	3.8	0.2
1	Blyth Demonstration Project	1.2	0	1.7	0.1	1	0.1	3.9	0.1
1	Dudgeon	-	-	-	-	-	-	-	-
1	East Anglia ONE	1.3	0	116.7	6.3	34	2.5	152	8.7
1	European Offshore Wind Deployment Centre	8.6	0	4.2	0.2	0.8	0.1	13.6	0.3
1	Galloper	4.6	0	20.2	1.1	23.1	1.7	47.9	2.8
1	Greater Gabbard	0.8	0	10.9	0.6	8.3	0.6	20	1.2
1	Gunfleet Sands	-	-	-	-	-	-	-	-
1	Hornsea Project One	32	26.5	40.7	2.2	15.2	1.1	87.9	29.8
1	Humber Gateway	1.4	1.4	2.3	0.1	1.4	0.1	5.1	1.6
1	Hywind	12.1	0	0.7	0.1	0.7	0.1	13.3	0.1
1	Kentish Flats	0	0	0.7	0.1	0.5	0.1	1.2	0.1
1	Kentish Flats Extension	0	0	0	0	2.7	0.2	2.7	0.2
1	Kincardine	16	0	6.5	0.4	0.7	0.1	23.3	0.4
1	Lincs	0.5	0.5	0.9	0.1	0.5	0.1	1.9	0.6
1	London Array	1	0	1.7	0.1	1.3	0.1	4	0.2
1	Lynn and Inner Dowsing	-	-	-	-	-	-	-	-
1	Race Bank	1.4	1.4	17.4	0.9	4.1	0.3	22.8	2.6
1	Rampion	39.6	0	27.2	1.5	21.6	1.5	88.4	3.1
1	Scroby Sands	-	-	-	-	-	-	-	-
1	Sheringham Shoal	-	-	-	-	-	-	-	-
1	Teesside	27.9	0	17.5	0.9	1.8	0.1	47.2	1.1
1	Thanet	0.1	0	0.4	0	0.3	0	0.8	0.1
1	Westermost Rough	0.1	0.1	0.1	0	0.1	0	0.4	0.1
2	Triton Knoll	17.9	17.9	101.1	5.5	33	2.4	152	25.7
3	Dogger Bank Creyke Beck Projects A and B	209.9	40.6	98.2	5.3	214.8	15.5	522.9	61.3
3	Dogger Bank Teesside Projects A and B	99.6	19.2	66	3.6	157.7	11.3	323.3	34.1
3	East Anglia THREE	4.4	0	50.2	2.7	27.3	2	82	4.7
3	Firth of Forth Alpha and Bravo	111.3	0	227.7	12.3	180.1	12.9	519.1	25.2
3	Hornsea Project Three	56	~~0~~52	27.6	~~0~~1.4	5.8	0.7	89.5	54.1 / 0*
3	Hornsea Project Two	11.6	9.7	6.5	0.4	2.2	0.1	20.4	10.2
3	Inch Cape	9.5	0	163.5	8.8	46.2	3.3	219.2	12.1
3	Methil	0.4	0	0	0	0	0	0.4	0
3	Moray Firth (EDA)	31.7	0	1.5	0.1	14	1	47.2	1.1
3	Moray West	57.5	0	17.5	0.9	5.1	0.4	80	1.3
3	Neart na Gaoithe	23.9	0	40.8	2.2	3.2	0.2	67.9	2.5
3	Norfolk Boreas	9.7	~~0~~8.3	23.4	~~0~~1.2	8.7	0.6	41.8	10.1 / 0*
3	Norfolk Vanguard	15.9	~~0~~13.6	11.9	0.6	14	~~0~~1	41.8	15.2 / 0*
3	East Anglia TWO	29.4	0	5.9	0.2	2.5	0.4	37.8	0.6 / 0*

Tier	Wind Farm	Breeding		Autumn		Spring		Annual	
		Total	FFC	Total	FFC	Total	FFC	Total	FFC
3	East Anglia ONE North	21.5	0	3.9	0.3	5.4	0.2	30.8	0.5 / 0*
3	Hornsea Project Four	54.2	51.2	10.1	0.5	3.3	0.2	67.6	51.9 / 0*
4	Rampion 2	1.3	0	1.2	0.1	5.3	0.4	7.7	0.4
4	DEP	6.6	5.6	3.4	0.2	0.9	0.1	10.9	5.9 / 0*
4	SEP	0.6	0.5	0.9	0	0	0	1.5	0.5 / 0*
4	Berwick Bank	426	0.4	155	7	104	10	685	17.4
4	Outer Dowsing	25.5	14.2	2.8	0.2	2.6	0.2	30.9	14.5
4	Five Estuaries	11.9	0	7.9	0.43	5.5	0.4	25.3	0.82
4	North Falls	8.8	6.3	3.6	0.5	7.8	1.0	20.2	7.8
Total before DBS		**1462.6**	**195.5**	**1310.3**	**65.93**	**998.1**	**72.4**	**3771**	**413.7 / 274.9***
5	DBS East	83	~~40.1~~42.6	41	2.2	15	1.1	139	~~43~~45.9
5	DBS West	108	~~51.8~~55.2	38	2.~~0~~	15	1.1	161	~~55~~58.3
5a	DBS East+West (53% adults in breeding season)	191	~~93~~97.8	79	4.2	~~29~~30	2.2	300	~~99~~104.2
5b	DBS East+West (100% adults in breeding season)		~~176~~184.6						~~182~~191.0
5a Total (all projects)		**~~1607~~1653.6**	**~~268~~293.3**	**~~1375~~1389.3**	**~~69~~70.1**	**~~1012~~1028.**	**74.6~~73~~**	**~~3995~~4071.0**	**~~351~~518.5 / 379.7***
5b Total (all projects)			**~~351~~380.1**						**~~434~~605.3 / 466.5***

** Note projects for which compensation is required have been given an annual apportioned mortality of 0.*

~~9.5.2.2.5.2~~9.6.2.2.5.2 *Population Viability Analysis Results for kittiwake*

~~161.~~183. The Natural England commissioned PVA tool was used to examine the effect of the estimated in-combination mortality on the Flamborough and Filey Coast SPA population. The complete input parameters and settings and results are provided in Annex A: SPA PVA Results. The counterfactuals of growth rate (CGR) and population size (CPS) are presented in **Table 9-24**.

Table 9-24 PVA results for in-combination impacts on FFC SPA kittiwake after 30 years.

PVA run scenario	Annual mortality	Decrease in adult survival rate	Mean CGR (95% c.i.)	Mean CPS (95% c.i.)
Project alone collisions (assuming 100% adult proportion from DBS)	191	0.0021425	0.9986 (0.9981-0.9991)	0.9565 (0.9418-0.9714)
In-combination collisions (assuming 53% adult proportion from DBS) exc. compensated projects	~~351~~380	0.~~0038568~~004263	0.~~9974~~9972 (0.~~9969~~9966-0.~~9979~~9976)	0.~~9231~~9154 (0.~~9082~~9011-0.~~9377~~9299)
In-combination collisions (assuming 100% adult proportion from DBS) exc. compensated projects	~~434~~466	0.~~0047688~~005227	0.~~9968~~9965 (0.~~9963~~996-0.~~9973~~997)	0.~~9057~~8972 (0.~~8913~~8827-0.~~9202~~9117)
In-combination collisions (assuming 53% adult proportion from DBS) inc. compensated projects	518	0.005811	0.9961 (0.9956-0.9966)	0.8865 (0.8718-0.901)
In-combination collisions (assuming 100% adult proportion from DBS) inc. compensated projects	605	0.006786	0.9955 (0.9949-0.996)	0.8688 (0.8541-0.883)

184. After a period of 30 years, the project alone collision risk reduced the population growth rate by up to 0.~~32~~14% (0.~~9968~~9986) and reduced the population size compared to the baseline size by up to ~~9~~4.4% (0.~~9057~~9565).

185. After a period of 30 years, the in-combination collision risk including projects for which compensation has been agreed reduced the population growth rate by up to 0.45% (0.9955) and reduced the population size compared to the baseline size by up to 13.1% (0.8688).

~~162.~~186. After a period of 30 years, the in-combination collision risk excluding projects for which compensation has been agreed reduced the population growth rate by up to 0.39% (0.9961) and reduced the population size compared to the baseline size by up to 11.3% (0.8865).

~~163.~~187. The choice of which counterfactual measure is more appropriate for understanding the potential population consequences of increased mortality is dependent on the model formulation, specifically whether or not the model incorporates realistic density dependent regulation. Natural England advise that PVA for seabird impact assessment should not include density dependence (on the basis that there is insufficient data to parameterise this for specific impacted populations). Density independent population predictions made under this assumption lack the natural feedback mechanisms that prevent natural populations growing indefinitely at an exponential rate. The implication of this for the current PVA is that the baseline population projections (no impact) and the impacted ones will diverge at an increasing rate as the simulated period increases. Therefore, the CPS figures are very sensitive to the duration of the simulation.

~~164.~~188. Furthermore, although the size of the impacted population may be, for example, much smaller than the baseline one, both populations could have increased considerably in size. Indeed, that is the case with the kittiwake PVA, with a baseline predicted annual average growth rate of 2.1% and a ~~maximum impacted~~ growth rate under the maximum impact scenario of 1.~~8~~65%. These result in median populations after 30 years of over ~~180~~166,000 and ~~165~~145,000 for baseline and maximum impact respectively. It is clear therefore that the ~~9.9~~corresponding 13.1% 'reduction' in population size suggested by the CPS for this level of mortality is in fact derived as a population which has simply not grown as quickly, but has still doubled from the starting size of over ~~91~~89,000.

~~165.~~189. The CPGR for a density independent model is a more consistent measure of population health, since it is much less sensitive to the duration considered. For example the worst case CPS after 10 years was 0.~~9642~~ ~~(3.6~~9494 (5.1%) which increased to 0.~~9057 (9.4~~8687 (13.1% after 30 years, while the CPGR after 10 years was almost exactly the same (0.~~9967~~9953) as that after 30 years (0.~~9968~~9954). Thus the interpretation of the CPS depends on the timespan, while interpretation of the CPGR is largely insensitive to this aspect.

~~166.~~190. The CPGR also lends itself to consideration against the recent observed trend in the growth rate of the population. For example, since 2000 the kittiwake population at Flamborough and Filey Coast SPA has grown at an average rate of 2.5% per year. The maximum CPGR was 0.~~32~~45% which if realised would only reduce the annual growth rate to 2.~~2~~1%. Thus, the population would continue to grow at a healthy rate even if the worst case in-combination mortality occurred. Although the presence of HPAI in 2022 and 2023 raised concerns for several species at the colony, including kittiwake, there was no evidence of HPAI mortality in any species in 2024 (Butcher *et al*. 2024) and colony counts overall have been little affected.

~~167.~~191. Furthermore, there are several additive precautionary assumptions baked into the estimated impacts, as discussed above in relation to gannet (paragraph 163).

~~168.~~192. Therefore, it is the Applicants' conclusion that the collision impacts predicted at DBS East and DBS West in-combination with other projects, will not adversely affect the integrity of the Flamborough and Filey Coast SPA.

~~169.~~193. Notwithstanding the above conclusion, the Applicants acknowledge that previous decisions on offshore wind farms by the Secretary of State have concluded that an AEoI for kittiwake at the Flamborough and Filey Coast SPA could not be ruled out for in-combination collision risk (e.g. Hornsea 3, Norfolk Vanguard, Norfolk Boreas). The Plan Level HRA conducted by The Crown Estate also concluded that an AEoI could not be ruled out. Given this, it is the Applicants assumption that the Secretary of State will conclude AEoI in this case also. Therefore, the Applicants do not consider it worthwhile to contest this point and on this basis **concede AEoI on the Flamborough and Filey Coast SPA.**

~~170.~~194. The conclusion of the Plan Level HRA led The Crown Estate to develop a strategic compensation scheme for the Round 4 wind farms and to which the Applicants are active and willing participants. Further details on the proposed compensation measures are provided in the accompanying **Volume 6, Appendix 1 Project Level Kittiwake Compensation Plan (application ref: 6.2.1).**

~~9.5.2.3~~9.6.2.3 Guillemot

~~171.~~195. Guillemot has been screened into the assessment to assess the impacts from disturbance / displacement in the construction and operation phase.

~~9.5.2.3.1~~9.6.2.3.1 Status

~~172.~~196. Guillemot is listed as a designated species of the Flamborough and Filey Coast SPA.

~~173.~~197. The SPA breeding population at classification was 41,607 pairs (83,214 breeding adults) for the period 2008 to 2011 (Natural England, 2017b). The most recent published count was of 111,925 individuals in 2023 (Clarkson *et al*. 2023), which once adjusted using standard approaches gives an AON of 74,989 (or 149,978 breeding adults).

~~174.~~198. Supplementary advice on the conservation objectives were added for qualifying features in 2020 (Natural England, 2020). For guillemot, these are:

- 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;
- Maintain safe passage of birds moving between nesting and feeding areas;
- Restrict the frequency, duration and / or intensity of disturbance affecting roosting, nesting, foraging, feeding, moulting and/or loafing birds so that they are not significantly disturbed;
- Restrict predation and disturbance caused by native and non-native predators;
- Maintain concentrations and deposition of air pollutants at below the site-relevant Critical Load or Level values given for this feature of the site on the Air Pollution Information System;
- Maintain the structure, function and supporting processes associated with the feature and its supporting habitat through management or other measures (whether within and/or outside the site boundary as

appropriate) and ensure these measures are not being undermined or compromised;

- Maintain the extent, distribution and availability of suitable breeding habitat which supports the feature for all necessary stages of its breeding cycle (courtship, nesting, feeding) at current extent;
- Maintain the distribution, abundance and availability of key food and prey items (e.g. sandeel, herring, sprat) at preferred sizes;
- Restrict aqueous contaminants to levels equating to High Status according to Annex VIII and Good Status according to Annex X of the Water Framework Directive, avoiding deterioration from existing levels;
- Maintain the dissolved oxygen (DO) concentration at levels equating to High Ecological Status (specifically ≥5.7mg per litre (at 35 salinity) for 95% of the year), avoiding deterioration from existing levels;
- Maintain water quality and specifically mean winter dissolved inorganic nitrogen (DIN) at a concentration equating to High Ecological Status (specifically mean winter DIN is <12µM for coastal waters), avoiding deterioration from existing levels; and
- Maintain natural levels of turbidity (e.g. concentrations of suspended sediment, plankton and other material) across the habitat.

~~9.5.2.3.2~~9.6.2.3.2 *Connectivity to the Projects*

~~175.~~199. DBS East and DBS West are 125km and 103km respectively from the Flamborough and Filey Coast SPA. The mean maximum foraging range of guillemot is 153.7km (73.2km + 80.5km, Woodward *et al*., 2019). Therefore, DBS East and DBS West are both within potential foraging range for breeding guillemot from the Flamborough and Filey Coast SPA. The estimated proportion of the guillemots recorded at the Projects during the breeding season that could be breeding adult birds from the Flamborough and Filey Coast SPA (based on the most recent count of 149,978 breeding adults) is calculated as 100%.

~~176.~~200. Although Furness (2015) only identified one nonbreeding period for guillemot (August to February), Natural England requested that further consideration be given to the post-breeding months of August and September, during which time the male of each pair accompanies their fledged young as they disperse from the colony. Both are effectively flightless at this time therefore, due to the constraint on how far these birds can travel in August and September, it is likely that most of the birds recorded on the wind farm will originate from Flamborough and Filey Coast SPA. Therefore, in acknowledgement of this, the guillemot breeding season for this SPA has been extended to include August and September, with the attendant 100% apportioning rate. However, it is also appropriate to assume that not all of the birds recorded in these two months are breeding adults since a large proportion will be juveniles. Several factors will contribute to the adult proportion in these two months: only the male of each pair accompanies the juvenile; the females remain at the colony for a few weeks before also dispersing; not all pairs breed successfully; and there will be older sub-adult birds also present. Therefore, taking all these together ~~it has been assumed~~the Applicants estimated that up to 70% of birds in August and September could be breeding adults from this SPA. Natural England subsequently advised that they considered a rate of 68.2% was appropriate (APP-039). Natural England (APP-039) also advised that the post-breeding period should be treated as an additional season ~~peak used in~~, therefore the guillemot assessment ~~(here treated as~~comprised the ~~period from~~ breeding season (March ~~to September) was the larger value of either the total number recorded in each month between March and -~~-July or ~~70% of the total number recorded in~~), post-breeding period (August and September~~.~~) with the remaining months assigned to the non-breeding season (October-February).

~~177.~~201. The reference population for the breeding and post-breeding seasons was the FFC SPA population. Outside the breeding season, breeding guillemots from the SPA are assumed to range widely and to mix with guillemots from breeding colonies in the UK and beyond. The relevant non-breeding season reference population is the UK North Sea and Channel BDMPS, consisting of 1,617,306 individuals (Furness, 2015).

~~178.~~202. During the non-breeding season it is estimated that 4.4% of birds present at the Projects are breeding adults from the Flamborough and Filey Coast SPA, and impacts are apportioned accordingly. Note, this percentage has been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

~~9.5.2.3.3~~9.6.2.3.3 *Assessment of Potential Effects of the Projects alone and Together*

~~179.~~203. The seasonal peak total number of guillemots recorded in DBS East and DBS West and the number apportioned to the Flamborough and Filey Coast SPA is provided in **Table 9-25**.

~~180.~~204. Construction displacement has been estimated on the basis this operates across half the wind farm. Thus, guillemot displacement was calculated using upper and lower displacement rate values of 15% and 35% (i.e. half the operational values) and 1% to 10% mortality. In addition, evidence based rates of 25% (half the operational rate of 50%) and 1% have also been assessed. These were then added to the number of birds expected to be displaced by up to three construction vessels (assuming 100% displacement within 2km of each vessel and 1% mortality), calculated from the seasonal densities (**Table 9-25**).

Table 9-25 Summary of guillemot density and abundance estimates and SPA apportioning rates used in the operation and construction displacement assessment for Flamborough and Filey Coast SPA. Note that displacement from the wind farm has been estimated as 15%-35%, half the operational rates. *Vessel mortality calculated as 2km buffer around 3 vessels at 1% mortality. Values for the breeding season remain as per the original version of this report*

Site	Season	Peak no.	SPA %	Adult %	No. apportionedappn. to SPA	Wind farm operation displacement mortality to SPA				Wind farm construction displacement mortality to SPA				Peak density (birds /km²)	Total vessel displacement	Vessel mortality to SPA	Total construction displacement mortality to SPA (array & vessel)			
						30-1	50-1	70-2	70-10	15-1	25 - 1	35-2	35-10				15-1 & vessel	25 - 1 & vessel	35-2	35-10 & vessel
DBS East	Breeding	9030.5	100	55.2	4984.8	15.0	24.9	69.8	348.9	7.5	12.5	34.9	174.5	17.71	6.7	3.7	11.2	16.12	38.6	178.2
				100	9030.5	27.1	45.12	126.4	632.1	13.5	22.6	63.2	316.01			6.7	20.2	29.3	69.9	322.78
	Post-breeding	7678	100	68.2	5236.4	15.7	26.2	73.3	366.5	7.9	13.1	36.7	183.3	15.06	5.7	3.9	11.7	17.0	40.5	187.1
	Non-breeding	12551.8	4.4	100	552.3	1.7	2.8	7.7	38.7	0.8	1.4	3.9	19.3	24.62	9.3	0.4	1.2	1.8	4.3	19.7
	Annual	Assuming 55.2% adults in breeding season			10773.5.1 16.7 27.7 387.6	832.3	1353.9	193150.8	-754.1	16.02	4.126.9	1275.4	17.9377.1	-	21.7	8.0	24.1	19734.9	83.4	385.1
		Assuming 100% adults in breeding season			9582.814819.2	28.844.5	47.974.1	670.8207.5	141037.3	2422.2	335.337.0	103.7	518.7			342.411.0	33.2	48.0	114.7	529.7
DBS West	Breeding	8783.5	100	55.2	4848.5	14.5	24.2	67.9	339.4	7.3	12.1	33.9	169.7	16.92	6.4	3.5	10.8	15.6		173.2
				100	8783.5	26.4	43.9	123.0	614.8	13.2	22.0	61.5	307.4			6.4	19.6	28.4		313.8
	Post-breeding	12498	100	68.2	8523.6	25.6	42.6	119.3	596.7	12.8	21.3	59.7	298.3	24.08	9.1	6.2	19.0	27.5	65.9	304.5
	Non-breeding	9895.4	4.4	100	549.9435.4	1.63	2.72	6.1	3830.5	0.87	1.41	3.0	15.2	19.206	24.087.29.1	0.43	1.20	1.84	3.4	1915.6
	Annual	Assuming 55.2% adults in breeding season			13807.5	539841.4	16.169.0	26.9193.3	377.9966.5	8.120.7	1334.5	188.996.7	-483.3	15.5-	3.922.6	1210.0	17.430.7	192.844.5	106.7	493.3
		Assuming 100% adults in breeding season			9333.417742.5	2853.2	88.7	248.4	1242.0	4626.6	653.344.4	14124.2	23.4621.0			12.9	6.839.5	20.857.2	30.2137.1	333.4633.9

Site	Season	Peak no.	SPA %	Adult %	No. ~~apportioned~~app n. to SPA	Wind farm operation displacement mortality to SPA 30-1	50-1	70-2	70-10	Wind farm construction displacement mortality to SPA 15-1	25 - 1	35-2	35-10	Peak density (birds /km²)	Total vessel displacement	Vessel mortality to SPA	Total construction displacement mortality to SPA (array & vessel) 15-1 & vessel	25 - 1 & vessel	35-2	35-10 & vessel
DBS East + DBS West	Breeding	17814~~14927.7~~	100	55.2	~~8240.1~~9833.3	~~24.7~~29.5	~~41~~49.2	~~576.8~~137.7	~~12.4~~688.3	14.7	~~20~~24.6	~~288.4~~68.8	~~-~~344.2	-	13.~~0~~1	7.2	~~19.6~~22.0	~~27~~31.8	~~295.6~~76.1	351.4
				100	17814~~14927.7~~	~~44.8~~53.4	~~74.6~~89.1	~~1044.9~~249.4	~~22.4~~1247.0	26.7~~37.3~~	~~522~~44.5	124.7	623.5			13.~~0~~1	~~35.4~~39.8	~~50.3~~57.6	~~535.5~~137.8	636.6
	Post-breeding	20176	100	68.2	13760.0	41.3	68.8	192.6	963.2	20.6	34.4	96.3	481.6		14.8	10.1	30.7	44.5	106.4	491.7
	Non-breeding	~~20136.0~~22447	4.4	100	~~886.0~~987.7	~~2.7~~3.0	4.~~4~~9	~~62.0~~13.8	69.1~~.3~~	~~2.2~~1.5	~~31.0~~2.5	~~-~~6.9	~~18.4~~34.6	~~0.8~~-	~~2.1~~16.5	~~3.~~0.7	~~31.8~~2.2	3.2	7.6	35.3
	Annual	Assuming 55.2% adults in breeding season			~~9126.1~~24581.0	~~27.4~~73.7	~~45.6~~122.9	~~638.8~~344.1	~~13~~1720.7	~~22.8~~36.9	~~319.4~~61.5	~~-~~172.1	~~31.4~~860.3	~~8~~-	~~21.7~~44.3	~~30.8~~18.0	~~327.4~~54.9	79.5	190.1	878.3
		Assuming 100% adults in breeding season			~~15813~~32561.7	~~47.5~~97.7	~~79~~162.8	~~1106~~455.9	~~23.7~~2279.3	~~39.5~~48.8	~~553.5~~81.4	227.9	1139.7			~~53.3~~23.9	~~567.3~~72.7	105.3	251.8	1163.5

~~9.5.2.3.3.1~~9.6.2.3.3.1 *Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines*

~~9.5.2.3.3.1.1~~9.6.2.3.3.1.1 *DBS East in Isolation*

205. The wind farm construction displacement, assuming the worst case rates of 35% and 10%, from DBS East in the breeding~~, and nonbreeding seasons were~~ season was up to 174.5 (assuming 55.2% adults) or 316 (assuming 100% adults~~) and~~), in the post-breeding season was 183.3 and in the nonbreeding season was 19.3~~, respectively~~ (**Table 9-25**).

206. Displacement mortalities due to construction vessels in the breeding season were 3.7 (assuming 55.2% adults) or 6.7 (assuming 100% adults~~)~~), in the post-breeding season was 3.9 and in the nonbreeding season was 0.4 ~~in each season respectively.~~ (**Table 9-25**).

~~181.~~207. Thus, the maximum total combined ~~seasonal~~ construction displacement mortalities apportioned to the SPA in the breeding season were 178.2 (55.2% adults) or 322.~~7~~8 (100% adults~~)~~), in the post-breeding season was 187.1 and in the nonbreeding season was 19.7 ~~birds during the breeding and nonbreeding seasons.~~. The equivalent ~~evidence based~~ mortalities ~~were 16.1~~ assuming 35% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) were 38.6 (55.2% adults) or ~~29.3~~69.9 (100% adults~~)~~), 40.5 and ~~1.8~~4.3 respectively.

~~182.~~208. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Flamborough and Filey Coast SPA population expected to die is 9,149 (149,978 x 0.061) adults per annum. The predicted annual (breeding, post-breeding and non-breeding periods combined) construction impacts from DBS East alone on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is ~~197.9~~385.1 (55.2% adults in the breeding season) or ~~342.4~~529.7 (assuming 100% adults in the breeding season) birds per annum. ~~This~~These would result in a predicted change in adult mortality rate of 4.2~~.16~~% to ~~3.7%.~~ 5.7%. Using a 2%[1] displacement mortality rate the estimated impact would be between 83.4 and 114.7 and the increase in background mortality would be 0.91% to 1.25%.

[1] Note that 2% mortality was accepted for the Sheringham and Dudgeon Extensions in decision by SoS made after the assessment in the application (APP-048) was completed, hence this was not included at the time

~~183.~~209. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background adult mortality rate of 6%. If displacement did have such a ~~serious~~large effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years in areas where there are operational offshore wind farms. But there is no such indication of mortality effects of this magnitude.

~~184.~~210. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the ~~seasonal~~annual displacement mortalities apportioned to the FFC SPA ~~(16.1 or 29.3 in the breeding season~~would be between 34.9 and ~~1.8 in the nonbreeding season)~~ 48 which would increase the ~~predicted annual background~~ mortality rate by 0.~~19~~38% to 0.~~33%~~52%, which are below the 1% threshold for detectability ~~and therefore no further assessment was required. Furthermore, the results~~. Nonetheless, the different levels of ~~the~~impact have been assessed using PVA ~~presented in the in-combination assessment (and are discussed in~~ section ~~9.5.2.1.3) encompass the worst case prediction above (for 70% displaced and 10% mortality) and demonstrate that this would not result in an Adverse Effect on Integrity on the SPA.~~9.6.2.3.5.2

~~9.5.2.3.3.1.2~~9.6.2.3.3.1.2 DBS West in Isolation

211. The wind farm construction displacement, assuming the worst case rates of 35% and 10%, from DBS West in the breeding~~, and nonbreeding seasons were~~ season was up to 169.7 (assuming 55.2% adults) or 307.4 (assuming 100% adults~~) and 19.~~), in the post-breeding season was 298.3 and in the nonbreeding season was 15.2~~, respectively~~ (**Table 9-25**).

212. Displacement mortalities due to construction vessels in the breeding season were 3.5 (assuming 55.2% adults) or 6.4 (assuming 100% adults~~)~~), in the post-breeding season was 6.2 and in the nonbreeding season was 0.~~4 in each season respectively.~~ 3 (**Table 9-25**).

~~185.~~213. Thus, the maximum total combined ~~seasonal~~ construction displacement mortalities apportioned to the SPA in the breeding season were 173.2 (55.2% adults) or 313.8 (100% adults~~)~~), in the post-breeding season was 304.5 and ~~19.6 birds during~~in the ~~breeding and~~ nonbreeding ~~seasons~~season was 15.6. The equivalent ~~evidence based~~ mortalities ~~were 15.6~~assuming 35% displacement and 2% mortality were 37.5 (55.2% adults) or ~~28.4~~67.9 (100% adults~~)~~), 65.9 and ~~1.8~~3.4 respectively.

~~186.~~214. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Flamborough and Filey Coast SPA population expected to die is 9,149 (149,978 x 0.061) adults per annum. The predicted annual (breeding, post-breeding and non-breeding periods combined) construction impacts from DBS West alone on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is ~~192.8~~493.3 (55.2% adults in the breeding season) or ~~333.4 (~~633.9 (assuming 100% adults in the breeding season) birds per annum. These would result in a predicted change in adult mortality rate of ~~2.1~~5.4% to ~~3.~~6~~%.~~.9%. Using a 2% displacement mortality rate the estimated impact would be between 106.7 and 137.1 and the increase in background mortality would be 1.2% to 1.5%.

~~187.~~215. As noted above, these displacement rates are highly precautionary and have little support from studies at operational wind farms (paragraph 209). At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the ~~seasonal~~annual displacement mortalities apportioned to the FFC SPA ~~(15.6 or 28.4 in the breeding season~~would be between 44.5 and ~~1.8 birds in the nonbreeding season)~~ 57.2 which would increase the ~~predicted annual~~ background mortality rate by 0.~~19~~48% to 0.~~33%~~62%, which are below the 1% threshold for detectability ~~and therefore no further assessment was required. Furthermore, the results of the PVA presented in the in-combination assessment (section 9.5.2.1.3) encompass the worst case prediction above (for 70% displaced and 10% mortality) and demonstrate that this would not result in an Adverse Effect on Integrity on the SPA.~~.

216. The different levels of impact have been assessed using PVA and are discussed in section 9.6.2.3.5.2.

~~9.5.2.3.3.1.3~~9.6.2.3.3.1.3 DBS East and West Together

217. The wind farm construction displacement, assuming the worst case rates of 35% and 10%, from DBS East and DBS West in the breeding ~~and nonbreeding seasons were~~season was up to ~~288.4~~344.2 (assuming 55.2% adults) or ~~522~~623.5 (assuming 100% adults~~) and 31.0, respectively.~~), in the post-breeding season was 481.6 and in the nonbreeding season was 34.6 (**Table 9-25**).

218. Displacement mortalities due to construction vessels in the breeding season were 7.2 (assuming 55.2% adults) or 13~~(~~.1 (assuming 100% adults~~) and 0.8 in each season respectively. Thus~~), in the post-breeding season was 10.1 and in the nonbreeding season was 0.7 (**Table 9-25**).

~~188.~~219. Thus, the maximum total combined ~~seasonal~~ construction displacement mortalities apportioned to the SPA in the breeding season were ~~295.6~~351.4 (55.2% adults) or ~~535.5~~636.6 (100% adults~~) and 31.8 birds during~~), in the post-breeding season was 491.7 and ~~nonbreeding seasons.~~ in the nonbreeding season was 35.3. The equivalent mortalities assuming 35% displacement and 2% mortality were 76.1 (55.2% adults) or 137.8 (100% adults), 106.4 and 7.6 respectively.

~~189.~~220. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Flamborough and Filey Coast SPA population expected to die is 9,149 (149,978 x 0.061) adults per annum. The predicted annual (breeding, post-breeding and non-breeding periods combined) construction impacts from ~~the Projects alone~~DBS East and DBS West on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is ~~327.4~~878.3 (55.2% adults in the breeding season) or ~~567.3 (~~1163.5 (assuming 100% adults in the breeding season) birds per annum. These would result in a predicted change in adult mortality rate of ~~3~~9.6% to ~~6.2%.~~ 12.7%. Using a 2% displacement mortality ~~However, as noted above (paragraph 181), there is little evidence in support of either the (operational) 70% displacement~~ rate ~~or the 10% mortality rate.~~the estimated impact would be between 190.1 and 251.8 and the increase in background mortality would be 2.1% to 2.7%.

~~190.~~221. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the ~~seasonal~~annual displacement mortalities apportioned to the FFC SPA ~~(27.8 or 50.3 in the breeding season~~would be between 79.5 and ~~3.0 birds in the nonbreeding season)~~ 105.3 which would increase the ~~predicted annual~~ background mortality rate by 0.~~33~~9% to ~~0.58% which are below the~~ 1~~% threshold for detectability and therefore no further assessment was required. Furthermore, the results of the PVA presented in the in-combination assessment (section 9.5.2.1.3) encompass the worst case prediction above (for 70% displaced and 10% mortality) and demonstrate that this would not result in an Adverse Effect on Integrity on the SPA.~~.1%.

222. The different levels of impact have been assessed using PVA and are discussed in section 9.6.2.3.5.2.

~~9.5.2.3.3.2~~9.6.2.3.3.2 *Potential Effects During Operation: Disturbance and Displacement*

~~9.5.2.3.3.2.1~~9.6.2.3.3.2.1 *DBS East in Isolation*

~~191.~~223. The wind farm operation displacement, assuming the worst case rates of 70% and 10%, from DBS East apportioned to the SPA in the breeding ~~and nonbreeding seasons were~~season was up to 349 (55.2% adults) or 632 (100% adults~~)~~), in the post-breeding season was 366 and in the nonbreeding season was 39~~, respectively~~ (**Table 9-25**).

224. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Flamborough and Filey Coast SPA population expected to die is 9,149 (149,978 x 0.061) adults per annum. The predicted annual (breeding, post-breeding and non-breeding periods combined) impacts from DBS East alone on the breeding guillemot population is ~~387.6~~754.1 (55.2% adults) or ~~671~~1037.3 (100% adults) birds per annum. These result in a predicted change in adult mortality rate of ~~4~~8.2% to ~~7.3%.~~ 11.3%. At a displacement rate of 70% and 2% mortality the annual totals are 150.8 (55.2% adults) and 207.5 (100% adults), which would increase the adult mortality rate by 1.6% and 2.3%.

~~192.~~ These are above the 1% level considered to be the threshold for detection. However, ~~as noted above (paragraph 181), there is little evidence in support of either the 70% displacement rate or the 10% mortality rate.~~

~~193.~~225. ~~At~~at a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the ~~seasonal~~annual displacement mortalities apportioned to the FFC SPA would be ~~24~~53.9 (55.2% adults) or ~~45~~74.1 (100% adults~~) and 2.8 birds in the breeding and nonbreeding seasons respectively.~~). These would reduce the predicted annual mortality ~~(for 27.7 to 48 birds)~~ to 0.~~3~~58% to 0.~~5~~81% which are below the 1% threshold for detectability and therefore no further assessment was required. ~~Furthermore~~Nonetheless, the ~~results~~different levels of ~~the~~impact have been assessed using PVA ~~presented in the in-combination assessment~~ (and are discussed in section ~~9.5.2.1.3)~~ ~~encompass the worst case prediction above (for 70% displaced and 10% mortality) and demonstrate that this would not result in an Adverse Effect on Integrity on the SPA.~~9.6.2.3.5.2.

~~9.5.2.3.3.2.2~~9.6.2.3.3.2.2 *DBS West in Isolation*

~~194.~~226. The wind farm operation displacement, assuming the worst case rates of 70% and 10%, from DBS ~~East~~West apportioned to the SPA in the breeding ~~and nonbreeding seasons were~~ season was up to 339~~.4~~ (55.2% adults) or ~~614.8~~615 (100% adults~~) and 38.5, respectively~~), in the post-breeding season was 597 and in the nonbreeding season was 30 (**Table 9-25**).

~~195. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Flamborough and Filey Coast SPA population expected to die is 9,149 (149,978 x 0.061) adults per annum. The predicted annual (breeding and non-breeding periods combined) impacts from DBS East alone on the breeding guillemot population is 378 (55.2% adults) or 653 (100% adults) birds per annum. These result in a predicted change in adult mortality rate of 4.1% to 7.1%. However, as noted above (paragraph 181), there is little evidence in support of either the 70% displacement rate or the 10% mortality rate.~~

~~196. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the seasonal displacement mortalities apportioned to the FFC SPA would be 24.2 (55.2% adults) or 43.9 (100% adults) and 2.7 birds in the breeding and nonbreeding seasons respectively. These would reduce the predicted annual mortality (for 26.9 to 46.6 birds) to 0.3% to 0.5% which are below the 1% threshold for detectability and therefore no further assessment was required. Furthermore, the results of the PVA presented in the in-combination assessment (section 9.5.2.1.3) encompass the worst case prediction above (for 70% displaced and 10% mortality) and demonstrate that this would not result in an Adverse Effect on Integrity on the SPA.~~

~~197. The wind farm operation displacement from DBS East and DBS West apportioned to the SPA in the breeding and nonbreeding seasons were up to 576.8 (55.2% adults) or 1044.9 (100% adults) and 62, respectively (**Table 9-22**).~~

~~198.~~227. ~~At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**~~**Table 9-7**) the number of individuals from the Flamborough and Filey Coast SPA population expected to die is 9,149 (149,978 x 0.061) adults per annum. The predicted annual (breeding~~-~~, post-breeding and non-breeding periods combined) impacts from ~~the Projects~~DBS West alone on the breeding guillemot population is ~~639~~966.5 (55.2% adults) or ~~1107~~1242.0 (100% adults) birds per annum. These result in a predicted change in adult mortality rate of 10.6~~.9~~% to 13.6%. At a ~~12.1%. These are above the 1% level considered to be the threshold for detection. However, as noted above (paragraph 181), there is little evidence in support of either the 70%~~ displacement rate ~~or the 10~~of 70% and 2% mortality the annual totals are 193.3 (55.2% adults) and 248.4 (100% adults), which would increase the adult mortality rate~~.~~ by 2.1% and 2.7%.

228. These are above the 1% level considered to be the threshold for detection. ~~At~~However, at a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b~~),~~), the ~~seasonal~~annual displacement mortalities apportioned to the FFC SPA would be ~~41.2~~269.0 (55.2% adults) or ~~74.6~~88.7 (100% adults~~) and 4.4 birds in the breeding and nonbreeding seasons respectively.~~). These would reduce the predicted annual mortality ~~(for 45.6 to 79 birds)~~ to 0.~~49~~75% to 0.~~86~~97% which are below the 1% threshold for detectability ~~and therefore no further assessment was required. Furthermore, the results~~. Nonetheless, the different levels of ~~the~~ impact have been assessed using PVA ~~presented in the in-combination assessment (~~and are discussed in section 9.6.2.3.5.2.

~~*9.5.2.3.3.2.3*~~*9.6.2.3.3.2.3 DBS East and West Together*

229. ~~9.5.2.1.3) encompass~~The wind farm operation displacement, assuming the worst case ~~prediction above (for~~ rates of 70% ~~displaced~~and 10%, from DBS East and ~~10%~~DBS West, apportioned to the SPA was up to 688.3 (55.2% adults) or 1247 (100% adults) in the breeding season, was 963 in the post-breeding season and was 69 in the nonbreeding season (**Table 9-25**).

~~199.~~230. At the baseline mortality~~) and demonstrate that this would not~~ rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Flamborough and Filey Coast SPA population expected to die is 9,149 (149,978 x 0.061) adults per annum. The predicted annual (breeding, post-breeding and non-breeding periods combined) impacts from DBS East and DBS West on the breeding guillemot population is 1720.7 (55.2% adults) or 2279.3 (100% adults) birds per annum. These result in ~~an Adverse Effect on Integrity on the SPA.~~a predicted change in adult mortality rate of 18.8% to 24.9%. At a displacement rate of 70% and 2% mortality the annual totals are 344.1 (55.2% adults) and 455.9 (100% adults), which would increase the adult mortality rate by 3.8% and 4.9%.

231. These are above the 1% level considered to be the threshold for detection. However, at a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortalities apportioned to the FFC SPA would be 122.9 (55.2% adults) or 162.8 (100% adults). These would reduce the predicted annual mortality to 1.34% to 1.78%.

232. The different levels of impact have been assessed using PVA and are discussed in section 9.6.2.3.5.2.

~~9.5.2.3.4~~9.6.2.3.4 *Summary of DBS alone*

233. A matrix of the annual operational displacement estimates for DBS East and DBS West is provided in **Table 9-26**.

Table 9-26 Displacement matrix for annual project alone (DBS East plus DBS West) guillemot apportioned to Flamborough and Filey Coast SPA adult population.

Mortality %	**Displacement %**									
	10	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**
1	33	65	98	130	163	195	228	260	293	326
2	65	130	195	260	326	391	456	521	586	651
3	98	195	293	391	488	586	684	781	879	977
4	130	260	391	521	651	781	912	1042	1172	1302
5	163	326	488	651	814	977	1140	1302	1465	1628
6	195	391	586	781	977	1172	1368	1563	1758	1954
7	228	456	684	912	1140	1368	1595	1823	2051	2279

8	260	521	781	1042	1302	1563	1823	2084	2344	2605
9	293	586	879	1172	1465	1758	2051	2344	2637	2930
10	326	651	977	1302	1628	1954	2279	2605	2930	3256
20	651	1302	1954	2605	3256	3907	4559	5210	5861	6512
30	977	1954	2930	3907	4884	5861	6838	7815	8791	9768
50	1628	3256	4884	6512	8140	9768	11396	13024	14652	16281
75	2442	4884	7326	9768	12210	14652	17095	19537	21979	24421
100	3256	6512	9768	13024	16281	19537	22793	26049	29305	32561

~~200.~~234. A table summarising the guillemot construction and operational disturbance and displacement assessment for DBS East and DBS West together is provided below (**Table 9-27**).

~~201. It is concluded that predicted guillemot mortality due to construction and operational phase disturbance and displacement impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the Flamborough and Filey Coast SPA**.~~

Table 9-27 Summary of predicted guillemot displacement mortality from Flamborough and Filey Coast SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.

Guillemot	**Displacement**		
Potential Effects During Construction: Disturbance and Displacement			
Displacement mortality	Mean (@25% x 1%)	Mean (@35% x ~~10~~2%)	Mean (@~~25~~35% x ~~1~~10%)
Breeding season (at 55.2% to 100% adults)	16.2-29.3	~~295~~38.6~~–535.5~~-69.9	~~27~~178.2-322.8~~–50.3~~
Post-breeding	17.0	40.5	187.1
Nonbreeding season	~~31~~1.8	4.3~~.0~~	19.7

Guillemot		Displacement		
Annual		34.9-48.0	~~327~~83.4-~~567.3~~114.7	~~30.8 – 53.3~~385.1-529.7
Effect	Reference population	149,978		
	Increase in background mortality (%)	0.~~33 –~~ 38-0.~~58~~52	0.91-1.25	4.2-5.7
Potential Effects During Operation: Disturbance and Displacement				
Displacement mortality		Mean (@50 x 1%)	Mean (@70% x ~~10~~2%)	Mean (@~~50~~70% x ~~1~~10%)
Breeding season (at 55.2% to 100% adults)		~~41~~49.2 ~~–~~ -89.1	137.7-249.9	688.3-1247.0
Post-breeding		68.8	192.6	963.2
Nonbreeding season		4.~~4~~9	13.8	69.1
Annual		~~639 – 1107~~122.9-162.8	~~45.6 – 79~~344.1-455.9	1720.7-2279.3
Effect	Reference population	149,978		
	Increase in background mortality (%)	~~6.9 – 12.~~1.34-1.78	~~0.49 – 0.86~~3.8-4.9	18.8-24.9

235. The range of project alone impacts have been assessed using PVA (see section 9.6.2.3.5.2). Even at the upper end of the 70% displaced and 2% mortality figures (456) the population growth rate would only be reduced by 0.21%. This would reduce the FFC SPA population growth rate from 3.8% to 3.59% (i.e. a small decline in the positive growth trend).

236. It is concluded that predicted guillemot mortality due to construction and operational phase disturbance and displacement impacts at either DBS East, DBS West or the Projects together would **not adversely affect the integrity of the Flamborough and Filey Coast SPA**.

~~9.5.2.3.5~~9.6.2.3.5 *Assessment of potential effects of the Projects in combination with other plans and projects*

~~9.5.2.3.5.1~~9.6.2.3.5.1 *Potential Effects During Operation: Disturbance and Displacement*

~~202.~~237. Seasonal and annual abundance estimates of guillemots, both total values and apportioned to Flamborough and Filey Coast SPA, reported for all OWFs included in the in-combination assessment are presented in ~~**Table 9-24.** This information was taken from the DCO Application and Examination for the Dudgeon and Sheringham Extension projects (Royal HaskoningDHV 2022, 2023).~~Table 9-28.

~~203.~~238. The estimated total number of guillemots at risk of displacement from all OWFs within the UK North Sea BDMPS combined is ~~614,112 of which between 38,809 and 46,789 (not including Hornsea 4 as this project's impacts are subject to compensation) are estimated to be breeding adults from Flamborough and Filey Coast SPA (**Table 9-24**). Using displacement rates of 30% to 70% and a mortality rate of 1% to 10% for displaced birds, the number of Flamborough and Filey Coast SPA birds predicted to die each year would be between 116 and 3,275.~~ 647,032. The estimated number of these that are adults from FFC SPA is 110,084, of which 33,012 are at projects for which compensation has been agreed (Hornsea 4, Dudgeon and Sheringham Extensions). The total suggests that over 73% of the FFC SPA guillemot population (110,084 of the SPA population of 149,978) is apparently present on UK wind farms through the course of the year and at risk of displacement. This highlights the precautionary basis of the methods used to estimate seasonal abundance and apportioning since offshore wind farms make up approximately 6% of the area within 300km of the FFC SPA, 12 times less than the in-combination assessment indicates. Indeed, it is not difficult to envisage that, with the addition of a small number of wind farms the current assessment methods could predict more birds are at risk of displacement than are present in the population.

239. ~~At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the~~ The above apparent limitations in the assessment notwithstanding a matrix of displacement impacts is provided in **Table 9-29**. Using displacement rates of 30% to 70% and mortality rates of 1% to 10% for displaced birds, and either including or excluding (in brackets) the projects for which compensation has been agreed, the number of Flamborough and Filey Coast SPA ~~population expected to die is 9,149 (149,978 x 0.061) adults per annum. The~~ birds predicted ~~annual in-combination mortality on the breeding guillemot population~~to die each year would ~~result in a predicted change in adult~~be:

- At 50% displaced and 1% mortality: 550 (385)
- At 70% displaced and 2% mortality ~~rate of between 1.3% and 36%.~~ : 1541 (1079)

240. These ~~are above~~ magnitudes of displacement would increase the background mortality rate of the ~~1% threshold below which effects are considered undetectable, therefore PVA was undertaken to investigate further.~~ FFC Spa population by:

- At 50% displaced and 1% mortality: 6.0% (4.2%)
- At 70% displaced and 2% mortality: 16.8% (11.8%)

~~204.~~241. The results of ~~the PVA~~PVA to investigate these impacts are considered below (section 9.6.2.3.5.2).

Table 9-28 Total in-combination guillemot abundance on North Sea and English Channel Wind Farms and apportioned to Flamborough and Filey Coast SPA adult population.

Tier	Wind Farm	Breeding		Nonbreeding		Annual	
		Total	FFC	Total	FFC	Total	FFC
1	Beatrice	13610	0	2755	121.2	16365	121.2
1	Beatrice Demonstrator	No data					
1	Blyth Demonstration Project	1220	0	1321	58.1	2541	58.1
1	Dudgeon	334	0	542	23.8	876	23.8
1	East Anglia ONE	274	0	640	28.2	914	28.2
1	European Offshore Wind Deployment Centre	547	0	225	9.9	772	9.9
1	Galloper	305	0	593	26.1	898	26.1
1	Greater Gabbard	345	0	548	24.1	893	24.1
1	Gunfleet Sands	0	0	363	16	363	16
1	Hornsea Project One	9836	4554.1	8097	356.3	17933	4910.4
1	Humber Gateway	99	99	138	6.1	237	105.1
1	Hywind	249	0	2136	94	2385	94
1	Kentish Flats	0	0	3	0.1	3	0.1
1	Kentish Flats Extension	0	0	4	0.2	4	0
1	Kincardine	632	0	0	0	632	35.8
1	Lincs & LID	582	0	814	35.8	1396	16.6
1	London Array	192	0	377	16.6	569	31.2
1	Race Bank	361	0	708	31.2	1069	683.6
1	Rampion	10887	0	15536	683.6	26423	
1	Scroby Sands	No data					
1	Sheringham Shoal	390	0	715	31.5	1105	31.5
1	Teesside	267	267	901	39.6	1168	306.6
1	Thanet	18	0	124	5.5	142	5.5
1	Westermost Rough	347	347	486	21.4	833	368.4
1	Hornsea Project Two	7735	3581.3	13164	579.2	20899	4160.5
2	Triton Knoll	425	425	746	32.8	1171	457.8
3	Dogger Bank Creyke Beck Projects A	5407	1892.5	6142	270.2	11549	2162.7
3	Dogger Bank Creyke Beck Projects B	9479	3317.7	10621	467.3	20100	3785
3	Dogger Bank Teesside Projects A	3283	1149.1	2268	99.8	5551	1248.9
3	Dogger Bank Teesside Projects B	5211	1823.9	3701	162.8	8912	1986.7
3	East Anglia THREE	1744	0	2859	125.8	4603	125.8
3	Firth of Forth Alpha	13606	0	4688	206.3	18294	206.3
3	Firth of Forth Bravo	11118	0	4112	180.9	15230	180.9
3	Hornsea Project Three	13374	0	17772	782	31146	782
3	Inch Cape	4371	0	3177	139.8	7548	139.8
3	Methil	25	0	0	0	25	0
3	Moray Firth (EDA)	9820	0	547	24.1	10367	24.1
3	Moray West	24426	0	38174	1679.7	62600	1679.7
3	Neart na Gaoithe	1755	0	3761	165.5	5516	165.5
3	Norfolk Boreas	7767	0	13777	606.2	21544	606.2

Tier	Wind Farm	Breeding		Nonbreeding		Annual	
		Total	FFC	Total	FFC	Total	FFC
3	Norfolk Vanguard	4320	0	4776	210.2	9096	210.2
3	East Anglia ONE North	4183	0	1888	83.1	6071	83.1
3	East Anglia TWO	2077	0	1675	73.7	3752	73.7
3	Hornsea Project Four (inc. separate post-breeding)**	~~15245~~9382	~~15245~~9382	69555	~~3060.4~~22927	~~84800~~78937	32309 / 0*
4	DEP	3839	0	14887	655	18726	655 / 0*
4	SEP	1094.5	0	1085	47.7	2179	47.7 / 0*
4	Rampion 2	134	0	5723	251.8	5723	251.8
4	Berwick Bank	74154	0	44171	1943.5	118325	1943.5
4	North Falls (ES)	886	0	5365	236	6231	236
4	Five Estuaries (ES)	1201	0	3698	163	4899	163
4	Outer Dowsing (ES)	16445	16445	11208	495	27653	16940
Total without DBS		~~190934~~**277757**	~~32702~~**43284**	~~262124~~**326566**	~~11534~~**34238**	~~452923~~**604168**	~~27873~~**77521**
5	~~DBS East~~DBS East (100% adults in BS & inc. separate post-breeding)**	9031	~~4984.8~~9031	12552	~~552.3~~5789	21582	~~5537~~14820
5	~~DBS West~~DBS West (100% adults in BS & inc. separate post-breeding)**	8784	~~4848.5~~8784	12498	~~549.9~~8959	21282	~~5398~~17743
~~5a~~5	DBS East+West (~~55.2~~100% adults in BS & inc. separate post-breeding ~~season)~~)**	17815	~~9833~~17815	25050	~~1102~~14748	42864	~~10936~~32563
~~5b~~	~~DBS East+West (100% adults in breeding season)~~						~~18916~~
~~5a~~ Total (all projects)		~~282902~~**295572**	~~42535~~**61099**	~~331345~~**351616**	~~14579~~**48985**	~~614112~~**647032**	~~38809~~**110084 / 77072***
~~5b Total (all projects)~~			~~50516~~				~~46789~~

** Note projects for which compensation is ~~required have been given an~~ agreed are marked in the annual FFC total '*' and an alternative total omitting these is provided*

*** Hornsea 4 and Dogger Bank South nonbreeding values are summed post-breeding and non-breeding figures*

Table 9-29 Displacement matrix for in-combination guillemot apportioned to Flamborough and Filey Coast SPA adult population. Total impact includes projects for which compensation has been agreed.

Mortality %	Displacement %									
	10	20	30	40	50	60	70	80	90	100
1	110	220	330	440	550	661	771	881	991	1101
2	220	440	661	881	1101	1321	1541	1761	1982	2202
3	330	661	991	1321	1651	1982	2312	2642	2972	3303
4	440	881	1321	1761	2202	2642	3082	3523	3963	4403
5	550	1101	1651	2202	2752	3303	3853	4403	4954	5504
6	661	1321	1982	2642	3303	3963	4624	5284	5945	6605
7	771	1541	2312	3082	3853	4624	5394	6165	6935	7706
8	881	1761	2642	3523	4403	5284	6165	7045	7926	8807
9	991	1982	2972	3963	4954	5945	6935	7926	8917	9908
10	1101	2202	3303	4403	5504	6605	7706	8807	9908	11008
20	2202	4403	6605	8807	11008	13210	15412	17613	19815	22017
30	3303	6605	9908	13210	16513	19815	23118	26420	29723	33025
50	5504	11008	16513	22017	27521	33025	38529	44034	49538	55042
75	8256	16513	24769	33025	41281	49538	57794	66050	74307	82563
100	11008	22017	33025	44034	55042	66050	77059	88067	99075	110084

~~9.5.2.3.5.2~~9.6.2.3.5.2 *Population Viability Analysis Results for guillemot*

~~205.~~242. The Natural England commissioned PVA tool was used to examine the effect of the estimated in-combination mortality on the Flamborough and Filey Coast SPA population. The complete input parameters and settings and results are provided in Annex A: SPA PVA Results. The counterfactuals of growth rate (CGR) and population size (CPS) are presented in **Table 9-30**.

Table 9-30 PVA results for in-combination impacts on FFC SPA guillemot after 30 years.

PVA run scenario	Annual mortality	Decrease in adult survival rate	Mean CGR (95% c.i.)	Mean CPS (95% c.i.)
~~In-combination~~Project alone displacement ~~lower (30~~(50% x 1%; 55~~.2~~% adults ~~from DBS~~ in ~~the~~ breeding season)	~~116~~123	0.~~00077344~~0008201	0.~~9995~~9994 (0.9992-0.9997)	0.~~9838~~9829 (0.~~9763~~9754-0.~~9914~~9902)
~~In-combination~~Project alone displacement ~~lower (30~~(50% x 1%; 100% adults ~~from DBS~~ in ~~the~~ breeding season)	~~140~~163	0.~~00093347~~001120	0.~~9994~~9992 (0.~~9991~~9999-0.~~9996~~9995)	0.~~9806~~9767 (0.~~9734~~9694-0.~~9878~~9841)
~~In-combination~~Project alone displacement ~~Evidence based (50~~(70% x ~~1~~2%; 55~~.2~~% adults ~~from DBS~~ in ~~the~~ breeding season)	~~194~~344	0.~~00129352~~002294	0.~~9991~~9984 (0.~~9989~~9982-0.~~9994~~9987)	0.~~9732~~9528 (0.~~9660~~9457-0.~~9804~~9599)
~~In-combination~~Project alone displacement ~~lower (50~~(70% x ~~1~~2%; 100% adults ~~from DBS~~ in ~~the~~ breeding season)	~~234~~456	0.~~00156022~~003040	0.~~9989~~9979 (0.~~9987~~9977-0.~~9992~~9982)	0.~~9678~~9381 (0.~~9609~~9306-0.~~9751~~9454)

PVA run scenario	Annual mortality	Decrease in adult survival rate	Mean CGR (95% c.i.)	Mean CPS (95% c.i.)
In-combination displacement (50% x 1%; exc. agreed compensation)	385	0.002567	0.9983 (0.998-0.9985)	0.9474 (0.9401-0.9545)
In-combination displacement (50% x 1%; inc. agreed compensation)	550	0.003667	0.9975 (0.9973-0.9978)	0.9258 (0.9182-0.9331)
In-combination displacement ~~upper~~ (70% x ~~10%; 55.~~2~~% adults from DBS in the breeding season~~%; exc. agreed compensation)	~~2717~~1079	0.~~0181159~~007194	0.~~98789~~9951 (0.~~98749~~9949-0.~~98839~~9954)	0.~~68428~~8597 (0.~~67478~~8525-0.~~69358~~867)
In-combination displacement ~~lower~~ (70% x ~~10%; 100% adults from DBS in the breeding season~~2%; inc. agreed compensation)	~~3275~~1541	0.~~0218365~~~~4~~010275	0.~~98549~~9931 (0.~~98499~~9927-0.~~98589~~9934)	0.~~63318~~06 (0.~~6230-6430~~798-0.8139)

243. After a period of 30 years, ~~worst case~~assuming all birds on the Array areas were adults in~~-combination~~ the breeding season, the project alone displacement at 50% x 1% and reduced the population growth rate by up to ~~1.5% (~~0.~~9854~~06% (0.9994) and reduced the population size ~~relative~~compared to the baseline size by up to ~~37% (0.6331). At the evidence based rates of 50% and~~ 1~~%, the CPGR~~.7% (0.9829), while at 70% x 2% the population growth rate would be reduced by up to 0.21% (0.9979) and ~~CPS were 0.~~the population size compared to the baseline size would be reduced by up to 6.19% (0.9381).

~~206.~~244. After a period of 30 years, in-combination displacement at 50% x 1% and ~~3.2% respectively.~~ including projects for which compensation has been agreed reduced the population growth rate by up to 0.25% (0.9975) and reduced the population size compared to the baseline size by up to 7.42% (0.9258), while at the same rates but excluding projects for which compensation has been agreed reduced the population growth rate by up to 0.17% (0.9983) and reduced the population size compared to the baseline size by up to 5.26% (0.9474).

245. After a period of 30 years, in-combination displacement at 70% x 2% and including projects for which compensation has been agreed reduced the population growth rate by up to 0.69% (0.9931) and reduced the population size compared to the baseline size by up to 19.4% (0.8060), while at the same rates but excluding projects for which compensation has been agreed reduced the population growth rate by up to 0.49% (0.9951) and reduced the population size compared to the baseline size by up to 14.0% (0.8597).

246. The choice of which counterfactual measure is more appropriate for understanding the potential population consequences of increased mortality is dependent on the model formulation, specifically whether or not the model incorporates realistic density dependent regulation. Natural England advise that PVA for seabird impact assessment should not include density dependence (on the basis that there is insufficient data to parameterise this for specific impacted populations). Density independent population predictions made under this assumption lack the natural feedback mechanisms that prevent natural populations growing indefinitely at an exponential rate. The implication of this for the current PVA is that the baseline population projections (no impact) and the impacted ones will diverge at an increasing rate as the simulated period increases. Therefore, the CPS figures are very sensitive to the duration of the simulation.

~~207.~~247. Furthermore, although the size of the impacted population may be, for example, much smaller than the baseline one, both populations could have increased considerably in size. Indeed, that is the case with the guillemot PVA, with a baseline annual average growth rate of 3.6% and a maximum impact growth rate of 2.~~1~~9%. These result in median populations after 30 years of over 433,000 and ~~280~~324,000 for baseline and maximum impact respectively. It is clear therefore that the ~~41~~19% 'reduction' in population size is in fact a population which has simply not grown as quickly, but has still ~~nearly~~more than doubled from the starting size of over 150,000.

~~208.~~248. The CPGR for a density independent model is a more consistent measure of population health, since it is much less sensitive to the duration considered. For example at the largest impact the CPS after 10 years was 0.~~8423 (169~~222 (7.8%) which decreased to 0.~~6331 (37~~8059 (19.4%) after 30 years, while the CPGR after 10 years was almost exactly the same 0.~~9845 (1.55~~9927 (0.73%) as that after 30 years 0.~~9854 (1.46~~9931 (0.69%). Thus the interpretation of the CPS depends on the timespan, while interpretation of the CPGR is largely insensitive to this aspect.

~~209.~~249. The CPGR also lends itself to consideration against the recent observed trend in the growth rate of the population. For example, the guillemot population at Flamborough and Filey Coast SPA has grown at an average rate of 3.8% per year since 2000. Although there were reports of elevated guillemot mortality in 2022, attributed to the presence of HPAI, subsequent monitoring has not reported any apparent population scale effects (Butcher *et al*. 2024). The maximum CPGR was ~~1.5~~0.7% which if realised would only reduce the annual growth rate to ~~2.~~3.1%. Thus, the population would continue to grow at a healthy rate even if the worst case in-combination mortality occurred.

~~210.~~250. Furthermore, there are several additive precautionary assumptions baked into the estimated impacts, as discussed above in relation to gannet (paragraph 163).

~~211.~~251. Therefore, it is the Applicants' conclusion that the combined displacement and collision impacts predicted at DBS East and DBS West in-combination with other projects, will not adversely affect the integrity of the Flamborough and Filey Coast SPA.

~~212.~~252. Notwithstanding the above conclusion, the Applicant acknowledges that previous decisions on offshore wind farms by the Secretary of State have concluded that an AEoI for guillemot at the Flamborough and Filey Coast SPA could not be ruled out for in-combination displacement risk (e.g. Hornsea 4). Given this, it is the Applicants assumption that the Secretary of State will conclude AEoI in this case also. Therefore, the Applicants do not consider it worthwhile to contest this point and on this basis **concede AEoI on the Flamborough and Filey Coast SPA.**

~~213.~~253. The Applicant has therefore proposed compensation measures for guillemot. Further details on the proposed compensation measures are provided in the accompanying **Volume 6, Appendix 2 Guillemot and Razorbill Compensation Plan (Revision 3) (application ref: 6.2.2).**

~~9.5.2.4~~9.6.2.4 Puffin

~~214.~~254. Puffin has been screened into the assessment to assess the impacts from disturbance / displacement in the construction and operation phase.

~~9.5.2.4.1~~9.6.2.4.1 Status

~~215.~~255. Puffin is listed as a named feature of the seabirds assemblage of the Flamborough and Filey Coast SPA.

~~216.~~256. Data from the Seabird Monitoring Programme (2008-2011; Aitken *et al*., 2011) indicated there were 980 pairs breeding adult puffins within the SPA (1,960 individuals), however evidence from pre-breeding rafting counts suggested a higher figure of approximately 2,300 individuals (Babcock *et al*., 2016). Subsequent repeats of this survey recorded around 2,600 individuals in 2017 (Lloyd *et al*., 2019). In 2018, after the reclassification and extension of the site the figure was 4,000 individuals. The most recent SPA estimate, as reported in Burnell *et al*. 2023 is 4,279 AOB. Natural England [APP-039] stated this count should not be considered accurate (Natural England quote Burnell *et al*. 2023: "*the change to a less accurate survey method has introduced some uncertainty in this trend.*"). However, it appears that Burnell *et al*. (2023) in fact consider that caution should be taken when comparing this figure with previous ones due to the change in methods, rather than that this estimate itself is necessarily incorrect (or that previous ones were more reliable). Nevertheless, Natural England [APP-039] recommend that a previous count of 3,080 individuals, obtained as a count of rafting birds, on the 15th March 2022 (Clarkson *et al*. 2022) should be used. Burnell *et al*. (2023) recommend that counts of individuals, such as this one, conducted before 1st May are adjusted using 1.5 individuals equals 1 AOB, so this equates to 2,053 AOB, and 4107 individual breeding adults.

~~217.~~257. Supplementary advice on the conservation objectives were added for qualifying features in 2020 (Natural England, 2020). For the seabird assemblage, of which puffin is a component, these are:

- Maintain the overall abundance of the assemblage at a level which is above 216,730 individuals whilst avoiding deterioration from its current level as indicated by the latest peak mean count or equivalent;
- Maintain the species diversity of the bird assemblage;
- Restrict the frequency, duration and / or intensity of disturbance affecting roosting, nesting, foraging, feeding, moulting and/or loafing birds so that they are not significantly disturbed;
- Restrict predation and disturbance caused by native and non-native predators;

- Maintain concentrations and deposition of air pollutants at below the site-relevant Critical Load or Level values given for this feature of the site on the Air Pollution Information System;
- Maintain the structure, function and supporting processes associated with the feature and its supporting habitat through management or other measures (whether within and/or outside the site boundary as appropriate) and ensure these measures are not being undermined or compromised;
- Maintain the extent, distribution and availability of suitable breeding habitat which supports the feature for all necessary stages of its breeding cycle (courtship, nesting, feeding) current extent - (water column; vegetated sea cliffs of the Atlantic and Baltic coast; intertidal rock);
- Maintain the structure, function and availability of the following habitats which support the assemblage feature for all stages (breeding, moulting, roosting, loafing, feeding) of the breeding period – (vegetated sea cliff and water column);
- Reduce aqueous contaminants to levels equating to High Status according to Annex VIII and Good Status according to Annex X of the Water Framework Directive, avoiding deterioration from existing levels. This target was set using the Environmental Agency 2019 water body classifications data;
- Maintain the dissolved oxygen (DO) concentration at levels equating to High Ecological Status (specifically ≥5.7mg per litre (at 35 salinity) for 95% of the year), avoiding deterioration from existing levels;
- Maintain water quality and specifically mean winter dissolved inorganic nitrogen (DIN) at a concentration equating to High Ecological Status (specifically mean winter DIN is <12μM for coastal waters), avoiding deterioration from existing levels; and
- Maintain natural levels of turbidity (e.g. concentrations of suspended sediment, plankton and other material) across the habitat.

~~9.5.2.4.2~~9.6.2.4.2 *Connectivity to the Projects*

~~218.~~258. DBS East and DBS West are 125km and 103km respectively from the Flamborough and Filey Coast SPA. The mean maximum foraging range of puffin is 265.4km (137.1km + 128.3km, Woodward *et al.*, 2019). Therefore, DBS East and DBS West are both within potential foraging range for breeding puffin from the Flamborough and Filey Coast SPA. The estimated proportion of the puffin recorded at the Projects during the breeding season that could be breeding adult birds from the Flamborough and Filey Coast SPA is calculated as ~~26.7~~13.0% (**Table 9-9**).

~~219.~~259. Outside the breeding season, breeding puffins from the SPA are assumed to range widely and to mix with puffins from breeding colonies in the UK and beyond. The relevant non-breeding season reference population is the UK North Sea and Channel BDMPS, consisting of 231,957 individuals (mid-August to March; (Furness, 2015).

~~220.~~260. During the non-breeding season it is estimated that 0.4% of birds present at the Projects are breeding adults from the Flamborough and Filey Coast SPA, and impacts are apportioned accordingly. Note, this percentage has been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

~~9.5.2.4.3~~9.6.2.4.3 *Assessment of Potential Effects of the Projects alone and Together*

~~221.~~261. The seasonal peak total number of puffins recorded in DBS East and DBS West and the number apportioned to the Flamborough and Filey Coast SPA is provided in **Table 9-31.**

~~222.~~262. Construction displacement has been estimated on the basis this operates across half the wind farm. Thus, puffin displacement was calculated using upper and lower displacement rate values of 15% and 35% (i.e. half the operational values) and 1% to 10% mortality. In addition, evidence based rates of 25% (half the operational rate of 50%) and 1% have also been assessed. These were then added to the number of birds expected to be displaced by up to three construction vessels (assuming 100% displacement within 2km of each vessel and 1% mortality), calculated from the seasonal densities (**Table 9-31**).

Table 9-31 Summary of puffin density and abundance estimates and SPA apportioning rates and used in the operation and construction displacement assessment for Flamborough and Filey Coast SPA. Note that displacement from the wind farm has been estimated as 15%-35%, half the operational rates.

Site	Season	Peak no.	SPA %	Adult %	No. apportioned to SPA	Wind farm operation displacement mortality to SPA			Wind farm construction displacement mortality to SPA			Peak density (birds/km2)	Total vessel displacement mortality (2km around 3 vessels, 1% mortality)	Vessel mortality to SPA	Total construction displacement mortality to SPA		
						30-1	50-1	70-10	15-1	25 - 1	35-10				15-1 & vessel	25 – 1 & vessel	35-10 & vessel
DBS East	Breed-ing	62.6	13.0	54.3	~~9.1~~4.4	0.~~03~~01	0.~~05~~02	0.~~64~~31	0.01	0.~~02~~01	0.~~32~~15	0.12	0.05	0.~~007~~004	0.~~02~~01	0.~~03~~01	0.~~32~~16
				100	~~16.7~~8.1	0.~~05~~02	0.~~08~~04	~~1.17~~0.57	0.~~03~~01	0.~~04~~02	0.~~58~~28			0.~~01~~007	0.~~04~~02	0.~~05~~03	0.~~60~~29
	Non-breed-ing	178.7	0.4	100	0.7	0.00	0.00	0.05	0.00	0.00	0.03	0.35	0.13	0.~~00~~001	0.00	0.00	0.03
	Annual (54.3% adults)				~~9.8~~5.1	0.~~0~~01	0.~~0~~02	0.~~7~~4	0.~~0~~01	0.~~0~~01	0.~~3~~18	-	0.2	0.01	0.~~02~~01	0.~~03~~02	0.~~35~~19
	Annual (100% adults)				~~17.4~~8.8	0.~~1~~02	0.~~1~~04	~~1.2~~0.6	0.~~0~~01	0.~~0~~02	0.~~6~~31			0.01	0.~~04~~02	0.~~06~~03	0.~~62~~32
DBS West	Breed-ing	109.3	~~26.7~~ 13.0	54.3	~~15.9~~7.7	0.~~05~~02	0.~~08~~04	~~1.11~~0.54	0.~~02~~01	0.~~04~~02	0.~~56~~27	0.21	0.08	0.~~011~~006	0.~~04~~02	0.~~05~~02	0.~~57~~28
				100	~~29~~14.2	0.~~09~~04	0.~~15~~07	~~2.04~~0.99	0.~~04~~02	0.~~07~~04	~~1.02~~0.50			0.~~02~~010	0.~~06~~03	0.~~09~~05	~~1.04~~0.51
	Non-breed-ing	198.2	0.4	100	0.8	0.00	0.00	0.06	0.00	0.00	0.03	0.38	0.14	0.001	0.~~002~~000	0.~~003~~000	0.03
	Annual (54.3% adults)				~~16.6~~8.5	0.~~0~~02	0.~~1~~04	~~1.17~~0.6	0.~~0~~01	0.~~0~~02	0.~~6~~30	-	0.2	0.01	0.~~04~~02	0.~~05~~03	0.~~59~~31
	Annual (100% adults)				~~30~~15.0	0.~~1~~04	0.~~1~~07	~~2.10~~1.0	0.~~0~~02	0.~~1~~04	~~1.~~0.53			0.02	0.~~07~~03	0.~~10~~05	~~1.07~~0.54
DBS East + DBS West	Breed-ing	146.6	~~26.7~~ 13.0	54.3	~~21~~10.3	0.~~06~~03	0.~~11~~05	~~1.49~~0.72	0.~~03~~02	0.~~05~~03	0.~~74~~36	-	0.12	0.~~018~~008	0.~~05~~02	0.~~07~~03	0.~~76~~37
				100	~~39~~19.1	0.~~12~~06	0.~~20~~10	~~2.74~~1.33	0.~~06~~03	0.~~10~~05	~~1.37~~0.67			0.~~03~~016	0.~~09~~04	0.~~13~~06	~~1.40~~0.68
	Non-breed-ing	372.7	0.4	100	1.5	0.00	0.01	0.10	0.00	0.00	0.05	-	0.28	0.001	0.~~003~~000	0.~~005~~000	0.~~06~~03
	Annual (54.3% adults)				~~22.7~~11.8	0.~~1~~03	0.~~1~~05	~~1.59~~0.8	0.~~0~~02	0.~~1~~03	0.~~8~~39	-	0.40	0.02	0.~~05~~03	0.~~08~~04	0.~~82~~40
	Annual (100% adults)				~~40.6~~20.5	0.~~1~~06	0.~~2~~10	~~2.84~~1.4	0.~~1~~03	0.~~1~~05	~~1.4~~0.70			0.03	0.~~10~~05	0.~~14~~06	~~1.46~~0.71

~~9.5.2.4.3.1~~9.6.2.4.3.1 *Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines*

~~9.5.2.4.3.1.1~~9.6.2.4.3.1.1 *DBS East in Isolation*

~~223.~~263. The wind farm construction displacement from DBS East in the breeding and nonbreeding seasons ~~were~~was 0.~~32~~15 (assuming 54.3% adults) or 0.~~58~~28 (assuming 100% adults) and 0.03 respectively (**Table 9-31**). Displacement mortalities due to construction vessels were 0.~~007~~004 (at 54.3% adults) or 0.~~01~~007 (at 100% adults) and 0.001 in each season respectively. Thus, the maximum total combined seasonal construction displacement mortalities apportioned to the SPA were 0.~~32~~16 (54,3% adults) or 0.~~6~~29 (100% adults) and 0.03 birds during the breeding and nonbreeding seasons.

~~224.~~264. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-7**) the number of individuals from the Flamborough and Filey Coast SPA population expected to die is ~~804 (8,558~~386 (4,106 x 0.094) adults per annum. The predicted annual (breeding and non-breeding periods combined) impacts from DBS East alone on the breeding puffin population is 0.~~35~~19 to 0.~~62~~32 birds per annum. These result in a predicted change in adult mortality rate of 0.~~04~~05% to 0.~~07~~08% which ~~is~~are below the 1% threshold for detectability and therefore no further assessment was required.

~~9.5.2.4.3.1.2~~9.6.2.4.3.1.2 *DBS West in Isolation*

~~225.~~265. The wind farm construction displacement from DBS West in the breeding and nonbreeding seasons were 0.~~56~~27 (assuming 54.3% adults) or ~~1.~~0.5 (assuming 100% adults) and 0.03 respectively (**Table 9-31**). Displacement mortalities due to construction vessels were 0.~~011~~006 (54.3% adults) or 0.~~2~~01 (100% adults) and 0.001 in each season respectively. Thus, the maximum total combined seasonal construction displacement mortalities apportioned to the SPA were 0.~~57~~28 (54.3% adults) or ~~1.04~~0.51 (100% adults) and 0.03 birds during the breeding and nonbreeding seasons.

~~226.~~266. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-7**) the number of individuals from the Flamborough and Filey Coast SPA population expected to die is ~~804 (8,558~~386 (4,106 x 0.094) adults per annum. The predicted annual (breeding and non-breeding periods combined) impacts from DBS West alone on the breeding puffin population is 0.~~63~~31 to ~~1.1~~0.54 birds per annum. These result in a predicted change in adult mortality rate of 0.~~07~~08% to 0.~~13~~14% which are below the 1% threshold for detectability and therefore no further assessment was required.

~~9.5.2.4.3.1.3~~9.6.2.4.3.1.3 DBS East and West Together

~~227.~~267. The wind farm construction displacement from DBS East and DBS West in the breeding and nonbreeding seasons were up to 0.~~74~~36 (assuming 54.3% adults) or ~~1.37~~0.67 (assuming 100% adults) and 0.~~05~~03, respectively. Displacement mortalities due to construction vessels were 0.~~018~~008 (54.3% adults) or 0.~~030~~016 (100% adults) and 0.001 in each season respectively. Thus the maximum total combined seasonal construction displacement mortalities apportioned to the SPA were 0.~~76~~37 (54.3% adults) or ~~1.4~~0.68 (100% adults) and 0.~~06~~03 birds during the breeding and nonbreeding seasons.

~~228.~~268. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-7**) the number of individuals from the Flamborough and Filey Coast SPA population expected to die is ~~804 (8,558~~386 (4106 x 0.094) adults per annum. The predicted annual (breeding and non-breeding periods combined) impacts from the Projects alone on the breeding puffin population applying highly precautionary rates of 35% displacement and 10% mortality is 0.~~82~~40 to ~~1.46~~0.71 birds per annum. These result in a predicted change in adult mortality rate of 0.10% to 0.18% which are below the 1% threshold for detectability and therefore no further assessment was required.

~~9.5.2.4.3.2~~9.6.2.4.3.2 Potential Effects During Operation: Disturbance and Displacement

~~9.5.2.4.3.2.1~~9.6.2.4.3.2.1 DBS East in Isolation

~~229.~~269. The wind farm operation displacement from DBS East apportioned to the SPA in the breeding and nonbreeding seasons were up to 0.~~64~~31 (assuming 54.3% adults) or 0.57~~1.17~~ (assuming 100% adults) and 0.~~05~~03, respectively (**Table 9-31**).

~~230.~~270. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-7**) the number of individuals from the Flamborough and Filey Coast SPA population expected to die is ~~804 (8,558~~386 (4,106 x 0.094) adults per annum. The predicted annual (breeding and non-breeding periods combined) impacts from DBS East alone on the breeding puffin population is 0.~~7~~4 to ~~1.2~~0.6 birds per annum. These result in a predicted change in adult mortality rate of 0.~~09~~10% to 0.~~15~~16% which are below the 1% threshold for detectability and therefore no further assessment was required.

~~9.5.2.4.3.2.2~~9.6.2.4.3.2.2 *DBS West in Isolation*

~~231.~~271. The wind farm operation displacement from DBS East apportioned to the SPA in the breeding and nonbreeding seasons were up to ~~1.1~~0.54 (assuming 54.3% adults) or ~~2.~~0.99 (assuming 100% adults) and 0.06, respectively (**Table 9-31**).

~~232.~~272. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-7**) the number of individuals from the Flamborough and Filey Coast SPA population expected to die is ~~804 (8,558~~386 (4106 x 0.094) adults per annum. The predicted annual (breeding and non-breeding periods combined) impacts from DBS West alone on the breeding puffin population is ~~1.17~~0.6 to ~~2.~~1.0 birds per annum. These result in a predicted change in adult mortality rate of 0.~~14~~16% to 0.26% which are below the 1% threshold for detectability and therefore no further assessment was required.

~~9.5.2.4.3.2.3~~9.6.2.4.3.2.3 *DBS East and West Together*

~~233.~~273. The wind farm operation displacement from DBS East apportioned to the SPA in the breeding and nonbreeding seasons were up to ~~1.5~~0.72 (assuming 54.3% adults) or ~~2.7~~1.33 (assuming 100% adults) and 0.1, respectively (**Table 9-31**).

~~234.~~274. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-7**) the number of individuals from the Flamborough and Filey Coast SPA population expected to die is ~~804 (8,558~~386 (4106 x 0.094) adults per annum. The predicted annual (breeding and non-breeding periods combined) impacts from the Projects alone on the breeding puffin population applying highly precautionary rates of 70% displacement and 10% mortality is ~~1.59~~0.8 to ~~2.84~~1.4 birds per annum. These result in a predicted change in adult mortality rate of 0.~~2~~21% to 0.~~35~~36% which are below the 1% threshold for detectability and therefore no further assessment was required.

~~9.5.2.4.4~~9.6.2.4.4 *Summary*

~~235.~~275. A table summarising the puffin construction and operational disturbance and displacement assessment for DBS East and DBS West together is provided below (**Table 9-32**).

~~236.~~276. It is concluded that predicted puffin mortality due to construction and operational phase disturbance and displacement impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the Flamborough and Filey Coast SPA**.

Table 9-32 Summary of predicted puffin displacement mortality from Flamborough and Filey Coast SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.

Puffin		**Displacement**
Potential Effects During Construction: Disturbance and Displacement		
Displacement mortality (@35% x 10%) & Vessel displacement		Mean
Breeding season (54.3% - 100% adults)		0.~~76-1.40~~37-0.68
Nonbreeding season		0.~~06~~03
Annual		0.~~82-1.46~~40-0.71
Effect	Reference population	~~8,558~~4106
	Increase in background mortality (%)	0.~~1~~10-0.18
Potential Effects During Operation: Disturbance and Displacement		
Displacement mortality (@70% x 10%)		Mean
Breeding season (54.3% - 100% adults)		0.72-1.~~49-2.74~~33
Nonbreeding season		0.~~11~~10
Annual		0.82-1.~~59-2.84~~43
Effect	Reference population	~~8,558~~4106
	Increase in background mortality (%)	0.~~2~~21-0.~~35~~36

~~9.5.2.4.5~~9.6.2.4.5 Assessment of potential effects of the Projects in combination with other plans and projects

~~237.~~277. Given that no measurable increase in the Flamborough and Filey Coast SPA puffin mortality is predicted as a result of DBS East and DBS West combined (e.g. with total displacement mortality of only ~~1.6~~0.8 to ~~2.8~~1.4 birds per year during operation even under the most precautionary assumptions), it is concluded that the projects would not contribute to in-combination effects on this species. ~~Therefore, it is concluded that predicted puffin mortality due to construction and operational phase disturbance and displacement impacts at DBS East and DBS West together in-combination with other offshore wind farms would~~ ~~**not adversely affect the integrity of the Flamborough and Filey Coast SPA**.~~

278. The Applicants note that for the Dudgeon and Sheringham Extension wind farms Natural England estimated the worst case mortality on the FFC SPA puffin population would be up to 2.4 (compared to 1.4 for the Projects) and for which Natural England[2] stated:

> *"…there would be no measurable contribution to an in-combination assessment of puffin mortality due to displacement from SEP and DEP"*

279. It is therefore appropriate to reach a similar conclusion that the predicted puffin mortality due to construction and operational phase disturbance and displacement impacts at DBS East and DBS West together would not measurably contribute to an in-combination impact with other offshore wind farms and therefore would **not adversely affect the integrity of the Flamborough and Filey Coast SPA**.

~~9.5.2.5~~9.6.2.5 Razorbill

~~238.~~280. Razorbill has been screened into the assessment to assess the impacts from disturbance / displacement in the construction and operation phase.

~~9.5.2.5.1~~9.6.2.5.1 Status

~~239.~~281. Razorbill is listed as a designated species of the Flamborough and Filey Coast SPA.

~~240.~~282. The SPA breeding population at classification was cited as 10,570 pairs or 21,140 breeding adults, for the period 2008 to 2011 (Natural England, 2018b). The most recent published count was 27,967 pairs or 55,934 individuals in 2017 (JNCC, 2023b). ~~This is~~Natural England (RR-039) advised use of a population of 61,345 individual adults. Therefore the latter has been used as the reference population for the assessment. The baseline mortality of this population is ~~5,873~~6,441 adult birds per year based on this reference population and the published adult mortality rate of 10.5% (Horswill and Robinson, 2015).

~~241.~~283. Supplementary advice on the conservation objectives were added for qualifying features in 2020 (Natural England, 2020). For razorbill, these are:

[2] https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010109/EN010109-001403-Natural%20England%20Advice%20on%20Apportioning%20and%20HRA%20Technical%20Note%C2%A0%20%5bREP2-037%5d%20and%20Auk%20Construction%20Phase%20Displacement%20Assessment%C2%A0%20%5bREP2-049%5d%20Deadline%203.pdf

- 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;
- Maintain safe passage of birds moving between nesting and feeding areas;
- Restrict the frequency, duration and / or intensity of disturbance affecting roosting, nesting, foraging, feeding, moulting and/or loafing birds so that they are not significantly disturbed;
- Restrict predation and disturbance caused by native and non-native predators;
- Maintain concentrations and deposition of air pollutants at below the site-relevant Critical Load or Level values given for this feature of the site on the Air Pollution Information System;
- Maintain the structure, function and supporting processes associated with the feature and its supporting habitat through management or other measures (whether within and/or outside the site boundary as appropriate) and ensure these measures are not being undermined or compromised;
- Maintain the extent, distribution and availability of suitable breeding habitat which supports the feature for all necessary stages of its breeding cycle (courtship, nesting, feeding) at: current extent;
- Maintain the distribution, abundance and availability of key food and prey items (e.g. sandeel, herring, sprat) at preferred sizes;
- Restrict aqueous contaminants to levels equating to High Status according to Annex VIII and Good Status according to Annex X of the Water Framework Directive, avoiding deterioration from existing levels;
- Maintain the dissolved oxygen (DO) concentration at levels equating to High Ecological Status (specifically ≥ 5.7mg per litre (at 35 salinity) for 95% of the year), avoiding deterioration from existing levels;
- Maintain water quality and specifically mean winter dissolved inorganic nitrogen (DIN) at a concentration equating to High Ecological Status (specifically mean winter DIN is <12μM for coastal waters), avoiding deterioration from existing levels; and
- Maintain natural levels of turbidity (e.g. concentrations of suspended sediment, plankton and other material) across the habitat.

~~9.5.2.5.2~~9.6.2.5.2 *Connectivity to the Projects*

~~242.~~284. DBS East and DBS West are 125km and 103km respectively from the Flamborough and Filey Coast SPA. The mean maximum foraging range of razorbill is 164.6km (88.7 + 75.9km, Woodward *et al*., 2019). Therefore, DBS East and DBS West are both within potential foraging range for breeding razorbill from the Flamborough and Filey Coast SPA. The estimated proportion of the razorbills recorded at the Projects during the breeding season that could be breeding adult birds from the Flamborough and Filey Coast SPA ~~(based on the most recent count of 55,967 breeding adults)~~ has been assumed to be 100%.

~~243.~~285. Outside the breeding season, breeding razorbills from the SPA are assumed to range widely and to mix with razorbills from breeding colonies in the UK and further afield. The relevant background population is considered to be the UK North Sea and Channel BDMPS, consisting of 591,874 individuals during autumn and spring passage periods (August to October and January to March), and 218,622 individuals during winter (November and December) (Furness, 2015). However, Natural England advised (RR-039) that razorbills in the post-breeding period should also be apportioned predominantly to FFC SPA at a rate of 69.93%, therefore this assessment applies this bespoke apportioning rate.

~~244.~~286. During the ~~autumn and~~ spring migration Flamborough and Filey Coast SPA breeding adults are estimated to represent 3.4% of the BDMPS population. During the winter season Flamborough and Filey Coast SPA breeding adults are estimated to represent ~~1~~2.7% of the BDMPS population. Note, these percentages have been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

~~9.5.2.5.3~~9.6.2.5.3 *Assessment of Potential Effects of the Projects alone and Together*

~~245.~~287. The seasonal peak total number of razorbills recorded in DBS East and DBS West and the number apportioned to the Flamborough and Filey Coast SPA is provided in **Table 9-33.**

~~246.~~288. Construction displacement has been estimated on the basis this operates across half the wind farm. Thus, razorbill displacement was calculated using upper and lower displacement rate values of 15% and 35% (i.e. half the operational values) and 1% to 10% mortality. In addition, evidence based rates of 25% (half the operational rate of 50%) and 1% have also been assessed. These were then added to the number of birds expected to be displaced by up to three construction vessels (assuming 100% displacement within 2km of each vessel and 1% mortality), calculated from the seasonal densities (**Table 9-33**).

Table 9-33 Summary of razorbill density and abundance estimates and SPA apportioning rates and ~~-~~used in the operation and construction displacement assessment for Flamborough and Filey Coast SPA. Note that displacement from the wind farm has been estimated as 15%-35%, half the operational rates~~.~~

Site	Season	Peak no.	SPA %	Adult %	No. apportioned to SPA	Wind farm operation displacement mortality to SPA				Wind farm construction displacement mortality to SPA				Peak density (birds/	Total vessel displacement mortality ~~(2km around 3 vessels;~~	Vessel mortality to SPA	Total construction displacement mortality to SPA (array & vessel)			
						30-1	50-1	70-2	70-10	15-1	25 – 1	35-2	35-10				15-1 ~~& vessel~~	25 – 1 ~~& vessel~~	35-2	35-10 ~~& vessel~~
DBS East	Breeding	555.1	100	61.3	340.3	1.0	1.7	4.8	23.8	0.5	0.9	2.4	11.9	1.1	0.441	0.~~25~~3	0.~~76~~8	1.~~101~~	2.6	12.~~1~~62
DBS East	Breeding			100	555.1	1.7	2.8	7.8	38.9	0.8	1.4	3.9	19.4			0.~~41~~4	1.~~25~~2	1.~~808~~	4.3	19.~~8~~48
DBS East	Autumn	4685.3	100	~~159.~~ ~~3~~69.93	~~0.5~~3276.4	~~0~~9.8	~~11.~~216.4	~~0.2~~45.9	~~0~~229.4	~~5.6~~4.9	8.2	22.9	114.7	9.2	3.5	~~0.12~~2.4	~~0.36~~7.3	10.6	~~5.69~~25.4	117.1
DBS East	Winter	3376.7	~~1~~2.7	100	~~33.89~~1.2	0.~~1~~3	0.~~2~~5	1.3	~~2~~6.4	0.1	0.~~1~~2	0.6	~~1~~3.2	6.6	2.5	0.~~02~~1	0.~~08~~2	0.~~11~~3	~~1.21~~0.7	3.3
DBS East	Spring	3578.5	3.4	100	121.7	0.4	0.6	1.7	8.5	0.2	0.3	0.9	4.3	7.~~0~~	2.6	0.~~09~~1	0.~~27~~3	0.~~394~~	0.9	4.~~35~~3
DBS East	Annual	~~Annual~~ (Assuming 61.3% adults) in breeding season			~~655.0~~3829.5	~~2.0~~11.5	~~3.3~~19.1	~~45.9~~53.6	268.1.~~0~~	5.7	~~1~~9.6	~~22.9~~26.8	134.0	-	9.0	~~0.49~~2.8	8.6	~~2.~~12.4	~~23.41~~29.6	136.9
DBS East	Annual	~~Annual~~ (Assuming 100% adults) in breeding season			~~869.8~~4044.4	12.1	20.2	~~256.~~6	~~4.3~~283.1	~~60.9~~61.1	10.1	~~1~~28.3	~~2.2~~141.6			3.0	~~0.65~~9.1	13.1~~.95~~	31.~~09~~3	144.5
DBS West	Breeding	2280.6	100	61.3	1398.0	4.2	7.0	19.6	97.9	2.1	3.5	9.8	48.9	4.4	1.7	1.~~01~~0	3.~~11~~1	4.~~515~~	10.8	49.~~9~~49
DBS West	Breeding			100	2280.6	6.8	11.4	31.9	159.6	3.4	5.7	16.0	79.8			1.~~66~~7	5.~~08~~1	7.~~364~~	17.6	81.~~4~~85
DBS West	Autumn	4886.9	100	~~166.~~ ~~2~~69.93	~~0.5~~3417.4	10.3	17.1	~~0~~47.8	~~11.6~~239.2	~~0.2~~5.1	8.5.~~8~~	23.9~~.4~~	119.6	9.4	3.5	~~0.12~~2.5	~~0.37~~7.6	11.0.~~54~~	~~5.94~~26.4	122.1
DBS West	Winter	5066.2	~~1~~2.7	100	~~50.6~~136.8	0.~~1~~54	0.~~2~~57	~~3.5~~1.9	~~0.1~~9.6	0.~~12~~2	~~1.7~~0.3	1.0	4.8	9.7	3.67	0.~~03~~1	0.~~13~~3	0.~~15~~4	1.~~73~~1	4.9
DBS West	Spring	4454.6	3.4	100	151.5	0.5	0.8	2.1	10.6	0.2	0.4	~~5.3~~1.1	~~8.6~~5.3	~~3.2~~8.6	~~0.11~~13.2	0.~~3~~41	0.~~49~~3	0.5.~~41~~	1.2	5.4
DBS West	Annual	~~Annual~~ (Assuming 61.3% adults) in breeding season			~~1766.~~ ~~3~~5103.7	~~5.3~~ ~~5~~15.3	~~8.8~~ ~~5~~25.5	~~123.~~ ~~6~~71.5	~~2.6~~357.3	~~4.4~~27.7	~~61.7~~12.8	35.7	178.6	-	12.~~0~~1	~~1.~~3.7	11.4~~.0~~	16.5.~~7~~	~~63.0~~39.4	182.3
DBS West	Annual	~~Annual~~ (Assuming 100% adults) in breeding season			~~2648.~~ ~~9~~5986.3	~~7.9~~ ~~5~~18.0	~~13.25~~	~~185.~~ ~~3~~83.8	~~3.9~~419.0	~~6.6~~29.0	~~92.6~~15.0	41.9	209.5			~~8.5~~4.3	~~94.6~~13.3	19.3	46.2	213.9

Site	Season	Peak no.	SPA %	Adult %	No. apportioned to SPA	Wind farm operation displacement mortality to SPA				Wind farm construction displacement mortality to SPA				Peak density (birds/	Total vessel displacement mortality ~~(2km around 3 vessels,~~	Vessel mortality to SPA	Total construction displacement mortality to SPA (array & vessel)			
						30-1	50-1	70-2	70-10	15-1	25 ~~-~~-1	35-2	35-10				15-1 ~~& vessel~~	25 – 1 ~~& vessel~~	35-2	35-10 ~~& vessel~~
							29.9													
DBS East + DBS West	Breeding	~~2826.1~~2835.7	100	61.3	~~1732.4~~1738.3	5.2	8.7	24.3	121.~~3~~7	2.6	4.3	12.2	60.~~6~~8	-	2.1	1.~~27~~3	3.~~86~~9	5.~~60~~5	~~61.90~~13.4	62.1
				100	~~2826.1~~2835.7	8.5	14.~~1~~2	~~197.839.~~7	~~4.2~~198.5	~~7.1~~4.3	~~98.9~~7.1	19.8	99.2	~~2.07~~		~~9.14~~2.1	6.3	9.2	21.9	101.~~0~~3
	Autumn	~~6349.6~~9572.2	100	~~215.9~~69.93	~~0.6~~6693.8	~~1~~20.1	~~15.1~~33.5	~~0.3~~93.7	~~0.5~~468.6	~~7.6~~10.0	~~-~~16.7	~~7.0~~46.9	~~0.24~~234.3	~~0.56~~	7.0~~.78~~	~~7.79~~4.9	14.9	21.6	51.8	239.2
	Winter	~~5823.7~~8442.9	~~1~~2.7	100	~~58.2~~228.0	0.~~2~~7	~~0.3~~1.1	~~4.1~~3.2	16.0~~.1~~	0.~~15~~3	~~2.~~0.6	~~-~~1.6	~~6.1~~8.0	~~0.06~~-	~~0.16~~6.1	0.~~21~~2	~~2.06~~0.5	0.7	1.8	8.1
	Spring	~~6302.5~~8033.1	3.4	100	~~214.3~~273.1	0.~~6~~8	1.~~1~~4	~~15.0~~3.8	~~0.3~~19.1	0.~~5~~4	0.7~~.5~~	~~-~~1.9	~~5.~~9.6	~~0.20~~	~~0.52~~5.9	0.~~74~~2	~~7.70~~0.6	0.9	2.1	9.8
	Annual	~~Annual (~~Assuming 61.3% adults~~)~~ in breeding season			~~2220.8~~8933.2	~~6.6~~26.8	~~11.2~~44.7	~~155.5~~125.1	~~3~~625.3	~~5.45~~13.4	~~77.7~~22.3	62.5	312.7	-	21.1	~~1.8~~6.5	~~5.1~~19.9	~~7.2~~28.9	~~79.5~~69.1	319.2
		~~Annual (~~Assuming 100% adults~~)~~ in breeding season			~~3314.5~~10030.6	~~9.9~~30.1	~~16.6~~50.2	~~232~~140.4	~~4.9~~702.1	15.0	~~8.~~25.1	~~116~~70.2	351.1			7.~~5~~3	~~10.8~~22.4	~~118.6~~32.4	77.6	358.4

~~9.5.2.5.3.1~~9.6.2.5.3.1 *Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines*

~~9.5.2.5.3.1.1~~9.6.2.5.3.1.1 *DBS East in Isolation*

~~247.~~289. The wind farm construction displacement from DBS East in the breeding, autumn, winter and spring seasons were up to 11.9 (assuming 61.3% adults) or 19.4 (assuming 100% adults), ~~5.6, 1~~114.7, 3.2 and 4.3, respectively (**Table 9-33**). Displacement mortalities due to construction vessels were 0.25 (61.3% adults) or 0.41 (100% adults), 2.4, 0.~~12, 0.02~~1 and 0.~~09~~1 in each season respectively. Thus, the maximum total combined seasonal construction displacement mortalities apportioned to the SPA were 12.2 (61.3% adults) or 19.8 (100% adults), ~~5.7, 1~~17.1~~.2,~~ 3.3 and 4.3 birds during the breeding, autumn, winter and spring seasons. The equivalent evidence based mortalities were 1.1 (61.3% adults) or 1.8 (100% adults), 10.6, 0.~~5, 0.1~~3 and 0.4 respectively.

~~248.~~ At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-7**) the number of individuals from the Flamborough and Filey Coast SPA population expected to die is ~~2,936 (27,967~~6,441 (61,345 x 0.105) adults per annum. The predicted annual impacts from DBS East alone on the breeding razorbill population applying highly precautionary rates of 35% displacement and 10% mortality is ~~23.4~~136.9 to ~~31.1~~144.5 birds per annum. These would result in a predicted change in adult mortality rate of ~~0.8~~2.1% to ~~1.06%.~~

290. ~~There is no evidence in support of either the (operational) 70~~2.2%. The equivalent mortalities assuming 35% displacement ~~rate or the 10~~and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) were 27.4 (61.2% adults) or 28.9 (100% adults) per annum respectively which would result in a predicted change in adult mortality rate of 0.42% to 0.45%.

~~249.~~291. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. ~~rate.~~ In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al.* 2024) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement would double the natural adult background mortality rate. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years in areas where there are operational offshore wind farms. But there is no such indication of mortality effects of this magnitude.

~~250.~~292. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the seasonal displacement mortalities apportioned to the FFC SPA (~~2.1~~12.4 to ~~2.8~~13.1 annually) would increase the predicted annual mortality by 0.~~07~~19% to 0.~~09~~20% which are below the 1% threshold for detectability and therefore no further assessment was required.

~~9.5.2.5.3.1.2~~9.6.2.5.3.1.2 *DBS West in Isolation*

~~251.~~293. The wind farm construction displacement from DBS West in the breeding, autumn, winter and spring seasons were up to 48.9 (61.3% adults) or 79.8 (100% adults), ~~5~~119.6, 4.8~~, 1.7~~ and 5.3, respectively (**Table 9-33**). Displacement mortalities due to construction vessels were 1.0 (61.3% adults) or 1.7 (100% adults), 2.5, 0.~~12, 0.03~~1 and 0.~~11~~1 in each season respectively. Thus, the maximum total combined seasonal construction displacement mortalities apportioned to the SPA were 49.9 (61.3% adults) or 81.5 (100% adults), ~~5~~122.1, 4.9~~, 1.7~~ and 5.4 birds during the breeding, autumn, winter and spring seasons. The equivalent evidence based mortalities were 4.5 (61.3% adults) or 7.4 (100% adults), 11.0~~.5~~, 0.~~15~~4 and 0.5 respectively.

~~252.~~294. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-7**) the number of individuals from the Flamborough and Filey Coast SPA population expected to die is ~~2,936 (27,967~~6,441 (61,345 x 0.105) adults per annum. The predicted annual impacts from DBS West alone on the breeding razorbill population applying highly precautionary rates of 35% displacement and 10% mortality is ~~63.0~~182.3 to ~~94.6~~213.9 birds per annum. These would result in a predicted change in adult mortality rate of 2.~~1~~8% to 3.3%. The equivalent mortalities assuming 35% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects) were 36.5 (61.2% adults) or 42.8 (100% adults) per annum respectively which would result in a predicted change in adult mortality rate of 0.57% to 0.66%.

~~253.~~ As noted above, these displacement rates are highly precautionary and have little support from studies at operational wind farms (paragraph 291~~).~~ ~~At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the seasonal displacement mortalities apportioned to the FFC SPA (5.7 to 8.5 annually) would increase the predicted annual mortality by 0.19% to 0.28% which are below the 1% threshold for detectability and therefore no further assessment was required. Furthermore, the results of the PVA presented in the in-combination assessment (section 9.5.2.5.5) encompass the worst case prediction above (for 70% displaced and 10% mortality) and demonstrate that this would not result in an Adverse Effect on Integrity on the SPA.~~

~~254.~~).~~The wind farm construction displacement from DBS East and DBS West in the breeding, autumn, winter and spring seasons were up to 60.6 (61.3% adults) or 98.9 (100% adults), 7.6, 2.0 and 7.5, respectively (**Table 9-28**). Displacement mortalities due to construction vessels were 1.3 (61.3% adults) or 2.1 (100% adults), 0.24, 0.06 and 0.2 in each season respectively. Thus, the maximum total combined seasonal construction displacement mortalities apportioned to the SPA were 61.9 (61.3% adults) or 101.0 (100% adults), 7.8, 2.1 and 7.7 birds during the breeding, autumn, winter and spring seasons. The equivalent evidence based mortalities were 5.60 (61.3% adults) or 9.1 (100% adults), 0.78, 0.21 and 0.74 respectively.~~

~~255.~~ ~~At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-5**) the number of individuals from the Flamborough and Filey Coast SPA population expected to die is 2,936 (27,967 x 0.105) adults per annum. The predicted annual impacts from DBS East and DBS West on the breeding razorbill population applying highly precautionary rates of 35% displacement and 10% mortality is 79.5 to 118.6 birds per annum. These would result in a predicted change in adult mortality rate of 2.7% to 4.0%.~~

295. ~~As noted above, these displacement rates are highly precautionary and have little support from studies at operational wind farms (paragraph 247).~~ At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the seasonal displacement mortalities apportioned to the FFC SPA (~~7.2~~16.5 to ~~10.8~~19.3 annually) would increase the predicted annual mortality by 0.~~24~~26% to 0.30% which are below the 1% threshold for detectability and therefore no further assessment was required.

~~9.5.2.5.3.1.3~~9.6.2.5.3.1.3 DBS East and West Together

296. ~~37~~The wind farm construction displacement from DBS East and DBS West in the breeding, autumn, winter and spring seasons were up to 60.8 (61.3% adults) or 99.2 (100% adults), 234.3, 8.0 and 9.6, respectively (**Table 9-33**). Displacement mortalities due to construction vessels were 1.3 (61.3% adults) or 2.1 (100% adults), 4.9, 0.2 and 0.2 in each season respectively. Thus, the maximum total combined seasonal construction displacement mortalities apportioned to the SPA were 62.1 (61.3% adults) or 101.3 (100% adults), 239.1, 8.1 and 9.8 birds during the breeding, autumn, winter and spring seasons. The equivalent evidence based mortalities (at 25% x 1%) were 5.5 (61.3% adults) or 9.2 (100% adults), 21.6, 0.7 and 0.9 respectively.

297. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-7**) the number of individuals from the Flamborough and Filey Coast SPA population expected to die is 6,441 (61,345 x 0.105) adults per annum. The predicted annual impacts from DBS East and DBS West on the breeding razorbill population applying highly precautionary rates of 35% displacement and 10% mortality is 319.2 to 358.4 birds per annum. These would result in a predicted change in adult mortality rate of 4.9% to 5.6%. The equivalent mortalities assuming 35% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) were 63.8 (61.2% adults) or 71.7 (100% adults) per annum respectively which would result in a predicted change in adult mortality rate of 0.99% to 1.11%.

298. As noted above, these displacement rates are highly precautionary and have little support from studies at operational wind farms (paragraph 291). At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the displacement mortalities apportioned to the FFC SPA (28.9 to 32.4 annually) would increase the predicted annual mortality by 0.44% to 0.50% which are below the 1% threshold for detectability and therefore no further assessment was required.

~~256.~~299. Furthermore, the results of the PVA presented in the in-combination assessment (section 9.6.2.5.5) encompass the worst case prediction above (for 70% displaced and 10% mortality) and demonstrate that this would not result in an Adverse Effect on Integrity on the SPA.

~~9.5.2.5.3.2~~9.6.2.5.3.2 *Potential Effects During Operation: Disturbance and Displacement*

~~9.5.2.5.3.2.1~~9.6.2.5.3.2.1 *DBS East in Isolation*

~~257.~~300. The wind farm operation displacement from DBS East apportioned to the SPA in the breeding, autumn, winter and spring seasons were up to 23.8 (assuming 61.3% adults) or 38.9 (assuming 100% adults), ~~11.2, 22~~29.4, 6.4 and 8.5 respectively (**Table 9-33**).

~~258.~~301. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-7**) the number of individuals from the Flamborough and Filey Coast SPA population expected to die is ~~2,936 (27,967~~6,441 (61,345 x 0.105) adults per annum. The predicted annual impacts from DBS East alone on the breeding razorbill population applying highly precautionary rates of 70% displacement and 10% mortality is ~~45.9~~268.1 to ~~60.9~~283.1 birds per annum. These would result in a predicted change in adult mortality rate of ~~1.6~~4.2% to 4.4%. The equivalent mortalities assuming 70% displacement and 2~~.07~~% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) were 53.6 (61.2% adults) or 56.6 (100% adults) per annum respectively which would result in a predicted change in adult mortality rate of 0.83% to 0.88%.

302. As noted above, these displacement rates are highly precautionary and have little support from studies at operational wind farms (paragraph 291). At a more appropriate (operational) displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the ~~seasonal~~ displacement mortalities apportioned to the FFC SPA (~~3.3~~19.1 to ~~4.3~~20.2 annually) would increase the predicted annual mortality by 0.~~11~~30% to 0.~~15~~31% which are below the 1% threshold for detectability and therefore no further assessment was required.

~~259.~~303. Furthermore, the results of the PVA presented in the in-combination assessment (section 9.6.2.5.5) encompass the worst case prediction above (for 70% displaced and 10% mortality) and demonstrate that this would not result in an Adverse Effect on Integrity on the SPA.

~~9.5.2.5.3.2.2~~9.6.2.5.3.2.2 *DBS West in Isolation*

~~260.~~304. The wind farm operation displacement from DBS West apportioned to the SPA in the breeding, autumn, winter and spring seasons were up to 97.9 (assuming 61.3% adults) or 159.6 (assuming 100% adults), ~~11~~239.2, 9.6~~, 3.5~~ and 10.6 respectively (**Table 9-33**).

~~261.~~305. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-7**) the number of individuals from the Flamborough and Filey Coast SPA population expected to die is ~~2,936 (27,967~~6,441 (61,345 x 0.105) adults per annum. The predicted annual impacts from DBS West alone on the breeding razorbill population applying highly precautionary rates of 70% displacement and 10% mortality is ~~123.6~~357.3 to ~~185.3~~419.0 birds per annum. These would result in a predicted change in adult mortality rate of ~~4.2~~5.5% to 6.~~3~~5%. The equivalent mortalities assuming 70% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) were 71.5 (61.2% adults) or 83.8 (100% adults) per annum respectively which would result in a predicted change in adult mortality rate of 1.11% to 1.30%.

306. As noted above, these displacement rates are highly precautionary and have little support from studies at operational wind farms (paragraph 291). At a more appropriate (operational) displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the ~~seasonal~~ displacement mortalities apportioned to the FFC SPA (~~8.9~~25.5 to ~~13.2~~29.9 annually) would increase the predicted annual mortality by 0.~~3~~4% to 0.~~44~~46% which are below the 1% threshold for detectability and therefore no further assessment was required.

~~262.~~307. Furthermore, the results of the PVA presented in the in-combination assessment (section 9.6.2.5.5) encompass the worst case prediction above (for 70% displaced and 10% mortality) and demonstrate that this would not result in an Adverse Effect on Integrity on the SPA.

~~9.5.2.5.3.2.3~~9.6.2.5.3.2.3 DBS East and West Together

~~263.~~308. The wind farm operation displacement from DBS East and DBS West apportioned to the SPA in the breeding, autumn, winter and spring seasons were up to 121.~~3~~7 (assuming 61.3% adults) or ~~197.8~~198.5 (assuming 100% adults), ~~15~~468.6, 16.0~~, 4.1~~ and ~~15.0~~19.1 respectively (**Table 9-33**).

~~264.~~309. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-7**) the number of individuals from the Flamborough and Filey Coast SPA population expected to die is ~~2,936 (27,967~~6,441 (61,345 x 0.105) adults per annum. The predicted annual impacts from DBS East and DBS West on the breeding razorbill population, applying highly precautionary rates of 70% displacement and 10% mortality, is ~~155.5~~625.3 to ~~232.0~~702.1 birds per annum. These would result in a predicted change in adult mortality rate of ~~5.3~~9.7% to ~~7.9~~10.9%. The equivalent mortalities assuming 70% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) were 125.1 (61.2% adults) or 140.4 (100% adults) per annum respectively which would result in a predicted change in adult mortality rate of 1.94% to 2.18%.

310. As noted above, these displacement rates are highly precautionary and have little support from studies at operational wind farms (paragraph 291). At a more appropriate (operational) displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the ~~seasonal~~ displacement mortalities apportioned to the FFC SPA (~~11.2~~44.7 to ~~16.6~~50.2 annually) would increase the predicted annual mortality by 0.~~37~~69% to 0.~~56~~78% which are below the 1% threshold for detectability and therefore no further assessment was required.

~~265.~~311. Furthermore, the results of the PVA presented in the in-combination assessment (section 9.6.2.5.5) encompass the worst case prediction above (for 70% displaced and 10% mortality) and demonstrate that this would not result in an Adverse Effect on Integrity on the SPA.

~~9.5.2.5.4~~9.6.2.5.4 *Summary*

312. A matrix of the annual operational displacement estimates for DBS East and DBS West is provided in Table 9-34.

Table 9-34 Displacement matrix for annual project alone (DBS East plus DBS West) razorbill apportioned to Flamborough and Filey Coast SPA adult population.

Mortality %	**Displacement %**									
	10	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**
1	10	20	30	40	50	60	70	80	90	100
2	20	40	60	80	100	120	140	160	181	201
3	30	60	90	120	150	181	211	241	271	301

Mortality %	Displacement %									
	10	20	30	40	50	60	70	80	90	100
4	40	80	120	160	201	241	281	321	361	401
5	50	100	150	201	251	301	351	401	451	502
6	60	120	181	241	301	361	421	481	542	602
7	70	140	211	281	351	421	491	562	632	702
8	80	160	241	321	401	481	562	642	722	802
9	90	181	271	361	451	542	632	722	812	903
10	100	201	301	401	502	602	702	802	903	1003
20	201	401	602	802	1003	1204	1404	1605	1806	2006
30	301	602	903	1204	1505	1806	2106	2407	2708	3009
50	502	1003	1505	2006	2508	3009	3511	4012	4514	5015
75	752	1505	2257	3009	3761	4514	5266	6018	6771	7523
100	1003	2006	3009	4012	5015	6018	7021	8024	9028	10031

~~266.~~313. A table summarising the razorbill construction and operational disturbance and displacement assessment for DBS East and DBS West together is provided below (**Table 9-35**).

~~267.~~314. It is concluded that predicted razorbill mortality due to construction and operational phase disturbance and displacement impacts at DBS East, DBS West together would **not adversely affect the integrity of the Flamborough and Filey Coast SPA**.

Table 9-35 Summary of predicted razorbill displacement mortality from Flamborough and Filey Coast SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.

Razorbill		**Displacement**		
Potential Effects During Construction: Disturbance and Displacement				
Displacement mortality		Mean (@25% x 1%)	Mean (@35% x ~~10~~2%)	Mean (@~~25~~35% x ~~1~~10%)
Breeding season (63.1% to 100% adults)		5.~~60~~5-9.~~14~~2	13.4-21.9	62.1-101.3
Autumn		~~7.79~~21.6	~~0.78~~51.8	239.2
Winter		0.~~21~~7	1.8	8.1
Spring		0.~~74~~9	2.1	9.8
Annual		28.9-32.4	~~79.5-118~~69.1-77.6	~~7~~319.2-~~10.8~~358.4
Effect	Reference population	~~27,967~~61,345		
	Increase in background mortality (%)	0.~~25~~45-0.~~36~~50	1.07-1.20	4.9-5.6
Potential Effects During Operation: Disturbance and Displacement				
Displacement mortality		Mean (@50% x 1%)	Mean (@70% x ~~10~~2%)	Mean (@~~50~~70% x ~~1~~10%)
Breeding season (63.1% to 100% adults)		8.7-14.~~1~~2	24.3-39.7	121.7-198.5
Autumn		~~15.1~~33.5	~~1.1~~93.7	468.6
Winter		~~4~~1.1	~~0.~~3.2	16.0
Spring		~~15.0~~1.4	3.8	~~1~~19.1
Annual		~~11~~44.7-50.2~~-16.6~~	125.1-140.4	625.3-702.1
Effect	Reference population	~~27,967~~61,345		
	Increase in background mortality (%)	0.~~37~~69-0.~~56~~78	1.94-2.18	9.7-10.9

~~9.5.2.5.5~~9.6.2.5.5 Assessment of potential effects of the Projects in combination with other plans and projects

~~9.5.2.5.5.1~~9.6.2.5.5.1 Potential Effects During Operation: Disturbance and Displacement

~~268.~~315. Seasonal and annual abundance estimates of razorbill, both total values and apportioned to Flamborough and Filey Coast SPA, reported for all OWFs included in the in-combination assessment are presented in **Table 9-36**~~. This information was taken from the DCO Application and Examination for the Dudgeon and Sheringham Extension projects (Royal HaskoningDHV 2022, 2023).~~ .

~~269.~~316. The estimated total number of razorbills at risk of displacement from all OWFs within the UK North Sea BDMPS combined is ~~180,805~~209,286 of which ~~between 9,943 and 11,031~~24,512 are estimated to be breeding adults from Flamborough and Filey Coast SPA (**Table 9-36**~~). Using displacement rates of 30% to 70% and a mortality rate of 1% to 10% for displaced birds, the number of Flamborough and Filey Coast SPA birds predicted to die each year would be between 30 and 772.~~). Of this total, 3,554 are at projects for which compensation has been agreed (Hornsea 4, Dudgeon and Sheringham Extensions). The total suggests that 40% of the FFC SPA razorbill population is apparently present on UK wind farms through the course of the year and at risk of displacement. This highlights the precautionary basis of the methods used to estimate seasonal abundance and apportioning since offshore wind farms make up approximately 6% of the area within 300km of the FFC SPA, 7 times less than the in-combination assessment indicates. Indeed, it is not difficult to envisage that, with the addition of a small number of wind farms the current assessment methods could predict more birds are at risk of displacement than are present in the population.

~~270. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-5**) the number of individuals from the Flamborough and Filey Coast SPA population expected to die is 2,936 (26,967 x 0.105) adults per annum. The predicted annual in-combination mortality on the breeding razorbill population would result in a predicted change in adult mortality rate of between 1.0% and 26%. These are above the 1% threshold below which effects are considered undetectable, therefore Population Viability analysis (PVA) was undertaken to investigate further. The results of the PVA are considered below (paragraph 479).~~

317. The above apparent limitations in the assessment notwithstanding a matrix of displacement impacts is provided in Table 9-37Table 9-29. Using displacement rates of 30% to 70% and mortality rates of 1% to 10% for displaced birds, and either including or excluding (in brackets) the projects for which compensation has been agreed, the number of Flamborough and Filey Coast SPA birds predicted to die each year would be:

- At 50% displaced and 1% mortality: 123 (105)
- At 70% displaced and 2% mortality: 343 (293)

318. These magnitudes of displacement would increase the background mortality rate of the FFC SPA population by:

- At 50% displaced and 1% mortality: 1.9% (1.6%)
- At 70% displaced and 2% mortality: 5.3% (4.5%)

319. The results of PVA to investigate these impacts are considered below (section 9.6.2.5.5).

Table 9-36 Total in-combination razorbill abundance on North Sea and English Channel Wind Farms and apportioned to Flamborough and Filey Coast SPA adult population.

Tier	Wind Farm	Breeding		Autumn		Winter		Spring		Annual	
		Total	FFC	Total	FFC	Total	FFC	Total	FFC	Total	FFC
1	Beatrice	873	0	833	28	555	15	833	28	3094	72
1	Beatrice Demonstrator	n/a									
1	Blyth Demonstration Project	121	0	91	3	61	2	91	3	364	8
1	Dudgeon	256	0	346	12	745	20	346	12	1693	44
1	East Anglia ONE	16	0	26	1	155	4	336	11	533	17
1	European Offshore Wind Deployment Centre	161	0	64	2	7	0	26	1	258	3
1	Galloper	44	0	43	2	106	3	394	13	587	18
1	Greater Gabbard	0	0	0	0	387	11	84	3	471	13
1	Gunfleet Sands	0	0	0	0	30	1	0	0	30	1
1	Hornsea Project One	1109	535	4812	164	1518	41	1803	61	9242	800
1	Humber Gateway	27	0	20	1	13	0	20	1	80	2
1	Hywind	30	0	719	24	10	0	-	-	759	25
1	Kentish Flats & Kentish Flats Extension	n/a									
1	Kincardine	22	0		0		0			22	0
1	Lincs & LID	45	0	34	1	22	1	34	1	134	3
1	London Array	14	0	20	1	14	0	20	1	68	2
1	Race Bank	28	0	42	1	28	1	42	1	140	4
1	Rampion	630	0	66	2	1244	34	3327	113	5267	149
1	Scroby Sands	n/a									
1	Sheringham Shoal	106	0	1343	46	211	6	30	1	1690	52
1	Teesside	16	0	61	2	2	0	20	1	99	3
1	Thanet	3	0	0	0	14	0	21	1	37	1
1	Westermost Rough	91	91	121	4	152	4	91	3	455	102
2	Triton Knoll	40	0	254	9	855	23	117	4	1265	36
3	Dogger Bank Creyke Beck Projects A	1250	375	1576	54	1728	47	4149	141	8703	616
3	Dogger Bank Creyke Beck Projects B	1538	461	2097	71	2143	58	5119	174	10897	765

Tier	Wind Farm	Breeding		Autumn		Winter		Spring		Annual	
		Total	FFC	Total	FFC	Total	FFC	Total	FFC	Total	FFC
3	Dogger Bank Teesside Projects A	834	250	310	11	959	26	1919	65	4022	352
3	Dogger Bank Teesside Projects B	1153	346	592	20	1426	39	2953	100	6125	505
3	East Anglia THREE	1807	0	1122	38	1499	41	1524	52	5952	130
3	Firth of Forth Alpha	5876	0	-	-	1103	30	-	-	6979	30
3	Firth of Forth Bravo	3698	0	-	-	1272	34	-	-	4970	34
3	Hornsea Project Three	630	0	2020	69	3649	99	2105	72	8404	240
1	Hornsea Project Two	2511	1,210	4221	144	720	19	1668	57	9119	1,430
3	Inch Cape	1436	0	2870	98	651	18	-	-	4957	115
3	Methil	4	0	0	0	0	0	0	0	4	0
3	Moray Firth (EDA)	2423	0	1103	38	30	1	168	6	3724	44
3	Moray West	2808	0	3544	121	184	5	3585	122	10121	247
3	Neart na Gaoithe	331	0	5492	187	508	14	-	-	6331	200
3	Norfolk Boreas	630	0	263	9	1065	29	345	12	2303	49
3	Norfolk Vanguard	879	0	866	30	839	23	924	31	3508	84
3	East Anglia ONE North	403	0	85	3	54	2	207	7	749	11
3	East Anglia TWO	281	0	44.1	2	136.4	4	230	8	692	13
3	Hornsea Project Four	~~-~~386	386	~~-~~4311	~~146~~2845	~~-~~455	12	~~-~~449	15	~~-~~5601	~~559~~3258 / 0*
4	DEP	923	64	3741	127	845	23	320	11	5829	225 / 0*
4	SEP	316	22	759	26	686	19	144	5	1905	71 / 0*
4	Rampion 2	n/a	0	26	1	1193	1	6303	72.0	7522	73.0
4	Berwick Bank	4040	0	8849	300.87	1399	13.99	7480	254.32	21768	569.2
4	North Falls (ES)	104	0	248	8	1781	48	1741	59	3874	115
4	Five Estuaries (ES)	90	0	284	9.6	1046	9.6	756	25.6	2176	45
4	Outer Dowsing (ES)	3596	3596	2390	81	1956	18	5537	210	13479	3905
Total without DBS		**~~37403~~41193**	**~~3740~~7336**	**~~48475~~55708**	**~~1798.9~~4596**	**~~28218~~33456**	**~~723.9~~799.6**	**~~46778~~55261**	**~~1463.3~~1758**	**~~160872~~186002**	**~~7717.2~~14481 / 10927***

Tier	Wind Farm	Breeding		Autumn		Winter		Spring		Annual	
		Total	FFC	Total	FFC	Total	FFC	Total	FFC	Total	FFC
5	DBS East (100% adults in BS)	555	~~340.3~~555.1	4685~~.3~~	~~159.3~~3276	~~3376.7~~3377	~~33.8~~91.2	3579	121.7	12196	~~655~~4044
5	DBS West (100% adults in BS)	2281	~~1398.0~~2281	~~4886.9~~4887	~~166.2~~3417	5066~~.2~~	~~50.6~~136.8	4455	151.5	~~12581~~16689	~~1766.3~~5986
~~5a~~	~~DBS East+West (61.3% adults)~~	~~2826~~	~~1738~~	~~6350~~	~~216~~	~~5823.7~~	~~58~~	~~6303~~	~~214~~	~~19933~~	~~2226~~
~~5b~~5	DBS East~~-~~+West (100% adults in BS)	2836	~~2826~~2836	9572	6693	8443	228	8034	273.2	28885	~~3314~~10031
~~5a~~ Total (all projects)		**~~40229~~44029**	**~~547~~10172**	**~~54825~~60969**	**~~2015~~11290**	**~~32674~~41444**	**~~769~~1028**	**~~53081~~62846**	**~~1678~~2031**	**~~180805~~209286**	**~~994~~24512 / 20958***
~~5a Total (all projects)~~			**~~6566~~**								**~~11031~~**

** Note projects for which compensation is agreed are marked in the annual FFC total '*' and an alternative total omitting these is provided*

*** Hornsea 4 and Dogger Bank South nonbreeding values are summed post-breeding and non-breeding figures*

Table 9-37 Displacement matrix for in-combination razorbill apportioned to Flamborough and Filey Coast SPA adult population. Total impact includes projects for which compensation has been agreed.

Mortality %	**Displacement %**									
	10	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**
1	25	49	74	98	123	147	172	196	221	245
2	49	98	147	196	245	294	343	392	441	490
3	74	147	221	294	368	441	515	588	662	735
4	98	196	294	392	490	588	686	784	882	980
5	123	245	368	490	613	735	858	980	1103	1226
6	147	294	441	588	735	882	1030	1177	1324	1471
7	172	343	515	686	858	1030	1201	1373	1544	1716
8	196	392	588	784	980	1177	1373	1569	1765	1961
9	221	441	662	882	1103	1324	1544	1765	1985	2206
10	245	490	735	980	1226	1471	1716	1961	2206	2451
20	490	980	1471	1961	2451	2941	3432	3922	4412	4902
30	735	1471	2206	2941	3677	4412	5148	5883	6618	7354
50	1226	2451	3677	4902	6128	7354	8579	9805	11030	12256
75	1838	3677	5515	7354	9192	11030	12869	14707	16546	18384
100	2451	4902	7354	9805	12256	14707	17158	19610	22061	24512

~~9.5.2.5.5.2~~9.6.2.5.5.2 *Population Viability Analysis Results for razorbill*

~~271.~~320. The Natural England commissioned PVA tool was used to examine the effect of the estimated in-combination mortality on the Flamborough and Filey Coast SPA population. The complete input parameters and settings and results are provided in Annex A: SPA PVA Results. The counterfactuals of growth rate (CGR) and population size (CPS) are presented in Annex A: SPA PVA Results.

Table 9-38 PVA results for in-combination impacts on FFC SPA razorbill after 30 years.

PVA run scenario	Annual mortality	Decrease in adult survival rate	Mean CGR (95% c.i.)	Mean CPS (95% c.i.)
~~In-combination~~Project alone displacement ~~lower (30~~(50% x 1%; 61.3% adults ~~from DBS~~ in ~~the~~ breeding season)	~~30~~44.7	0.~~00097806~~000728	0.~~9993~~9995 (0.~~9982~~9999- 1.~~0003~~)	0.~~9773~~985 (0.~~9458~~9693- 1.~~0103~~0007)
~~In-combination~~Project alone displacement ~~lower (30~~(50% x 1%; 100% adults ~~from DBS~~ in ~~the~~ breeding season)	~~33~~50.2	0.~~00107586~~00082	0.~~9992~~9994 (0.~~9982-~~ ~~1.0002~~9989-0.9999)	0.~~9753~~9831 (0.~~9442-~~ ~~1.0082~~9673-0.999)
~~In-combination~~Project alone displacement ~~Evidence based~~ ~~(50~~(70% x ~~1~~2%; 61.3% adults ~~from DBS~~ in ~~the~~ breeding season)	~~50~~125.1	0.~~00163010~~00204	0.~~9988~~9986 (0.~~9978~~9981- 0.~~9998~~9991)	0.~~9627~~9585 (0.~~9315~~9433- 0.~~9957~~974)
~~In-combination~~Project alone displacement ~~lower (50~~(70% x ~~1~~2%; 100% adults ~~from DBS~~ in ~~the~~ breeding season)	~~55~~140.4	0.~~00179311~~00229	0.~~9986~~9985 (0.~~9976~~9998- 0.~~9997~~999)	0.~~9591~~9535 (0.~~9273~~9379- 0.~~9924~~9687)

PVA run scenario	Annual mortality	Decrease in adult survival rate	Mean CGR (95% c.i.)	Mean CPS (95% c.i.)
In-combination displacement (50% x 1%; exc. agreed compensation)	105	0.00171	0.9989 (0.9984-0.9993)	0.965 (0.9495-0.9806)
In-combination displacement (50% x 1%; inc. agreed compensation)	123	0.00200	0.9987 (0.9982-0.9992)	0.9592 (0.9434-0.9749)
In-combination displacement ~~upper~~ (70% x ~~10%; 61.3% adults from DBS in the breeding season~~2%; exc. agreed compensation)	~~695~~293	0.~~02265836~~00477	0.~~9831~~9968 (0.~~9818~~9963-0.~~9843~~9973)	0.~~5900~~9056 (0.~~5666~~8905-0.~~6137~~9204)
In-combination displacement ~~lower~~ (70% x ~~10%; 100% adults from DBS in the breeding season~~2%; inc. agreed compensation)	~~772~~343	0.~~02513687~~00559	0.~~9813~~9963 (0.~~9800~~9958-0.~~9825~~9968)	0.~~5563~~8906 (0.~~5342~~8763-0.~~5784~~905)

321. After a period of 30 years, ~~worst case~~assuming all birds on the Array areas were adults in~~-combination~~ the breeding season, the project alone displacement at 50% x 1% reduced the population growth rate by up to ~~1.9% (~~0.~~9813~~06% (0.9994) and reduced the population size ~~relative~~compared to the baseline size by up to ~~44.4% (0.5563). At the evidence based rates of 50% and~~ 1~~%, the CPGR and CPS were~~.7% (0.9831), while at 70% x 2% the population growth rate would be reduced by up to 0.15% (0.9985) and the population size compared to the baseline size would be reduced by up to 4.65% (0.9535).

~~272.~~322. After a period of 30 years, in-combination displacement at 50% x 1% ~~(0.9986~~and including projects for which compensation has been agreed reduced the population growth rate by up to 0.23% (0.9987) and reduced the population size compared to the baseline size by up to 4.1% (0.~~9591) respectively.~~ 9592), while at the same rates but excluding projects for which compensation has been agreed reduced the population growth rate by up to 0.21% (0.9989) and reduced the population size compared to the baseline size by up to 3.5% (0.9650).

323. After a period of 30 years, in-combination displacement at 70% x 2% and including projects for which compensation has been agreed reduced the population growth rate by up to 0.37% (0.9963) and reduced the population size compared to the baseline size by up to 10.9% (0.8906), while at the same rates but excluding projects for which compensation has been agreed reduced the population growth rate by up to 0.32% (0.9968) and reduced the population size compared to the baseline size by up to 9.4% (0.9056).

~~273.~~324. The choice of which counterfactual measure is more appropriate for understanding the potential population consequences of increased mortality is dependent on the model formulation, specifically whether or not the model incorporates realistic density dependent regulation. Natural England advise that PVA for seabird impact assessment should not include density dependence (on the basis that there is insufficient data to parameterise this for specific impacted populations). Density independent population predictions made under this assumption lack the natural feedback mechanisms that prevent natural populations growing indefinitely at an exponential rate. The implication of this for the current PVA is that the baseline population projections (no impact) and the impacted ones will diverge at an increasing rate as the simulated period increases. Therefore, the CPS figures are very sensitive to the duration of the simulation.

~~274.~~325. The CPGR for a density independent model is a more consistent measure of population health, since it is much less sensitive to the duration considered. For example the CPS after 10 years was 0.~~8050 (20~~9578 (4.2%) which increased to 0.~~5563 (44.4~~8905 (10.9%) after 30 years, while the CPGR after 10 years, 0.~~9805 (2~~9961 (0.39%) was almost exactly the same 0.~~9813 (1.9~~9963 (0.37%) as that after 30 years. Thus the interpretation of the CPS depends on the timespan, while interpretation of the CPGR is largely insensitive to this aspect.

~~275.~~326. The CPGR also lends itself to consideration against the recent observed trend in the growth rate of the population. For example, the razorbill population at Flamborough and Filey Coast SPA has grown at an average rate of 8% per year since 2000. Although there were reports of elevated razorbill mortality in 2022, attributed to the presence of HPAI, subsequent monitoring has not reported any apparent population scale effects (Butcher *et al*. 2024). The maximum CPGR was ~~2.~~0.37% which if realised would only reduce the annual growth rate to 7.6%. Thus, the population would continue to grow at a healthy rate even if the worst case in-combination mortality occurred.

~~276.~~327. Furthermore, there are several additive precautionary assumptions ~~baked~~included into the estimated impacts, as discussed above in relation to gannet (paragraph 163). It is also of note that in the Hornsea 4 HRA (DESNZ, 2023) the Secretary of State considered displacement and mortality rates of 70% and 2% were appropriate for this SPA feature. This gave an in-combination mortality of 142.7 and a predicted reduction in the growth rate of 0.44% which was not considered likely to result in an AEoI. ~~With the addition of subsequent projects, including DBS East and West, the in-combination total estimated using this approach would rise to 154, which would result in a very similar change in growth rate and therefore the same conclusion as reached for Hornsea 4 is anticipated.~~

~~277.~~328. Therefore, in conclusion, the displacement impacts predicted for razorbill at DBS East and DBS West in-combination with other projects, will **not adversely affect the integrity of the Flamborough and Filey Coast SPA**.

~~278.~~ Recognising that in-combination displacement may lead the Secretary of State to conclude AEoI for the Flamborough and Filey Coast SPA, the Applicants have therefore proposed compensation measures for razorbill on a without prejudice basis. Further details on the proposed compensation measures are provided in the accompanying **Volume 6, Appendix 2 Guillemot and Razorbill Compensation Plan (application ref: 6.2.2).**

~~9.6~~9.7 Coquet Island SPA

~~9.6.1~~9.7.1 Site Description

~~280.~~330. Coquet Island is located 1km off the coast of Northumberland. It is a small, flat-topped island with a plateau extent of approximately seven hectares. The island consists of sandy soil and peat over a soft sandstone base. Low cliffs of up to 3.7m high result from earlier quarrying. Surrounding the island is a rocky upper shore and intertidal. There is a sandy beach on the southwest of the island and the southeast corner is shingle and rock.

~~9.6.1.1~~9.7.1.1 Qualifying Features

~~281.~~331. Puffin, a named component of the breeding seabird assemblage for Coquet Island SPA is screened into the assessment Table 4-7 of **RIAA HRA Part 1 of 4 – Introduction and Terrestrial Ecology (application ref: 6.1)**.

~~9.6.1.2~~9.7.1.2 Conservation Objectives

~~282.~~332. The SPA's over-arching conservation objectives are to ensure that, subject to natural change, the integrity of the site is maintained or restored as appropriate, and that the site contributes to achieving the aims of the Wild Birds Directive, by maintaining or restoring:

- The extent and distribution of the habitats of the qualifying features;
- The structure and function of the habitats of the qualifying features;
- The supporting processes on which the habitats of the qualifying features rely;
- The populations of each of the qualifying features; and
- The distribution of qualifying features within the site.

~~9.6.2~~9.7.2 Assessment: Array Areas

~~9.6.2.1~~9.7.2.1 Puffin

~~283.~~333. Puffin has been screened into the assessment to assess the impacts from disturbance / displacement in the construction and operation phase.

~~9.6.2.1.1~~9.7.2.1.1 Status

~~284.~~334. Puffin is listed as a named component of the breeding seabird assemblage of the Coquet Island SPA.

~~285.~~335. The SPA breeding population at classification was cited as 31,686 breeding adults, for the period 2010 to 2014 (Natural England, 2017a). The most recent count is 25,029 apparently occupied burrows, or 50,058 breeding adults in 2019 (JNCC, 2023b). The baseline mortality of this population is 4,705 breeding adult birds per year based on the published adult mortality rate of 9.4% (Horswill and Robinson, 2015).

~~9.6.2.1.2~~9.7.2.1.2 Connectivity to the Projects

~~286.~~336. DBS East and DBS West are 230km and 196km respectively from the Coquet Island SPA. The mean maximum foraging range of puffin is 265.4km (137.1km +128.3km, Woodward *et al.*, 2019). Therefore, DBS East and DBS West are both within potential foraging range for breeding puffin from the Coquet Island SPA. The estimated proportion of the puffins recorded at the Projects during the breeding season that could be breeding adult birds from the Coquet Island SPA (based on the most recent count of 50,058 breeding adults) is calculated as ~~29.5~~35% (**Table 9-9**).

~~287.~~337. Outside the breeding season, breeding puffins from the SPA are assumed to range widely and to mix with puffins from breeding colonies in the UK and further afield. The relevant non-breeding season reference population is the UK North Sea and Channel BDMPS, consisting of 231,957 individuals (mid-August to March) (Furness, 2015). It is estimated that 5.3% of birds present at the Projects are breeding adults from the Coquet Island SPA, and impacts are apportioned accordingly. Note, this percentage has been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

~~9.6.2.1.3~~9.7.2.1.3 Assessment of Potential Effects of the Projects alone and Together

~~288.~~338. The seasonal peak total number of puffins recorded in DBS East and DBS West and the number apportioned to the Flamborough and Filey Coast SPA is provided in **Table 9-31.**

~~289.~~339. Construction displacement has been estimated on the basis this operates across half the wind farm. Thus, puffin displacement was calculated using upper and lower displacement rate values of 15% and 35% (i.e. half the operational values) and 1% to 10% mortality. In addition, evidence based rates of 25% (half the operational rate of 50%) and 1% have also been assessed. These were then added to the number of birds expected to be displaced by up to three construction vessels (assuming 100% displacement within 2km of each vessel and 1% mortality), calculated from the seasonal densities (**Table 9-31**).

Table 9-39 Summary of puffin density and abundance estimates and SPA apportioning rates and used in the operation and construction displacement assessment for Coquet SPA. Note that displacement from the wind farm has been estimated as 15%-35%, half the operational rates.

Site	Season	Peak no.	SPA %	Adult %	No. apportioned to SPA	Wind farm operation displacement mortality to SPA			Wind farm construction displacement mortality to SPA			Peak density (birds / km²)	Total vessel displacement mortality (2km around 3 vessels, 1% mortality)	Vessel mortality to SPA	Total construction displacement mortality to SPA		
						30-1	50-1	70-10	15-1	25 - 1	35-10				15-1 & vessel	25 – 1 & vessel	35-10 & vessel
DBS East	Breeding	62.6	~~29.5~~35	54.3	~~10.0~~11.9	0.~~03~~04	0.~~05~~06	0.~~70~~83	0.02	0.03	0.~~35~~42	0.12	0.05	0.~~007~~01	0.~~02~~03	0.~~03~~04	0.~~36~~42
				100	~~18.5~~21.9	0.~~06~~07	0.~~09~~11	1.~~29~~53	0.03	0.05	0.~~65~~77			0.~~01~~02	0.~~04~~05	0.~~06~~07	0.~~66~~78
	Nonbreeding	178.7	5.3	100	9.5	0.03	0.05	0.66	0.01	0.02	0.33	0.35	0.13	0.01	0.02	0.03	0.34
	Annual (54.3% adults)				~~19.5~~21.4	0.~~1~~06	0.~~1~~11	1.~~4~~5	0.~~0~~03	0.~~0~~05	0.~~7~~75		0.18	0.~~01~~02	0.~~04~~05	0.~~06~~07	0.~~70~~76
	Annual (100% adults)				~~27.9~~31.4	0.~~1~~09	0.~~1~~16	2.~~0~~2	0.~~0~~05	0.~~1~~08	1.~~0~~10			0.02	0.~~06~~07	0.~~09~~10	1.~~00~~12
DBS West	Breeding	109.3	~~29.5~~35	54.3	~~17.5~~20.8	0.~~05~~06	0.~~09~~10	1.~~23~~45	0.03	0.~~04~~05	0.~~61~~73	0.21	0.08	0.~~01~~02	0.~~04~~05	0.~~06~~07	0.~~63~~74
				100	~~32.2~~38.3	0.~~10~~11	0.~~16~~19	2.~~26~~68	0.~~05~~06	0.~~08~~10	1.~~13~~34			0.~~02~~03	0.~~07~~09	0.~~10~~12	1.~~15~~37
	Nonbreeding	198.2	5.3	100	10.5	0.03	0.05	0.74	0.02	0.03	0.37	0.38	0.14	0.01	0.02	0.03	0.38
	Annual (54.3% adults)				~~28.0~~31.3	0.~~1~~09	0.~~1~~16	2.~~0~~2	0.~~0~~05	0.~~1~~08	1.~~0~~09		0.22	0.02	0.~~06~~07	0.~~09~~10	1.~~00~~12
	Annual (100% adults)				~~42.7~~48.8	0.~~1~~15	0.~~2~~24	3.~~0~~4	0.~~1~~07	0.~~1~~12	1.~~5~~71			0.~~03~~04	0.~~10~~11	0.~~14~~16	1.~~53~~74
DBS East + DBS West	Breeding	~~146.6~~171.9	~~29.5~~35	54.3	~~23.5~~32.7	0.~~07~~10	0.~~12~~16	~~1.64~~2.29	0.~~04~~05	0.~~06~~08	~~0.82~~1.14	-	0.12	0.02	0.~~06~~07	0.~~08~~11	~~0.84~~1.17
				100	~~43~~60.2	0.~~13~~18	0.~~22~~30	~~3.03~~4.21	0.~~06~~09	0.~~11~~15	~~1.51~~2.11			0.04	0.~~10~~13	0.~~14~~19	~~1.55~~2.15
	Nonbreeding	~~372.7~~376.9	5.3	100	~~19.8~~20.0	0.06	0.10	1.~~38~~40	0.03	0.05	0.~~69~~70	-	0.28	0.01	0.04	0.06	0.71
	Annual (54.3% adults)				~~43.2~~52.6	0.~~1~~16	0.~~2~~26	3.~~0~~69	0.~~1~~08	0.~~1~~13	1.~~5~~84		0.40	0.~~03~~04	0.~~10~~12	0.~~14~~17	1.~~55~~88
	Annual (100% adults)				~~63.0~~80.1	0.~~2~~24	0.~~3~~40	~~4.4~~5.61	0.~~1~~12	0.~~2~~20	2.~~2~~80			0.~~05~~06	0.~~15~~18	0.~~21~~26	2.~~26~~86

~~9.6.2.1.3.1~~9.7.2.1.3.1 *Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines*

~~9.6.2.1.3.1.1~~9.7.2.1.3.1.1 *DBS East in Isolation*

~~290.~~340. The wind farm construction displacement from DBS East in the breeding and nonbreeding seasons were 0.~~35~~42 (assuming 54.3% adults) or 0.~~65~~77 (assuming 100% adults) and 0.33 respectively (**Table 9-39**). Displacement mortalities due to construction vessels were 0.~~007~~01 (at 54.3% adults) or 0.~~01~~02 (at 100% adults) and 0.~~001~~01 in each season respectively. Thus, the maximum total combined seasonal construction displacement mortalities apportioned to the SPA were 0.~~36~~42 (54,3% adults) or 0.~~66~~78 (100% adults) and 0.34 birds during the breeding and nonbreeding seasons.

~~291.~~341. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-7**) the number of individuals from the Coquet SPA population expected to die is 4,705 (50,058 x 0.094) adults per annum. The predicted annual (breeding and non-breeding periods combined) impacts from DBS East alone on the breeding puffin population is 0.~~7~~76 to 1.~~0~~12 birds per annum. These result in a predicted change in adult mortality rate of 0.01% to 0.02% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.6.2.1.3.1.2~~9.7.2.1.3.1.2 *DBS West in Isolation*

~~292.~~342. The wind farm construction displacement from DBS West in the breeding and nonbreeding seasons were 0.~~61~~73 (assuming 54.3% adults) or 1.~~13~~34 (assuming 100% adults) and 0.37 respectively (**Table 9-39**). Displacement mortalities due to construction vessels were 0.~~01~~02 (at 54.3% adults) or 0.~~02~~03 (at 100% adults) and 0.01 in each season respectively. Thus, the maximum total combined seasonal construction displacement mortalities apportioned to the SPA were 0.~~63~~74 (54,3% adults) or 1.~~15~~37 (100% adults) and 0.~~34~~38 birds during the breeding and nonbreeding seasons.

~~293.~~343. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-7**) the number of individuals from the Coquet SPA population expected to die is 4,705 (50,058 x 0.094) adults per annum. The predicted annual (breeding and non-breeding periods combined) impacts from DBS East alone on the breeding puffin population is 1.~~0~~12 to 1.~~5~~74 birds per annum. These result in a predicted change in adult mortality rate of 0.02% to 0.03% which ~~is~~are below the 1% threshold for detectability and therefore no further assessment was required.

~~9.6.2.1.3.1.3~~9.7.2.1.3.1.3 *DBS East and West Together*

~~294.~~344. The wind farm construction displacement from DBS East and DBS West combined in the breeding and nonbreeding seasons were ~~0.82~~1.14 (assuming 54.3% adults) or ~~1.51~~2.11 (assuming 100% adults) and 0.~~69~~70 respectively (**Table 9-39**). Displacement mortalities due to construction vessels were 0.02 (at 54.3% adults) or 0.04 (at 100% adults) and 0.01 in each season respectively. Thus, the maximum total combined seasonal construction displacement mortalities apportioned to the SPA were ~~0.84~~1.17 (54.3% adults) or ~~1.55~~2.15 (100% adults) and 0.71 birds during the breeding and nonbreeding seasons.

~~295.~~345. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-7**) the number of individuals from the Coquet SPA population expected to die is 4,705 (50,058 x 0.094) adults per annum. The predicted annual (breeding and non-breeding periods combined) impacts from DBS East alone on the breeding puffin population is 1.~~55~~88 to 2.~~26~~86 birds per annum. These result in a predicted change in adult mortality rate of 0.~~03~~04% to 0.~~04~~06% which ~~is~~are below the 1% threshold for detectability and therefore no further assessment was required.

~~9.6.2.1.3.2~~9.7.2.1.3.2 *Potential Effects During Operation: Disturbance and Displacement*

~~9.6.2.1.3.2.1~~9.7.2.1.3.2.1 *DBS East in Isolation*

~~296.~~346. The wind farm operation displacement from DBS East apportioned to the SPA in the breeding and nonbreeding seasons were up to 0.~~7~~83 (assuming 54.3% adults) or 1.~~3~~53 (assuming 100% adults) and 0.66, respectively (**Table 9-39**).

~~297.~~347. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-7**) the number of individuals from the Coquet SPA population expected to die is 4,705 (50,058 x 0.094) adults per annum. The predicted annual (breeding and non-breeding periods combined) impacts from DBS East alone on the breeding puffin population is 1.~~4~~5 to 2.~~0~~2 birds per annum. These result in a predicted change in adult mortality rate of 0.03% to 0.~~04~~05% which are below the 1% threshold for detectability and therefore no further assessment was required.

~~9.6.2.1.3.2.2~~9.7.2.1.3.2.2 *DBS West in Isolation*

~~298.~~348. The wind farm operation displacement from DBS West apportioned to the SPA in the breeding and nonbreeding seasons were up to 1.~~23~~45 (assuming 54.3% adults) or 2.~~26~~68 (assuming 100% adults) and 0.74, respectively (**Table 9-39**).

~~299.~~349. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-7**) the number of individuals from the Coquet SPA population expected to die is 4,705 (50,058 x 0.094) adults per annum. The predicted annual (breeding and non-breeding periods combined) impacts from DBS East alone on the breeding puffin population is 2.~~0~~2 to 3.~~0~~4 birds per annum. These result in a predicted change in adult mortality rate of 0.~~04~~05% to 0.~~06~~07% which are below the 1% threshold for detectability and therefore no further assessment was required.

~~9.6.2.1.3.2.3~~9.7.2.1.3.2.3 DBS East and West Together

~~300.~~350. The wind farm operation displacement from DBS East and DBS West combined apportioned to the SPA in the breeding and nonbreeding seasons were up to ~~1.64~~2.29 (assuming 54.3% adults) or ~~3.0~~4.21 (assuming 100% adults) and 1.4, respectively (**Table 9-39**).

~~301.~~351. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-7**) the number of individuals from the Coquet SPA population expected to die is 4,705 (50,058 x 0.094) adults per annum. The predicted annual (breeding and non-breeding periods combined) impacts from DBS East and DBS West alone on the breeding puffin population is 3.~~0~~69 to ~~4.4~~5.61 birds per annum. These result in a predicted change in adult mortality rate of 0.~~06~~08% to 0.~~09~~12% which are below the 1% threshold for detectability and therefore no further assessment was required.

~~9.6.2.1.4~~9.7.2.1.4 Summary

~~302.~~352. A table summarising the puffin construction and operational disturbance and displacement assessment for DBS East and DBS West together is provided below (**Table 9-40**).

~~303.~~353. It is concluded that predicted puffin mortality due to construction and operational phase disturbance and displacement impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the Coquet Island SPA**.

Table 9-40 Summary of predicted puffin displacement mortality from Coquet Island SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.

Puffin	**Displacement**	
Potential Effects During Construction: Disturbance and Displacement		
Displacement mortality	Mean (@35% x 10%)	Mean (@25% x 1%)
Breeding season (54.3% - 100% adults)	~~0.84-~~1.~~55~~17-2.15	0.~~08~~11-0.~~14~~19
Nonbreeding season	0.71	0.06
Annual	1.~~55~~88-2.~~26~~86	0.~~14~~17-0.~~21~~26

Puffin		Displacement	
Effect	Reference population	50,058	
	Increase in background mortality (%)	0.~~03~~04-0.~~05~~06	0.003-0.~~004~~005
Potential Effects During Operation: Disturbance and Displacement			
Displacement mortality		Mean (@70% x 10%)	Mean (@50% x 1%)
Breeding season (54.3% - 100% adults)		~~1.64-3.03~~2.29-4.21	0.~~12~~16-0.~~22~~30
Nonbreeding season		1.~~39~~40	0.~~1~~10
Annual		3.~~03-4.4~~69-5.61	0.~~22~~26-0.~~3~~40
Effect	Reference population	50,058	
	Increase in background mortality (%)	0.~~06~~08-0.~~09~~12	0.005-0.~~006~~008

~~9.6.2.1.5~~9.7.2.1.5 Assessment of potential effects of the Projects in combination with other plans and projects

~~304.~~354. Given that no measurable increase in the Coquet Island SPA puffin mortality is predicted as a result of DBS East and DBS West combined (e.g. with total displacement mortality of only ~~3~~5.6 birds per year during operation even under the most precautionary assumptions), it is concluded that the projects would not contribute to in-combination effects on this species. therefore, it is concluded that predicted puffin mortality due to construction and operational phase disturbance and displacement impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Coquet Island SPA**.

~~9.7~~9.8 Farne Islands SPA

~~9.7.1~~9.8.1 Site Description

~~305.~~355. The Farne Islands are a group of low-lying islands situated between 2km and 6km off the coast of Northumberland in northeast England. The islands are important nesting areas for a range of seabirds, especially terns, gulls and auks. Seabirds breeding at the SPA feed outside it in nearby waters, as well as more distantly in the North Sea.

~~9.7.1.1~~9.8.1.1 Qualifying Features

~~306.~~356. The qualifying features of the Farne Islands SPA screened into the Assessment are listed in Table 4-7 of of **RIAA HRA Part 1 of 4 – Introduction and Terrestrial Ecology (application ref: 6.1).** These are breeding guillemot and two named components of the breeding seabird assemblage, kittiwake and puffin.

~~9.7.1.2~~9.8.1.2 Conservation Objectives

~~307.~~357. The SPA's over-arching conservation objectives are to ensure that, subject to natural change, the integrity of the site is maintained or restored as appropriate, and that the site contributes to achieving the aims of the Wild Birds Directive, by maintaining or restoring:

- The extent and distribution of the habitats of the qualifying features;
- The structure and function of the habitats of the qualifying features;
- The supporting processes on which the habitats of the qualifying features rely;
- The populations of each of the qualifying features; and
- The distribution of qualifying features within the site.

~~9.7.2~~9.8.2 Assessment: Array Areas

~~9.7.2.1~~9.8.2.1 Kittiwake

~~308.~~358. Kittiwake has been screened in to assess the impacts from collision risk in the operation phase.

~~9.7.2.1.1~~9.8.2.1.1 Status

~~309.~~359. Kittiwake is listed as a named component of the breeding seabird assemblage of the Farne Islands SPA.

~~310.~~360. The SPA breeding population at classification was cited as 8,241 pairs or 16,482 breeding adults, for the period 2010 to 2014 (Natural England, 2017b). The most recent count is 4,402 apparently occupied nests, or 8,804 breeding adults in 2019 (JNCC, 2023a). The baseline mortality of this population is 1,285 breeding adult birds per year based on the published adult mortality rate of 14.6% (Horswill and Robinson, 2015).

~~311.~~361. Supplementary advice on the conservation objectives were added for named components of the breeding seabird assemblage of the Farne Islands SPA in 2023 (Natural England, 2023). For kittiwake, these are:

- Maintain the overall abundance of the assemblage at a level which is above 163,819 whilst avoiding deterioration from its current level as indicated by the latest peak mean count or equivalent;

- Maintain the species diversity of the bird assemblage;
- Reduce the frequency, duration and / or intensity of disturbance affecting roosting, nesting, foraging, feeding, moulting and/or loafing birds so that they are not significantly disturbed;
- Reduce predation and disturbance caused by native and non-native predators;
- Maintain concentrations and deposition of air pollutants at below the site-relevant Critical Load or Level values given for this feature of the site on the Air Pollution Information System;
- Maintain the structure, function and supporting processes associated with the feature and its supporting habitat through management or other measures (whether within and/or outside the site boundary as appropriate) and ensure these measures are not being undermined or compromised;
- Maintain the extent, distribution and availability of suitable habitat (either within or outside the site boundary) which supports the feature for all necessary stages of its breeding cycle (courtship, nesting, feeding).
- Maintain the structure, function and availability of the following habitats which support the assemblage feature for all stages (breeding, moulting, roosting, loafing, feeding) of the breeding period;
- Reduce aqueous contaminants to levels equating to High Status according to Annex VIII and Good Status according to Annex X of the Water Framework Directive, avoiding deterioration from existing levels;
- Maintain the dissolved oxygen (DO) concentration at levels equating to High Ecological Status (specifically ≥ 5.7 mg L-1 (at 35 salinity) for 95 % of year) avoiding deterioration from existing levels;
- Maintain water quality and specifically mean winter dissolved inorganic nitrogen (DIN) at a concentration equating to High Ecological Status (specifically mean winter DIN is < 12 μM for coastal waters), avoiding deterioration from existing levels; and
- Maintain natural levels of turbidity (e.g. concentrations of suspended sediment, plankton and other material) across the habitat.

~~9.7.2.1.2~~9.8.2.1.2 *Connectivity to the Projects*

~~312.~~362. DBS East and DBS West are 247km and 213km respectively from the Farne Islands SPA. The mean maximum foraging range of kittiwake is 300.6km (156.1km + 144.5km, Woodward *et al*., 2019). Therefore, DBS East and DBS West are both within potential foraging range for breeding kittiwake from the Farne Islands SPA. The estimated proportion of the kittiwakes recorded at the Projects during the breeding season that could be breeding adult birds from the Farne Islands SPA (based on the most recent count of 8,804 breeding adults) is calculated as 2.5% (**Table 9-8**).

~~313.~~363. Outside the breeding season breeding kittiwakes, including those from the Farne Islands SPA, are not constrained by requirements to visit nests to incubate eggs or provision chicks. At this time, they are assumed to range more widely and to mix with kittiwakes of all age classes from breeding colonies in the UK and further afield. The background population during these seasons is the UK North Sea BDMPS. This consists of 829,937 individuals during the autumn migration season (August to December), and 627,816 individuals during the spring migration season (January to April) (Furness, 2015).

~~314.~~364. During the autumn migration and spring migration seasons, 60% of the Farne Islands SPA breeding adults are assumed to be present in the BDMPS. It is estimated that 0.5% and 0.7% of birds respectively present in the Project Array Areas are considered to be breeding adults from the Farne Islands SPA. Note, these percentages have been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

~~9.7.2.1.3~~9.8.2.1.3 *Assessment of Potential Effects of the Projects alone and Together*

~~9.7.2.1.3.1~~9.8.2.1.3.1 *Potential Effects During Operation: Collision risk*

Table 9-41 Summary of kittiwake total collisions and those apportioned to the Farne Islands SPA.

Site	Season	Collision mortality			SPA %	Adult %	Collisions apportioned to SPA		
		Lower 95% c.i.	Mean	Upper 95% c.i.			Lower 95% c.i.	Mean	Upper 95% c.i.
DBS East	Breeding	42.3	83.3	168.5	2	53	0.45	0.88	1.79
						100	0.85	1.67	3.37
	Autumn	14.6	41.4	82.9	0.5	100	0.07	0.21	0.41
	Spring	6.8	14.6	28.0	0.7	100	0.05	0.10	0.20
	Annual (53% adults)	66.9	139.3	261.3	-	-	0.57	1.19	2.40

Site	Season	Collision mortality			SPA %	Adult %	Collisions apportioned to SPA		
		Lower 95% c.i.	Mean	Upper 95% c.i.			Lower 95% c.i.	Mean	Upper 95% c.i.
	Annual (100% adults)						0.97	1.98	3.98
DBS West	Breeding	36.9	107.8	280.8	2	53	0.39	1.14	2.98
						100	0.74	2.16	5.62
	Autumn	9.5	37.9	81.9	0.5	100	0.05	0.19	0.41
	Spring	7.1	14.9	26.5	0.7	100	0.05	0.10	0.19
	Annual (53% adults)	55.9	160.6	327.0	-	-	0.49	1.44	3.57
	Annual (100% adults)						0.84	2.45	6.21
DBS East + DBS West	Breeding	96.2	191.1	378.4	2	53	1.02	2.03	4.01
						100	1.92	3.82	7.57
	Autumn	30.5	79.3	143.1	0.5	100	0.15	0.40	0.72
	Spring	16.9	29.5	47.3	0.7	100	0.12	0.21	0.33
	Annual (53% adults)	150.9	299.9	540.5	-	-	1.29	2.63	5.06
	Annual (100% adults)						2.19	4.43	8.61

~~9.7.2.1.3.1.1~~9.8.2.1.3.1.1 DBS East in Isolation

~~315.~~365. Based on adult kittiwake proportions of 53% and 100% (**Table 9-7**) applied to the breeding season impact and the proportions of birds recorded at the Projects predicted to be adult birds from the Farne Islands SPA (2%, 0.5% and 0.7% in the breeding, autumn and spring respectively), the predicted mean (lower c.i. and upper c.i.) collision risk impact from DBS East alone on the breeding kittiwake population is 0.9 (0.4 to 1.8) or 1.7 (0.8 to 3.4) birds in the breeding season, 0.2 (0.07 to 0.4) birds during autumn migration and 0.1 (0.05 to 0.2) birds during spring migration (**Table 9-41).**

~~316.~~366. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-7**) the number of individuals from the Farne Islands SPA population expected to die is 1,285 (8,804 x 0.146) adults per annum. The predicted annual (breeding, autumn migration and spring migration periods combined) impacts from DBS East alone on the breeding kittiwake population is 1.2 (0.6 to 2.4) or 2.0 (1.0 to 4.0) birds per annum. These result in a predicted change in adult mortality rate of 0.09% to 0.15% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.7.2.1.3.1.2~~9.8.2.1.3.1.2 *DBS West in Isolation*

~~317.~~367. Based on adult kittiwake proportions of 53% and 100% (**Table 9-7**) applied to the breeding season impact and the proportions of birds recorded at the Projects predicted to be adult birds from the Farne Islands SPA (2%, 0.5% and 0.7% in the breeding, autumn and spring respectively), the predicted mean (lower c.i. and upper c.i.) collision risk impact from DBS West alone on the breeding kittiwake population is 1.1 (0.4 to 3.0) or 2.2 (0.7 to 5.6) birds in the breeding season, 0.2 (0.05 to 0.4) birds during autumn migration and 0.1 (0.05 to 0.2) birds during spring migration (**Table 9-41).**

~~318.~~368. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-7**) the number of individuals from the Farne Islands SPA population expected to die is 1,285 (8,804 x 0.146) adults per annum. The predicted annual (breeding, autumn migration and spring migration periods combined) impacts from DBS West alone on the breeding kittiwake population is 1.4 (0.5 to 3.6) or 2.4 (0.8 to 6.2) birds per annum. These result in a predicted change in adult mortality rate of 0.11% to 0.18% which are below the 1% threshold for detectability and therefore no further assessment was required.

~~9.7.2.1.3.1.3~~9.8.2.1.3.1.3 *DBS East and DBS West Together*

~~319.~~369. Based on adult kittiwake proportions of 53% and 100% (**Table 9-7**) applied to the breeding season impact and the proportions of birds recorded at the Projects predicted to be adult birds from the Farne Islands SPA (2%, 0.5% and 0.7% in the breeding, autumn and spring respectively), the predicted mean (lower c.i. and upper c.i.) collision risk impact from the Projects (DBS East and DBS West together) alone on the breeding kittiwake population is 2.0 (1.0 to 4.0) or 3.8 (1.9 to 7.6) birds in the breeding season, 0.4 (0.15 to 0.7) birds during autumn migration and 0.2 (0.12 to 0.33) birds during spring migration (**Table 9-41).**

~~320.~~370. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-7**) the number of individuals from the Farne Islands SPA population expected to die is 1,285 (8,804 x 0.146) adults per annum. The predicted annual (breeding, autumn migration and spring migration periods combined) impacts from the Projects on the breeding kittiwake population is 2.6 (1.3 to 5.1) or 4.4 (2.2 to 8.6) birds per annum. These result in a predicted change in adult mortality rate of 0.2% to 0.34% which are below the 1% threshold for detectability and therefore no further assessment was required.

~~9.7.2.1.4~~9.8.2.1.4 *Summary of DBS alone*

~~321.~~371. A table summarising the kittiwake operational collision risk assessment for DBS East and DBS West together is provided below (**Table 9-42**).

~~322.~~372. It is concluded that predicted kittiwake mortality due to operational phase collision risk at DBS East, DBS West, and the Projects together would **not adversely affect the integrity of the Farne Islands SPA**.

Table 9-42 Summary of predicted Kittiwake collision mortality from Fane Islands SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations for the Worst Case Wind Turbine Scenario.

Kittiwake		**Collisions**		
Potential Effects During Operation: Collision Risk				
Collision mortality		Lower c.i.	Mean.	Upper c.i.
Breeding season (53% - 100% adults)		1.0-1.9	2.0-3.8	4.0-7.6
Autumn		0.15	0.40	0.7
Spring		0.12	0.21	0.33
Annual		1.3-2.2	2.6-4.4	5.1-8.6
Effect	Reference population	8,804		
	Increase in background mortality (%)	0.1-0.2	0.2-0.34	0.39-0.67

~~9.7.2.1.5~~9.8.2.1.5 *Assessment of potential effects of the Projects in combination with other plans and projects*

~~323.~~373. Given that no measurable increase in the Farne Islands SPA kittiwake mortality is predicted as a result of DBS East and DBS West combined (e.g. with total collision mortality of only 8.6 birds per year during operation even under the most precautionary assumptions), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, it is concluded that predicted kittiwake mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Farne Islands SPA**.

~~9.7.2.2~~9.8.2.2 Guillemot

~~324.~~374. Guillemot has been screened in to assess the impacts from disturbance / displacement in the construction and operation phases.

~~325.~~375. The guillemot assessment is based on a displacement matrix approach presented in the EIA following statutory guidance (Joint SNCB Note, 2017) using displacement rates of 30% to 70% and mortality rates of 1% to 10%. At the upper end these rates represent a highly precautionary worst-case scenario (for further details on displacement rates and the matrix approach, refer to **Volume 7, Chapter 12 Offshore Ornithology (application ref: 7.12)**).

~~9.7.2.2.1~~9.8.2.2.1 Status

~~326.~~376. Guillemot is listed as a designated species of the Farne Islands SPA.

~~327.~~377. The SPA breeding population at classification was 32,875 pairs (65,750 breeding adults) for the period 2010 to 2014 (Natural England, 2017b). Burnell *et al.* (2023) give an updated count of 64,042 individuals which has been used in this assessment.

~~9.7.2.2.2~~9.8.2.2.2 Connectivity to the Projects

~~328.~~378. DBS East and DBS West are 247km and 213km respectively from the Farne Islands SPA. The mean maximum foraging range of guillemot is 153.7km (73.2km + 80.5km, Woodward *et al.*, 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding guillemot from the Farne Islands SPA, there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

~~329.~~379. Outside the breeding season, breeding guillemots from the SPA are assumed to range widely and to mix with guillemots from breeding colonies in the UK and beyond. The relevant non-breeding season reference population is the UK North Sea and Channel BDMPS, consisting of 1,617,306 individuals (August to February) (Furness, 2015).

~~330.~~380. It is estimated that 3.7% of birds present at the Projects are breeding adults from the Farne Islands SPA, and impacts are apportioned accordingly. Note, this percentage has been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

~~9.7.2.2.3~~9.8.2.2.3 *Assessment of Potential Effects of the Projects alone and Together*

~~331.~~381. The seasonal peak total number of guillemots recorded in DBS East and DBS West and the number apportioned to the Farne Islands SPA is provided in **Table 9-43**.

~~332.~~382. Construction displacement has been estimated on the basis this operates across half the wind farm. Thus, guillemot displacement was calculated using upper and lower displacement rate values of 15% and 35% (i.e. half the operational values) and 1% to 10% mortality. In addition, evidence based rates of 25% (half the operational rate of 50%) and 1% have also been assessed. These were then added to the number of birds expected to be displaced by up to three construction vessels (assuming 100% displacement within 2km of each vessel and 1% mortality), calculated from the seasonal densities (**Table 9-43**).

Table 9-43 Summary of guillemot density and abundance estimates and SPA apportioning rates and used in the operation and construction displacement assessment for Farne Islands SPA. Note that displacement from the wind farm has been estimated as 15%-35%, half the operational rates.

Site	Season	Peak no.	SPA %	Adult %	No. apportioned to SPA	Wind farm operation displacement mortality to SPA			Wind farm construction displacement mortality to SPA			Peak density (birds / km^2)	Total vessel displacement mortality (2km around 3 vessels, 1% mortality)	Vessel mortality to SPA	Total construction displacement mortality to SPA		
						30-1	50-1	70-10	15-1	25 - 1	35-10				15-1 & vessel	25 – 1 & vessel	35-10 & vessel
DBS East	Breeding	9030.5	0	55.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.71	6.7	0.0	0.0	0.0	0.0
	Nonbreeding	12551.8	3.7	100	464.4	1.4	2.3	32.5	0.7	1.2	16.3	24.62	9.3	0.3	1.0	1.5	16.6
	Annual	21582.3			464.4	1.4	2.3	32.5	0.7	1.2	16.3	24.62	9.3	0.3	1.0	1.5	16.6
DBS West	Breeding	8783.5	0	55.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.92	6.4	0.0	0.0	0.0	0.0
	Nonbreeding	12498.4	3.7	100	462.4	1.4	2.3	32.4	0.7	1.2	16.2	24.08	9.1	0.3	1.0	1.5	16.5
	Annual	21281.9			462.4	1.4	2.3	32.4	0.7	1.2	16.2	24.08	9.1	0.3	1.0	1.5	16.5
DBS East + DBS West	Breeding	~~14927.7~~17815	0	55.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	13.0	0.0	0.0	0.0	0.0
	Nonbreeding	~~20136.0~~25050	3.7	100	~~745.0~~926.9	2.~~2~~8	~~3.7~~4.6	~~52.2~~64.9	1.~~1~~4	~~1.9~~2.3	~~26.1~~32.4	-	18.4	0.7	2.1~~.8~~	~~2.5~~3.0	~~26.8~~33.1
	Annual	35063.7			~~745.0~~926.9	2.~~2~~8	~~3.7~~4.6	~~52.2~~64.9	1.~~1~~4	~~1.9~~2.3	~~26.1~~32.4	-	18.4	0.7	2.1~~.8~~	~~2.5~~3.0	~~26.8~~33.1

~~9.7.2.2.3.1~~9.8.2.2.3.1 *Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines*

~~9.7.2.2.3.1.1~~9.8.2.2.3.1.1 *DBS East in Isolation*

~~333.~~383. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Farne Islands SPA population expected to die is 3,906 (64,402 x 0.061) adults per annum. The predicted annual construction impacts from DBS East alone on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality plus vessel displacement is 16.6 birds per annum (**Table 9-43**). This would result in a predicted change in adult mortality rate of 0.43%. The equivalent mortality assuming 35% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 3.3 which would increase the background mortality rate by 0.08%.

~~334.~~384. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~335.~~385. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Farne Islands SPA (1.5) would increase the predicted annual mortality by 0.04% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.7.2.2.3.1.2~~9.8.2.2.3.1.2 DBS West in Isolation

~~336.~~386. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Farne Islands SPA population expected to die is 3,906 (64,402 x 0.061) adults per annum. The predicted annual construction impacts from DBS West alone on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality plus vessel displacement is 16.7 birds per annum (**Table 9-43**). This would result in a predicted change in adult mortality rate of 0.4%. The equivalent mortality assuming 35% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 3.3 which would increase the background mortality rate by 0.08%.

~~337.~~387. As noted above, these displacement rates are highly precautionary and have little support from studies at operational wind farms (paragraph 209). At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Farne Islands SPA (1.5) would increase the predicted annual mortality by 0.04% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.7.2.2.3.1.3~~9.8.2.2.3.1.3 DBS East and West Together

~~338.~~388. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Farne Islands SPA population expected to die is 3,906 (64,402 x 0.061) adults per annum. The predicted annual construction impacts from the Projects alone ~~including~~applying highly precautionary rates of 35% displacement and 10% mortality plus vessel displacement on the breeding guillemot population is ~~27.0~~33.1 birds per annum (**Table 9-43**). This results in a predicted change in adult mortality rate of 0.~~7~~85% which is below the 1% threshold for detectability and therefore no further assessment was required. The equivalent mortality assuming 35% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 6.6 which would increase the background mortality rate by 0.17%.

~~339.~~389. At a more appropriate construction displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b) the annual displacement mortality apportioned to the Farne Islands SPA would be ~~2.6~~3.0. This would reduce the predicted annual mortality to 0.~~06~~08% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.7.2.2.3.2~~9.8.2.2.3.2 *Potential Effects During Operation: Disturbance and Displacement*

~~9.7.2.2.3.2.1~~9.8.2.2.3.2.1 *DBS East in Isolation*

~~340.~~390. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Farne Islands SPA population expected to die is 3,906 (64,402 x 0.061) adults per annum. The predicted annual impact from DBS East alone on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 32.8 birds per annum (**Table 9-43**). This results in a predicted change in adult mortality rate of 0.84% which is below the 1% threshold for detectability and therefore no further assessment was required. The equivalent mortality assuming 70% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 6.6 which would increase the background mortality rate by 0.17%.

~~341.~~391. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Farne Islands SPA would be 2.3. This would reduce the predicted annual mortality to 0.06% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.7.2.2.3.2.2~~9.8.2.2.3.2.2 *DBS West in Isolation*

~~342.~~392. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Farne Islands SPA population expected to die is 3,906 (64,402 x 0.061) adults per annum. The predicted annual impact from DBS East alone on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 32.6 birds per annum (**Table 9-43**). This results in a predicted change in adult mortality rate of 0.84%. which is below the 1% threshold for detectability and therefore no further assessment was required. However, as noted above (paragraph 209), there is little evidence in support of either the 70% displacement rate or the 10% mortality rate. The equivalent mortality assuming 70% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 6.6 which would increase the background mortality rate by 0.17%.

~~343.~~393. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Farne Islands SPA would be 2.3 birds in the breeding and nonbreeding seasons respectively. This would reduce the predicted annual mortality to 0.06% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.7.2.2.3.2.3~~9.8.2.2.3.2.3 DBS East and West Together

~~344.~~394. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Farne Islands SPA population expected to die is 3,906 (64,402 x 0.061) adults per annum. The predicted annual impact from the Projects alone on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is ~~52.6~~64.9 birds per annum (**Table 9-43**). This results in a predicted change in adult mortality rate of 1.~~3~~7%. This is above the 1% level considered to be the threshold for detection. However, as noted above (paragraph 209), there is little evidence in support of either the 70% displacement rate or the 10% mortality rate. A reduction in the displacement mortality rate to 6% would reduce the increase in background mortality of this impact to 1%. The equivalent mortality assuming 70% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 13.0 which would increase the background mortality rate by 0.33%.

~~345.~~395. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Farne Islands SPA would be ~~3.8~~4.6 birds. This would reduce the predicted annual mortality to 0.~~09~~12% which is below the 1% threshold for detectability and therefore no further assessment was required.

9.8.2.2.4 Summary of DBS alone

~~346.~~396. A matrix of the annual operational displacement estimates for DBS East and DBS West is provided in **Table 9-44**.

Table 9-44 Displacement matrix for annual project alone (DBS East plus DBS West) guillemot apportioned to Farne Islands SPA adult population.

Mortality %	Displacement %									
	10	20	30	40	50	60	70	80	90	100
1	1	2	3	4	5	6	6	7	8	9
2	2	4	6	7	9	11	13	15	17	19
3	3	6	8	11	14	17	19	22	25	28
4	4	7	11	15	19	22	26	30	33	37
5	5	9	14	19	23	28	32	37	42	46
6	6	11	17	22	28	33	39	44	50	56
7	6	13	19	26	32	39	45	52	58	65
8	7	15	22	30	37	44	52	59	67	74
9	8	17	25	33	42	50	58	67	75	83
10	9	19	28	37	46	56	65	74	83	93
20	19	37	56	74	93	111	130	148	167	185
30	28	56	83	111	139	167	195	222	250	278
50	46	93	139	185	232	278	324	371	417	463
75	70	139	209	278	348	417	487	556	626	695
100	93	185	278	371	463	556	649	742	834	927

~~347.~~397. It is concluded that predicted guillemot mortality due to construction and operational phase disturbance and displacement impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the Farne Islands SPA**.

Table 9-45 Summary of predicted guillemot displacement mortality from Farne Islands SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.

Guillemot		Displacement		
Potential Effects During Construction: Disturbance and Displacement				
Displacement mortality		Mean (@25% x 1%)	Mean (@35% x ~~10~~2%)	Mean (@~~25~~35% x ~~1~~10%)
Breeding season		0	0	0
Nonbreeding season		~~26.8~~3.0	~~2.5~~6.6	33.1
Annual		~~26.8~~3.0	~~2.5~~6.6	33.1
Effect	Reference population	64,402		
	Increase in back-ground mortality (%)	0.~~7~~08	0.~~06~~17	0.85
Potential Effects During Operation: Disturbance and Displacement				
Displacement mortality		Mean (@50% x 1%)	Mean (@70% x ~~10~~2%)	Mean (@~~50~~70% x ~~1~~10%)
Breeding season		0	0	0
Nonbreeding season		~~52.2~~4.6	~~3.7~~13.0	64.9
Annual		~~52.2~~4.6	~~3.7~~13.0	64.9
Effect	Reference population	64,402		
	Increase in back-ground mortality (%)	~~1.34~~0.12	0.~~09~~33	1.66

~~9.7.2.2.4~~9.8.2.2.5 *Assessment of potential effects of the Projects in combination with other plans and projects*

~~348.~~398. Given that no measurable increase in the Farne Islands SPA guillemot mortality is predicted as a result of DBS East and DBS West combined (e.g. with realistic displacement mortality of only ~~4~~5 birds per year during operation), ~~it is~~the Applicant's concluded that the Projects would not contribute to in-combination effects on this species. ~~Therefore, predicted guillemot mortality due to operational phase collision impacts at DBS East and DBS West together~~However, Natural England (APP-039) advised that an in-combination ~~with other offshore wind farms would **not adversely affect the integrity of the Farne Islands SPA**~~assessment should be conducted.

9.8.2.2.5.1 Potential Effects During Operation: Disturbance and Displacement

399. The only wind farm within the guillemot foraging range of the Farne Islands SPA is the Blyth wind farm, therefore breeding season impacts are only related to this project which had a seasonal abundance of 1,220 (**Table 9-28**). The nonbreeding season guillemot total abundance in the North Sea for all wind farms (including DBS) was 351,616 (**Table 9-28**). The nonbreeding season apportioning rate for the Farne Islands SPA is estimated to be 3.7%, therefore the annual total number of guillemot from the Farne Islands SPA estimated to be at risk of displacement is 13,055 (3.7% x 1220+351,616).

400. A matrix of in-combination displacement impacts is provided in Table 9-46. Using displacement rates of 30% to 70% and mortality rates of 1% to 10% for displaced birds the number of Farne Islands SPA birds predicted to die each year would be:

- At 50% displaced and 1% mortality: 65
- At 70% displaced and 2% mortality: 183

401. These magnitudes of displacement would increase the background mortality (64,042 x 0.061 = 3,906) rate of the Farne Islands SPA population by:

- At 50% displaced and 1% mortality: 1.6%
- At 70% displaced and 2% mortality: 4.7%

402. The results of PVA to investigate these impacts are considered below.

Table 9-46 Guillemot in-combination displacement matrix for Farne Islands SPA.

Mortality %	**Displacement %**									
	10	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**
1	13	26	39	52	65	78	91	104	117	131
2	26	52	78	104	131	157	183	209	235	261
3	39	78	117	157	196	235	274	313	352	392
4	52	104	157	209	261	313	366	418	470	522
5	65	131	196	261	326	392	457	522	587	653
6	78	157	235	313	392	470	548	627	705	783

Mortality %	Displacement %									
	10	20	30	40	50	60	70	80	90	100
7	91	183	274	366	457	548	640	731	822	914
8	104	209	313	418	522	627	731	836	940	1044
9	117	235	352	470	587	705	822	940	1057	1175
10	131	261	392	522	653	783	914	1044	1175	1306
20	261	522	783	1044	1306	1567	1828	2089	2350	2611
30	392	783	1175	1567	1958	2350	2742	3133	3525	3917
50	653	1306	1958	2611	3264	3917	4569	5222	5875	6528
75	979	1958	2937	3917	4896	5875	6854	7833	8812	9791
100	1306	2611	3917	5222	6528	7833	9139	10444	11750	13055

9.8.2.2.5.2 Population Viability Analysis Results for guillemot

403. The Natural England commissioned PVA tool was used to examine the effect of the estimated in-combination mortality on the Farne Islands SPA population. The complete input parameters and settings and results are provided in Annex A: SPA PVA Results. The counterfactuals of growth rate (CGR) and population size (CPS) are presented in **Table 9-47**.

Table 9-47 PVA results for in-combination impacts on the Farne Islands SPA guillemot after 30 years.

PVA run scenario	Annual mortality	Decrease in adult survival rate	Mean CGR (95% c.i.)	Mean CPS (95% c.i.)
In-combination displacement (50% x 1%)	65	0.001015	0.9993 (0.9989-0.9996)	0.9786 (0.9676-0.9893)
In-combination displacement (70% x 2%)	183	0.002857	0.9981 (0.9977-0.9984)	0.9416 (0.9310-0.9521)

404. After a period of 30 years, in-combination displacement at 50% x 1% reduced the population growth rate by up to 0.07% (0.9993) and reduced the population size compared to the baseline size by up to 2.1% (0.9786).

405. After a period of 30 years, in-combination displacement at 70% x 2% reduced the population growth rate by up to 0.19% (0.9981) and reduced the population size compared to the baseline size by up to 5.8% (0.9416).

406. The choice of which counterfactual measure is more appropriate for understanding the potential population consequences of increased mortality is dependent on the model formulation, specifically whether or not the model incorporates realistic density dependent regulation. Natural England advise that PVA for seabird impact assessment should not include density dependence (on the basis that there is insufficient data to parameterise this for specific impacted populations). Density independent population predictions made under this assumption lack the natural feedback mechanisms that prevent natural populations growing indefinitely at an exponential rate. The implication of this for the current PVA is that the baseline population projections (no impact) and the impacted ones will diverge at an increasing rate as the simulated period increases. Therefore, the CPS figures are very sensitive to the duration of the simulation.

407. Furthermore, although the size of the impacted population may be, for example, much smaller than the baseline one, both populations could have increased considerably in size. Indeed, that is the case with the guillemot PVA, with a baseline annual average growth rate of 3.6% and a maximum impact growth rate of 3.4%. These result in median populations after 30 years of over 185,000 and 175,000 for baseline and maximum impact respectively. It is clear therefore that the 5.8% 'reduction' in population size is in fact a population which has simply not grown as quickly, but has still more than doubled from the starting size of over 60,000.

408. The CPGR for a density independent model is a more consistent measure of population health, since it is much less sensitive to the duration considered. For example at the largest impact the CPS after 10 years was 0.9776 (2.2%) which decreased to 0.9416 (5.8%) after 30 years, while the CPGR after 10 years was almost exactly the same 0.9979 (0.2%) as that after 30 years 0.9981 (0.19%). Thus the interpretation of the CPS depends on the timespan, while interpretation of the CPGR is largely insensitive to this aspect.

409. The CPGR also lends itself to consideration against the recent observed trend in the growth rate of the population. For example, the guillemot population at Farne Islands SPA has grown at an average rate of 3.5% per year since 2000. The maximum CPGR was 0.19% which if realised would only reduce the annual growth rate to 3.3%. Thus, the population would continue to grow at a healthy rate even if the worst case in-combination mortality occurred. It should be noted that Tremlett *et al*. (2024) reported a 26% decline in the Farne Islands guillemot population in 2023 compared to the previous count (Burnell *et al*. 2023), which was apparently attributable to HPAI. While there are obvious concerns about the potential effects of HPAI, there is no indication that further declines have occurred (e.g. at FFC SPA mortalities across all species were at normal levels in 2024, Butcher *et al*. 2024) and it is reasonable to assume the previous positive trend in this population will resume.

410. Furthermore, there are several additive precautionary assumptions baked into the estimated impacts, as discussed above in relation to gannet at the Flamborough and Filey Coast SPA (paragraph 163).

411. Therefore, it is the Applicants' conclusion that the displacement impacts predicted at DBS East and DBS West in-combination with other projects, will **not adversely affect the integrity of the Farne Islands SPA**.

~~9.7.2.3~~9.8.2.3 Puffin

~~349.~~412. Puffin has been screened in to assess the impacts from disturbance / displacement in the construction and operation phases.

~~350.~~413. The puffin assessment is based on a displacement matrix approach presented in the EIA following statutory guidance (Joint SNCB Note, 2017) using displacement rates of 30% to 70% and mortality rates of 1% to 10%. At the upper end these rates represent a highly precautionary worst-case scenario (for further details on displacement rates and the matrix approach, refer to **Volume 7, Chapter 12 Offshore Ornithology (application ref: 7.12)**).

~~9.7.2.3.1~~9.8.2.3.1 Status

~~351.~~414. Puffin is listed as a named component of the breeding seabird assemblage of the Farne Islands SPA.

~~352.~~415. The SPA breeding population at classification was 76,798 individuals (Natural England, 2017b). The most recent published count was 87,504 individuals in 2019 (JNCC, 2023b). This is used as the reference population for the assessment.

~~353.~~416. Supplementary advice on the conservation objectives were added for named components of the breeding seabird assemblage of the Farne Islands SPA in 2023 (Natural England, 2023). For puffin, these are:

- Maintain the overall abundance of the assemblage at a level which is above 163,819 whilst avoiding deterioration from its current level as indicated by the latest peak mean count or equivalent;
- Maintain the species diversity of the bird assemblage;
- Reduce the frequency, duration and / or intensity of disturbance affecting roosting, nesting, foraging, feeding, moulting and/or loafing birds so that they are not significantly disturbed;
- Reduce predation and disturbance caused by native and non-native predators;
- Maintain concentrations and deposition of air pollutants at below the site-relevant Critical Load or Level values given for this feature of the site on the Air Pollution Information System (www.apis.ac.uk);
- Maintain the structure, function and supporting processes associated with the feature and its supporting habitat through management or other measures (whether within and/or outside the site boundary as appropriate) and ensure these measures are not being undermined or compromised;
- Maintain the extent, distribution and availability of suitable habitat (either within or outside the site boundary) which supports the feature for all necessary stages of its breeding cycle (courtship, nesting, feeding).
- Maintain the structure, function and availability of the following habitats which support the assemblage feature for all stages (breeding, moulting, roosting, loafing, feeding) of the breeding period;
- Reduce aqueous contaminants to levels equating to High Status according to Annex VIII and Good Status according to Annex X of the Water Framework Directive, avoiding deterioration from existing levels;
- Maintain the dissolved oxygen (DO) concentration at levels equating to High Ecological Status (specifically ≥ 5.7 mg L-1 (at 35 salinity) for 95 % of year) avoiding deterioration from existing levels;
- Maintain water quality and specifically mean winter dissolved inorganic nitrogen (DIN) at a concentration equating to High Ecological Status (specifically mean winter DIN is < 12 μM for coastal waters), avoiding deterioration from existing levels; and

- Maintain natural levels of turbidity (e.g. concentrations of suspended sediment, plankton and other material) across the habitat.

~~9.7.2.3.2~~9.8.2.3.2 *Connectivity to the Projects*

~~354.~~417. DBS East and DBS West are 247km and 213km respectively from the Farne Islands SPA. The mean maximum foraging range of puffin is 265.4km (137.1km +128.3km, Woodward *et al.*, 2019). Therefore, DBS East and DBS West are both within potential foraging range for breeding puffin from the Farne Islands SPA. The estimated proportion of the puffins recorded at the Projects during the breeding season that could be breeding adult birds from the Farne Islands SPA (based on the most recent count of 87,504 breeding adults) is calculated as ~~56~~52% (**Table 9-9**).

~~355.~~418. Outside the breeding season, breeding puffins from the SPA are assumed to range widely and to mix with puffins from breeding colonies in the UK and further afield. The relevant non-breeding season reference population is the UK North Sea and Channel BDMPS, consisting of 231,957 individuals (mid-August to March) (Furness, 2015).

~~356.~~419. It is estimated that 17.2% of birds present at the Projects are breeding adults from the Farne Islands SPA, and impacts are apportioned accordingly. Note, this percentage has been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

~~9.7.2.3.3~~9.8.2.3.3 *Assessment of Potential Effects of the Projects alone and Together*

~~357.~~420. The seasonal peak total number of puffins recorded in DBS East and DBS West and the number apportioned to the Farne Islands SPA is provided in **Table 9-48**.

~~358.~~421. Construction displacement has been estimated on the basis this operates across half the wind farm. Thus, puffin displacement was calculated using upper and lower displacement rate values of 15% and 35% (i.e. half the operational values) and 1% to 10% mortality. In addition, evidence based rates of 25% (half the operational rate of 50%) and 1% have also been assessed. These were then added to the number of birds expected to be displaced by up to three construction vessels (assuming 100% displacement within 2km of each vessel and 1% mortality), calculated from the seasonal densities (**Table 9-48**).

Table 9-48 Summary of puffin density and abundance estimates and SPA apportioning rates used in the operation and construction displacement assessment for Farne Islands SPA. Note that displacement from the wind farm has been estimated as 15%-35%, half the operational rates.

Site	Season	Peak no.	SPA %	Adult %	No. apportioned to SPA	Wind farm operation displacement mortality to SPA			Wind farm construction displacement mortality to SPA			Peak density (birds/km²)	Total vessel displacement mortality (2km around 3 vessels, 1% mortality)	Vessel mortality to SPA	Total construction displacement mortality to SPA		
						30-1	50-1	70-10	15-1	25 - 1	35-10				15-1 & vessel	25 – 1 & vessel	35-10 & vessel
DBS East	Breeding	62.6	52	54.3	~~14.9~~17.7	0.~~04~~05	0.~~07~~09	1.~~04~~24	0.~~02~~03	0.04	0.~~52~~62	0.12	0.05	0.01	0.~~03~~04	0.~~05~~06	0.~~53~~63
				100	~~27.4~~32.6	0.~~08~~10	0.~~14~~16	~~1.92~~2.28	0.~~04~~05	0.~~07~~08	~~0.96~~1.14			0.02	0.~~06~~07	0.~~09~~10	~~0.98~~1.16
	Non-breeding	178.7	17.2	100	30.7	0.09	0.15	2.15	0.05	0.08	1.08	0.35	0.13	0.02	0.07	0.10	1.10
	Annual (54.3% adults)				~~45.6~~48.4	0.~~1~~15	0.~~2~~24	3.~~2~~4	0.~~1~~07	0.~~1~~12	1.~~6~~69		0.18	0.~~03~~04	0.~~10~~11	0.~~15~~16	1.~~63~~73
	Annual (100% adults)				~~58.2~~63.3	0.~~2~~19	0.~~3~~32	4.~~1~~4	0.~~1~~09	0.~~1~~16	2.~~0~~22			0.~~04~~05	0.~~13~~14	0.~~19~~20	2.~~08~~26
DBS West	Breeding	109.3	52	54.3	~~26.0~~30.9	0.~~08~~09	0.~~13~~15	~~1.82~~2.16	0.~~04~~05	0.~~06~~08	~~0.91~~1.08	0.21	0.08	0.02	0.~~06~~07	0.~~08~~10	~~0.93~~1.10
				100	~~47.9~~56.8	0.~~14~~17	0.~~24~~28	3.~~35~~98	0.~~07~~09	0.~~12~~14	1.~~68~~99			0.~~03~~04	0.~~11~~13	0.~~15~~18	~~1.71~~2.03
	Non-breeding	198.2	17.2	100	34.1	0.10	0.17	2.39	0.05	0.09	1.19	0.38	0.14	0.02	0.08	0.11	1.22
	Annual (54.3% adults)				~~60.1~~65.0	0.~~2~~19	0.~~3~~32	4.~~2~~5	0.~~1~~10	0.~~2~~16	2.~~1~~27		0.22	0.~~04~~06	0.~~13~~14	0.~~19~~21	2.~~15~~32
	Annual (100% adults)				~~82.0~~90.9	0.~~2~~27	0.~~4~~45	~~5.7~~6.4	0.~~1~~14	0.~~2~~23	~~2.9~~3.18			0.~~06~~07	0.~~18~~20	0.~~26~~29	~~2.93~~3.25
DBS East + DBS West	Breeding	~~146.6~~171.9	~~43.8~~52	54.3	~~34.9~~48.5	0.~~10~~15	0.~~17~~24	~~2.44~~3.40	0.~~05~~07	0.~~09~~12	1.~~22~~70	-	0.12	0.~~03~~04	0.~~08~~11	0.~~12~~16	1.~~25~~73
				100	~~64.2~~89.4	0.~~19~~27	0.~~32~~45	~~4.49~~6.26	0.~~10~~13	0.~~16~~22	~~2.25~~3.13			0.~~05~~06	0.~~15~~20	0.~~22~~29	~~2.30~~3.19
	Non-breeding	~~372.7~~376.9	17.2	100	64.~~1~~8	0.19	0.32	4.~~49~~54	0.10	0.16	2.~~24~~27	-	0.28	0.05	0.14	0.21	2.~~29~~32
	Annual (54.3% adults)				~~99.0~~113.4	0.~~3~~34	0.~~5~~57	~~6.9~~7.94	0.~~1~~17	0.~~2~~28	3.~~5~~97		0.40	0.08	0.~~23~~25	0.~~32~~37	~~3.54~~4.05
	Annual (100% adults)				~~128.3~~154.2	0.~~4~~46	0.~~6~~77	~~9.0~~10.80	0.~~2~~23	0.~~3~~39	~~4.~~5.40			0.~~10~~11	0.~~29~~34	0.~~42~~50	~~4.59~~5.51

~~9.7.2.3.3.1~~9.8.2.3.3.1 *Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines*

~~9.7.2.3.3.1.1~~9.8.2.3.3.1.1 *DBS East in Isolation*

~~359.~~422. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-7**) the number of individuals from the Farne Islands SPA population expected to die is 8,225 (87,504 x 0.094) adults per annum. The predicted annual (breeding and non-breeding periods combined) impacts from DBS East alone on the breeding puffin population including vessel displacement is 1.~~63~~73 (assuming 54.3% adults in the breeding season) or 2.~~1~~26 (assuming 100% adults in the breeding season) birds per annum (**Table 9-48**). These result in a predicted change in adult mortality rate of 0.02% to 0.~~025~~027% which are below the 1% threshold for detectability and therefore no further assessment was required.

~~9.7.2.3.3.1.2~~9.8.2.3.3.1.2 *DBS West in Isolation*

~~360.~~423. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-7**) the number of individuals from the Farne Islands SPA population expected to die is 8,225 (87,504 x 0.094) adults per annum. The predicted annual (breeding and non-breeding periods combined) impacts from DBS West alone on the breeding puffin population including vessel displacement is 2.32 (assuming 54.3% adults in the breeding season) or 3.25 (assuming 100% adults in the breeding season) birds per annum (**Table 9-48**). These result in a predicted change in adult mortality rate of 0.028% to 0.039% which are below the 1% threshold for detectability and therefore no further assessment was required.

~~9.7.2.3.3.1.3~~9.8.2.3.3.1.3 DBS East and West Together

~~361.~~424. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-7**) the number of individuals from the Farne Islands SPA population expected to die is 8,225 (87,504 x 0.094) adults per annum. ~~The predicted annual (breeding and non-breeding periods combined) impacts from DBS West alone on the breeding puffin population including vessel displacement is 2.15 (assuming 54.3% adults in the breeding season) or 2.93 (assuming 100% adults in the breeding season) birds per annum (**Table 9-38**). These result in a predicted change in adult mortality rate of 0.029% to 0.035At the baseline mortality rate for adult puffin of 0.094 (**Table 9-5**) the number of individuals from the Farne Islands SPA population expected to die is 8,225 (87,504 x 0.094) adults per annum.~~ The predicted annual (breeding and non-breeding periods combined) impacts from DBS East and DBS West on the breeding puffin population including vessel displacement is ~~3.54~~4.05 (assuming 54.3% adults in the breeding season) or ~~4.65~~5.51 (assuming 100% adults in the breeding season) birds per annum (**Table 9-48**). These result in a predicted change in adult mortality rate of 0.~~04~~05% to 0.~~05~~07% which are below the 1% threshold for detectability and therefore no further assessment was required.

~~9.7.2.3.3.2~~9.8.2.3.3.2 Potential Effects During Operation: Disturbance and Displacement

~~9.7.2.3.3.2.1~~9.8.2.3.3.2.1 DBS East in Isolation

~~362.~~425. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-7**) the number of individuals from the Farne Islands SPA population expected to die is 8,225 (87,504 x 0.094) adults per annum. The predicted annual (breeding and non-breeding periods combined) impacts from DBS East alone on the breeding puffin population is 3.~~20~~4 (assuming 54.3% adults in the breeding season) or 4.~~1~~4 (assuming 100% adults in the breeding season) birds per annum (**Table 9-48**). These result in a predicted change in adult mortality rate of 0.04% to 0.05% which are below the 1% threshold for detectability and therefore no further assessment was required.

~~9.7.2.3.3.2.2~~9.8.2.3.3.2.2 DBS West in Isolation

~~363.~~426. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-7**) the number of individuals from the Farne Islands SPA population expected to die is 8,225 (87,504 x 0.094) adults per annum. The predicted annual (breeding and non-breeding periods combined) impacts from DBS West alone on the breeding puffin population is 4.~~2~~15 (assuming 54.3% adults in the breeding season) or ~~5.7~~6.4 (assuming 100% adults in the breeding season) birds per annum (**Table 9-48**). These result in a predicted change in adult mortality rate of 0.05% to 0.~~07~~08% which are below the 1% threshold for detectability and therefore no further assessment was required.

~~9.7.2.3.3.2.3~~9.8.2.3.3.2.3 DBS East and West Together

~~364.~~427. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-7**) the number of individuals from the Farne Islands SPA population expected to die is 8,225 (87,504 x 0.094) adults per annum. The predicted annual (breeding and non-breeding periods combined) impacts from the Projects alone on the breeding puffin population is ~~6~~7.9 (assuming 54.3% adults in the breeding season) or ~~9.0~~10.8 (assuming 100% adults in the breeding season) birds per annum (**Table 9-48**). These result in a predicted change in adult mortality rate of 0.~~08~~10% to 0.~~11~~13% which are below the 1% threshold for detectability and therefore no further assessment was required.

~~9.7.2.3.4~~9.8.2.3.4 Summary

~~365.~~428. A table summarising the puffin construction and operational disturbance and displacement assessment for DBS East and DBS West together is provided below (**Table 9-49**).

~~366.~~429. It is concluded that predicted puffin mortality due to construction and operational phase disturbance and displacement impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the Farne Islands SPA**.

Table 9-49 Summary of predicted puffin displacement mortality from Farne Islands SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.

Puffin	Displacement	
Potential Effects During Construction: Disturbance and Displacement		
Displacement mortality & Vessel displacement	Mean (@~~35~~25% x ~~10~~1%)	Mean (@~~25~~35% x ~~1~~10%)
Breeding season (54.3% - 100% adults)	~~1.25-2.30~~0.16-0.29	~~0.12-0.22~~1.73-3.19

Puffin		**Displacement**	
Nonbreeding season		~~2.29~~0.21	~~0.21~~2.32
Annual		0.37-0.50	4.05-5.51
Effect	Reference population	87,504	
	Increase in background mortality (%)~~3.54-4.59~~	0.~~32~~004-0.~~42~~006	0.05-0.07
Potential Effects During Operation: Disturbance and Displacement			
Displacement mortality		Mean (@50% x 1%)	Mean (@70% x 10%)
Breeding season (54.3% - 100% adults)		0.24-0.45	3.4-6.3
Nonbreeding season		0.32	4.5
Annual		0.57-0.77	7.9-10.8
Effect	Reference population	87,504	
		~~0.04-0.05~~	~~0.004-0.005~~
~~**Potential Effects During Operation: Disturbance and Displacement**~~			
~~Displacement mortality~~		~~Mean (@70% x 10%)~~	~~Mean (@50% x 1%)~~
~~Breeding season (54.3% - 100% adults)~~		~~2.4-4.5~~	~~0.17-0.32~~
~~Nonbreeding season~~		~~4.5~~	~~0.32~~
~~Annual~~		~~6.9-9.0~~	~~0.50-0.6~~
~~Effect~~	~~Reference population~~	~~87,504~~	
	Increase in background mortality (%)	0.~~08~~007-0.~~11~~009	0.~~006~~096-0.~~007~~13

~~9.7.2.3.5~~9.8.2.3.5 *Assessment of potential effects of the Projects in combination with other plans and projects*

~~367.~~430. Given that no measurable increase in the Farne Islands SPA puffin mortality is predicted as a result of DBS East and DBS West combined (e.g. with total displacement mortality of only ~~6.9~~10.8 birds per year during operation even under the most precautionary assumptions), ~~it is~~the Applicants concluded that the projects would not contribute to in-combination effects on this species. ~~Therefore, it is concluded that predicted puffin mortality due to construction and operational phase disturbance and displacement impacts at DBS East and DBS West together in-combination with other offshore wind farms would~~ ~~**not adversely affect the integrity of the Farne Islands SPA**~~.

431. However, Natural England (APP-039) advised that an in-combination assessment should be conducted. In the HRA for the recent Dudgeon and Sheringham Extension[3], the SoS applied precautionary rates of displacement and mortality of 70% and 2% respectively for auk assessment and these rates have been applied to the in-combination assessment below.

9.8.2.3.5.1 Potential Effects During Operation: Disturbance and Displacement

432. There are relatively few details available for puffin impacts from other wind farms, therefore the estimates of puffin at risk presented in the Dudgeon and Sheringham assessment[3] have been used as the starting point. The breeding season abundance of puffins on wind farms within foraging range of the Farne Islands SPA was estimated to be 384, to which the Projects add a maximum of 89, bringing this to 473.

433. During the nonbreeding season the estimated total abundance of puffin on all wind farms was 45,017. To this figure, an additional 645 (Outer Dowsing), 3 (North Falls), 0 (Five Estuaries), 35 (Dudgeon and Sheringham Estension) and 377 (Dogger Bank South), bring the total to 46,077. Of this, 17.2% are estimated to be birds from the Farne Islands SPA: 7,925.

434. Thus the annual total population of Farne Islands SPA puffin at risk of displacement at UK North Sea wind farms is 8,398 (473+7925).

435. A matrix of in-combination displacement impacts is provided in **Table 9-50**. Using displacement rates of 30% to 70% and mortality rates of 1% to 10% for displaced birds the number of Farne Islands SPA birds predicted to die each year would be:

- At 50% displaced and 1% mortality: 42
- At 70% displaced and 2% mortality: 118

436. These magnitudes of displacement would increase the background mortality (87,504 x 0.094 = 8,225) rate of the Farne Islands SPA population by:

- At 50% displaced and 1% mortality: 0.51%
- At 70% displaced and 2% mortality: 1.43%

[3] https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010109/EN010109-000432-5.4%20Report%20to%20Inform%20Appropriate%20Assessment.pdf

437. The results of PVA to investigate these impacts are considered below.

Table 9-50 Puffin in-combination displacement matrix for Farne Islands SPA.

Mortality %	Displacement %									
	10	20	30	40	50	60	70	80	90	100
1	8	17	25	34	42	50	59	67	76	84
2	17	34	50	67	84	101	118	134	151	168
3	25	50	76	101	126	151	176	202	227	252
4	34	67	101	134	168	202	235	269	302	336
5	42	84	126	168	210	252	294	336	378	420
6	50	101	151	202	252	302	353	403	453	504
7	59	118	176	235	294	353	412	470	529	588
8	67	134	202	269	336	403	470	537	605	672
9	76	151	227	302	378	453	529	605	680	756
10	84	168	252	336	420	504	588	672	756	840
20	168	336	504	672	840	1008	1176	1344	1512	1680
30	252	504	756	1008	1260	1512	1764	2016	2267	2519
50	420	840	1260	1680	2100	2519	2939	3359	3779	4199
75	630	1260	1890	2519	3149	3779	4409	5039	5669	6299
100	840	1680	2519	3359	4199	5039	5879	6718	7558	8398

9.8.2.3.5.2 Population Viability Analysis Results for guillemot

438. The Natural England commissioned PVA tool was used to examine the effect of the estimated in-combination mortality on the Farne Islands SPA population. The complete input parameters and settings and results are provided in Annex A: SPA PVA Results. The counterfactuals of growth rate (CGR) and population size (CPS) are presented in **Table 9-51**.

Table 9-51 PVA results for in-combination impacts on the Farne Islands SPA puffin after 30 years.

PVA run scenario	**Annual mortality**	**Decrease in adult survival rate**	**Mean CGR (95% c.i.)**	**Mean CPS (95% c.i.)**
In-combination displacement (50% x 1%)	42	0.000480	0.9997 (0.9993-1.0000)	0.9904 (0.9797-1.0009)
In-combination displacement (70% x 2%)	118	0.001349	0.9991 (0.9988-0.9995)	0.9733 (0.9628-0.9838)

439. After a period of 30 years, in-combination displacement at 50% x 1% reduced the population growth rate by up to 0.03% (0.9997) and reduced the population size compared to the baseline size by up to 0.96% (0.9904).

440. After a period of 30 years, in-combination displacement at 70% x 2% reduced the population growth rate by up to 0.09% (0.9991) and reduced the population size compared to the baseline size by up to 2.7% (0.9733).

441. The choice of which counterfactual measure is more appropriate for understanding the potential population consequences of increased mortality is dependent on the model formulation, specifically whether or not the model incorporates realistic density dependent regulation. Natural England advise that PVA for seabird impact assessment should not include density dependence (on the basis that there is insufficient data to parameterise this for specific impacted populations). Density independent population predictions made under this assumption lack the natural feedback mechanisms that prevent natural populations growing indefinitely at an exponential rate. The implication of this for the current PVA is that the baseline population projections (no impact) and the impacted ones will diverge at an increasing rate as the simulated period increases. Therefore, the CPS figures are very sensitive to the duration of the simulation.

442. Furthermore, although the size of the impacted population may be, for example, much smaller than the baseline one, both populations could have increased considerably in size. Indeed, that is the case with the puffin PVA, with a baseline annual average growth rate of 4.2% and a maximum impact growth rate of 4.1%. These result in median populations after 30 years of over 344,000 and 335,000 for baseline and maximum impact respectively. It is clear therefore that the 2.7% 'reduction' in population size is in fact a population which has simply not grown as quickly, but has still more than doubled from the starting size of around 87,000.

443. The CPGR for a density independent model is a more consistent measure of population health, since it is much less sensitive to the duration considered. For example at the largest impact the CPS after 10 years was 0.9899 (1.0%) which decreased to 0.9733 (2.7%) after 30 years, while the CPGR after 10 years was exactly the same, 0.9991 (0.09%), as that after 30 years. Thus the interpretation of the CPS depends on the timespan, while interpretation of the CPGR is largely insensitive to this aspect.

444. Furthermore, there are several additive precautionary assumptions baked into the estimated impacts, as discussed above in relation to gannet at the Flamborough and Filey Coast SPA (paragraph 163).

445. Therefore, it is the Applicants' conclusion that the displacement impacts predicted at DBS East and DBS West in-combination with other projects, will **not adversely affect the integrity of the Farne Islands SPA**.

~~9.8~~9.9 St Abbs Head to Fast Castle SPA

~~9.8.1~~9.9.1 Site Description

~~368.~~446. St Abb's Head to Fast Castle SPA was designated in 1997. The site comprises an area of sea cliffs and coastal strip stretching over 10km along the Berwickshire Coast north of St Abbs.

~~369.~~447. The boundary of the SPA overlaps with that of St Abb's Head to Fast Castle SSSI, and the seaward extension extends approximately 1 km into the marine environment to include the seabed, water column and surface.

~~9.8.1.1~~9.9.1.1 Qualifying Features

~~370.~~448. The qualifying features of St Abbs Head to Fast Castle SPA screened into the Assessment are listed in Table 4-7 of **RIAA HRA Part 1 of 4 – Introduction and Terrestrial Ecology (application ref: 6.1)**. These are three named components of the breeding seabird assemblage; kittiwake, guillemot and razorbill.

~~9.8.1.2~~9.9.1.2 Conservation Objectives

~~371.~~449. The over-arching conservation objectives of the site are:

- To avoid deterioration of the habitats of the qualifying species or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained; and
- To ensure for the qualifying species that the following are maintained in the long term:
  - Population of the species as a viable component of the site;
  - Distribution of the species within site;
  - Distribution and extent of habitats supporting the species;
  - Structure, function and supporting processes of habitats supporting the species; and
  - No significant disturbance of the species.

~~9.8.2~~9.9.2 Assessment: Array Areas

~~9.8.2.1~~9.9.2.1 Kittiwake

~~372.~~450. Kittiwake has been screened in to assess the impacts from collision risk in the operation phase.

~~9.8.2.1.1~~9.9.2.1.1 Status

~~373.~~451. Kittiwake is listed as a named component of the breeding seabird assemblage of the St Abbs Head to Fast Castle SPA.

~~374.~~452. The SPA breeding population at classification in 1997 was cited as 21,170 pairs or 42,340 breeding adults (SNH, 2009). The most recent count is 5,150 apparently occupied nests, or 10,300 breeding adults recorded between 2018-2021 (JNCC, 2023a). The baseline mortality of this population is 1,503 breeding adult birds per year based on the published adult mortality rate of 14.6% (Horswill and Robinson, 2015).

~~9.8.2.1.2~~9.9.2.1.2 Connectivity to the Projects

~~375.~~453. DBS East and DBS West are 290km and 256km respectively from the St Abbs Head to Fast Castle SPA. The mean maximum foraging range of kittiwake is 300.6km (156.1km + 144.5km, Woodward *et al.*, 2019). Therefore, DBS East and DBS West are both within potential foraging range for breeding kittiwake from the St Abbs Head to Fast Castle SPA. The estimated proportion of the kittiwakes recorded at the Projects during the breeding season that could be breeding adult birds from the St Abbs Head to Fast Castle SPA (based on the most recent count of 10,300 breeding adults) is calculated as 2.1% (**Table 9-8**).

~~376.~~454. Outside the breeding season breeding kittiwakes, including those from the St Abbs Head to Fast Castle SPA, are not constrained by requirements to visit nests to incubate eggs or provision chicks. At this time, they are assumed to range more widely and to mix with kittiwakes of all age classes from breeding colonies in the UK and further afield. The background population during these seasons is the UK North Sea BDMPS. This consists of 829,937 individuals during the autumn migration season (August to December), and 627,816 individuals during the spring migration season (January to April) (Furness, 2015).

~~377.~~ It is estimated that 0.5% and 0.7% of birds present in the Project Array Areas are breeding adults from the St Abbs Head to Fast Castle SPA in the autumn and spring respectively. Note, these percentages have been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

~~9.8.2.1.3~~9.9.2.1.3 *Assessment of Potential Effects of the Projects alone and Together*

~~9.8.2.1.3.1~~9.9.2.1.3.1 *Potential Effects During Operation: Collision risk*

Table 9-52 Summary of kittiwake total collisions and apportioned to the St Abbs Head to Fast Castle SPA.

Site	Season	Collision mortality			SPA %	Adult %	Collisions apportioned to SPA		
		Lower 95% c.i.	Mean	Upper 95% c.i.			Lower 95% c.i.	Mean	Upper 95% c.i.
DBS East	Breeding	42.3	83.3	168.5	2	53	0.45	0.88	1.79
						100	0.85	1.67	3.37
	Autumn	14.6	41.4	82.9	0.5	100	0.07	0.21	0.41
	Spring	6.8	14.6	28.0	0.7	100	0.05	0.10	0.20
	Annual (53% adults)	66.9	139.3	261.3	-	-	0.57	1.19	2.40
	Annual (100% adults)						0.97	1.98	3.98
DBS West	Breeding	36.9	107.8	280.8	2	53	0.39	1.14	2.98
						100	0.74	2.16	5.62
	Autumn	9.5	37.9	81.9	0.5	100	0.05	0.19	0.41
	Spring	7.1	14.9	26.5	0.7	100	0.05	0.10	0.19
	Annual (53% adults)	55.9	160.6	327.0	-	-	0.49	1.44	3.57

Site	Season	Collision mortality			SPA %	Adult %	Collisions apportioned to SPA		
		Lower 95% c.i.	Mean	Upper 95% c.i.			Lower 95% c.i.	Mean	Upper 95% c.i.
	Annual (100% adults)						0.84	2.45	6.21
DBS East + DBS West	Breeding	96.2	191.1	378.4	2	53	1.02	2.03	4.01
						100	1.92	3.82	7.57
	Autumn	30.5	79.3	143.1	0.5	100	0.15	0.40	0.72
	Spring	16.9	29.5	47.3	0.7	100	0.12	0.21	0.33
	Annual (53% adults)	150.9	299.9	540.5	-	-	1.29	2.63	5.06
	Annual (100% adults)						2.19	4.43	8.61

~~9.8.2.1.3.1.1~~9.9.2.1.3.1.1 *DBS East in Isolation*

~~378.~~455. Based on adult kittiwake proportions of 53% and 100% (**Table 9-7**) applied to the breeding season impact and the proportions of birds recorded at the Projects predicted to be adult birds from the St Abb's Head to Fast Castle SPA (2%, 0.5% and 0.7% in the breeding, autumn and spring respectively), the predicted mean (lower c.i. and upper c.i.) collision risk impact from DBS East alone on the breeding kittiwake population is 0.9 (0.4 to 1.8) or 1.7 (0.8 to 3.4) birds in the breeding season, 0.2 (0.07 to 0.4) birds during autumn migration and 0.1 (0.05 to 0.2) birds during spring migration (**Table 9-41).**

~~379.~~456. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-7**) the number of individuals from the St Abb's Head to Fast Castle SPA population expected to die is 1,285 (8,804 x 0.146) adults per annum. The predicted annual (breeding, autumn migration and spring migration periods combined) impacts from DBS East alone on the breeding kittiwake population is 1.2 (0.6 to 2.4) or 2.0 (1.0 to 4.0) birds per annum. These result in a predicted change in adult mortality rate of 0.09% to 0.15% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.8.2.1.3.1.2~~9.9.2.1.3.1.2 DBS West in Isolation

~~380.~~457. Based on adult kittiwake proportions of 53% and 100% (**Table 9-7**) applied to the breeding season impact and the proportions of birds recorded at the Projects predicted to be adult birds from the St Abb's Head to Fast Castle SPA (2%, 0.5% and 0.7% in the breeding, autumn and spring respectively), the predicted mean (lower c.i. and upper c.i.) collision risk impact from DBS West alone on the breeding kittiwake population is 1.1 (0.4 to 3.0) or 2.2 (0.7 to 5.6) birds in the breeding season, 0.2 (0.05 to 0.4) birds during autumn migration and 0.1 (0.05 to 0.2) birds during spring migration (**Table 9-41).**

~~381.~~458. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-7**) the number of individuals from the St Abb's Head to Fast Castle SPA population expected to die is 1,285 (8,804 x 0.146) adults per annum. The predicted annual (breeding, autumn migration and spring migration periods combined) impacts from DBS West alone on the breeding kittiwake population is 1.4 (0.5 to 3.6) or 2.4 (0.8 to 6.2) birds per annum. These result in a predicted change in adult mortality rate of 0.11% to 0.18% which are below the 1% threshold for detectability and therefore no further assessment was required.

~~9.8.2.1.3.1.3~~9.9.2.1.3.1.3 DBS East and DBS West Together

~~382.~~459. Based on adult kittiwake proportions of 53% and 100% (**Table 9-7**~~) applied to the breeding season impact and the proportions of birds recorded at the Projects predicted to be adult birds from the St Abb's Head to Fast Castle SPA (2%, 0.5% and 0.7% in the breeding, autumn and spring respectively), the predicted mean (lower c.i. and upper c.i.)~~) applied to the breeding season impact and the proportions of birds recorded at the Projects predicted to be adult birds from the St Abb's Head to Fast Castle SPA (2%, 0.5% and 0.7% in the breeding, autumn and spring respectively), the predicted mean (lower c.i. and upper c.i.) collision risk impact from the Projects (DBS East and DBS West together) alone on the breeding kittiwake population is 2.0 (1.0 to 4.0) or 3.8 (1.9 to 7.6) birds in the breeding season, 0.4 (0.15 to 0.7) birds during autumn migration and 0.2 (0.12 to 0.33) birds during spring migration (**Table 9-41).**

~~383.~~460. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-7**) the number of individuals from the St Abb's Head to Fast Castle SPA population expected to die is 1,285 (8,804 x 0.146) adults per annum. The predicted annual (breeding, autumn migration and spring migration periods combined) impacts from the Projects on the breeding kittiwake population is 2.6 (1.3 to 5.1) or 4.4 (2.2 to 8.6) birds per annum. These result in a predicted change in adult mortality rate of 0.2% to 0.34% which are below the 1% threshold for detectability and therefore no further assessment was required.

~~9.8.2.1.4~~9.9.2.1.4 *Summary of DBS alone*

~~384.~~461. A table summarising the kittiwake operational collision risk assessment for DBS East and DBS West together is provided below (**Table 9-53**).

~~385.~~462. It is concluded that predicted kittiwake mortality due to operational phase collision risk at DBS East, DBS West, and the Projects together would **not adversely affect the integrity of the St Abb's Head to Fast Castle SPA**.

Table 9-53 Summary of predicted Kittiwake collision mortality from St Abb's Head to Fast Castle SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations for the Worst Case Wind Turbine Scenario.

Kittiwake		Collisions		
Potential Effects During Operation: Collision Risk				
Collision mortality		Lower c.i.	Mean.	Upper c.i.
Breeding season (53% - 100% adults)		1.0-1.9	2.0-3.8	4.0-7.6
Autumn		0.15	0.40	0.7
Spring		0.12	0.21	0.33
Annual		1.3-2.2	2.6-4.4	5.1-8.6
Effect	Reference population			8,804
	Increase in background mortality (%)	0.1-0.2	0.2-0.34	0.39-0.67

~~9.8.2.1.5~~9.9.2.1.5 *Assessment of potential effects of the Projects in combination with other plans and projects*

~~386.~~463. Given that no measurable increase in the St Abb's Head to Fast Castle SPA kittiwake mortality is predicted as a result of DBS East and DBS West combined (e.g. with total collision mortality of only 2.7 birds per year during operation even under the most precautionary assumptions), it is concluded that the projects would not contribute to in-combination effects on this species.

~~387.~~464. Therefore, it is concluded that predicted kittiwake mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the St Abb's Head to Fast Castle SPA**.

~~9.8.2.2~~9.9.2.2 Guillemot

~~388.~~465. Guillemot has been screened into the Assessment to assess the impacts from disturbance / displacement in the construction and operation phase.

~~9.8.2.2.1~~9.9.2.2.1 Status

~~389.~~466. Guillemot is listed as a named component of the breeding seabird assemblage of the St Abbs Head to Fast Castle SPA. The SPA breeding population at classification in 1997 was 31,750 breeding adults (SNH, 2009). Burnell *et al*. (2023) give an updated count of 45,827 individuals which has been used in this assessment.

~~9.8.2.2.2~~9.9.2.2.2 Connectivity to the Projects

~~390.~~467. DBS East and DBS West are 290km and 256km respectively from the St Abbs Head to Fast Castle SPA. The mean maximum foraging range of guillemot is 153.7km (73.2km + 80.5km, Woodward *et al*., 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding guillemot from the St Abbs Head to Fast Castle SPA, there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

~~391.~~468. Outside the breeding season, breeding guillemots from the SPA are assumed to range widely and to mix with guillemots from breeding colonies in the UK and beyond. The relevant non-breeding season reference population is the UK North Sea and Channel BDMPS, consisting of 1,617,306 individuals (August to February) (Furness, 2015). It is estimated that 2.5% of birds present at the Projects are considered to be breeding adults from St Abbs Head to Fast Castle SPA. Note, this percentage has been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

~~9.8.2.2.3~~9.9.2.2.3 Assessment of Potential Effects of the Projects alone and Together

Table 9-54 Summary of guillemot density and abundance estimates and SPA apportioning rates and used in the operation and construction displacement assessment for St Abbs Head to Fast Castle SPA. Note that displacement from the wind farm has been estimated as 15%-35%, half the operational rates.

Site	Season	Peak no.	SPA %	Adult %	No. apportioned to SPA	Wind farm operation displacement mortality to SPA			Wind farm construction displacement mortality to SPA			Peak density (birds / km²)	Total vessel displacement mortality (2km around 3 vessels, 1% mortality)	Vessel mortality to SPA	Total construction displacement mortality to SPA		
						30-1	50-1	70-10	15-1	25 - 1	35-10				15-1 & vessel	25 – 1 & vessel	35-10 & vessel
DBS East	Breeding	9030.5	0	55.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18	6.7	0.00	0.00	0.00	0.00
	Nonbreeding	12551.8	2.5	100	313.8	0.9	1.6	22.0	0.5	0.8	11.0	25	9.3	0.23	0.70	1.02	11.21
	Annual				313.8	0.9	1.6	22.0	0.5	0.8	11.0	-	16	0.23	0.70	1.02	11.21
DBS West	Breeding	8783.5	0	55.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17	6.4	0.00	0.00	0.00	0.00
	Nonbreeding	12498.4	2.5	100	312.5	0.9	1.6	21.9	0.5	0.8	10.9	24	9.1	0.23	0.70	1.01	11.16
	Annual				312.5	0.9	1.6	21.9	0.5	0.8	10.9	-	15.5	0.23	0.70	1.01	11.16
DBS East + DBS West	Breeding	~~14927.7~~17814.0	0	55.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	13.0	0.00	0.00	0.00	0.00
	Nonbreeding	~~20136.0~~25050.2	2.5	100	~~503.4~~626.3	1.~~5~~9	~~2.5~~3.1	43.8~~35.2~~	0.~~8~~9	1.~~3~~6	~~17.6~~21.9		18.4	0.46	1.~~21~~4	~~1.72~~2.0	~~18.08~~22.4
	Annual				~~503.4~~626.3	1.~~5~~9	~~2.5~~3.1	43.8~~35.2~~	0.~~8~~9	1.~~3~~6	~~17.6~~21.9		31.4	0.46	1.~~21~~4	~~1.72~~2.0	~~18.08~~22.4

~~9.8.2.2.3.1~~9.9.2.2.3.1 *Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines*

~~9.8.2.2.3.1.1~~9.9.2.2.3.1.1 DBS East in Isolation

~~392.~~469. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the St Abbs Head to Fast Castle SPA population expected to die is 2,795 (45,827 x 0.061) adults per annum. The predicted annual construction impact from DBS East alone on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 11.2 birds per annum (**Table 9-54**). This would result in a predicted change in adult mortality rate of 0.4%. The equivalent mortality assuming 35% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 2.2 which would increase the background mortality rate by 0.08%.

~~393.~~470. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~394.~~471. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the St Abbs Head to Fast Castle SPA (1.0) would increase the predicted annual mortality by 0.04% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.8.2.2.3.1.2~~9.9.2.2.3.1.2 *DBS West in Isolation*

~~395.~~472. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the St Abbs Head to Fast Castle SPA population expected to die is 2,795 (45,827 x 0.061) adults per annum. The predicted annual construction impact from DBS West alone on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 11.2 birds per annum (**Table 9-54)**. This would result in a predicted change in adult mortality rate of 0.4%. The equivalent mortality assuming 35% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 2.2 which would increase the background mortality rate by 0.08%.

~~396.~~473. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~397.~~474. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the St Abbs Head to Fast Castle SPA (1.0) would increase the predicted annual mortality by 0.04% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.8.2.2.3.1.3~~9.9.2.2.3.1.3 DBS East and West Together

~~398.~~475. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the St Abbs Head to Fast Castle SPA population expected to die is 2,795 (45,827 x 0.061) adults per annum. The predicted annual construction impact from DBS East and DBS West on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is ~~18.1~~22.4 birds per annum (**Table 9-54**). This would result in a predicted change in adult mortality rate of 0.~~6%.~~ 8%. The equivalent mortality assuming 35% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 4.5 which would increase the background mortality rate by 0.16%.

~~399.~~476. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~400.~~477. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the St Abbs Head to Fast Castle SPA (~~1.7~~2.0) would increase the predicted annual mortality by 0.~~06~~07% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.8.2.2.3.2~~9.9.2.2.3.2 Potential Effects During Operation: Disturbance and Displacement

~~9.8.2.2.3.2.1~~9.9.2.2.3.2.1 DBS East in Isolation

~~401.~~478. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the St Abbs Head to Fast Castle SPA population expected to die is 2,795 (45,827 x 0.061) adults per annum. The predicted annual operation impact from DBS East alone on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 22.0 birds per annum (**Table 9-54**). This would result in a predicted change in adult mortality rate of 0.8%. The equivalent mortality assuming 70% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 4.4 which would increase the background mortality rate by 0.16%.

~~402.~~479. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~403.~~480. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the St Abbs Head to Fast Castle SPA (1.6) would increase the predicted annual mortality by 0.05% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.8.2.2.3.2.2~~9.9.2.2.3.2.2 DBS West in Isolation

~~404.~~481. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the St Abbs Head to Fast Castle SPA population expected to die is 2,795 (45,827 x 0.061) adults per annum. The predicted annual operation impact from DBS West alone on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 22.0 birds per annum (**Table 9-54**). This would result in a predicted change in adult mortality rate of 0.8%. The equivalent mortality assuming 70% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 4.4 which would increase the background mortality rate by 0.16%.

~~405.~~482. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~406.~~483. At a more appropriate (construction) displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the St Abbs Head to Fast Castle SPA (1.6) would increase the predicted annual mortality by 0.05% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.8.2.2.3.2.3~~9.9.2.2.3.2.3 DBS East and West Together

~~407.~~484. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the St Abbs Head to Fast Castle SPA population expected to die is 2,795 (45,827 x 0.061) adults per annum. The predicted annual operation impact from DBS East and DBS West on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is ~~35.2~~43.8 birds per annum (**Table 9-54**). This would result in a predicted change in adult mortality rate of 1.~~2%.~~ 6%. The equivalent mortality assuming 70% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 8.8 which would increase the background mortality rate by 0.31%.

~~408.~~485. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~409.~~486. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the St Abbs Head to Fast Castle SPA (~~2.5~~3.1) would increase the predicted annual mortality by 0.~~09~~11% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.8.2.2.4~~9.9.2.2.4 Summary

~~410.~~487. A matrix of the annual operational displacement estimates for DBS East and DBS West is provided in **Table 9-55**.

Table 9-55 Displacement matrix for annual project alone (DBS East plus DBS West) guillemot apportioned to St.Abbs Head to Fast Castle SPA adult population.

Mortality %	Displacement %									
	10	20	30	40	50	60	70	80	90	100
1	1	1	2	3	3	4	4	5	6	6
2	1	3	4	5	6	8	9	10	11	13
3	2	4	6	8	9	11	13	15	17	19
4	3	5	8	10	13	15	18	20	23	25
5	3	6	9	13	16	19	22	25	28	31
6	4	8	11	15	19	23	26	30	34	38
7	4	9	13	18	22	26	31	35	39	44
8	5	10	15	20	25	30	35	40	45	50
9	6	11	17	23	28	34	39	45	51	56
10	6	13	19	25	31	38	44	50	56	63
20	13	25	38	50	63	75	88	100	113	125
30	19	38	56	75	94	113	132	150	169	188
50	31	63	94	125	157	188	219	251	282	313
75	47	94	141	188	235	282	329	376	423	470
100	63	125	188	251	313	376	438	501	564	626

~~411.~~488. A table summarising the guillemot construction and operational disturbance and displacement assessment for DBS East and DBS West together is provided below (**Table 9-56)**.

~~412.~~489. It is concluded that predicted guillemot mortality due to construction and operational phase disturbance and displacement impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the St Abbs Head to Fast Castle SPA**.

Table 9-56 Summary of predicted guillemot displacement mortality from St Abbs Head to Fast Castle SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.

Guillemot		Displacement		
Potential Effects During Construction: Disturbance and Displacement				
Displacement mortality		Mean (@25% x 1%)	Mean (@35% x ~~10~~2%)	Mean (@~~25~~35% x ~~1~~10%)
Breeding season		0	0	0
Nonbreeding season		~~18.1~~2.0	~~1.7~~4.5	22.4
Annual		~~18.1~~2.0	~~1.7~~4.5	22.4
Effect	Reference population	45,827		
	Increase in back-ground mortality (%)	0.~~64~~07	0.~~06~~16	0.80
Potential Effects During Operation: Disturbance and Displacement				
Displacement mortality		Mean (@50% x 1%)	Mean (@70% x ~~10~~2%)	Mean (@~~50~~70% x ~~1~~10%)
Breeding season		0	0	0
Nonbreeding season		~~35.2~~3.1	~~2.5~~8.8	43.8
Annual		~~35.2~~3.1	~~2.5~~8.8	43.8
Effect	Reference population	45,827		
	Increase in back-ground mortality (%)	~~1.26~~0.11	0.~~09~~31	

~~9.8.2.2.5~~9.9.2.2.5 *Assessment of potential effects of the Projects in combination with other plans and projects*

~~413.~~490. Given that no measurable increase in the St Abbs Head to Fast Castle SPA guillemot mortality is predicted as a result of DBS East and DBS West combined (e.g. with realistic displacement mortality of ~~2.5~~3 birds per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted guillemot mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the St Abbs Head to Fast Castle SPA**.

~~9.8.2.3~~9.9.2.3 Razorbill

~~414.~~491. Razorbill has been screened into the Assessment to assess the impacts from disturbance / displacement in the construction and operation phase.

~~9.8.2.3.1~~9.9.2.3.1 Status

~~415.~~492. Razorbill is listed as a named component of the breeding seabird assemblage of the St Abbs Head to Fast Castle SPA.

~~416.~~493. The SPA breeding population at classification in 1997 was 2,180 breeding adults (SNH, 2009). Burnell *et al.* (2023) give an updated count of 2,931 individuals which has been used in this assessment.

~~9.8.2.3.2~~9.9.2.3.2 Connectivity to the Projects

~~417.~~494. DBS East and DBS West are 290km and 256km respectively from the St Abbs Head to Fast Castle SPA. The mean maximum foraging range of razorbill is 164.6km (88.7km + 75.9km, Woodward *et al.*, 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding razorbill from the St Abbs Head to Fast Castle SPA, there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

~~418.~~495. Outside the breeding season, breeding razorbills from the SPA are assumed to range widely and to mix with razorbills from breeding colonies in the UK and further afield. The relevant background population is considered to be the UK North Sea and Channel BDMPS, consisting of 591,874 individuals during autumn and spring passage periods (August to October and January to March), and 218,622 individuals during winter (November and December) (Furness, 2015).

~~419.~~496. During the autumn and spring migration it is estimated that St Abbs Head to Fast Castle birds make up 0.4% of the BDMPS population, and during the winter 0.3% of the BDMPS population. Note, these percentages have been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

~~9.8.2.3.3~~9.9.2.3.3 Assessment of Potential Effects of the Projects alone and Together

Table 9-57 Summary of razorbill density and abundance estimates and SPA apportioning rates and used in the operation and construction displacement assessment for St Abbs Head to Fast Castle SPA. Note that displacement from the wind farm has been estimated as 15%-35%, half the operational rates.

Site	Season	Peak no.	SPA %	Adult %	No. apportioned to SPA	Wind farm operation displacement mortality to SPA			Wind farm construction displacement mortality to SPA			Peak density (birds/km²)	Total vessel displacement mortality (2km around 3 vessels, 1% mortality)	Vessel mortality to SPA	Total construction displacement mortality to SPA		
						30-1	50-1	70-10	15-1	25 - 1	35-10				15-1 & vessel	25 – 1 & vessel	35-10 & vessel
DBS East	Breeding	555.1	0.0	61.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.4	0.00	0.00	0.00	0.00
	Autumn	4685.3	0.4	100	18.7	0.1	0.1	1.3	0.0	0.0	0.7	9.2	3.5	0.01	0.04	0.06	0.67
	Winter	3376.7	0.3	100	10.1	0.0	0.1	0.7	0.0	0.0	0.4	6.6	2.5	0.01	0.02	0.03	0.36
	Spring	3578.5	0.4	100	14.3	0.0	0.1	1.0	0.0	0.0	0.5	7.0	2.6	0.01	0.03	0.05	0.51
	Annual				43.1	0.1	0.3	3	0	0	1.6	-	9	0.03	0.09	0.14	1.54
DBS West	Breeding	2280.6	0.0	61.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.4	1.7	0.00	0.00	0.00	0.00
	Autumn	4886.9	0.4	100	19.5	0.1	0.1	1.4	0.0	0.0	0.7	9.4	3.5	0.01	0.04	0.06	0.70
	Winter	5066.2	0.3	100	15.2	0.0	0.1	1.1	0.0	0.0	0.5	9.7	3.7	0.01	0.03	0.05	0.54
	Spring	4454.6	0.4	100	17.8	0.1	0.1	1.2	0.0	0.0	0.6	8.6	3.2	0.01	0.04	0.06	0.64
	Annual				52.5	0.2	0.3	3.7	0.1	0.2	1.9	-	10.4	0.03	0.11	0.17	1.88
DBS East + DBS West	Breeding	~~2826.1~~ 2835.7	~~0.~~0	61.3	0.0	0.0	0.0	0.0	~~0.~~0	~~0.~~0	~~0.~~0		2.1	0.00	0~~.00~~	0~~.00~~	0~~.00~~
	Autumn	~~6349.6~~ 9572.2	0.4	100	~~25.4~~38.3	0.~~1~~11	0.~~1~~19	~~1.8~~2.68	0.~~0~~06	0.~~1~~10	~~0.9~~1.34		7.0	0.03	0.~~07~~09	0.~~09~~13	~~0.92~~1.37
	Winter	~~5823.7~~ 8442.9	0.3	100	~~17.5~~25.3	0.~~1~~08	0.~~1~~13	1.~~2~~77	0.~~0~~04	0.~~00~~06	0.~~6~~89	-	6.1	0.02	0.~~03~~06	0.~~04~~08	0.~~48~~91

Site	Season	Peak no.	SPA %	Adult %	No. apportioned to SPA	Wind farm operation displacement mortality to SPA			Wind farm construction displacement mortality to SPA			Peak density (birds/km²)	Total vessel displacement mortality (2km around 3 vessels, 1% mortality)	Vessel mortality to SPA	Total construction displacement mortality to SPA		
						30-1	50-1	70-10	15-1	25 - 1	35-10				15-1 & vessel	25 – 1 & vessel	35-10 & vessel
	Spring	~~6302.5~~ 8033.1	0.4	100	~~25.2~~32.1	0.~~1~~10	0.~~1~~16	~~1.8~~2.25	0.~~0~~005	0.~~1~~08	~~0.9~~1.12		5.9	0.02	0.~~06~~07	0.~~09~~10	~~0.91~~1.14
	Annual				~~68.1~~95.7	0.~~3~~29	0.~~3~~48	~~4.8~~6.70	0.~~2~~14	0.~~2~~24	~~2.4~~3.35		21.1	0.07	0.~~22~~21	0.~~22~~31	~~2.47~~3.42

~~9.8.2.3.3.1~~9.9.2.3.3.1 *Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines*

~~9.8.2.3.3.1.1~~9.9.2.3.3.1.1 *DBS East in Isolation*

~~420.~~497. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-7**) the number of individuals from the St Abbs Head to Fast Castle SPA population expected to die is 308 (2,931 x 0.105) adults per annum. The predicted annual construction impact from DBS East alone on the breeding razorbill population applying highly precautionary rates of 35% displacement and 10% mortality is 1.54 (0.7, 0.4, 0.5 in autumn winter and spring respectively) birds per annum (**Table 9-57**). This would result in a predicted change in adult mortality rate of 0.5%. The equivalent mortality assuming 35% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 0.31 which would increase the background mortality rate by 0.1%.

~~421.~~498. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~422.~~499. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the St Abbs Head to Fast Castle SPA (0.14) would increase the predicted annual mortality by 0.04% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.8.2.3.3.1.2~~9.9.2.3.3.1.2 *DBS West in Isolation*

~~423.~~500. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-7**) the number of individuals from the St Abbs Head to Fast Castle SPA population expected to die is 308 (2,931 x 0.105) adults per annum. The predicted annual construction impact from DBS West alone on the breeding razorbill population applying highly precautionary rates of 35% displacement and 10% mortality is 1.9 (0.7, 0.5, 0.6 in autumn winter and spring respectively) birds per annum (**Table 9-57**). This would result in a predicted change in adult mortality rate of 0.6%. The equivalent mortality assuming 35% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 0.38 which would increase the background mortality rate by 0.12%.

~~424.~~501. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~425.~~502. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the St Abbs Head to Fast Castle SPA (0.2) would increase the predicted annual mortality by 0.06% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.8.2.3.3.1.3~~9.9.2.3.3.1.3 *DBS East and West Together*

~~426.~~503. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-7**) the number of individuals from the St Abbs Head to Fast Castle SPA population expected to die is 308 (2,931 x 0.105) adults per annum. The predicted annual construction impact from DBS East and DBS West on the breeding razorbill population applying highly precautionary rates of 35% displacement and 10% mortality is ~~2~~3.4 (1.4, 0.9, ~~0.6, 0.9~~1.1 in autumn, winter and spring respectively) birds per annum (**Table 9-57**). This would result in a predicted change in adult mortality rate of ~~0.8~~1.1%. The equivalent mortality assuming 35% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 0.68 which would increase the background mortality rate by 0.22%.

~~427.~~504. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~428.~~505. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the St Abbs Head to Fast Castle SPA (0.~~2~~31) would increase the predicted annual mortality by 0.~~06~~1% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.8.2.3.3.2~~9.9.2.3.3.2 Potential Effects During Operation: Disturbance and Displacement

~~9.8.2.3.3.2.1~~9.9.2.3.3.2.1 DBS East in Isolation

~~429.~~506. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-7**) the number of individuals from the St Abbs Head to Fast Castle SPA population expected to die is 308 (2,931 x 0.105) adults per annum. The predicted annual operation impact from DBS East alone on the breeding razorbill population applying highly precautionary rates of 70% displacement and 10% mortality is 3.0 (1.3, 0.7, 1.0 in autumn winter and spring respectively) birds per annum (**Table 9-57**). This would result in a predicted change in adult mortality rate of 0.9%. The equivalent mortality assuming 70% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 0.6 which would increase the background mortality rate by 0.19%.

~~430.~~507. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~431.~~508. At a more appropriate operational displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the St Abbs Head to Fast Castle SPA (0.2) would increase the predicted annual mortality by 0.07% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.8.2.3.3.2.2~~9.9.2.3.3.2.2 *DBS West in Isolation*

~~432.~~509. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-7**) the number of individuals from the St Abbs Head to Fast Castle SPA population expected to die is 308 (2,931 x 0.105) adults per annum. The predicted annual operation impact from DBS West alone on the breeding razorbill population applying highly precautionary rates of 70% displacement and 10% mortality is 3.7 (1.4, 1.1, 1.2 in autumn winter and spring respectively) birds per annum (**Table 9-57**). This would result in a predicted change in adult mortality rate of 1.2%. The equivalent mortality assuming 70% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 0.74 which would increase the background mortality rate by 0.24%.

~~433.~~510. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~434.~~511. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the St Abbs Head to Fast Castle SPA (0.3) would increase the predicted annual mortality by 0.1% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.8.2.3.3.2.3~~9.9.2.3.3.2.3 DBS East and West Together

~~435.~~512. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-7**) the number of individuals from the St Abbs Head to Fast Castle SPA population expected to die is 308 (2,931 x 0.105) adults per annum. The predicted annual construction impact from DBS East and DBS West on the breeding razorbill population applying highly precautionary rates of 70% displacement and 10% mortality is ~~4.8 (~~6.7 (2.7, 1.8, ~~1.~~2~~, 1.8~~.2 in autumn, winter and spring respectively) birds per annum (**Table 9-57**). This would result in a predicted change in adult mortality rate of ~~1.6~~2.2%. The equivalent mortality assuming 70% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 1.3 which would increase the background mortality rate by 0.43%.

~~436.~~513. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~437.~~514. At a more appropriate operational displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the St Abbs Head to Fast Castle SPA (0.~~3~~48) would increase the predicted annual mortality by 0.~~1~~16% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.8.2.3.4~~9.9.2.3.4 Summary

~~438.~~515. A matrix of the annual operational displacement estimates for DBS East and DBS West is provided in **Table 9-58**.

Table 9-58 Displacement matrix for annual project alone (DBS East plus DBS West) razorbill apportioned to St.Abbs Head to Fast Castle SPA adult population.

Mortality %	Displacement %									
	10	20	30	40	50	60	70	80	90	100
1	0	0	0	0	0	1	1	1	1	1
2	0	0	1	1	1	1	1	2	2	2
3	0	1	1	1	1	2	2	2	3	3
4	0	1	1	2	2	2	3	3	3	4
5	0	1	1	2	2	3	3	4	4	5
6	1	1	2	2	3	3	4	5	5	6
7	1	1	2	3	3	4	5	5	6	7
8	1	2	2	3	4	5	5	6	7	8
9	1	2	3	3	4	5	6	7	8	9
10	1	2	3	4	5	6	7	8	9	10
20	2	4	6	8	10	11	13	15	17	19
30	3	6	9	11	14	17	20	23	26	29
50	5	10	14	19	24	29	33	38	43	48
75	7	14	22	29	36	43	50	57	65	72
100	10	19	29	38	48	57	67	77	86	96

~~439.~~516. A table summarising the razorbill construction and operational disturbance and displacement assessment for DBS East and DBS West together is provided below (**Table 9-59**).

~~440.~~517. It is concluded that predicted razorbill mortality due to construction and operational phase disturbance and displacement impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the St Abbs Head to Fast Castle SPA**.

Table 9-59 Summary of predicted razorbill displacement mortality from St Abbs Head to Fast Castle SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.

Guillemot	Displacement		
Potential Effects During Construction: Disturbance and Displacement			
Displacement mortality	Mean (@25% x 1%)	Mean (@35% x ~~10~~2%)	Mean (@~~25~~35% x ~~1~~10%)
Breeding season	0		0
Autumn	0.~~92~~13	0.~~09~~27	1.37
Winter	0.~~60~~08	0.~~04~~18	0.91
Spring	0.~~91~~1	0.~~09~~23	1.14
Annual	~~2.4~~0.31	0.~~2~~68	3.42
Effect: Reference population	2,931		
Effect: Increase in background mortality (%)	0.~~8~~10	0.~~07~~18	1.1
Potential Effects During Operation: Disturbance and Displacement			
Displacement mortality	Mean (@50% x 1%)	Mean (@70% x ~~10~~2%)	Mean (@~~50~~70% x ~~1~~10%)
Breeding season	0		0
Autumn	~~1.8~~0.19	0.~~1~~54	2.68
Winter	~~1.2~~0.13	0.~~1~~35	1.77
Spring	~~1.8~~0.16	0.~~1~~45	2.25
Annual	0.~~3~~48	1.34	6.70
Effect: Reference population	2,931		
Effect: Increase in background mortality (%)	~~1.55~~0.16	0.~~1~~43	2.2

~~9.8.2.3.5~~9.9.2.3.5 *Assessment of potential effects of the Projects in combination with other plans and projects*

~~441.~~518. Given that no measurable increase in the St Abbs Head to Fast Castle SPA razorbill mortality is predicted as a result of DBS East and DBS West combined (e.g. with realistic displacement mortality of 0.~~1~~5 bird per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted guillemot mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the St Abbs Head to Fast Castle SPA**.

~~9.9~~9.10 Forth Islands SPA

~~9.9.1~~9.10.1 Site Description

~~442.~~519. The Forth Islands SPA consists of a series of islands supporting the main seabird colonies in the Firth of Forth. The seaward extension extends approximately 2km to include the seabed, water column and surface. Seabirds included within the designation feed both inside and outside the SPA in nearby waters, as well as more distantly in the wider North Sea.

~~9.9.1.1~~9.10.1.1 Qualifying Features

~~443.~~520. The qualifying features of the Forth Islands SPA screened into the Assessment are listed in Table 4-7 of **RIAA HRA Part 1 of 4 – Introduction and Terrestrial Ecology (application ref: 6.1)**. These are breeding gannet, lesser black-backed gull and puffin and four named components of the breeding seabird assemblage (kittiwake, guillemot, razorbill and herring gull).

~~9.9.1.2~~9.10.1.2 Conservation Objectives

~~444.~~521. The over-arching conservation objectives of the site are:

- To avoid deterioration of the habitats of the qualifying species or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained; and
- To ensure for the qualifying species that the following are maintained in the long term:
  - Population of the species as a viable component of the site;
  - Distribution of the species within site;
  - Distribution and extent of habitats supporting the species;
  - Structure, function and supporting processes of habitats supporting the species; and
  - No significant disturbance of the species.

~~9.9.2~~9.10.2 Assessment: Array Areas

~~9.9.2.1~~9.10.2.1 Gannet

~~445.~~522. Gannet has been screened in to assess the impacts from disturbance / displacement and collision risk in the construction and operation phases.

~~9.9.2.1.1~~9.10.2.1.1 Status

~~446.~~523. Gannet is listed as a designated species of the Forth Islands SPA.

~~447.~~524. The SPA breeding population at classification in 1990 was cited as 21,600 pairs, 43,200 breeding adults (SNH, 2009). The most recent count is 75,259 apparently occupied nests, or 150,518 breeding adults in 2014 (JNCC, 2023a). The baseline mortality of this population is 9,765 breeding adult birds per year based on the published adult mortality rate of 8.8% (Horswill and Robinson, 2015) and the Forth Islands SPA population of 110,964 breeding adults published in Furness (2015). Burnell *et al*. (2023) give an updated count of 75,259 AON (150,518 adults) which has been used in this assessment.

~~9.9.2.1.2~~9.10.2.1.2 Connectivity to the Projects

~~448.~~525. DBS East and DBS West are 326km and 291km respectively from the Forth Islands SPA. The mean maximum foraging range of gannet is 509.4km (315.2 + 194.2km, Woodward *et al*., 2019). However, although DBS East and DBS West are both within potential foraging range for breeding gannet from the Forth Islands SPA, Wakefield *et al*. (2013) found very little overlap in colony foraging areas, so connectivity is considered very unlikely during the breeding season. It is considered that 100% of the breeding adult gannets recorded at the Projects during the breeding season are birds from the Flamborough and Filey Coast SPA.

~~449.~~526. Outside the breeding season breeding gannets, including those from the Forth Islands SPA, are not constrained by requirements to visit nests to incubate eggs or provision chicks. At this time, they are assumed to range more widely and to mix with gannets of all age classes from breeding colonies in the UK and further afield. The background population during these seasons is the UK North Sea BDMPS. This consists of 456,298 individuals during autumn migration (September to November), and 248,385 individuals during spring migration (December to March) (Furness, 2015).

~~9.9.2.1.3~~9.10.2.1.3 *Assessment of Potential Effects of the Projects alone and Together*

~~450.~~527. The seasonal peak total number of gannets recorded in DBS East and DBS West and the number apportioned to Forth Islands SPA is provided in **Table 9-60**.

~~451.~~528. Construction displacement has been estimated on the basis this operates across half the wind farm. Thus, gannet displacement was calculated using 30% and 40% displacement rates (i.e. half the operational values) and 1% mortality. These were then added to the number of birds expected to be displaced by up to three construction vessels (assuming 100% displacement within 2km of each vessel and 1% mortality), calculated from the seasonal densities (**Table 9-60**).

Table 9-60 Summary of gannet density and abundance estimates and SPA apportioning rates and used in the operation and construction displacement assessment for Forth Islands SPA. Note that displacement from the wind farm has been estimated as 30%-40%, half the operational rates.

Site	Season	Peak no. (mean)	SPA %	Adult %	No. apportioned to SPA	Wind farm operation displacement mortality to SPA		Wind farm construction displacement mortality to SPA		Peak density (birds/ km^2)	Total vessel displacement mortality (2km around 3 vessels, 1% mortality)	Vessel mortality to SPA	Total construction displacement mortality to SPA	
						60-1	80-1	30-1	40-1				30-1 & vessel	40-1 & vessel
DBS East	Breeding	754.9	0	60	0.0	0.00	0.00	0.00	0.00	1.48	0.56	0.00	0.00	0.00
	Autumn	776.1	24.3	100	188.6	1.13	1.51	0.57	0.75	1.52	0.57	0.14	0.70	0.89
	Spring	75.1	31.3	100	23.5	0.14	0.19	0.07	0.09	0.15	0.06	0.02	0.09	0.11
	Annual				212.1	1.27	1.7	0.64	0.84	-	1.19	0.16	0.79	1
DBS West	Breeding	805.3	0	60	0.0	0.00	0.00	0.00	0.00	1.55	0.58	0.00	0.00	0.00
	Autumn	797.5	24.3	100	193.8	1.16	1.55	0.58	0.78	1.54	0.58	0.14	0.72	0.92
	Spring	86.2	31.3	100	27.0	0.16	0.22	0.08	0.11	0.17	0.06	0.02	0.10	0.13
	Annual				220.8	1.32	1.77	0.66	0.89	-	1.22	0.16	0.82	1.05
DBS East + DBS West	Breeding	1560.2	0	60	0.0	0.00	0.00	0.00	0.00		1.14	0.00	0.00	0.00
	Autumn	1573.6	24.3	100	382.4	2.29	3.06	1.15	1.53		1.15	0.28	1.43	1.81
	Spring	161.3	31.3	100	50.5	0.30	0.40	0.15	0.20		0.12	0.04	0.19	0.24
	Annual				432.9	2.59	3.46	1.3	1.73	-	2.41	0.32	1.62	2.05

~~9.9.2.1.3.1.1~~9.10.2.1.3.1.1 *DBS East in Isolation*

~~452.~~529. At the baseline mortality rate for adult gannet of 0.088 (**Table 9-7**) the number of adults from Forth Islands SPA population expected to die per year is 13,246 (150,518 x 0.088). The predicted annual construction mortality impacts from DBS East alone on the breeding gannet population is 1.0 bird per annum (**Table 9-60**). This results in a predicted change in adult mortality rate of <0.01% which is below the 1% threshold for detectability and therefore no further assessment is required.

~~9.9.2.1.3.1.2~~9.10.2.1.3.1.2 *DBS West in Isolation*

~~453.~~530. At the baseline mortality rate for adult gannet of 0.088 (**Table 9-7**) the number of adults from Forth Islands SPA population expected to die per year is 13,246 (150,518 x 0.088). The predicted annual construction mortality impacts from DBS West alone on the breeding gannet population is 1.0 bird per annum (**Table 9-60**). This results in a predicted change in adult mortality rate of <0.01% which is below the 1% threshold for detectability and therefore no further assessment is required.

~~9.9.2.1.3.1.3~~9.10.2.1.3.1.3 *DBS East and West Together*

~~454.~~531. At the baseline mortality rate for adult gannet of 0.088 (**Table 9-7**) the number of adults from Forth Islands SPA population expected to die per year is 13,246 (150,518 x 0.088). The predicted annual construction mortality impacts from DBS East and DBS West on the breeding gannet population is 2.0 birds per annum (**Table 9-60**). This results in a predicted change in adult mortality rate of 0.01% which is below the 1% threshold for detectability and therefore no further assessment is required.

~~9.9.2.1.3.2~~9.10.2.1.3.2 *Potential Effects During Operation: Disturbance and Displacement*

~~9.9.2.1.3.2.1~~9.10.2.1.3.2.1 *DBS East in Isolation*

~~455.~~532. At the baseline mortality rate for adult gannet of 0.088 (**Table 9-7**) the number of individuals from Forth Islands SPA population expected to die per year is 13,246 (150,518 x 0.088). The predicted annual impacts from DBS East alone on the breeding gannet population is 1.7 birds per annum (**Table 9-60**). This results in a predicted change in adult mortality rate of 0.01% which is below the 1% threshold for detectability and therefore no further assessment is required.

~~9.9.2.1.3.2.2~~9.10.2.1.3.2.2 *DBS West in Isolation*

~~456.~~533. At the baseline mortality rate for adult gannet of 0.088 (**Table 9-7**) the number of individuals from Forth Islands SPA population expected to die per year is 13,246 (150,518 x 0.088). The predicted annual impacts from DBS West alone on the breeding gannet population is 1.8 birds per annum (**Table 9-60**). This results in a predicted change in adult mortality rate of 0.01% which is below the 1% threshold for detectability and therefore no further assessment is required.

~~9.9.2.1.3.2.3~~9.10.2.1.3.2.3 *DBS East and West Together*

~~457.~~534. At the baseline mortality rate for adult gannet of 0.088 (**Table 9-7**) the number of individuals from Forth Islands SPA population expected to die per year is 13,246 (150,518 x 0.088). The predicted annual impacts from DBS West alone on the breeding gannet population is 3.5 birds per annum (**Table 9-60**). This results in a predicted change in adult mortality rate of 0.02% which is below the 1% threshold for detectability and therefore no further assessment is required.

~~9.9.2.1.3.3~~9.10.2.1.3.3 *Potential Effects During Operation: Collision Risk*

Table 9-61 Summary of gannet total collisions and apportioned to Forth Islands SPA.

Site	Season	Collision mortality			SPA %	Adult %	Collisions apportioned to SPA		
		Lower 95% c.i.	Mean	Upper 95% c.i.			Lower 95% c.i.	Mean	Upper 95% c.i.
DBS East	Breeding	0.7	3.4	7.8	0	60	0	0	0
	Autumn	0.3	1.6	3.8	24.3	100	0.1	0.4	0.9
	Spring	0.0	0.1	0.6	31.3	100	0.0	0.0	0.2
	Annual	1.1	5.1	12.2	-	-	0.1	0.4	1.1
DBS West	Breeding	0.6	4.9	15.3	0	60	0.0	0.0	0.0
	Autumn	0.3	2.1	6.0	24.3	100	0.1	0.5	1.5
	Spring	0.0	0.1	0.7	31.3	100	0.0	0.0	0.2
	Annual	1.5	7.1	17.7	-	-	0.1	0.5	1.7
DBS East + DBS West	Breeding	0.9	8.4	26.5	0	60	0.0	0.0	0.0
	Autumn	0.5	3.7	10.8	24.3	100	0.1	0.9	2.6

Site	Season	Collision mortality			SPA %	Adult %	Collisions apportioned to SPA		
		Lower 95% c.i.	Mean	Upper 95% c.i.			Lower 95% c.i.	Mean	Upper 95% c.i.
	Spring	0.0	0.3	1.3	31.3	100	0.0	0.1	0.4
	Annual	2.7	12.4	29.8	-	-	0.1	1.0	3.0

~~9.9.2.1.3.3.1~~9.10.2.1.3.3.1 DBS East in Isolation

~~458.~~535. At the baseline mortality rate for adult gannet of 0.088 (**Table 9-7**) the number of individuals from Forth Islands SPA population expected to die per year is 13,246 (150,518 x 0.088) adults per annum. The predicted impacts from DBS East alone on the breeding gannet population is 0.4 (0.1to 1.1) birds per annum (**Table 9-61**). This results in a predicted change in adult mortality rate of <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.9.2.1.3.3.2~~9.10.2.1.3.3.2 DBS West in Isolation

~~459.~~536. At the baseline mortality rate for adult gannet of 0.088 (**Table 9-7**) the number of individuals from Forth Islands SPA population expected to die per year is 13,246 (150,518 x 0.088) adults per annum. The predicted impacts from DBS West alone on the breeding gannet population is 0.5 (0.1 to 1.7) birds per annum (**Table 9-61**). This results in a predicted change in adult mortality rate of <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.9.2.1.3.3.3~~9.10.2.1.3.3.3 DBS East and West Together

~~460.~~537. At the baseline mortality rate for adult gannet of 0.088 (**Table 9-7**) the number of individuals from Forth Islands SPA population expected to die per year is 13,246 (150,518 x 0.088) adults per annum. The predicted impacts from DBS East and DBS West on the breeding gannet population is 1.0 (0.1 to 3.0) birds per annum (**Table 9-61**). This results in a predicted change in adult mortality rate of 0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.9.2.1.3.4~~9.10.2.1.3.4 Potential Effects During Operation: Combined Operational Displacement and Collision Risk

~~9.9.2.1.3.4.1~~9.10.2.1.3.4.1 DBS East in Isolation

~~461.~~538. Since the estimated impacts from DBS East on the Forth Islands SPA population due to operational displacement and collision risk were extremely small, there is no risk of a combined impact from both together.

~~9.9.2.1.3.4.2~~9.10.2.1.3.4.2 DBS West in Isolation

~~462.~~539. Since the estimated impacts from DBS West on the Forth Islands SPA population due to operational displacement and collision risk were extremely small, there is no risk of a combined impact from both together.

~~9.9.2.1.3.4.3~~9.10.2.1.3.4.3 DBS East and West Together

~~463.~~540. Since the estimated impacts from DBS East and DBS West on the Forth Islands SPA population due to operational displacement and collision risk were extremely small, there is no risk of a combined impact from both together.

~~9.9.2.1.4~~9.10.2.1.4 Summary

~~464.~~541. A table summarising the gannet construction and operational disturbance / displacement, as well as operational collision risk and finally the combination of operational disturbance and displacement with collision risk assessment for DBS East and DBS West together is provided below (**Table 9-62**).

~~465.~~542. It is concluded that predicted gannet mortality due to construction and operational phase displacement, as well as operational collision risk and finally the combination of operational disturbance and displacement with collision risk impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the Forth Islands SPA**.

Table 9-62 Summary of predicted gannet displacement mortality from Forth Islands SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.

Gannet				
Potential Effects During Construction: Disturbance and Displacement				
Displacement mortality (80% + 1%)		Mean	Lower c.i.	Upper c.i.
Breeding season		0	-	-
Autumn		1.81	-	-
Spring		0.24	-	-
Annual		2.05		
Effect	Reference population	150,518	-	-
	Increase in background mortality (%)	0.01	-	-

Gannet				
Potential Effects During Operation: Disturbance and Displacement				
Displacement mortality (80% + 1%)		Mean	Lower c.i.	Upper c.i.
Breeding season		0	-	-
Autumn		3.06	-	-
Spring		0.4	-	-
Annual		3.5		
Effect	Reference population	150,518	-	-
	Increase in background mortality (%)	0.02	-	-
Potential Effects During Operation: Collision Risk				
Collision mortality		Lower c.i.	Mean	Upper c.i.
Breeding season		0	0	0
Autumn		0.1	0.9	2.6
Spring		0.0	0.1	0.4
Annual		0.1	1.0	3.0
Effect	Reference population	150,518		
	Increase in background mortality (%)	0.00	0.01	0.02
Potential Effects During Operation: Combined Disturbance and Displacement and Collision Risk				
Combined Displacement and Collision mortality		Mean	Lower c.i.	Upper c.i.
Breeding season		0	-	-
Autumn		3.16	-	-
Spring		0.48	-	-
Annual		3.6		
Effect	Reference population	150,518	-	-
	Increase in background mortality (%)	0.02	-	-

~~9.9.2.1.5~~9.10.2.1.5 *Assessment of potential effects of the Projects in combination with other plans and projects*

~~466.~~543. Given that no measurable increase in the Forth Islands SPA gannet mortality is predicted as a result of DBS East and DBS West combined (e.g. with total displacement and collision mortality of only 4.4 birds per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted gannet mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Forth Islands SPA**.

~~9.9.2.2~~9.10.2.2 Kittiwake

~~467.~~544. Kittiwake has been screened into the Assessment to assess the impacts from collision risk in the operation phase.

~~9.9.2.2.1~~9.10.2.2.1 Status

~~468.~~545. Kittiwake is listed as a named component of the breeding seabird assemblage of the Forth Islands SPA.

~~469.~~546. The SPA breeding population at classification in 1990 was cited as 8,400 pairs or 16,800 breeding adults (SNH, 2009). The baseline mortality of this population is 1,339 breeding adult birds per year based on the published adult mortality rate of 14.6% (Horswill and Robinson, 2015). Burnell *et al*. (2023) give an updated count of 4,542 AON which has been used in this assessment.

~~9.9.2.2.2~~9.10.2.2.2 Connectivity to the Projects

~~470.~~547. DBS East and DBS West are 326km and 291km respectively from the Forth Islands SPA. The mean maximum foraging range of kittiwake is 300.6km (156.1km + 144.5km, Woodward *et al*., 2019). Therefore, DBS East is outside the potential foraging range for breeding kittiwake from the Forth Islands SPA and, while DBS West is just within potential foraging range for breeding kittiwake from the Forth Islands SPA, it is considered that the likelihood of breeding season connectivity is so low that this can be ruled out.

~~471.~~548. Outside the breeding season breeding kittiwakes, including those from the Forth Islands SPA, are not constrained by requirements to visit nests to incubate eggs or provision chicks. At this time, they are assumed to range more widely and to mix with kittiwakes of all age classes from breeding colonies in the UK and further afield. The background population during these seasons is the UK North Sea BDMPS. This consists of 829,937 individuals during the autumn migration season (August to December), and 627,816 individuals during the spring migration season (January to April) (Furness, 2015).

~~472.~~549. It is estimated that 0.4% and 0.6% of birds present in the Project Array Areas in the autumn and spring migration seasons respectively are considered to be breeding adults from Forth Islands SPA. Note, these percentages have been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

~~9.9.2.2.3~~9.10.2.2.3 Assessment of Potential Effects of the Projects alone and Together

Table 9-63 Summary of kittiwake total collisions and apportioned to Forth Islands SPA.

Site	Season	Collision mortality			SPA %	Adult %	Collisions apportioned to SPA		
		Lower 95% c.i.	Mean	Upper 95% c.i.			Lower 95% c.i.	Mean	Upper 95% c.i.
DBS East	Breeding	42.3	83.3	168.5	0	53	0	0	0
	Autumn	14.6	41.4	82.9	0.4	100	0.06	0.17	0.33
	Spring	6.8	14.6	28.0	0.6	100	0.04	0.09	0.17
	Annual	66.9	139.3	261.3	-	-	0.10	0.25	0.50
DBS West	Breeding	36.9	107.8	280.8	0	53	0	0	0
	Autumn	9.5	37.9	81.9	0.4	100	0.04	0.15	0.33
	Spring	7.1	14.9	26.5	0.6	100	0.04	0.09	0.16
	Annual	55.9	160.6	327.0	-	-	0.08	0.24	0.49
DBS East + DBS West	Breeding	96.2	191.1	378.4	0	53	0	0	0
	Autumn	30.5	79.3	143.1	0.4	100	0.12	0.32	0.57
	Spring	16.9	29.5	47.3	0.6	100	0.10	0.18	0.28
	Annual	150.9	299.9	540.5	-	-	0.22	0.49	0.86

~~9.9.2.2.3.1.1~~9.10.2.2.3.1.1 DBS East in Isolation

~~473.~~550. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-7**) the number of individuals from the Forth Islands SPA population expected to die is 1,326 (9,084 x 0.146) adults per annum. The predicted annual impacts from DBS East alone on the breeding kittiwake population is 0.25 birds per annum **(Table 9-63**). This results in a predicted change in adult mortality rate of 0.02% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.9.2.2.3.1.2~~9.10.2.2.3.1.2 DBS West in Isolation

~~474.~~551. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-7**) the number of individuals from the Forth Islands SPA population expected to die is 1,326 (9,084 x 0.146) adults per annum. The predicted annual impacts from DBS West alone on the breeding kittiwake population is 0.24 birds per annum (**Table 9-63**). This results in a predicted change in adult mortality rate of 0.02% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.9.2.2.3.1.3~~9.10.2.2.3.1.3 DBS East and West Together

~~475.~~552. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-7**) the number of individuals from the Forth Islands SPA population expected to die is 1,326 (9,084 x 0.146) adults per annum. The predicted annual impacts from DBS East and DBS West on the breeding kittiwake population is 0.5 birds per annum (**Table 9-63**). This results in a predicted change in adult mortality rate of 0.04% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.9.2.2.4~~9.10.2.2.4 Summary

~~476.~~553. A table summarising the kittiwake operational collision risk assessment for DBS East and DBS West together is provided below (**Table 9-64**).

~~477.~~554. It is concluded that predicted kittiwake mortality due to operational phase collision risk at DBS East, DBS West, and the Projects together would **not adversely affect the integrity of the Forth Islands SPA**.

Table 9-64 Summary of predicted Kittiwake collision mortality from Forth Islands SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations for the Worst Case Wind Turbine Scenario.

Kittiwake	Collisions		
Potential Effects During Operation: Collision Risk			
Collision mortality	Lower c.i.	Mean.	Upper c.i.

Kittiwake		Collisions		
Breeding season		0	0	0
Autumn		0.12	0.32	0.57
Spring		0.10	0.18	0.28
Annual		0.22	0.49	0.86
Effect	Reference population	9,084		
	Increase in background mortality (%)	0.01	0.06	0.10

~~9.9.2.2.5~~9.10.2.2.5 *Assessment of potential effects of the Projects in combination with other plans and projects*

~~478.~~555. Given that no measurable increase in the Forth Islands SPA kittiwake mortality is predicted as a result of DBS East and DBS West combined (e.g. with total collision mortality of less than 0.5 birds per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted kittiwake mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Forth Islands SPA**.

~~9.9.2.3~~9.10.2.3 Guillemot

~~479.~~556. Guillemot has been screened into the Assessment to assess the impacts from disturbance / displacement in the construction and operation phase.

~~9.9.2.3.1~~9.10.2.3.1 *Status*

~~480.~~557. Guillemot is listed as a named component of the breeding seabird assemblage of the Forth Islands SPA.

~~481.~~558. The SPA breeding population at classification in 1997 was 16,000 breeding pairs (SNH, 2009). Burnell *et al*. (2023) give an updated count of 26,510 individuals which has been used in this assessment.

~~9.9.2.3.2~~9.10.2.3.2 *Connectivity to the Projects*

~~482.~~559. DBS East and DBS West are 326km and 291km respectively from the Forth Islands SPA. The mean maximum foraging range of guillemot is 153.7km (73.2km + 80.5km, Woodward *et al*., 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding guillemot from the Forth Islands SPA, there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

~~483.~~560. Outside the breeding season, breeding guillemots from the SPA are assumed to range widely and to mix with guillemots from breeding colonies in the UK and beyond. The relevant non-breeding season reference population is the UK North Sea and Channel BDMPS, consisting of 1,617,306 individuals (August to February) (Furness, 2015).

~~484.~~561. It is estimated that 1.6% of birds present at the Projects during the nonbreeding season are breeding adults from Forth Islands SPA. Note, this percentage has been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

~~9.9.2.3.3~~9.10.2.3.3 *Assessment of Potential Effects of the Projects alone and Together*

Table 9-65 Summary of guillemot density and abundance estimates and SPA apportioning rates and used in the operation and construction displacement assessment for Forth Islands SPA. Note that displacement from the wind farm has been estimated as 15%-35%, half the operational rates.

Site	Season	Peak no.	SPA %	Adult %	No. apportioned to SPA	Wind farm operation displacement mortality to SPA			Wind farm construction displacement mortality to SPA			Peak density (birds/km²)	Total vessel displacement mortality (2km around 3 vessels, 1% mortality)	Vessel mortality to SPA	Total construction displacement mortality to SPA		
						30-1	50-1	70-10	15-1	25 - 1	35-10				15-1 & vessel	25 – 1 & vessel	35-10 & vessel
DBS East	Breeding	9030.5	0	0.552	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18	6.7	0.00	0.00	0.00	0.00
	Non-breeding	12551.8	0.016	1	200.8	0.6	1.0	14.1	0.3	0.5	7.0	25	9.3	0.15	0.45	0.65	7.18
	Annual				200.8	0.6	1.0	14.1	0.3	0.5	7.0	-	16	0.15	0.45	0.65	7.18
DBS West	Breeding	8783.5	0	0.552	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17	6.4	0.00	0.00	0.00	0.00
	Non-breeding	12498.4	0.016	1	200.0	0.6	1.0	14.0	0.3	0.5	7.0	24	9.1	0.15	0.45	0.65	7.14
	Annual				200.0	0.6	1.0	14.0	0.3	0.5	7.0	-	15.5	0.15	0.45	0.65	7.14
DBS East + DBS West	Breeding	~~14927.7~~17815	0	0.552	0.0	0.0	0.0	0.0	0.0	0.0	0.0		13.0	0.00	0.00	0.00	0.00
	Non-breeding	~~20136.0~~25050.2	~~0.016~~1.6	~~1~~100	~~322.2~~400.8	1.~~0~~2	~~1.6~~2.0	~~22.6~~28.1	0.~~5~~6	1.0~~.8~~	~~11.3~~14.0		18.4	0.29	0.~~78~~9	1.~~10~~3	~~11.57~~14.3
	Annual				~~322.2~~400.8	1.~~0~~2	~~1.6~~2.0	~~22.6~~28.1	0.~~5~~6	1.0~~.8~~	~~11.3~~14.0	-	31.4	0.29	0.~~78~~9	1.~~10~~3	~~11.57~~14.3

~~9.9.2.3.3.1~~9.10.2.3.3.1 *Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines*

~~9.9.2.3.3.1.1~~9.10.2.3.3.1.1 *DBS East in Isolation*

~~485.~~562. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Forth Islands SPA population expected to die is 1,617 (26,510 x 0.061) adults per annum. The predicted annual construction impact from DBS East alone on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 7.2 birds per annum (**Table 9-65**). This would result in a predicted change in adult mortality rate of 0.4%. The equivalent mortality assuming 35% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 1.4 which would increase the background mortality rate by 0.09%.

~~486.~~563. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~487.~~564. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Forth Islands SPA (0.65) would increase the predicted annual mortality by 0.04% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.9.2.3.3.1.2~~9.10.2.3.3.1.2DBS West in Isolation

~~488.~~565. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Forth Islands SPA population expected to die is 1,617 (26,510 x 0.061) adults per annum. The predicted annual construction impact from DBS West alone on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 7.1 birds per annum (**Table 9-65**). This would result in a predicted change in adult mortality rate of 0.4%. The equivalent mortality assuming 35% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 1.4 which would increase the background mortality rate by 0.09%.

~~489.~~566. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~490.~~567. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Forth Islands SPA (0.65) would increase the predicted annual mortality by 0.04% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.9.2.3.3.1.3~~9.10.2.3.3.1.3 DBS East and West Together

~~491.~~568. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Forth Islands SPA population expected to die is 1,617 (26,510 x 0.061) adults per annum. The predicted annual construction impact from DBS East and DBS West on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is ~~11.6~~14.3 birds per annum (**Table 9-65**). This would result in a predicted change in adult mortality rate of 0.~~7%.~~ 8%. The equivalent mortality assuming 35% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 2.9 which would increase the background mortality rate by 0.18%.

~~492.~~569. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~493.~~570. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Forth Islands SPA (1.~~1~~3) would increase the predicted annual mortality by 0.~~07~~08% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.9.2.3.3.2~~9.10.2.3.3.2 *Potential Effects During Operation: Disturbance and Displacement*

~~9.9.2.3.3.2.1~~9.10.2.3.3.2.1 *DBS East in Isolation*

~~494.~~571. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Forth Islands SPA population expected to die is 1,617 (26,510 x 0.061) adults per annum. The predicted annual operation impact from DBS East alone on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 14.1 birds per annum (**Table 9-65**). This would result in a predicted change in adult mortality rate of 0.9%. The equivalent mortality assuming 70% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 2.8 which would increase the background mortality rate by 0.09%.

~~495.~~572. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~496.~~573. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Forth Islands SPA (1.0) would increase the predicted annual mortality by 0.06% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.9.2.3.3.2.2~~9.10.2.3.3.2.2 *DBS West in Isolation*

~~497.~~574. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Forth Islands SPA population expected to die is 1,617 (26,510 x 0.061) adults per annum. The predicted annual operation impact from DBS West alone on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 14.0 birds per annum (**Table 9-65**). This would result in a predicted change in adult mortality rate of 0.9%. The equivalent mortality assuming 70% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 2.8 which would increase the background mortality rate by 0.17%.

~~498.~~575. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~499.~~576. At a more appropriate (construction) displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Forth Islands SPA (1.0) would increase the predicted annual mortality by 0.06% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.9.2.3.3.2.3~~9.10.2.3.3.2.3 *DBS East and West Together*

~~500.~~577. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Forth Islands SPA population expected to die is 1,617 (26,510 x 0.061) adults per annum. The predicted annual operation impact from DBS East and DBS West on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is ~~22.6~~28.1 birds per annum (**Table 9-65**). This would result in a predicted change in adult mortality rate of 1.~~4~~7%, but is based on highly precautionary impact rates. The equivalent mortality assuming 70% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 5.6 which would increase the background mortality rate by 0.34%.A reduction in either the displacement rate (e.g. to 55%) or the mortality rate (e.g. to 7%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in both together).

~~501.~~578. Furthermore, there is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~502.~~579. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Forth Islands SPA (~~1.6~~2.0) would increase the predicted annual mortality by 0.1% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.9.2.3.4~~9.10.2.3.4 *Summary*

580. A matrix of the annual operational displacement estimates for DBS East and DBS West is provided in **Table 9-66**.

Table 9-66 Displacement matrix for annual project alone (DBS East plus DBS West) guillemot apportioned to Forth Islands SPA adult population.

Mortality %	Displacement %									
	10	20	30	40	50	60	70	80	90	100
1	0	1	1	2	2	2	3	3	4	4
2	1	2	2	3	4	5	6	6	7	8
3	1	2	4	5	6	7	8	10	11	12
4	2	3	5	6	8	10	11	13	14	16
5	2	4	6	8	10	12	14	16	18	20
6	2	5	7	10	12	14	17	19	22	24
7	3	6	8	11	14	17	20	22	25	28
8	3	6	10	13	16	19	22	26	29	32
9	4	7	11	14	18	22	25	29	32	36
10	4	8	12	16	20	24	28	32	36	40
20	8	16	24	32	40	48	56	64	72	80
30	12	24	36	48	60	72	84	96	108	120
50	20	40	60	80	100	120	140	160	180	200
75	30	60	90	120	150	180	210	240	271	301
100	40	80	120	160	200	240	281	321	361	401

~~503.~~581. A table summarising the guillemot construction and operational disturbance and displacement assessment for DBS East and DBS West together is provided below (**Table 9-67**).

~~504.~~582. It is concluded that predicted guillemot mortality due to construction and operational phase disturbance and displacement impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the Forth Islands SPA**.

Table 9-67 Summary of predicted guillemot displacement mortality from Forth Islands SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.

Guillemot		**Displacement**		
Potential Effects During Construction: Disturbance and Displacement				
Displacement mortality		Mean (@25% x 1%)	Mean (@35% x ~~10~~2%)	Mean (@~~25~~35% x ~~1~~10%)
Breeding season		0	0	0
Nonbreeding season		1.3	2.9	14.3
Annual		1.3	2.9	14.3
Effect	Reference population	26,510		
	Increase in background mortality (%)	0.08	0.17	0.8
Potential Effects During Operation: Disturbance and Displacement				
Displacement mortality		Mean (@50% x 1%)	Mean (@70% x 2%)	Mean (@70% x 10%)
Breeding season		0	0	0
Nonbreeding season		2.0	~~11~~5.6	~~12~~8.1
Annual		2.0	~~11~~5.6	~~12~~8.1
Effect	Reference population	26,510		
	Increase in background mortality (%)	0.~~7~~12	0.~~06~~35	1.73
~~**Potential Effects During Operation: Disturbance and Displacement**~~				
~~Displacement mortality~~		~~Mean (@70% x 10%)~~		
~~Breeding season~~		~~0~~	~~0~~	
~~Nonbreeding season~~		~~22.6~~	~~1.6~~	
~~Annual~~		~~22.6~~	~~1.6~~	
~~Effect~~	~~Reference population~~	~~26,510~~		
		~~1.39~~	~~0.099~~	

~~9.9.2.3.5~~9.10.2.3.5 *Assessment of potential effects of the Projects in combination with other plans and projects*

~~505.~~583. Given that no measurable increase in the Forth Islands SPA guillemot mortality is predicted as a result of DBS East and DBS West combined (e.g. with realistic displacement mortality of only ~~1.6~~2.0 birds per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted guillemot mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Forth Islands SPA**.

~~9.9.2.4~~9.10.2.4 Razorbill

~~506.~~584. Razorbill has been screened into the Assessment to assess the impacts from disturbance / displacement in the construction and operation phase.

~~9.9.2.4.1~~9.10.2.4.1 *Status*

~~507.~~585. Razorbill is listed as a named component of the breeding seabird assemblage of the Forth Islands SPA.

~~508.~~586. The SPA breeding population at classification in 1990 was 1,400 pairs (SNH, 2009). Burnell *et al*. (2023) give an updated count of 5,695 individuals which has been used in this assessment.

~~9.9.2.4.2~~9.10.2.4.2 *Connectivity to the Projects*

~~509.~~587. DBS East and DBS West are 326km and 291km respectively from the Forth Islands SPA. The mean maximum foraging range of razorbill is 164.6km (88.7km + 75.9km, Woodward *et al*., 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding razorbill from the Forth Islands SPA, there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

~~510.~~588. Outside the breeding season, breeding razorbills from the SPA are assumed to range widely and to mix with razorbills from breeding colonies in the UK and further afield. The relevant background population is considered to be the UK North Sea and Channel BDMPS, consisting of 591,874 individuals during autumn and spring passage periods (August to October and January to March), and 218,622 individuals during winter (November and December) (Furness, 2015).

~~511.~~589. During the autumn and spring migration it is estimated that East Caithness Cliffs birds make up 0.9% of the BDMPS population, and during the winter 0.7% of the BDMPS population. Note, these percentages have been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

~~9.9.2.4.3~~9.10.2.4.3 Assessment of Potential Effects of the Projects alone and Together

Table 9-68 Summary of razorbill density and abundance estimates and SPA apportioning rates used in the operation and construction displacement assessment for Forth Islands SPA. Note that displacement from the wind farm has been estimated as 15%-35%, half the operational rates.

Site	Season	Peak no.	SPA %	Adult %	No. apportioned to SPA	Wind farm operation displacement mortality to SPA			Wind farm construction displacement mortality to SPA			Peak density (birds/km²)	Total vessel displacement mortality (2km around 3 vessels, 1% mortality)	Vessel mortality to SPA	Total construction displacement mortality to SPA		
						30-1	50-1	70-10	15-1	25 - 1	35-10				15-1 & vessel	25 – 1 & vessel	35-10 & vessel
DBS East	Breeding	555.1	0.0	61.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.4	0.00	0.00	0.00	0.00
	Autumn	4685.3	0.9	100	42.2	0.1	0.2	3.0	0.1	0.1	1.5	9.2	3.5	0.03	0.09	0.14	1.51
	Winter	3376.7	0.7	100	23.6	0.1	0.1	1.7	0.0	0.1	0.8	6.6	2.5	0.02	0.05	0.08	0.84
	Spring	3578.5	0.9	100	32.2	0.1	0.2	2.3	0.0	0.1	1.1	7.0	2.6	0.02	0.07	0.10	1.15
	Annual				98	0.3	0.5	7	0.1	0.3	3.4	-	9	0.07	0.21	0.32	3.5
DBS West	Breeding	2280.6	0.0	61.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.4	1.7	0.00	0.00	0.00	0.00
	Autumn	4886.9	0.9	100	44.0	0.1	0.2	3.1	0.1	0.1	1.5	9.4	3.5	0.03	0.10	0.14	1.57
	Winter	5066.2	0.7	100	35.5	0.1	0.2	2.5	0.1	0.1	1.2	9.7	3.7	0.03	0.08	0.11	1.27
	Spring	4454.6	0.9	100	40.1	0.1	0.2	2.8	0.1	0.1	1.4	8.6	3.2	0.03	0.09	0.13	1.43
	Annual				119.6	0.4	0.6	8.4	0.2	0.3	4.2	-	10.4	0.09	0.27	0.38	4.27
DBS East + DBS West	Breeding	~~2826.1~~2835.7	0.0	61.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0		2.1	0.00	0.00	0.00	0.00
	Autumn	~~6349.6~~9572.2	0.9	100	~~57~~86.1	0.~~2~~3	0.~~3~~4	~~4~~6.0	0.1	0.~~1~~2	~~2~~3.0		7.0	0.06	0.~~15~~19	0.~~21~~28	~~2.06~~3.08
	Winter	~~5823.7~~8442.9	0.7	100	~~40.8~~59.1	0.~~1~~2	0.~~2~~3	~~2.9~~4.1	0.1	0.1	2.1~~.4~~		6.1	0.04	0.~~10~~13	0.~~14~~19	~~1.47~~2.11
	Spring	~~6302.5~~8033.1	0.9	100	~~56.7~~72.3	0.2	0.~~3~~4	~~4.0~~5.1	0.1	0.~~1~~2	2.~~0~~5		5.9	0.05	0.~~14~~16	0.~~19~~23	2.~~04~~58
	Annual				~~154.6~~217.5	0.~~5~~7	~~0.8~~1.1	~~10.8~~15.2	0.~~2~~3	0.~~4~~5	~~5.4~~7.6	-	21.1	0.15	0.~~39~~48	0.~~54~~69	~~5.57~~7.76

~~9.9.2.4.3.1~~9.10.2.4.3.1 *Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines*

~~9.9.2.4.3.1.1~~9.10.2.4.3.1.1 *DBS East in Isolation*

~~512.~~590. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-7**) the number of individuals from the Forth Islands SPA population expected to die is 598 (5,695 x 0.105) adults per annum. The predicted annual construction impact from DBS East alone on the breeding razorbill population applying highly precautionary rates of 35% displacement and 10% mortality plus vessel displacement is 3.5 (1.5, 0.8, 1.1 in autumn winter and spring respectively) birds per annum (**Table 9-68)**. This would result in a predicted change in adult mortality rate of 0.6%. The equivalent mortality assuming 35% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 0.7 which would increase the background mortality rate by 0.12%.

~~513.~~591. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024Trinder *et al*. 2024) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~514.~~592. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Forth Islands SPA (0.3) would increase the predicted annual mortality by 0.05% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.9.2.4.3.1.2~~9.10.2.4.3.1.2DBS West in Isolation

~~515.~~593. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-7**) the number of individuals from the Forth Islands SPA population expected to die is 598 (5,695 x 0.105) adults per annum. The predicted annual construction impact from DBS West alone on the breeding razorbill population applying highly precautionary rates of 35% displacement and 10% mortality plus vessel displacement is 4.2 (1.5, 1.2, 1.4 in autumn winter and spring respectively) birds per annum (**Table 9-68**). This would result in a predicted change in adult mortality rate of 0.7%. The equivalent mortality assuming 35% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 0.84 which would increase the background mortality rate by 0.14%.

~~516.~~594. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~517.~~595. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Forth Islands SPA (0.3) would increase the predicted annual mortality by 0.05% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.9.2.4.3.1.3~~9.10.2.4.3.1.3DBS East and West Together

~~518.~~ At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-7**) the number of individuals from the Forth Islands SPA population expected to die is 598 (5,695 x 0.105) adults per annum. The predicted annual construction impact from DBS East and DBS West on the breeding razorbill population applying highly precautionary rates of 35% displacement and 10% mortality plus vessel displacement is ~~5.4 (~~7.8 (3.1, 2.~~0,~~ 1~~.4~~, 2.~~0~~6 in autumn, winter and spring respectively) birds per annum (**Table 9-68**). This would result in a predicted change in adult mortality rate of ~~0.9%.~~

596. ~~There is no evidence in support of either the (operational) 70~~1.3%. The equivalent mortality assuming 35% displacement and 2% mortality (the latter rate ~~or~~ as accepted in the ~~10%~~assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 1.6 which would increase the background mortality rate by 0.26%.

~~519.~~597. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. ~~.~~In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~520.~~598. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Forth Islands SPA (0.~~4~~7) would increase the predicted annual mortality by 0.~~07~~12% which is below the 1% and therefore no further assessment was required.

~~9.9.2.4.3.2~~9.10.2.4.3.2 *Potential Effects During Operation: Disturbance and Displacement*

~~9.9.2.4.3.2.1~~9.10.2.4.3.2.1 *DBS East in Isolation*

~~521.~~599. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-7**) the number of individuals from the Forth Islands SPA population expected to die is 598 (5,695 x 0.105) adults per annum. The predicted annual operation impact from DBS East alone on the breeding razorbill population applying highly precautionary rates of 70% displacement and 10% mortality is 6.8 (3.0, 1.6, 2.2 in autumn winter and spring respectively) birds per annum (**Table 9-68**). This would result in a predicted change in adult mortality rate of 1.1%, but is based on highly precautionary impact rates. The equivalent mortality assuming 70% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 1.4 which would increase the background mortality rate by 0.23%. A reduction in either the displacement rate (e.g. to 66%) or the mortality rate (e.g. to 8%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in both together).

~~522.~~600. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~523.~~601. At a more appropriate operational displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Forth Islands SPA (0.5) would increase the predicted annual mortality by 0.08% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.9.2.4.3.2.2~~9.10.2.4.3.2.2 DBS West in Isolation

~~524.~~602. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-7**) the number of individuals from the Forth Islands SPA population expected to die is 598 (5,695 x 0.105) adults per annum. The predicted annual operation impact from DBS West alone on the breeding razorbill population applying highly precautionary rates of 70% displacement and 10% mortality is 8.4 (3.1, 2.5, 2.8 in autumn winter and spring respectively) birds per annum (**Table 9-68**). This would result in a predicted change in adult mortality rate of 1.4% but is based on highly precautionary impact rates. The equivalent mortality assuming 70% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 1.7 which would increase the background mortality rate by 0.28%. A reduction in either the displacement rate (e.g. to 50%) or the mortality rate (e.g. to 7%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in both together).

~~525.~~603. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~526.~~604. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Forth Islands SPA (0.6) would increase the predicted annual mortality by 0.1% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.9.2.4.3.2.3~~9.10.2.4.3.2.3 DBS East and West Together

~~527.~~605. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-7**) the number of individuals from the Forth Islands SPA population expected to die is 598 (5,695 x 0.105) adults per annum. The predicted annual construction impact from DBS East and DBS West on the breeding razorbill population applying highly precautionary rates of 70% displacement and 10% mortality is ~~10.8 (4~~15.2 (6.0, ~~2.9,~~ 4.~~0~~1, 5.1 in autumn winter and spring respectively) birds per annum (**Table 9-68**). This would result in a predicted change in adult mortality rate of ~~1.8~~2.6% but is based on highly precautionary impact rates. The equivalent mortality assuming 70% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 3.0 which would increase the background mortality rate by 0.51%. A reduction in ~~either~~ the ~~displacement~~mortality rate (e.g. to ~~39%) or the mortality rate (e.g. to 5.5~~3.9%) would reduce the impact below the 1% threshold of detectability ~~(and this also applies for smaller reductions in both together)~~.

~~528.~~606. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~529.~~607. At a more appropriate operational displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Forth Islands SPA (~~0.8~~1.1) would increase the predicted annual mortality by 0.~~13~~18% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.9.2.4.4~~9.10.2.4.4 *Summary*

608. A matrix of the annual operational displacement estimates for DBS East and DBS West is provided in **Table 9-69**.

Table 9-69 Displacement matrix for annual project alone (DBS East plus DBS West) razorbill apportioned to Forth Islands SPA adult population.

Mortality %	**Displacement %**									
	10	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**
1	0	0	1	1	1	1	2	2	2	2
2	0	1	1	2	2	3	3	3	4	4
3	1	1	2	3	3	4	5	5	6	7
4	1	2	3	3	4	5	6	7	8	9
5	1	2	3	4	5	7	8	9	10	11
6	1	3	4	5	7	8	9	10	12	13
7	2	3	5	6	8	9	11	12	14	15

Mortality %	Displacement %									
	10	20	30	40	50	60	70	80	90	100
8	2	3	5	7	9	10	12	14	16	17
9	2	4	6	8	10	12	14	16	18	20
10	2	4	7	9	11	13	15	17	20	22
20	4	9	13	17	22	26	30	35	39	44
30	7	13	20	26	33	39	46	52	59	65
50	11	22	33	44	54	65	76	87	98	109
75	16	33	49	65	82	98	114	131	147	163
100	22	44	65	87	109	131	152	174	196	218

~~530.~~609. A table summarising the razorbill construction and operational disturbance and displacement assessment for DBS East and DBS West together is provided below (**Table 9-70)**.

~~531.~~610. It is concluded that predicted razorbill mortality due to construction and operational phase disturbance and displacement impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the Forth Islands SPA**.

Table 9-70 Summary of predicted razorbill displacement mortality from Forth Islands SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.

Razorbill	Displacement		
Potential Effects During Construction: Disturbance and Displacement			
Displacement mortality	Mean (@25% x 1%)	Mean (@35% x ~~10~~2%)	Mean (@~~25~~35% x ~~1~~10%)
Breeding season	0	0	0
Autumn	~~2.06~~0.28	0.~~21~~62	3.08
Winter	~~1.47~~0.19	0.~~14~~42	2.11
Spring	~~2.04~~0.23	0.~~19~~52	2.58
Annual	0.~~54~~69	1.55	7.76

Razorbill		Displacement		
Effect	Reference population		5,695	
	Increase in background mortality (%)	0.~~93~~12	0.~~09~~26	1.30
Potential Effects During Operation: Disturbance and Displacement				
Displacement mortality		Mean (@50% x 1%)	Mean (@70% x ~~10~~2%)	Mean (@~~50~~70% x ~~1~~10%)
Breeding season		0	0	0
Autumn		0.4~~.0~~	1.2	6.0~~.3~~
Winter		~~2.9~~0.3	0.~~2~~8	4.1
Spring		0.4~~.0~~	1.0~~.3~~	5.1
Annual		~~10.8~~1.1	3.0~~.8~~	15.2
Effect	Reference population			5,695
	Increase in background mortality (%)	~~1.8~~0.18	0.~~13~~51	2.55

~~9.9.2.4.5~~9.10.2.4.5 *Assessment of potential effects of the Projects in combination with other plans and projects*

~~532.~~611. Given that no measurable increase in the Forth Islands SPA razorbill mortality is predicted as a result of DBS East and DBS West combined (e.g. with realistic displacement mortality of ~~less than~~ 1.1 bird per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted razorbill mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Forth Islands SPA**.

~~9.9.2.5~~9.10.2.5 Puffin

~~533.~~612. Puffin has been screened into the Assessment to assess the impacts from disturbance / displacement in the construction and operation phase.

~~9.9.2.5.1~~9.10.2.5.1 *Status*

~~534.~~613. Puffin is listed as a designated species of the Forth Islands SPA.

~~535.~~614. The SPA breeding population at classification was 14,000 pairs (SNH, 2009). Burnell *et al*. (2023) give an updated count of 42,923 AOB which has been used in this assessment.

~~9.9.2.5.2~~9.10.2.5.2 *Connectivity to the Projects*

~~536.~~615. DBS East and DBS West are 326km and 291km respectively from the Forth Islands SPA. The mean maximum foraging range of puffin is 265.4km (137.1km +128.3km, Woodward *et al*., 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding puffin from the Forth Islands SPA, there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

~~537.~~616. Outside the breeding season, breeding puffins from the SPA are assumed to range widely and to mix with puffins from breeding colonies in the UK and further afield. The relevant non-breeding season reference population is the UK North Sea and Channel BDMPS, consisting of 231,957 individuals (mid-August to March) (Furness, 2015).

~~538.~~617. It is estimated that 26.8% of birds present at the Projects are breeding adults from Forth Islands SPA. Note, this percentage has been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

~~9.9.2.5.3~~9.10.2.5.3 *Assessment of Potential Effects of the Projects alone and Together*

Table 9-71 Summary of puffin density and abundance estimates and SPA apportioning rates and used in the operation and construction displacement assessment for Forth Islands SPA. Note that displacement from the wind farm has been estimated as 15%-35%, half the operational rates.

Site	Season	Peak no.	SPA %	Adult %	No. apportioned to SPA	Wind farm operation displacement mortality to SPA			Wind farm construction displacement mortality to SPA			Peak density (birds/ km²)	Total vessel displacement mortality (2km around 3 vessels, 1% mortality)	Vessel mortality to SPA	Total construction displacement mortality to SPA		
						30-1	50-1	70-10	15-1	25 - 1	35-10				15-1 & vessel	25 – 1 & vessel	35-10 & vessel
DBS East	Breeding	62.60	0	0.543	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.05	0.00	0.00	0.00	0.00
	Nonbreeding	178.70	26.8	1	47.9	0.14	0.24	3.35	0.07	0.12	1.68	0.35	0.13	0.04	0.11	0.16	1.71
	Annual				47.9	0.14	0.24	3.35	0.07	0.12	1.68	-	0.18	0.04	0.11	0.16	1.71
DBS West	Breeding	109.3	0	0.543	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.21	0.08	0.00	0.00	0.00	0.00
	Nonbreeding	198.2	26.8	1	53.1	0.16	0.27	3.72	0.08	0.13	1.86	0.38	0.14	0.04	0.12	0.17	1.90
	Annual				53.1	0.16	0.27	3.72	0.08	0.13	1.86	-	0.22	0.04	0.12	0.17	1.90
DBS East + DBS West	Breeding	~~146.60~~171.9	0	0.543	0.0	0.00	0.00	0.00	0.00	0.00	0.00		0.12	0.00	0.00	0.00	0.00
	Nonbreeding	~~372.70~~376.9	26.8	1	~~99.9~~101.0	0.30	0.~~50~~51	~~6.99~~7.07	0.15	0.25	3.~~50~~54		0.28	0.07	0.22	0.32	3.~~57~~61
	Annual				~~99.9~~101.0	0.30	0.~~50~~51	~~6.99~~7.07	0.15	0.25	3.~~50~~54	-	0.4	0.07	0.22	0.32	3.~~57~~61

~~9.9.2.5.3.1~~9.10.2.5.3.1 *Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines*

~~9.9.2.5.3.1.1~~9.10.2.5.3.1.1 *DBS East in Isolation*

~~539.~~618. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-7**) the number of individuals from the Forth Islands SPA population expected to die is 8,069 (85,846 x 0.094) adults per annum. The predicted annual construction impact from DBS East alone on the breeding puffin population applying highly precautionary rates of 35% displacement and 10% mortality is 1.7 birds per annum (**Table 9-71)**. This would result in a predicted change in adult mortality rate of 0.02%.

~~540.~~619. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al.* 2024) no evidence was found that puffins avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is equivalent to the natural adult background mortality rate of 9.4%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of puffin populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~541.~~620. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Forth Islands SPA (0.16) would increase the predicted annual mortality by <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.9.2.5.3.1.2~~9.10.2.5.3.1.2 *DBS West in Isolation*

~~542.~~621. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-7**) the number of individuals from the Forth Islands SPA population expected to die is 8,069 (85,846 x 0.094) adults per annum. The predicted annual construction impact from DBS West alone on the breeding puffin population applying highly precautionary rates of 35% displacement and 10% mortality is 1.9 birds per annum (**Table 9-71**). This would result in a predicted change in adult mortality rate of 0.02%.

~~543.~~622. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that puffins avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is equivalent to the natural adult background mortality rate of 9.4%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of puffin populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~544.~~623. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Forth Islands SPA (0.17) would increase the predicted annual mortality by <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.9.2.5.3.1.3~~9.10.2.5.3.1.3 DBS East and West Together

~~545.~~624. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-7**) the number of individuals from the Forth Islands SPA population expected to die is 8,069 (85,846 x 0.094) adults per annum. The predicted annual construction impact from DBS East and DBS West on the breeding puffin population applying highly precautionary rates of 35% displacement and 10% mortality is 3.6 birds per annum (**Table 9-71**). This would result in a predicted change in adult mortality rate of 0.04%.

~~546.~~625. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that puffins avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is equivalent to the natural adult background mortality rate of 9.4%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of puffin populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~547.~~626. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Forth Islands SPA (0.3) would increase the predicted annual mortality by <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.9.2.5.3.2~~9.10.2.5.3.2 *Potential Effects During Operation: Disturbance and Displacement*

~~9.9.2.5.3.2.1~~9.10.2.5.3.2.1 *DBS East in Isolation*

~~548.~~627. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-7**) the number of individuals from the Forth Islands SPA population expected to die is 8,069 (85,846 x 0.094) adults per annum. The predicted annual operation impact from DBS East alone on the breeding puffin population applying highly precautionary rates of 70% displacement and 10% mortality is 3.3 birds per annum (**Table 9-71**). This would result in a predicted change in adult mortality rate of 0.04%.

~~549.~~628. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that puffins avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is equivalent to the natural adult background mortality rate of 9.4%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of puffin populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~550.~~629. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Forth Islands SPA (0.2) would increase the predicted annual mortality by <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.9.2.5.3.2.2~~9.10.2.5.3.2.2 DBS West in Isolation

~~551.~~630. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-7**) the number of individuals from the Forth Islands SPA population expected to die is 8,069 (85,846 x 0.094) adults per annum. The predicted annual operation impact from DBS West alone on the breeding puffin population applying highly precautionary rates of 70% displacement and 10% mortality is 3.7 birds per annum (**Table 9-71**). This would result in a predicted change in adult mortality rate of 0.05%.

~~552.~~631. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that puffins avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is equivalent to the natural adult background mortality rate of 9.4%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of puffin populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~553.~~632. At a more appropriate (construction) displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Forth Islands SPA (0.3) would increase the predicted annual mortality by <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.9.2.5.3.2.3~~9.10.2.5.3.2.3 DBS East and West Together

~~554.~~633. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-7**) the number of individuals from the Forth Islands SPA population expected to die is 8,069 (85,846 x 0.094) adults per annum. The predicted annual operation impact from DBS East and DBS West on the breeding puffin population applying highly precautionary rates of 70% displacement and 10% mortality is 7.~~0~~1 birds per annum (**Table 9-71**). This would result in a predicted change in adult mortality rate of 0.~~08~~09%.

~~555.~~634. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that puffins avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is equivalent to the natural adult background mortality rate of 9.4%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of puffin populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~556.~~635. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Forth Islands SPA (0.5) would increase the predicted annual mortality by <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.9.2.5.4~~9.10.2.5.4 *Summary*

~~557.~~636. A table summarising the puffin construction and operational disturbance and displacement assessment for DBS East and DBS West together is provided below (**Table 9-72)**.

~~558.~~637. It is concluded that predicted puffin mortality due to construction and operational phase disturbance and displacement impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the Forth Islands SPA**.

Table 9-72 Summary of predicted puffin displacement mortality from Forth Islands SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.

~~Guillemot~~Puffin		**Displacement**	
Potential Effects During Construction: Disturbance and Displacement			
Displacement mortality		Mean (@~~35~~25% x ~~10~~1%)	Mean (@~~25~~35% x ~~1~~10%)
Breeding season		0	0
Nonbreeding season		0.3~~.6~~	~~0.~~3.6
Annual		0.3~~.6~~	~~0.~~3.6
Effect	Reference population	85,846	
	Increase in background mortality (%)	<0.~~04~~01	~~<~~0.~~01~~04
Potential Effects During Operation: Disturbance and Displacement			

~~Guillemot~~Puffin		Displacement	
Displacement mortality		Mean (@~~70~~50% x ~~10~~1%)	Mean (@~~50~~70% x ~~1~~10%)
Breeding season		0	0
Nonbreeding season		~~7.~~0.5	~~0.5~~7.1
Annual		~~7.~~0.5	~~0.5~~7.1
Effect	Reference population	85,846	
	Increase in background mortality (%)	<0.~~086~~01	~~<~~0.~~01~~09

~~9.9.2.5.5~~9.10.2.5.5 Assessment of potential effects of the Projects in combination with other plans and projects

~~559.~~638. Given that no measurable increase in the Forth Islands SPA puffin mortality is predicted as a result of DBS East and DBS West combined (e.g. with realistic displacement mortality of less than 1 bird per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted puffin mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Forth Islands SPA**.

~~9.10~~9.11 Fowlsheugh SPA

~~560.~~639. Fowlsheugh SPA, located 4km south of Stonehaven on the east coast of Aberdeenshire in north-east Scotland, is a stretch of sheer cliffs between 30m and 60m high. Large numbers of seabirds nest on the cliffs. The seaward extension of the SPA extends 2km into the marine environment and includes the seabed, water column and surface. Seabirds included within the designation feed both inside and outside the SPA in nearby waters, as well as more distantly in the wider North Sea.

~~9.10.1~~9.11.1 Site Description

~~9.10.1.1~~9.11.1.1 Qualifying Features

~~561.~~640. The qualifying features of the Fowlsheugh SPA screened into the Assessment are listed in Table 4-7 of **RIAA HRA Part 1 of 4 – Introduction and Terrestrial Ecology (application ref: 6.1)**. These are breeding kittiwake and guillemot and one named component of the breeding seabird assemblage (razorbill).

~~9.10.1.2~~9.11.1.2 Conservation Objectives

~~562.~~641. The over-arching conservation objectives of the site are:

- To avoid deterioration of the habitats of the qualifying species or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained; and
- To ensure for the qualifying species that the following are maintained in the long term:
  - Population of the species as a viable component of the site;
  - Distribution of the species within site;
  - Distribution and extent of habitats supporting the species;
  - Structure, function and supporting processes of habitats supporting the species; and
  - No significant disturbance of the species.

~~9.10.2~~9.11.2 Assessment: Array Areas

~~9.10.2.1~~9.11.2.1 Kittiwake

~~563.~~642. Kittiwake has been screened into the Assessment to assess the impacts from collision risk in the operation phase.

~~9.10.2.1.1~~9.11.2.1.1 Status

~~564.~~643. Kittiwake is listed as a designated species of the Fowlsheugh SPA.

~~565.~~644. The SPA breeding population at classification was cited as 36,650 pairs or 73,300 breeding adults in 2009 (SNH, 2009). Burnell *et al.* (2023) give an updated count of 14,039 AON which has been used in this assessment.

~~9.10.2.1.2~~9.11.2.1.2 Connectivity to the Projects

~~566.~~645. DBS East and DBS West are 360km and 327km respectively from the Fowlsheugh SPA. The mean maximum foraging range of kittiwake is 300.6km (156.1km + 144.5km, Woodward *et al.*, 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding kittiwake from the Fowlsheugh SPA there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

~~567.~~646. Outside the breeding season breeding kittiwakes, including those from the Fowlsheugh SPA, are not constrained by requirements to visit nests to incubate eggs or provision chicks. At this time, they are assumed to range more widely and to mix with kittiwakes of all age classes from breeding colonies in the UK and further afield. The background population during these seasons is the UK North Sea BDMPS. This consists of 829,937 individuals during the autumn migration season (August to December), and 627,816 individuals during the spring migration season (January to April) (Furness, 2015).

~~568.~~647. It is estimated that 1.3% and 1.8% of birds present in the Project array areas in the autumn and spring migration seasons respectively are considered to be breeding adults from Fowlsheugh SPA. Note, these percentages have been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

~~9.10.2.1.3~~9.11.2.1.3 Assessment of Potential Effects of the Projects alone and Together

~~9.10.2.1.3.1~~9.11.2.1.3.1 Potential Effects During Operation: Collision risk

Table 9-73 Summary of kittiwake total collisions and apportioned to the Fowlsheugh SPA.

Site	Season	Collision mortality			SPA %	Adult %	Collisions apportioned to SPA		
		Lower 95% c.i.	Mean	Upper 95% c.i.			Lower 95% c.i.	Mean	Upper 95% c.i.
DBS East	Breeding	42.3	83.3	168.5	0	53	0	0	0
	Autumn	14.6	41.4	82.9	1.3	100	0.19	0.54	1.08
	Spring	6.8	14.6	28.0	1.8	100	0.12	0.26	0.50
	Annual	66.9	139.3	261.3	-	-	0.31	0.80	1.58
DBS West	Breeding	36.9	107.8	280.8	0	53	0	0	0
	Autumn	9.5	37.9	81.9	1.3	100	0.12	0.49	1.06
	Spring	7.1	14.9	26.5	1.8	100	0.13	0.27	0.48
	Annual	55.9	160.6	327.0	-	-	0.25	0.76	1.54
DBS East + DBS West	Breeding	96.2	191.1	378.4	0	53	0	0	0
	Autumn	30.5	79.3	143.1	1.3	100	0.40	1.03	1.86
	Spring	16.9	29.5	47.3	1.8	100	0.30	0.53	0.85
	Annual	150.9	299.9	540.5	-	-	0.70	1.56	2.71

~~9.10.2.1.3.1.1~~9.11.2.1.3.1.1 *DBS East in Isolation*

~~569.~~648. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-7**) the number of individuals from the Fowlsheugh SPA population expected to die is 4,099 (28,078 x 0.146) adults per annum. The predicted annual impacts from DBS East alone on the breeding kittiwake population is 0.8 birds per annum (**Table 9-74**). This results in a predicted change in adult mortality rate of 0.02% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.10.2.1.3.1.2~~9.11.2.1.3.1.2 *DBS West in Isolation*

~~570.~~649. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-7**) the number of individuals from the Fowlsheugh SPA population expected to die is 4,099 (28,078 x 0.146) adults per annum. The predicted annual impacts from DBS West alone on the breeding kittiwake population is 0.8 birds per annum (**Table 9-74**). This results in a predicted change in adult mortality rate of 0.02% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.10.2.1.3.1.3~~9.11.2.1.3.1.3 *DBS East and West Together*

~~571.~~650. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-7**) the number of individuals from the Fowlsheugh SPA population expected to die is 4,099 (28,078x 0.146) adults per annum. The predicted annual impacts from DBS East and DBS West on the breeding kittiwake population is 1.6 birds per annum (**Table 9-74**). This results in a predicted change in adult mortality rate of 0.04% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.10.2.1.4~~9.11.2.1.4 *Summary*

~~572.~~651. A table summarising the kittiwake operational collision risk assessment for DBS East and DBS West together is provided below (**Table 9-74**).

~~573.~~652. It is concluded that predicted kittiwake mortality due to operational phase collision risk at DBS East, DBS West, and the Projects together would **not adversely affect the integrity of the Fowlsheugh SPA**.

Table 9-74 Summary of predicted Kittiwake collision mortality from Fowlsheugh SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations for the Worst Case Wind Turbine Scenario.

Kittiwake		Collisions		
Potential Effects During Operation: Collision Risk				
Collision mortality		Mean	Lower c.i.	Upper c.i.
Breeding season		-	-	-
Autumn		0.40	1.03	1.86
Spring		0.30	0.53	0.85
Annual		0.70	1.56	2.71
Effect	Reference population	28,078		
	Increase in background mortality (%)	0.01	0.06	0.11

~~9.10.2.1.5~~9.11.2.1.5 *Assessment of potential effects of the Projects in combination with other plans and projects*

~~574.~~653. Given that no measurable increase in the Fowlsheugh SPA kittiwake mortality is predicted as a result of DBS East and DBS West combined (e.g. with total collision mortality of only 1.6 birds per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted kittiwake mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Fowlsheugh SPA**.

~~9.10.2.2~~9.11.2.2 Guillemot

~~575.~~654. Guillemot has been screened into the Assessment to assess the impacts from disturbance / displacement in the construction and operation phase.

~~9.10.2.2.1~~9.11.2.2.1 *Status*

~~576.~~655. Guillemot is listed as a designated species of the Fowlsheugh SPA.

~~577.~~656. The SPA breeding population at classification was cited as 56,450 individuals in 1992 (SNH, 2009). Burnell *et al*. (2023) give an updated count of 69,828 individuals which has been used in this assessment.

~~9.10.2.2.2~~9.11.2.2.2 *Connectivity to the Projects*

~~578.~~657. DBS East and DBS West are 360km and 327km respectively from the Fowlsheugh SPA. The mean maximum foraging range of guillemot is 153.7km (73.2km + 80.5km, Woodward *et al*., 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding guillemot from Fowlsheugh SPA, there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

~~579.~~658. Outside the breeding season, breeding guillemots from Fowlsheugh SPA are assumed to range widely and to mix with guillemots from breeding colonies in the UK and beyond. The relevant non-breeding season reference population is the UK North Sea and Channel BDMPS, consisting of 1,617,306 individuals (August to February) (Furness, 2015).

~~580.~~659. It is estimated that 3.0% of birds present at the Projects are considered to be breeding adults from Fowlsheugh SPA. Note, this percentage has been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

~~9.10.2.2.3~~9.11.2.2.3 *Assessment of Potential Effects of the Projects alone and Together*

Table 9-75 Summary of guillemot density and abundance estimates and SPA apportioning rates used in the operation and construction displacement assessment for Fowlsheugh SPA. Note that displacement from the wind farm has been estimated as 15%-35%, half the operational rates.

Site	Season	Peak no.	SPA %	Adult %	No. apportioned to SPA	Wind farm operation displacement mortality to SPA			Wind farm construction displacement mortality to SPA			Peak density (birds/km²)	Total vessel displacement mortality (2km around 3 vessels, 1% mortality)	Vessel mortality to SPA	Total construction displacement mortality to SPA		
						30-1	50-1	70-10	15-1	25 - 1	35-10				15-1 & vessel	25 - 1 & vessel	35-10 & vessel
DBS East	Breeding	9030.5	0	55.2	0	0	0	0	0	0	0	17.71	6.7	0.20	0	0	0
	Nonbreeding	12551.8	3.0	100	376.5	1.1	1.9	26.2	0.6	0.9	13.2	24.62	9.3	0.28	0.8	1.2	13.4
	Annual					1.1	1.9	26.2	0.6	0.9	13.2	-	16	0.28	0.8	1.2	13.4
DBS West	Breeding	8783.5	0	55.2	0	0	0	0	0	0	0	16.92	6.4	0.20	0	0	0
	Nonbreeding	12498.4	3.0	100	374.9	1.1	1.9	26.0	0.6	0.9	13.1	24.08	9.1	0.27	0.8	1.2	13.3
	Annual				374.9	1.1	1.9	26.0	0.6	0.9	13.1		15.5	0.27	0.8	1.2	13.3
DBS East + DBS West	Breeding	~~14927.7~~17815	0	55.2	0	0	0	0	0	0	0	-	13.0	0.40	0	0	0
	Nonbreeding	~~20136.0~~25050	3.0	100	~~604.1~~751.5	~~1.8~~2.3	3.~~0~~8	~~41.9~~52.6	~~0.9~~1.1	1.~~5~~9	~~21.1~~26.3		18.4	0.55	1.~~4~~7	2.~~0~~4	~~21.5~~26.9
	Annual				~~604.1~~751.5	~~1.8~~2.3	3.~~0~~8	~~41.9~~52.6	~~0.9~~1.1	1.~~5~~9	~~21.1~~26.3		31.4	0.55	1.~~4~~7	2.~~0~~4	~~21.5~~26.9

~~9.10.2.2.3.1~~9.11.2.2.3.1 *Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines*

~~9.10.2.2.3.1.1~~9.11.2.2.3.1.1 *DBS East in Isolation*

~~581.~~660. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Fowlsheugh SPA population expected to die is 4,259 (69,828 x 0.061) adults per annum. The predicted annual construction impact from DBS East alone on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 13.4 birds per annum (**Table 9-75**). This would result in a predicted change in adult mortality rate of 0.3%. The equivalent mortality assuming 35% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 2.7 which would increase the background mortality rate by 0.06%.

~~582.~~661. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~583.~~662. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Fowlsheugh SPA (1.2) would increase the predicted annual mortality by 0.03% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.10.2.2.3.1.2~~9.11.2.2.3.1.2 *DBS West in Isolation*

~~584.~~663. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Fowlsheugh SPA population expected to die is 4,259 (69,828 x 0.061) adults per annum. The predicted annual construction impact from DBS West alone on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 13.3 birds per annum (**Table 9-75**). This would result in a predicted change in adult mortality rate of 0.3%. The equivalent mortality assuming 35% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 2.7 which would increase the background mortality rate by 0.06%.

~~585.~~664. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~586.~~665. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Fowlsheugh SPA (1.2) would increase the predicted annual mortality by 0.03% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.10.2.2.3.1.3~~9.11.2.2.3.1.3 *DBS East and West Together*

~~587.~~666. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Fowlsheugh SPA population expected to die is 4,259 (69,828 x 0.061) adults per annum. The predicted annual construction impact from DBS East and DBS West on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is ~~21.5~~26.9 birds per annum (**Table 9-75**). This would result in a predicted change in adult mortality rate of 0.~~5%.~~ 6%. The equivalent mortality assuming 35% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 5.4 which would increase the background mortality rate by 0.13%.

~~588.~~667. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~589.~~668. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Fowlsheugh SPA (2.~~0~~4) would increase the predicted annual mortality by 0.~~05~~06% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.10.2.2.3.2~~9.11.2.2.3.2 Potential Effects During Operation: Disturbance and Displacement

~~9.10.2.2.3.2.1~~9.11.2.2.3.2.1 DBS East in Isolation

~~590.~~669. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Fowlsheugh SPA population expected to die is 4,259 (69,828 x 0.061) adults per annum. The predicted annual operation impact from DBS East alone on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 26.2 birds per annum (**Table 9-75**). This would result in a predicted change in adult mortality rate of 0.6%. The equivalent mortality assuming 70% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 5.2 which would increase the background mortality rate by 0.12%.

~~591.~~670. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~592.~~671. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Fowlsheugh SPA (1.9) would increase the predicted annual mortality by 0.04% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.10.2.2.3.2.2~~9.11.2.2.3.2.2 DBS West in Isolation

~~593.~~672. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Fowlsheugh SPA population expected to die is 4,259 (69,828 x 0.061) adults per annum. The predicted annual operation impact from DBS West alone on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 26.0 birds per annum (**Table 9-75**). This would result in a predicted change in adult mortality rate of 0.6%. The equivalent mortality assuming 70% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 5.2 which would increase the background mortality rate by 0.12%.

~~594.~~673. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~595.~~674. At a more appropriate (construction) displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Fowlsheugh SPA (1.9) would increase the predicted annual mortality by 0.04% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.10.2.2.3.2.3~~9.11.2.2.3.2.3 DBS East and West Together

~~596.~~675. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Fowlsheugh SPA population expected to die is 4,259 (69,828 x 0.061) adults per annum. The predicted annual operation impact from DBS East and DBS West on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is ~~41.9~~52.6 birds per annum (**Table 9-75**). This would result in a predicted change in adult mortality rate of ~~0.98%.~~ 1.2%. The equivalent mortality assuming 70% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 10.5 which would increase the background mortality rate by 0.25%.

~~597.~~676. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~598.~~677. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Fowlsheugh SPA (3.~~0~~8) would increase the predicted annual mortality by 0.~~07~~09% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.10.2.2.4~~9.11.2.2.4 Summary

~~599.~~678. A matrix of the annual operational displacement estimates for DBS East and DBS West is provided in **Table 9-76**.

Table 9-76 Displacement matrix for annual project alone (DBS East plus DBS West) guillemot apportioned to Fowlsheugh SPA adult population.

Mortality %	Displacement %									
	10	20	30	40	50	60	70	80	90	100
1	1	2	2	3	4	5	5	6	7	8
2	2	3	5	6	8	9	11	12	14	15
3	2	5	7	9	11	14	16	18	20	23
4	3	6	9	12	15	18	21	24	27	30
5	4	8	11	15	19	23	26	30	34	38
6	5	9	14	18	23	27	32	36	41	45
7	5	11	16	21	26	32	37	42	47	53
8	6	12	18	24	30	36	42	48	54	60
9	7	14	20	27	34	41	47	54	61	68
10	8	15	23	30	38	45	53	60	68	75
20	15	30	45	60	75	90	105	120	135	150
30	23	45	68	90	113	135	158	180	203	225
50	38	75	113	150	188	225	263	301	338	376
75	56	113	169	225	282	338	395	451	507	564
100	75	150	225	301	376	451	526	601	676	752

~~600.~~679. A table summarising the guillemot construction and operational disturbance and displacement assessment for DBS East and DBS West together is provided below (**Table 9-77**).

~~601.~~680. It is concluded that predicted guillemot mortality due to construction and operational phase disturbance and displacement impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the Fowlsheugh SPA**.

Table 9-77 Summary of predicted guillemot displacement mortality from Fowlsheugh SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.

Guillemot		**Displacement**		
Potential Effects During Construction: Disturbance and Displacement				
Displacement mortality		Mean (@25% x 1%)	Mean (@35% x ~~10~~2%)	Mean (@~~25~~35% x ~~1~~10%)
Breeding season		0	0	0
Nonbreeding season		2.~~0~~4	5.4	26.9
Annual		2.~~0~~4	5.4	26.9
Ef-fect	Reference population	69,828		
	Increase in background mortality (%)	0.~~51~~06	0.~~05~~13	0.63
Potential Effects During Operation: Disturbance and Displacement				
Displacement mortality		Mean (@50% x 1%)	Mean (@70% x ~~10~~2%)	Mean (@~~50~~70% x ~~1~~10%)
Breeding season		0	0	0
Nonbreeding season		3.~~0~~8	10.5	52.6
Annual		3.~~0~~8	10.5	52.6
Ef-fect	Reference population	69,828		
	Increase in background mortality (%)	0.~~98~~09	0.~~07~~25	1.24

~~9.10.2.2.5~~9.11.2.2.5 *Assessment of potential effects of the Projects in combination with other plans and projects*

~~602.~~681. Given that no measurable increase in the Fowlsheugh SPA guillemot mortality is predicted as a result of DBS East and DBS West combined (e.g. with realistic displacement mortality of only 3.8 birds per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted guillemot mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Fowlsheugh SPA**.

~~9.10.2.3~~9.11.2.3 Razorbill

~~603.~~682. Razorbill has been screened into the Assessment to assess the impacts from disturbance / displacement in the construction and operation phase.

~~9.10.2.3.1~~9.11.2.3.1 Status

~~604.~~683. Razorbill is listed as a named component of the breeding seabird assemblage of the Fowlsheugh SPA.

~~605.~~684. The SPA breeding population at classification in 1992 was cited as 5,800 individuals (SNH, 2009). Burnell *et al.* (2023) give an updated count of 14,063 individuals which has been used in this assessment.

~~9.10.2.3.2~~9.11.2.3.2 Connectivity to the Projects

~~606.~~685. DBS East and DBS West are 360km and 327km respectively from Fowlsheugh SPA. The mean maximum foraging range of razorbill is 164.6km (88.7 + 75.9km, Woodward *et al.*, 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding razorbill from Fowlsheugh SPA, there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

~~607.~~686. Outside the breeding season, breeding razorbills from Fowlsheugh SPA are assumed to range widely and to mix with razorbills from breeding colonies in the UK and further afield. The relevant background population is considered to be the UK North Sea and Channel BDMPS, consisting of 591,874 individuals during autumn and spring passage periods (August to October and January to March), and 218,622 individuals during winter (November and December) (Furness, 2015).

~~608.~~687. During the autumn and spring migration it is estimated that Fowlsheugh birds make up 1.2% of the BDMPS population, and during the winter 0.4% of the BDMPS population. Note, these percentages have been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

~~9.10.2.3.3~~9.11.2.3.3 Assessment of Potential Effects of the Projects alone and Together

Table 9-78 Summary of razorbill density and abundance estimates and SPA apportioning rates and used in the operation and construction displacement assessment for Foulsheugh SPA. Note that displacement from the wind farm has been estimated as 15%-35%, half the operational rates.

Site	Season	Peak no.	SPA %	Adult %	No. apportioned to SPA	Wind farm operation displacement mortality to SPA			Wind farm construction displacement mortality to SPA			Peak density (birds/km²)	Total vessel displacement mortality (2km around 3 vessels, 1% mortality)	Vessel mortality to SPA	Total construction displacement mortality to SPA		
						30-1	50-1	70-10	15-1	25 - 1	35-10				15-1 & vessel	25 – 1 & vessel	35-10 & vessel
DBS East	Breeding	555.1	0	100	0	0	0	0	0	0	0	1.1	0.4	0	0	0	0
	Autumn	4685.3	1.2	100	56.2	0.2	0.3	3.9	0.1	0.1	2.0	9.2	3.5	0.04	0.1	0.2	2.0
	Winter	3376.7	0.4	100	13.5	0.0	0.1	0.9	0.0	0.0	0.5	6.6	2.5	0.01	0.0	0.0	0.5
	Spring	3578.5	1.2	100	42.9	0.1	0.2	3.0	0.1	0.1	1.5	7.0	2.6	0.03	0.1	0.1	1.5
	Annual				112.6	0.3	0.6	7.8	0.2	0.2	4	-	9	0.08	0.2	0.3	4
DBS West	Breeding	2280.6	0	100	0	0	0	0	0	0	0	4.4	1.7	0	0	0	0
	Autumn	4886.9	1.2	100	58.6	0.2	0.3	4.1	0.1	0.1	2.1	9.4	3.5	0.04	0.1	0.2	2.1
	Winter	5066.2	0.4	100	20.3	0.1	0.1	1.4	0.0	0.1	0.7	9.7	3.7	0.01	0.05	0.07	0.72
	Spring	4454.6	1.2	100	53.5	0.2	0.3	3.7	0.1	0.1	1.9	8.6	3.2	0.04	0.1	0.2	1.9
	Annual				132.4	0.4	0.7	9.3	0.2	0.3	4.6	-	9.1	0.09	0.25	0.47	4.72
DBS East + DBS West	Breeding	~~2826.1~~2835.7	0	100	0	0	0	0	0	0	0	-	2.1	0	0	0	0
	Autumn	~~6349.6~~9572.2	1.2	100	~~76.2~~114.9	0.~~2~~3	0.~~4~~6	~~5.3~~8.0	0.~~1~~2	0.~~2~~3	~~2.7~~4.0		7.0	0.08	0.~~2~~25	0.~~3~~37	~~2.7~~4.10
	Winter	~~5823.7~~8442.9	0.4	100	~~23.3~~33.8	0.1	0.~~1~~2	~~1.6~~2.4	0.~~0~~1	0.1	~~0.8~~1.2		6.1	0.02	0.~~06~~07	0.~~08~~10	~~0.84~~1.20
	Spring	~~6302.5~~8033.1	1.2	100	~~75.6~~96.4	0.~~2~~3	0.~~4~~5	~~5.3~~6.7	0.1	0.2	~~2.6~~3.4		5.9	0.07	0.~~2~~21	0.~~3~~31	~~2.7~~3.44
	Annual				~~175.1~~245.0	0.~~5~~7	~~0.9~~1.2	~~12.3~~17.2	0.~~3~~4	0.~~4~~6	8.6~~.1~~		~~21.1~~0.6	0.17	0.~~46~~54	0.~~68~~78	~~6.24~~8.75

~~9.10.2.3.3.1~~9.11.2.3.3.1 *Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines*

~~9.10.2.3.3.1.1~~9.11.2.3.3.1.1 *DBS East in Isolation*

~~609.~~688. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-7**) the number of individuals from the Fowlsheugh SPA population expected to die is 1,476 (14,063 x 0. 105) adults per annum. The predicted annual construction impact from DBS East alone on the breeding razorbill population applying highly precautionary rates of 35% displacement and 10% mortality is 8.75 (4.~~0 (~~1, 1.2.~~0, 0.5, 1.5,~~ 3.4 in autumn winter and spring respectively) birds per annum (**Table 9-78**). This would result in a predicted change in adult mortality rate of 0.~~27%.~~ 59%. The equivalent mortality assuming 35% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 1.75 which would increase the background mortality rate by 0.12%.

~~610.~~689. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~611.~~690. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Fowlsheugh SPA (0.~~4~~8) would increase the predicted annual mortality by 0.~~02~~05% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.10.2.3.3.1.2~~9.11.2.3.3.1.2 DBS West in Isolation

~~612.~~691. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-7**) the number of individuals from the Fowlsheugh SPA population expected to die is 1,476 (14,063 x 0. 105) adults per annum. The predicted annual construction impact from DBS West alone on the breeding razorbill population applying highly precautionary rates of 35% displacement and 10% mortality is 4.7 (2.1, 0.7, 1.9 in autumn winter and spring respectively) birds per annum (**Table 9-78**). This would result in a predicted change in adult mortality rate of 0.32%. The equivalent mortality assuming 35% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 0.94 which would increase the background mortality rate by 0.06%.

~~613.~~692. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~614.~~693. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Fowlsheugh SPA (0.5) would increase the predicted annual mortality by 0.025% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.10.2.3.3.1.3~~9.11.2.3.3.1.3 *DBS East and West Together*

~~615.~~694. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-7**) the number of individuals from the Fowlsheugh SPA population expected to die is 1,476 (14,063 x 0.105) adults per annum. The predicted annual construction impact from DBS East and DBS West on the breeding razorbill population applying highly precautionary rates of 35% displacement and 10% mortality is 6.2 (2.7, 0.8, 2.7 in autumn winter and spring respectively) birds per annum (**Table 9-78**). This would result in a predicted change in adult mortality rate of 0.4%. The equivalent mortality assuming 35% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 1.24 which would increase the background mortality rate by 0.08%.

~~616.~~695. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~617.~~696. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Fowlsheugh SPA (0.7) would increase the predicted annual mortality by 0.04% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.10.2.3.3.2~~9.11.2.3.3.2 *Potential Effects During Operation: Disturbance and Displacement*

~~9.10.2.3.3.2.1~~9.11.2.3.3.2.1 *DBS East in Isolation*

~~618.~~697. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-7**) the number of individuals from the Fowlsheugh SPA population expected to die is 1,476 (14,063 x 0.105) adults per annum. The predicted annual operation impact from DBS East alone on the breeding razorbill population applying highly precautionary rates of 70% displacement and 10% mortality is 7.8 (3.9, 0.9, 3.0 in autumn winter and spring respectively) birds per annum (**Table 9-78**). This would result in a predicted change in adult mortality rate of 0.52%. The equivalent mortality assuming 70% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 1.56 which would increase the background mortality rate by 0.11%.

~~619.~~698. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~620.~~699. At a more appropriate operational displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Fowlsheugh SPA (0.6) would increase the predicted annual mortality by 0.037% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.10.2.3.3.2.2~~9.11.2.3.3.2.2 DBS West in Isolation

~~621.~~700. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-7**) the number of individuals from the Fowlsheugh SPA population expected to die is 1,476 (14,063 x 0.105) adults per annum. The predicted annual operation impact from DBS West alone on the breeding razorbill population applying highly precautionary rates of 70% displacement and 10% mortality is 9.3 (4.1, 1.4, 3.7 in autumn winter and spring respectively) birds per annum (**Table 9-78**). This would result in a predicted change in adult mortality rate of 0.63%. The equivalent mortality assuming 70% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 1.86 which would increase the background mortality rate by 0.12%.

~~622.~~701. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. ~~There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate.~~ In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~623.~~702. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Fowlsheugh SPA (0.7) would increase the predicted annual mortality by 0.04% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.10.2.3.3.2.3~~9.11.2.3.3.2.3 DBS East and West Together

~~624.~~703. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-7**) the number of individuals from the Fowlsheugh SPA population expected to die is 1,476 (14,063 x 0.105) adults per annum. The predicted annual construction impact from DBS East and DBS West on the breeding razorbill population applying highly precautionary rates of 70% displacement and 10% mortality is ~~12.3 (5.3, 1.6, 5.3~~17.2 (8, 2.4, 6.7 in autumn winter and spring respectively) birds per annum (**Table 9-78**). This would result in a predicted change in adult mortality rate of ~~0.8~~1.1%. The equivalent mortality assuming 70% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 3.44 which would increase the background mortality rate by 0.23%.

~~625.~~704. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~626.~~705. At a more appropriate operational displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Fowlsheugh SPA (~~0.9~~1.2) would increase the predicted annual mortality by 0.~~06~~08% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.10.2.3.4~~9.11.2.3.4 Summary

~~627.~~706. A matrix of the annual operational displacement estimates for DBS East and DBS West is provided in **Table 9-79**.

Table 9-79 Displacement matrix for annual project alone (DBS East plus DBS West) razorbill apportioned to Foulsheugh SPA adult population.

Mortality %	Displacement %									
	10	20	30	40	50	60	70	80	90	100
1	0	0	1	1	1	1	2	2	2	2
2	0	1	1	2	2	3	3	4	4	5
3	1	1	2	3	4	4	5	6	7	7
4	1	2	3	4	5	6	7	8	9	10
5	1	2	4	5	6	7	9	10	11	12
6	1	3	4	6	7	9	10	12	13	15
7	2	3	5	7	9	10	12	14	15	17
8	2	4	6	8	10	12	14	16	18	20
9	2	4	7	9	11	13	15	18	20	22
10	2	5	7	10	12	15	17	20	22	25
20	5	10	15	20	25	29	34	39	44	49
30	7	15	22	29	37	44	51	59	66	74
50	12	25	37	49	61	74	86	98	110	123
75	18	37	55	74	92	110	129	147	165	184
100	25	49	74	98	123	147	172	196	221	245

~~628.~~707. A table summarising the razorbill construction and operational disturbance and displacement assessment for DBS East and DBS West together is provided below (**Table 9-80)**.

~~629.~~708. It is concluded that predicted razorbill mortality due to construction and operational phase disturbance and displacement impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the Fowlsheugh SPA**.

Table 9-80 Summary of predicted razorbill displacement mortality from Fowlsheugh SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.

~~Guillemot~~Razorbill		**Displacement**		
Potential Effects During Construction: Disturbance and Displacement				
Displacement mortality		Mean (@25% x 1%)	Mean (@35% x ~~10~~2%)	Mean (@~~25~~35% x ~~1~~10%)
Breeding season		0	0	0
Autumn		~~2.7~~0.37	0.~~3~~82	4.1
Winter		0.~~8~~1	0.~~1~~24	1.2
Spring		0.3	0.68	3.4
Annual		0.~~7~~78	1.75	8.75
Effect	Reference population	14,063		
	Increase in back-ground mortality (%)	0.~~4~~05	0.~~04~~12	0.59
Potential Effects During Operation: Disturbance and Displacement				
Displacement mortality		Mean (@50% x 1%)	Mean (@70% x ~~10~~2%)	Mean (@~~50~~70% x ~~1~~10%)
Breeding season		0	0	0
Autumn		0.~~4~~6	1.6	8.0
Winter		~~1.6~~0.2	0.~~1~~48	2.4
Spring		0.~~4~~5	1.34	6.7
Annual		1.2	~~12.~~3.44	~~0.9~~17.2
Effect	Reference population	14,063		
	Increase in back-ground mortality (%)	0.~~8~~08	0.~~06~~23	1.16

~~9.10.2.3.5~~9.11.2.3.5 *Assessment of potential effects of the Projects in combination with other plans and projects*

~~630.~~709. Given that no measurable increase in the Fowlsheugh SPA razorbill mortality is predicted as a result of DBS East and DBS West combined (e.g. with realistic displacement mortality of ~~less than~~ one bird per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted guillemot mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Fowlsheugh SPA**.

~~9.11~~9.12 Buchan Ness to Collieston Coast SPA

~~9.11.1~~9.12.1 Site Description

~~631.~~710. Buchan Ness to Collieston Coast SPA was designated in 2009. The site is a stretch of south-east facing cliff in Aberdeenshire, Scotland. The 15km stretch of cliffs, formed of granite, quartzite and other rocks, runs south of Peterhead, broken only by the sandy beach of Cruden Bay. The varied coastal vegetation on the ledges and the cliff tops includes maritime heath, grassland and brackish flushes.

~~632.~~711. The boundary of the SPA follows the boundaries of Bullers of Buchan Coast SSSI and Collieston to Whinnyfold Coast SSSI, and the seaward extension extends approximately 2km into the marine environment to include the seabed, water column and surface.

~~9.11.1.1~~9.12.1.1 Qualifying Features

~~633.~~712. The qualifying features of the Buchan Ness to Collieston Coast SPA screened into the Assessment are listed in Table 4-7 of **RIAA HRA Part 1 of 4 – Introduction and Terrestrial Ecology (application ref: 6.1)**. These are two named components of the breeding seabird assemblage (kittiwake and guillemot).

~~9.11.1.2~~9.12.1.2 Conservation Objectives

~~634.~~713. The SPA's over-arching conservation objectives are to avoid deterioration of the habitats of the qualifying species (listed below) or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained; and to ensure for the qualifying species that the following are maintained in the long term:

- Population of the species as a viable component of the site;
- Distribution of the species within site;
- Distribution and extent of habitats supporting the species;

- Structure, function and supporting processes of habitats supporting the species; and
- No significant disturbance of the species.

~~9.11.2~~9.12.2 Assessment: Array Areas

~~9.11.2.1~~9.12.2.1 Kittiwake

~~635.~~714. Kittiwake has been screened into the Assessment to assess the impacts from collision risk in the operation phase.

~~9.11.2.1.1~~9.12.2.1.1 Status

~~636.~~715. Kittiwake is listed as a named component of the breeding seabird assemblage of the Buchan Ness to Collieston Coast SPA.

~~637.~~716. The SPA breeding population at classification in 1998 was cited as 30,452 pairs (SNH, 2009). Burnell *et al*. (2023) give an updated count of 11,295 AON which has been used in this assessment.

~~9.11.2.1.2~~9.12.2.1.2 Connectivity to the Projects

~~638.~~717. DBS East and DBS West are 357km and 340km respectively from Buchan Ness to Collieston Coast SPA. The mean maximum foraging range of kittiwake is 300.6km (156.1km + 144.5km, Woodward *et al*., 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding kittiwake from Buchan Ness to Collieston Coast SPA there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

~~639.~~718. Outside the breeding season breeding kittiwakes, including those from Buchan Ness to Collieston Coast SPA, are not constrained by requirements to visit nests to incubate eggs or provision chicks. At this time, they are assumed to range more widely and to mix with kittiwakes of all age classes from breeding colonies in the UK and further afield. The background population during these seasons is the UK North Sea BDMPS. This consists of 829,937 individuals during the autumn migration season (August to December), and 627,816 individuals during the spring migration season (January to April) (Furness, 2015). It is estimated that 1.8% and 2.4% of birds present in the Project array areas in the autumn and spring migration seasons respectively are considered to be breeding adults from Buchan Ness to Collieston Coast SPA. Note, these percentages have been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

~~9.11.2.1.3~~9.12.2.1.3 Assessment of Potential Effects of the Projects alone and Together

~~9.11.2.1.3.1~~9.12.2.1.3.1 Potential Effects During Operation: Collision risk

Table 9-81 Summary of kittiwake total collisions and apportioned to Buchan Ness to Collieston Coast SPA.

Site	Season	Collision mortality			SPA %	Adult %	Collisions apportioned to SPA		
		Lower 95% c.i.	Mean	Upper 95% c.i.			Lower 95% c.i.	Mean	Upper 95% c.i.
DBS East	Breeding	42.3	83.3	168.5	0	53			
	Autumn	14.6	41.4	82.9	1.8	100	0.26	0.75	1.49
	Spring	6.8	14.6	28.0	2.4	100	0.16	0.35	0.67
	Annual	66.9	139.3	261.3	-	-	0.43	1.10	2.16
DBS West	Breeding	36.9	107.8	280.8	0	53			
	Autumn	9.5	37.9	81.9	1.8	100	0.17	0.68	1.47
	Spring	7.1	14.9	26.5	2.4	100	0.17	0.36	0.64
	Annual	55.9	160.6	327.0	-	-	0.34	1.04	2.11
DBS East + DBS West	Breeding	96.2	191.1	378.4	0	53			
	Autumn	30.5	79.3	143.1	1.8	100	0.55	1.43	2.58
	Spring	16.9	29.5	47.3	2.4	100	0.41	0.71	1.14
	Annual	150.9	299.9	540.5	-	-	0.95	2.14	3.71

~~9.11.2.1.3.1.1~~9.12.2.1.3.1.1 DBS East in Isolation

~~640.~~719. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-7**) the number of individuals from the Buchan Ness to Collieston Coast SPA population expected to die is 3,298 (28,078 x 0.146) adults per annum. The predicted annual impacts from DBS East alone on the breeding kittiwake population is 1.1 birds per annum (**Table 9-81**). This results in a predicted change in adult mortality rate of 0.03% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.11.2.1.3.1.2~~9.12.2.1.3.1.2 *DBS West in Isolation*

~~641.~~720. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-7**) the number of individuals from the Buchan Ness to Collieston Coast SPA population expected to die is 3,298 (28,078 x 0.146) adults per annum. The predicted annual impacts from DBS West alone on the breeding kittiwake population is 1.0 birds per annum (**Table 9-81**). This results in a predicted change in adult mortality rate of 0.03% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.11.2.1.3.1.3~~9.12.2.1.3.1.3 *DBS East and West Together*

~~642.~~721. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-7**) the number of individuals from the Buchan Ness to Collieston Coast SPA population expected to die is 3,298 (28,078 x 0.146) adults per annum. The predicted annual impacts from DBS East and DBS West on the breeding kittiwake population is 2.1 birds per annum (**Table 9-81**). This results in a predicted change in adult mortality rate of 0.07% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.11.2.1.4~~9.12.2.1.4 *Summary*

~~643.~~722. A table summarising the kittiwake operational collision risk assessment for DBS East and DBS West together is provided below (**Table 9-82**).

~~644.~~723. It is concluded that predicted kittiwake mortality due to operational phase collision risk at DBS East, DBS West, and the Projects together would **not adversely affect the integrity of the Buchan Ness to Collieston Coast SPA**.

Table 9-82 Summary of predicted Kittiwake collision mortality from Buchan Ness to Collieston Coast SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations for the Worst Case Wind Turbine Scenario.

Kittiwake		Collisions		
Potential Effects During Operation: Collision Risk				
Collision mortality		Lower c.i.	Mean.	Upper c.i.
Breeding season		-	-	-
Autumn		0.55	1.43	2.58
Spring		0.41	0.71	1.14
Annual		0.95	2.14	3.71
Effect	Reference population	28,078		
	Increase in background mortality (%)	0.02	0.07	0.11

~~9.11.2.1.5~~9.12.2.1.5 *Assessment of potential effects of the Projects in combination with other plans and projects*

~~645.~~724. Given that no measurable increase in the Buchan Ness to Collieston Coast SPA kittiwake mortality is predicted as a result of DBS East and DBS West combined (e.g. with total collision mortality of only 2.1 birds per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted kittiwake mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Buchan Ness to Collieston Coast SPA**.

~~9.11.2.2~~9.12.2.2 Guillemot

~~646.~~725. Guillemot has been screened into the Assessment to assess the impacts from disturbance / displacement in the construction and operation phase.

~~9.11.2.2.1~~9.12.2.2.1 *Status*

~~647.~~726. Guillemot is listed as a named component of the breeding seabird assemblage of the Buchan Ness to Collieston Coast SPA.

~~648.~~727. The SPA breeding population at classification in 1998 was cited as 8,640 pairs (SNH, 2009). Burnell *et al*. (2023) give an updated count of 29,433 individuals which has been used in this assessment.

~~9.11.2.2.2~~9.12.2.2.2 *Connectivity to the Projects*

~~649.~~728. DBS East and DBS West are 357km and 340km respectively from Buchan Ness to Collieston Coast SPA. The mean maximum foraging range of guillemot is 153.7km (73.2km + 80.5km, Woodward *et al*., 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding guillemot from Buchan Ness to Collieston Coast SPA, there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

~~650.~~729. Outside the breeding season, breeding guillemots from Buchan Ness to Collieston Coast SPA are assumed to range widely and to mix with guillemots from breeding colonies in the UK and beyond. The relevant non-breeding season reference population is the UK North Sea and Channel BDMPS, consisting of 1,617,306 individuals (August to February) (Furness, 2015).

~~651.~~730. It is estimated that 1.3% of birds present at the Projects are breeding adults from Buchan Ness to Collieston Coast SPA, and impacts are apportioned accordingly. Note, this percentage has been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

~~9.11.2.2.3~~9.12.2.2.3 *Assessment of Potential Effects of the Projects alone and Together*

Table 9-83 Summary of guillemot density and abundance estimates and SPA apportioning rates and used in the operation and construction displacement assessment for Buchan Ness to Collieston Coast SPA. Note that displacement from the wind farm has been estimated as 15%-35%, half the operational rates.

Site	Season	Peak no.	SPA %	Adult %	No. apportioned to SPA	Wind farm operation displacement mortality to SPA			Wind farm construction displacement mortality to SPA			Peak density (birds/ km^2)	Total vessel displacement mortality (2km around 3 vessels, 1% mortality)	Vessel mortality to SPA	Total construction displacement mortality to SPA		
						30-1	50-1	70-10	15-1	25 - 1	35-10				15-1 & vessel	25 – 1 & vessel	35-10 & vessel
DBS East	Breeding	9030.5	0	55.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.71	6.7	0.0	0.0	0.0	0.0
	Nonbreeding	12551.8	1.3	100	163.2	0.5	0.8	11.4	0.2	0.4	5.7	24.62	9.3	0.1	0.4	0.5	5.8
	Annual				163.2	0.5	0.8	11.4	0.2	0.4	5.7	-	16	0.1	0.4	0.5	5.8
DBS West	Breeding	8783.5	0	55.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.92	6.4	0.0	0.0	0.0	0.0
	Nonbreeding	12498.4	1.3	100	162.5	0.5	0.8	11.4	0.2	0.4	5.7	24.08	9.1	0.1	0.4	0.5	5.8
	Annual				162.5	0.5	0.8	11.4	0.2	0.4	5.7	-	15.5	0.1	0.4	0.5	5.8
DBS East + DBS West	Breeding	~~14927.7~~17815	0	55.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	13.0	0.0	0.0	0.0	0.0
	Nonbreeding	~~20136.0~~25050	1.3	100	~~261.8~~325.7	1.0~~.8~~	1.~~3~~6	~~18.3~~22.8	0.~~4~~5	0.~~7~~8	~~9.2~~11.4		18.4	0.2	0.~~6~~7	1.0~~.9~~	~~9.4~~11.6
	Annual				~~261.8~~325.7	1.0~~.8~~	1.~~3~~6	~~18.3~~22.8	0.~~4~~5	0.~~7~~8	~~9.2~~11.4		31.4	0.2	0.~~6~~7	1.0~~.9~~	~~9.4~~11.6

~~9.11.2.2.3.1~~9.12.2.2.3.1 *Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines*

~~9.11.2.2.3.1.1~~9.12.2.2.3.1.1 *DBS East in Isolation*

~~652.~~731. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Buchan Ness to Collieston Coast SPA population expected to die is 1,795 (29,433 x 0.061) adults per annum. The predicted annual construction impact from DBS East alone on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality plus vessel displacement is 5.8 birds per annum (**Table 9-83**). This would result in a predicted change in adult mortality rate of 0.3%. The equivalent mortality assuming 35% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 1.2 which would increase the background mortality rate by 0.06%.

~~653.~~732. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~654.~~733. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Buchan Ness to Collieston Coast SPA (0.5) would increase the predicted annual mortality by 0.03% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.11.2.2.3.1.2~~9.12.2.2.3.1.2 *DBS West in Isolation*

~~655.~~734. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Buchan Ness to Collieston Coast SPA population expected to die is 1,795 (29,433 x 0.061) adults per annum. The predicted annual construction impact from DBS West alone on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality plus vessel displacement is 5.7 birds per annum (**Table 9-83**). This would result in a predicted change in adult mortality rate of 0.3%. The equivalent mortality assuming 35% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 1.1 which would increase the background mortality rate by 0.06%.

~~656.~~735. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~657.~~736. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Buchan Ness to Collieston Coast SPA (0.5) would increase the predicted annual mortality by 0.03% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.11.2.2.3.1.3~~9.12.2.2.3.1.3 DBS East and West Together

~~658.~~737. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Buchan Ness to Collieston Coast SPA population expected to die is 1,795 (29,433 x 0.061) adults per annum. The predicted annual construction impact from DBS East and DBS West on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality plus vessel displacement is ~~9.2~~11.6 birds per annum (**Table 9-83**). This would result in a predicted change in adult mortality rate of 0.~~5%.~~ 6%. The equivalent mortality assuming 35% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 2.3 which would increase the background mortality rate by 0.13%.

~~659.~~738. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~660.~~739. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Buchan Ness to Collieston Coast SPA (1.0~~.9~~) would increase the predicted annual mortality by 0.~~05~~06% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.11.2.2.3.2~~9.12.2.2.3.2 *Potential Effects During Operation: Disturbance and Displacement*

~~9.11.2.2.3.2.1~~9.12.2.2.3.2.1 *DBS East in Isolation*

~~661.~~740. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Buchan Ness to Collieston Coast SPA population expected to die is 1,795 (29,433 x 0.061) adults per annum. The predicted annual operation impact from DBS East alone on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 11.2 birds per annum (**Table 9-83**). This would result in a predicted change in adult mortality rate of 0.6%. The equivalent mortality assuming 70% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 2.2 which would increase the background mortality rate by 0.12%.

~~662.~~741. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~663.~~742. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Buchan Ness to Collieston Coast SPA (0.8) would increase the predicted annual mortality by 0.04% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.11.2.2.3.2.2~~9.12.2.2.3.2.2 *DBS West in Isolation*

~~664.~~743. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Buchan Ness to Collieston Coast SPA population expected to die is 1,795 (29,433 x 0.061) adults per annum. The predicted annual operation impact from DBS West alone on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 11.2 birds per annum (**Table 9-83**). This would result in a predicted change in adult mortality rate of 0.6%. The equivalent mortality assuming 70% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 2.2 which would increase the background mortality rate by 0.12%.

~~665.~~744. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~666.~~745. At a more appropriate (construction) displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Buchan Ness to Collieston Coast SPA (0.8) would increase the predicted annual mortality by 0.04% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.11.2.2.3.2.3~~9.12.2.2.3.2.3 DBS East and West Together

~~667.~~746. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Buchan Ness to Collieston Coast SPA population expected to die is 1,795 (29,433 x 0.061) adults per annum. The predicted annual operation impact from DBS East and DBS West on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is ~~18.0~~22.8 birds per annum (**Table 9-83**). This would result in a predicted change in adult mortality rate of 1.~~0~~3% but is based on highly precautionary impact rates. The equivalent mortality assuming 70% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 4.6 which would increase the background mortality rate by 0.25%. A reduction in either the displacement rate (e.g. to ~~69~~55%) or the ~~mo~~rtality rate (e.g. to ~~9~~8%) would red~~u~~ce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in both together).

~~668.~~747. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~669.~~748. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Buchan Ness to Collieston Coast SPA (1.~~3~~6) would increase the predicted annual mortality by 0.~~07~~09% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.11.2.2.4~~9.12.2.2.4 Summary

749. A matrix of the annual operational displacement estimates for DBS East and DBS West is provided in **Table 9-84**.

Table 9-84 Displacement matrix for annual project alone (DBS East plus DBS West) guillemot apportioned to Buchan Ness to Collieston Coast SPA adult population.

Mortality %	Displacement %									
	10	20	30	40	50	60	70	80	90	100
1	0	1	1	1	2	2	2	3	3	3
2	1	1	2	3	3	4	5	5	6	7
3	1	2	3	4	5	6	7	8	9	10
4	1	3	4	5	7	8	9	10	12	13
5	2	3	5	7	8	10	11	13	15	16
6	2	4	6	8	10	12	14	16	18	20
7	2	5	7	9	11	14	16	18	21	23
8	3	5	8	10	13	16	18	21	23	26
9	3	6	9	12	15	18	21	23	26	29
10	3	7	10	13	16	20	23	26	29	33
20	7	13	20	26	33	39	46	52	59	65
30	10	20	29	39	49	59	68	78	88	98
50	16	33	49	65	81	98	114	130	147	163
75	24	49	73	98	122	147	171	195	220	244
100	33	65	98	130	163	195	228	261	293	326

~~670.~~750. A table summarising the guillemot construction and operational disturbance and displacement assessment for DBS East and DBS West together is provided below (**Table 9-85**).

~~671.~~751. It is concluded that predicted guillemot mortality due to construction and operational phase disturbance and displacement impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the Buchan Ness to Collieston Coast SPA**.

Table 9-85 Summary of predicted guillemot displacement mortality from Buchan Ness to Collieston Coast SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.

Guillemot		Displacement		
Potential Effects During Construction: Disturbance and Displacement				
Displacement mortality		Mean (@25% x 1%)	Mean (@35% x ~~10~~2%)	Mean (@~~25~~35% x ~~1~~10%)
Breeding season		0	0	0
Nonbreeding season		1.0~~.9~~	2.3	11.6
Annual		1.0~~.9~~	2.3	11.6
Effect	Reference population	29,433		
	Increase in background mortality (%)	0.~~51~~06	0.~~05~~13	0.65
Potential Effects During Operation: Disturbance and Displacement				
Displacement mortality		Mean (@50% x 1%)	Mean (@70% x ~~10~~2%)	Mean (@~~50~~70% x ~~1~~10%)
Breeding season		0	0	0
Nonbreeding season		1.~~3~~6	4.6	22.8
Annual		1.~~3~~6	4.6	22.8
Effect	Reference population	29,433		
	Increase in background mortality (%)	~~1.~~0.09	0.~~07~~25	1.27

~~9.11.2.2.5~~9.12.2.2.5 *Assessment of potential effects of the Projects in combination with other plans and projects*

~~672.~~752. Given that no measurable increase in the Buchan Ness to Collieston Coast SPA guillemot mortality is predicted as a result of DBS East and DBS West combined (e.g. with realistic displacement mortality of only 1.~~3~~6 birds per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted guillemot mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Buchan Ness to Collieston Coast SPA**.

~~9.12~~9.13 Troup, Pennan and Lion's Heads SPA

~~9.12.1~~9.13.1 Site Description

~~673.~~753. The Troup, Pennan and Lion's Heads SPA is a 9km stretch of sea cliffs along the Aberdeenshire coast which support large colonies of breeding seabirds.

~~674.~~754. The seaward extension of the SPA extends 2km into the marine environment and includes the seabed, water column and surface. Seabirds included within the designation feed both inside and outside the SPA in nearby waters, as well as more distantly in the wider North Sea.

~~9.12.1.1~~9.13.1.1 Qualifying Features

~~675.~~755. The qualifying features of the Troup, Pennan and Lion's Heads SPA screened into the Assessment are listed in Table 4-7 of **RIAA HRA Part 1 of 4 – Introduction and Terrestrial Ecology (application ref: 6.1)**. These are breeding kittiwake and guillemot and one named component of the breeding seabird assemblage (razorbill).

~~9.12.1.2~~9.13.1.2 Conservation Objectives

~~676.~~756. The over-arching conservation objectives of the site are:

- To avoid deterioration of the habitats of the qualifying species or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained; and
- To ensure for the qualifying species that the following are maintained in the long term:
  - Population of the species as a viable component of the site;
  - Distribution of the species within site;
  - Distribution and extent of habitats supporting the species;
  - Structure, function and supporting processes of habitats supporting the species; and
  - No significant disturbance of the species.

~~9.12.2~~9.13.2 Assessment: Array Areas

~~9.12.2.1~~9.13.2.1 Kittiwake

~~677.~~757. Kittiwake has been screened into the Assessment to assess the impacts from collision risk in the operation phase.

~~9.12.2.1.1~~9.13.2.1.1 Status

~~678.~~758. Kittiwake is listed as a designated species of the Troup, Pennan and Lion's Heads SPA.

~~679.~~759. The SPA breeding population at classification in 1997 was cited as 31,600 pairs (SNH, 2009). Burnell *et al*. (2023) give an updated count of 10,616 AON which has been used in this assessment.

~~9.12.2.1.2~~9.13.2.1.2 *Connectivity to the Projects*

~~680.~~760. DBS East and DBS West are 426km and 395km respectively from Troup, Pennan and Lion's Heads SPA. The mean maximum foraging range of kittiwake is 300.6km (156.1km + 144.5km, Woodward *et al*., 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding kittiwake from Troup, Pennan and Lion's Heads SPA there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

~~681.~~761. Outside the breeding season breeding kittiwakes, including those from Troup, Pennan and Lion's Heads SPA, are not constrained by requirements to visit nests to incubate eggs or provision chicks. At this time, they are assumed to range more widely and to mix with kittiwakes of all age classes from breeding colonies in the UK and further afield. The background population during these seasons is the UK North Sea BDMPS. This consists of 829,937 individuals during the autumn migration season (August to December), and 627,816 individuals during the spring migration season (January to April) (Furness, 2015). It is estimated that 2.2% and 2.8% of birds present in the Project array areas in the autumn and spring migration seasons respectively are considered to be breeding adults from Troup, Pennan and Lions Head SPA. Note, these percentages have been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

~~9.12.2.1.3~~9.13.2.1.3 *Assessment of Potential Effects of the Projects alone and Together*

~~9.12.2.1.3.1~~9.13.2.1.3.1 *Potential Effects During Operation: Collision risk*

Table 9-86 Summary of kittiwake total collisions and apportioned to the Troup, Pennan and Lions Head SPA.

Site	Season	Collision mortality			SPA %	Adult %	Collisions apportioned to SPA		
		Lower 95% c.i.	Mean	Upper 95% c.i.			Lower 95% c.i.	Mean	Upper 95% c.i.
DBS East	Breeding	42.3	83.3	168.5	0	53	0	0	0
	Autumn	14.6	41.4	82.9	2.2	100	0.32	0.91	1.82
	Spring	6.8	14.6	28.0	2.8	100	0.19	0.41	0.78

Site	Season	Collision mortality			SPA %	Adult %	Collisions apportioned to SPA		
		Lower 95% c.i.	Mean	Upper 95% c.i.			Lower 95% c.i.	Mean	Upper 95% c.i.
	Annual	66.9	139.3	261.3	-	-	0.51	1.32	2.61
DBS West	Breeding	36.9	107.8	280.8	0	53	0	0	0
	Autumn	9.5	37.9	81.9	2.2	100	0.21	0.83	1.80
	Spring	7.1	14.9	26.5	2.8	100	0.20	0.42	0.74
	Annual	55.9	160.6	327.0	-	-	0.41	1.25	2.54
DBS East + DBS West	Breeding	96.2	191.1	378.4	0	53	0	0	0
	Autumn	30.5	79.3	143.1	2.2	100	0.67	1.74	3.15
	Spring	16.9	29.5	47.3	2.8	100	0.47	0.83	1.32
	Annual	150.9	299.9	540.5	-	-	1.14	2.57	4.47

~~9.12.2.1.3.1.1~~9.13.2.1.3.1.1 *DBS East in Isolation*

~~682.~~762. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-7**) the number of individuals from the Troup, Pennan and Lions Head SPA population expected to die is 3,099 (21,232 x 0.146) adults per annum. The predicted annual impacts from DBS East alone on the breeding kittiwake population is 1.3 birds per annum (**Table 9-86**). This results in a predicted change in adult mortality rate of 0.04% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.12.2.1.3.1.2~~9.13.2.1.3.1.2 *DBS West in Isolation*

~~683.~~763. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-7**) the number of individuals from the Troup, Pennan and Lions Head SPA population expected to die is 3,099 (21,232 x 0.146) adults per annum. The predicted annual impacts from DBS West alone on the breeding kittiwake population is 1.2 birds per annum (**Table 9-86**). This results in a predicted change in adult mortality rate of 0.04% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.12.2.1.3.1.3~~9.13.2.1.3.1.3 *DBS East and West Together*

~~684.~~764. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-7**) the number of individuals from the Troup, Pennan and Lions Head SPA population expected to die is 3,099 (21,232 x 0.146) adults per annum. The predicted annual impacts from DBS East and DBS West on the breeding kittiwake population is 2.6 birds per annum (**Table 9-86**). This results in a predicted change in adult mortality rate of 0.08% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.12.2.1.4~~9.13.2.1.4 *Summary*

~~685.~~765. A table summarising the kittiwake operational collision risk assessment for DBS East and DBS West together is provided below **(Table 9-87)**.

~~686.~~766. It is concluded that predicted kittiwake mortality due to operational phase collision risk at DBS East, DBS West, and the Projects together would **not adversely affect the integrity of the Troup, Pennan and Lions Head SPA**.

Table 9-87 Summary of predicted Kittiwake collision mortality from Troup, Pennan and Lions Head SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations for the Worst Case Wind Turbine Scenario.

Kittiwake		**Collisions**		
Potential Effects During Operation: Collision Risk				
Collision mortality		Lower c.i.	Mean.	Upper c.i.
Breeding season		-	-	-
Autumn		0.67	1.74	3.15
Spring		0.47	0.83	1.32
Annual		1.14	2.57	4.47
Effect	Reference population	21,232		
	Increase in background mortality (%)	0.03	0.08	0.14

~~9.12.2.1.5~~9.13.2.1.5 *Assessment of potential effects of the Projects in combination with other plans and projects*

~~687.~~767. Given that no measurable increase in the Troup, Pennan and Lions Head SPA kittiwake mortality is predicted as a result of DBS East and DBS West combined (e.g. with total collision mortality of only 2.5 birds per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted kittiwake mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Troup, Pennan and Lions Head SPA**.

~~9.12.2.2~~9.13.2.2 Guillemot

~~688.~~768. Guillemot has been screened into the Assessment to assess the impacts from disturbance / displacement in the construction and operation phase.

~~9.12.2.2.1~~9.13.2.2.1 *Status*

~~689.~~769. Guillemot is listed as a designated species of the Troup, Pennan and Lion's Heads SPA.

~~690.~~770. The SPA breeding population at classification in 1997 was cited as 44,600 individuals (SNH, 2009). Burnell *et al*. (2023) give an updated count of 23,801 individuals which has been used in this assessment.

~~9.12.2.2.2~~9.13.2.2.2 *Connectivity to the Projects*

~~691.~~771. DBS East and DBS West are 426km and 395km respectively from Troup, Pennan and Lion's Heads SPA. The mean maximum foraging range of guillemot is 153.7km (73.2km + 80.5km, Woodward *et al*., 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding guillemot from Troup, Pennan and Lion's Heads SPA, there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

~~692.~~772. Outside the breeding season, breeding guillemots from Troup, Pennan and Lion's Heads SPA are assumed to range widely and to mix with guillemots from breeding colonies in the UK and beyond. The relevant non-breeding season reference population is the UK North Sea and Channel BDMPS, consisting of 1,617,306 individuals (August to February) (Furness, 2015).

~~693.~~773. It is estimated that 0.9% of birds present at the Projects are breeding adults from Troup, Pennan and Lion's Heads SPA, and impacts are apportioned accordingly. Note, this percentage has been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

~~9.12.2.2.3~~9.13.2.2.3 Assessment of Potential Effects of the Projects alone and Together

Table 9-88 Summary of guillemot density and abundance estimates and SPA apportioning rates and used in the operation and construction displacement assessment for Troup, Pennan and Lion's Heads SPA. Note that displacement from the wind farm has been estimated as 15%-35%, half the operational rates.

Site	Season	Peak no.	SPA %	Adult %	No. apportioned to SPA	Wind farm operation displacement mortality to SPA			Wind farm construction displacement mortality to SPA			Peak density (birds/ km^2)	Total vessel displacement mortality (2km around 3 vessels, 1% mortality)	Vessel mortality to SPA	Total construction displacement mortality to SPA		
						30-1	50-1	70-10	15-1	25 - 1	35-10				15-1 & vessel	25 - 1 & vessel	35-10 & vessel
DBS East	Breeding	9030.5	0	55.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.71	6.7	0.0	0.0	0.0	0.0
	Nonbreeding	12551.8	0.9	100	113.0	0.3	0.6	7.9	0.2	0.3	4.0	24.62	9.3	0.1	0.3	0.4	4.0
	Annual				113.0	0.3	0.6	7.9	0.2	0.3	4.0	-	16	0.1	0.3	0.4	4.0
DBS West	Breeding	8783.5	0	55.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.92	6.4	0.0	0.0	0.0	0.0
	Nonbreeding	12498.4	0.9	100	112.5	0.3	0.6	7.9	0.2	0.3	3.9	24.08	9.1	0.1	0.3	0.4	4.0
	Annual				112.5	0.3	0.6	7.9	0.2	0.3	3.9	-	15.5	0.1	0.3	0.4	4.0
DBS East + DBS West	Breeding	~~14927.7~~17815	0	55.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	13.0	0.0	0.0	0.0	0.0
	Nonbreeding	~~20136.0~~25050	0.9	100	~~181.2~~225.5	0.~~5~~7	~~0.9~~1.1	~~12.7~~15.8	0.3	0.~~5~~6	~~6.3~~7.9		18.4	0.2	0.~~4~~5	0.~~6~~8	~~6.5~~8.1
	Annual				~~181.2~~225.5	0.~~5~~7	~~0.9~~1.1	~~12.7~~15.8	0.3	0.~~5~~6	~~6.3~~7.9		31.4	0.2	0.~~4~~5	0.~~6~~8	~~6.5~~8.1

~~9.12.2.2.3.1~~9.13.2.2.3.1 *Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines*

~~9.12.2.2.3.1.1~~9.13.2.2.3.1.1 *DBS East in Isolation*

~~694.~~774. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Troup, Pennan and Lion's Heads SPA population expected to die is 1,451 (23,801 x 0.061) adults per annum. The predicted annual construction impact from DBS East alone on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality plus vessel displacement is 4.0 birds per annum (**Table 9-88**). This would result in a predicted change in adult mortality rate of 0.3%. The equivalent mortality assuming 35% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 0.8 which would increase the background mortality rate by 0.05%.

~~695.~~775. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~696.~~776. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Troup, Pennan and Lion's Heads SPA (0.4) would increase the predicted annual mortality by 0.03% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.12.2.2.3.1.2~~9.13.2.2.3.1.2 DBS West in Isolation

~~697.~~777. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Troup, Pennan and Lion's Heads SPA population expected to die is 1,~~795 (29,433~~452 (23,801 x 0.061) adults per annum. The predicted annual construction impact from DBS West alone on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality plus vessel displacement is 4.2 birds per annum (**Table 9-88**). This would result in a predicted change in adult mortality rate of 0.3%. The equivalent mortality assuming 35% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 0.84 which would increase the background mortality rate by 0.06%.

~~698.~~778. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~699.~~779. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Troup, Pennan and Lion's Heads SPA (0.4) would increase the predicted annual mortality by 0.03% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.12.2.2.3.1.3~~9.13.2.2.3.1.3 DBS East and West Together

~~700.~~780. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Troup, Pennan and Lion's Heads SPA population expected to die is 1,~~795 (29,433~~452 (23,801 x 0.061) adults per annum. The predicted annual construction impact from DBS East and DBS West on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality plus vessel displacement is ~~6.5~~8.1 birds per annum (**Table 9-88**). This would result in a predicted change in adult mortality rate of 0.~~5%.~~ 6%. The equivalent mortality assuming 35% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 1.6 which would increase the background mortality rate by 0.11%.

~~701.~~781. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~702.~~782. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Troup, Pennan and Lion's Heads SPA (0.~~6~~8) would increase the predicted annual mortality by 0.05% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.12.2.2.3.2~~9.13.2.2.3.2 Potential Effects During Operation: Disturbance and Displacement

~~9.12.2.2.3.2.1~~9.13.2.2.3.2.1 DBS East in Isolation

~~703.~~783. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Troup, Pennan and Lion's Heads SPA population expected to die is 1,~~795 (29,433~~452 (23,801 x 0.061) adults per annum. The predicted annual operation impact from DBS East alone on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 7.9 birds per annum (**Table 9-88**). This would result in a predicted change in adult mortality rate of 0.6%. The equivalent mortality assuming 70% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 1.6 which would increase the background mortality rate by 0.11%.

~~704.~~784. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~705.~~785. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Troup, Pennan and Lion's Heads SPA (0.6) would increase the predicted annual mortality by 0.04% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.12.2.2.3.2.2~~9.13.2.2.3.2.2 *DBS West in Isolation*

~~706.~~786. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Troup, Pennan and Lion's Heads SPA population expected to die is 1,~~795 (29,433~~452 (23,801 x 0.061) adults per annum. The predicted annual operation impact from DBS West alone on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 7.9 birds per annum (**Table 9-88**). This would result in a predicted change in adult mortality rate of 0.6%. The equivalent mortality assuming 70% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 1.6 which would increase the background mortality rate by 0.11%.

~~707.~~787. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~708.~~788. At a more appropriate (construction) displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Troup, Pennan and Lion's Heads SPA (0.6) would increase the predicted annual mortality by 0.04% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.12.2.2.3.2.3~~9.13.2.2.3.2.3 *DBS East and West Together*

~~709.~~789. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Troup, Pennan and Lion's Heads SPA population expected to die is 1,~~795 (29,433~~452 (23,801 x 0.061) adults per annum. The predicted annual operation impact from DBS East and DBS West on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is ~~12.7~~15.8 birds per annum (**Table 9-88**). This would result in a predicted change in adult mortality rate of ~~0.91%.~~ 1.1%. The equivalent mortality assuming 70% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 3.2 which would increase the background mortality rate by 0.22%.

~~710.~~790. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~711.~~791. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Troup, Pennan and Lion's Heads SPA (~~0.95~~1.1) would increase the predicted annual mortality by 0.~~06~~08% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.12.2.2.4~~9.13.2.2.4 *Summary*

~~712.~~792. A matrix of the annual operational displacement estimates for DBS East and DBS West is provided in **Table 9-89**.

Table 9-89 Displacement matrix for annual project alone (DBS East plus DBS West) guillemot apportioned to Troup, Pennan and Lion's Head SPA adult population.

Mortality %	Displacement %									
	10	20	30	40	50	60	70	80	90	100
1	0	0	1	1	1	1	2	2	2	2
2	0	1	1	2	2	3	3	4	4	5
3	1	1	2	3	3	4	5	5	6	7
4	1	2	3	4	5	5	6	7	8	9
5	1	2	3	5	6	7	8	9	10	11
6	1	3	4	5	7	8	9	11	12	14
7	2	3	5	6	8	9	11	13	14	16
8	2	4	5	7	9	11	13	14	16	18
9	2	4	6	8	10	12	14	16	18	20
10	2	5	7	9	11	14	16	18	20	23
20	5	9	14	18	23	27	32	36	41	45
30	7	14	20	27	34	41	47	54	61	68
50	11	23	34	45	56	68	79	90	101	113
75	17	34	51	68	85	101	118	135	152	169
100	23	45	68	90	113	135	158	180	203	226

~~713.~~793. A table summarising the guillemot construction and operational disturbance and displacement assessment for DBS East and DBS West together is provided below (**Table 9-90**).

~~714.~~794. It is concluded that predicted guillemot mortality due to construction and operational phase disturbance and displacement impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the Troup, Pennan and Lion's Heads SPA**.

Table 9-90 Summary of predicted guillemot displacement mortality from Troup, Pennan and Lion's Heads SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.

Guillemot		**Displacement**		
Potential Effects During Construction: Disturbance and Displacement				
Displacement mortality		Mean (@25% x 1%)	Mean (@35% x ~~10~~2%)	Mean (@~~25~~35% x ~~1~~10%)
Breeding season		0	0	0
Nonbreeding season		~~6.5~~0.8	~~0~~1.6	8.1
Annual		~~6.5~~0.8	~~0~~1.6	8.1
Effect	Reference population	23,801		
	Increase in background mortality (%)	0.~~47~~05	0.~~04~~11	0.56
Potential Effects During Operation: Disturbance and Displacement				
Displacement mortality		Mean (@50% x 1%)	Mean (@70% x ~~10~~2%)	Mean (@~~50~~70% x ~~1~~10%)
Breeding season		0	0	0
Nonbreeding season		~~12.7~~1.1	~~0.9~~3.2	15.8
Annual		~~12.7~~1.1	~~0.9~~3.2	15.8
Effect	Reference population	23,801		
	Increase in background mortality (%)	0.~~92~~08	0.~~07~~22	1.09

~~9.12.2.2.5~~9.13.2.2.5 *Assessment of potential effects of the Projects in combination with other plans and projects*

~~715.~~795. Given that no measurable increase in the Troup, Pennan and Lion's Heads SPA guillemot mortality is predicted as a result of DBS East and DBS West combined (e.g. with realistic displacement mortality of only 0.9 birds per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted guillemot mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Troup, Pennan and Lion's Heads SPA**.

~~9.12.2.3~~9.13.2.3 Razorbill

~~716.~~796. Razorbill has been screened into the assessment to assess the impacts from disturbance / displacement in the construction and operation phase.

~~9.12.2.3.1~~9.13.2.3.1 Status

~~717.~~797. Razorbill is listed as a named component of the breeding seabird assemblage of the Troup, Pennan and Lion's Heads SPA.

~~718.~~798. The SPA breeding population at classification in 1997 was cited as 4,800 individuals (SNH, 2009). Burnell *et al*. (2023) give an updated count of 4,518 individuals which has been used in this assessment.

~~9.12.2.3.2~~9.13.2.3.2 Connectivity to the Projects

~~719.~~799. DBS East and DBS West are 426km and 395km respectively from Troup, Pennan and Lion's Heads SPA. The mean maximum foraging range of razorbill is 164.6km (88.7 + 75.9km, Woodward *et al*., 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding razorbill from Troup, Pennan and Lion's Heads SPA, there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

~~720.~~800. Outside the breeding season, breeding razorbills from Troup, Pennan and Lion's Heads SPA are assumed to range widely and to mix with razorbills from breeding colonies in the UK and further afield. The relevant background population is considered to be the UK North Sea and Channel BDMPS, consisting of 591,874 individuals during autumn and spring passage periods (August to October and January to March), and 218,622 individuals during winter (November and December) (Furness, 2015).

~~721.~~801. During the autumn and spring migration it is estimated that Troup, Pennan and Lion's Heads birds make up 0.6% of the BDMPS population, and during the winter 0.2% of the BDMPS population. Note, these percentages have been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

~~9.12.2.3.3~~9.13.2.3.3 Assessment of Potential Effects of the Projects alone and Together

Table 9-91 Summary of razorbill density and abundance estimates and SPA apportioning rates and used in the operation and construction displacement assessment for Troup, Pennan and Lion's Heads SPA. Note that displacement from the wind farm has been estimated as 15%-35%, half the operational rates.

Site	Season	Peak no.	SPA %	Adult %	No. apportioned to SPA	Wind farm operation displacement mortality to SPA			Wind farm construction displacement mortality to SPA			Peak density (birds/ km^2)	Total vessel displacement mortality (2km around 3 vessels, 1% mortality)	Vessel mortality to SPA	Total construction displacement mortality to SPA		
						30-1	50-1	70-10	15-1	25 - 1	35-10				15-1 & vessel	25 – 1 & vessel	35-10 & vessel
DBS East	Breeding	555.1	0	100	0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.4	0.00	0.00	0.00	0.00
	Autumn	4685.3	0.6	100	28.1	0.1	0.1	2.0	0.0	0.1	1.0	9.2	3.5	0.02	0.06	0.09	1.00
	Winter	3376.7	0.2	100	6.8	0.0	0.0	0.5	0.0	0.0	0.2	6.6	2.5	0.00	0.02	0.02	0.24
	Spring	3578.5	0.6	100	21.5	0.1	0.1	1.5	0.0	0.1	0.8	7.0	2.6	0.02	0.05	0.07	0.77
	Annual				56.3	0.2	0.2	4	0	0.2	2	-	9	0.04	0.13	0.18	2.01
DBS West	Breeding	2280.6	0	100	0	0.0	0.0	0.0	0.0	0.0	0.0	4.4	1.7	0.00	0.00	0.00	0.00
	Autumn	4886.9	0.6	100	29.3	0.1	0.1	2.1	0.0	0.1	1.0	9.4	3.5	0.02	0.07	0.09	1.05
	Winter	5066.2	0.2	100	10.1	0.0	0.1	0.7	0.0	0.0	0.4	9.7	3.7	0.01	0.02	0.03	0.36
	Spring	4454.6	0.6	100	26.7	0.1	0.1	1.9	0.0	0.1	0.9	8.6	3.2	0.02	0.06	0.09	0.95
	Annual				66.2	0.2	0.3	4.6	0.1	0.2	2.3	-	10.4	0.05	0.15	0.21	2.36
DBS East + DBS West	Breeding	~~2826.1~~2835.7	0	100	0	0.0	0.0	0.0	0.0	0.0	0.0		2.1	0.00	0.00	0.00	0.00
	Autumn	~~6349.6~~9572.2	0.6	100	~~38.1~~57.4	0.~~1~~2	0.~~2~~3	~~2.7~~4.0	0.1	0.1	~~1.3~~2.0		7.0	0.04	0.~~10~~13	0.~~14~~18	~~1.38~~2.05
	Winter	~~5823.7~~8442.9	0.2	100	~~11.6~~16.9	0.~~0~~1	0.1	~~0.8~~1.2	0.0	0.0	0.~~4~~6		6.1	0.01	0.~~03~~04	0.~~04~~05	0.~~42~~60
	Spring	~~6302.5~~8033.1	0.6	100	~~37.8~~48.2	0.1	0.2	~~2.6~~3.4	0.1	0.1	1.~~3~~7		5.9	0.04	0.~~09~~11	0.~~13~~16	1.~~36~~73
	Annual				~~87.6~~122.5	0.~~3~~4	0.~~4~~6	8.6~~.1~~	0.~~1~~2	0.~~2~~3	4.3~~.1~~	-	21.1	0.09	0.~~22~~27	0.~~31~~40	~~3.16~~4.38

~~9.12.2.3.3.1~~9.13.2.3.3.1 *Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines*

~~9.12.2.3.3.1.1~~9.13.2.3.3.1.1 *DBS East in Isolation*

~~722.~~802. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-7**) the number of individuals from the Troup, Pennan and Lion's Heads SPA population expected to die is 474 (4,518 x 0.105) adults per annum. The predicted annual construction impact from DBS East alone on the breeding razorbill population applying highly precautionary rates of 35% displacement and 10% mortality plus vessel displacement is 2.0 (1.0, 0.24, 0.77 in autumn winter and spring respectively) birds per annum (**Table 9-91)**. This would result in a predicted change in adult mortality rate of 0.41%. The equivalent mortality assuming 35% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 0.4 which would increase the background mortality rate by 0.08%.

~~723.~~803. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~724.~~804. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Troup, Pennan and Lion's Heads SPA (0.2) would increase the predicted annual mortality by 0.04% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.12.2.3.3.1.2~~9.13.2.3.3.1.2 *DBS West in Isolation*

~~725.~~805. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-7**) the number of individuals from the Troup, Pennan and Lion's Heads SPA population expected to die is 474 (4,518 x 0.105) adults per annum. The predicted annual construction impact from DBS West alone on the breeding razorbill population applying highly precautionary rates of 35% displacement and 10% mortality plus vessel displacement is 2.4 (1.0, 0.4, 1.0 in autumn, winter and spring respectively) birds per annum (**Table 9-91**). This would result in a predicted change in adult mortality rate of 0.5%. The equivalent mortality assuming 35% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 0.5 which would increase the background mortality rate by 0.10%.

~~726.~~806. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~727.~~807. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Troup, Pennan and Lion's Heads SPA (0.2) would increase the predicted annual mortality by 0.04% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.12.2.3.3.1.3~~9.13.2.3.3.1.3 DBS East and West Together

~~728.~~808. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-7**) the number of individuals from the Troup, Pennan and Lion's Heads SPA population expected to die is 474 (4,518 x 0.105) adults per annum. The predicted annual construction impact from DBS East and DBS West on the breeding razorbill population applying highly precautionary rates of 35% displacement and 10% mortality plus vessel displacement is ~~3.2 (1.~~4~~, 0~~.4 (2.0, 0.6, 1.~~4~~7 in autumn, winter and spring respectively) birds per annum (**Table 9-91**). This would result in a predicted change in adult mortality rate of 0.~~6~~9%. The equivalent mortality assuming 35% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 0.88 which would increase the background mortality rate by 0.18%.

~~729.~~809. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~730.~~810. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Troup, Pennan and Lion's Heads SPA (0.~~3~~4) would increase the predicted annual mortality by 0.~~06~~08% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.12.2.3.3.2~~9.13.2.3.3.2 *Potential Effects During Operation: Disturbance and Displacement*

~~9.12.2.3.3.2.1~~9.13.2.3.3.2.1 *DBS East in Isolation*

~~9.12.2.3.3.3 Potential Effects During Operation: Disturbance and Displacement~~

~~731.~~811. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-7**) the number of individuals from the Troup, Pennan and Lion's Heads SPA population expected to die is 474 (4,518 x 0.105) adults per annum. The predicted annual operation impact from DBS East alone on the breeding razorbill population applying highly precautionary rates of 70% displacement and 10% mortality is 3.9 (2.0, 0.5, 1.5 in autumn winter and spring respectively) birds per annum (**Table 9-91**). This would result in a predicted change in adult mortality rate of 0.8%. The equivalent mortality assuming 70% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 0.78 which would increase the background mortality rate by 0.16%.

~~732.~~812. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~733.~~813. At a more appropriate operational displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Troup, Pennan and Lion's Heads SPA (0.3) would increase the predicted annual mortality by 0.06% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.12.2.3.3.3.1~~9.13.2.3.3.2.2 DBS West in Isolation

~~734.~~814. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-7**) the number of individuals from the Troup, Pennan and Lion's Heads SPA population expected to die is 474 (4,518 x 0.105) adults per annum. The predicted annual operation impact from DBS West alone on the breeding razorbill population applying highly precautionary rates of 70% displacement and 10% mortality is 4.6 (2.1, 0.7, 1.9 in autumn winter and spring respectively) birds per annum (**Table 9-91**). This would result in a predicted change in adult mortality rate of 0.9%. The equivalent mortality assuming 70% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 0.92 which would increase the background mortality rate by 0.19%.

~~735.~~815. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~736.~~816. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Troup, Pennan and Lion's Heads SPA (0.3) would increase the predicted annual mortality by 0.06% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.12.2.3.3.3.2~~9.13.2.3.3.2.3 DBS East and West Together

~~737.~~817. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-7**) the number of individuals from the Troup, Pennan and Lion's Heads SPA population expected to die is 474 (4,518 x 0.105) adults per annum. The predicted annual construction impact from DBS East and DBS West on the breeding razorbill population applying highly precautionary rates of 70% displacement and 10% mortality is ~~6.1 (2.7, 0.~~8~~, 2~~.6 (4.0, 1.2, 3.4 in autumn winter and spring respectively) birds per annum (**Table 9-91**). This would result in a predicted change in adult mortality rate of 1.~~3%~~ 8% but is based on highly precautionary impact rates. The equivalent mortality assuming 70% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 1.7 which would increase the background mortality rate by 0.36%.A reduction in either the displacement rate (e.g. to ~~54~~39%) or the mortality rate (e.g. to ~~7.7~~5.5%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in both together).

~~738.~~818. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~739.~~819. At a more appropriate operational displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Troup, Pennan and Lion's Heads SPA (0.~~4~~6) would increase the predicted annual mortality by 0.~~08~~13% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.12.2.3.4~~9.13.2.3.4 Summary

820. A matrix of the annual operational displacement estimates for DBS East and DBS West is provided in **Table 9-92**.

Table 9-92 Displacement matrix for annual project alone (DBS East plus DBS West) razorbill apportioned to Troup, Pennan and Lions Head SPA adult population.

Mortality %	Displacement %									
	10	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**
1	0	0	0	0	1	1	1	1	1	1
2	0	0	1	1	1	1	2	2	2	2
3	0	1	1	1	2	2	3	3	3	4
4	0	1	1	2	2	3	3	4	4	5
5	1	1	2	2	3	4	4	5	6	6
6	1	1	2	3	4	4	5	6	7	7
7	1	2	3	3	4	5	6	7	8	9
8	1	2	3	4	5	6	7	8	9	10
9	1	2	3	4	6	7	8	9	10	11
10	1	2	4	5	6	7	9	10	11	12
20	2	5	7	10	12	15	17	20	22	25
30	4	7	11	15	18	22	26	29	33	37
50	6	12	18	25	31	37	43	49	55	61
75	9	18	28	37	46	55	64	74	83	92
100	12	25	37	49	61	74	86	98	110	123

~~740.~~821. A table summarising the razorbill construction and operational disturbance and displacement assessment for DBS East and DBS West together is provided below (**Table 9-93**).

~~741.~~822. It is concluded that predicted razorbill mortality due to construction and operational phase disturbance and displacement impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the Troup, Pennan and Lion's Heads SPA**.

Table 9-93 Summary of predicted razorbill displacement mortality from Troup, Pennan and Lion's Heads SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.

~~Guillemot~~Razorbill		**Displacement**		
Potential Effects During Construction: Disturbance and Displacement				
Displacement mortality		Mean (@25% x 1%)	Mean (@35% x ~~10~~2%)	Mean (@~~25~~35% x ~~1~~10%)
Breeding season		0	0	0
Autumn		~~1.38~~0.18	0.~~14~~41	2.05
Winter		0.~~42~~05	0.~~04~~12	0.6
Spring		~~1.36~~0.16	0.~~13~~35	1.73
Annual		~~3.2~~0.4	0.~~3~~88	4.38
Effect	Reference population	4,518		
	Increase in background mortality (%)	0.~~6~~08	0.~~05~~18	0.92
Potential Effects During Operation: Disturbance and Displacement				
Displacement mortality		Mean (@50% x 1%)	Mean (@70% x ~~10~~2%)	Mean (@~~50~~70% x ~~1~~10%)
Breeding season		0	0	0
Autumn		~~2.7~~0.3	0.~~2~~8	4.0
Winter		0.~~8~~1	0.~~1~~24	1.2
Spring		0.2~~.6~~	0.~~2~~68	3.4
Annual		0.~~4~~6	1.72	8.6
Effect	Reference population	4,518		
	Increase in background mortality (%)	~~1.3~~0.13	0.~~08~~36	1.81

~~9.12.2.3.5~~9.13.2.3.5 Assessment of potential effects of the Projects in combination with other plans and projects

~~742.~~823. Given that no measurable increase in the Troup, Pennan and Lion's Heads SPA razorbill mortality is predicted as a result of DBS East and DBS West combined (e.g. with realistic displacement mortality of less than 1 bird per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted guillemot mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Troup, Pennan and Lion's Heads SPA**.

~~9.13~~9.14 East Caithness Cliffs SPA

~~9.13.1~~9.14.1 Site Description

~~743.~~824. The East Caithness Cliffs SPA is of high nature conservation and scientific importance within Britain and Europe for supporting very large populations of breeding seabirds. It includes most of the sea cliff areas between Wick and Helmsdale on the north-east coast of the Scottish mainland.

~~744.~~825. The seaward extension of the SPA extends 2km into the marine environment and includes the seabed, water column and surface. Seabirds included within the designation feed both inside and outside the SPA in nearby waters, as well as more distantly in the wider North Sea.

~~9.13.1.1~~9.14.1.1 Qualifying Features

~~745.~~826. The qualifying features of the East Caithness Cliffs SPA screened into the assessment are listed in Table 4-7 of **RIAA HRA Part 1 of 4 – Introduction and Terrestrial Ecology (application ref: 6.1)**. These are breeding kittiwake, guillemot and razorbill.

~~9.13.1.2~~9.14.1.2 Conservation Objectives

~~746.~~827. The over-arching conservation objectives of the site are:

- To avoid deterioration of the habitats of the qualifying species or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained; and
- To ensure for the qualifying species that the following are maintained in the long term:
  - Population of the species as a viable component of the site;
  - Distribution of the species within site;

- Distribution and extent of habitats supporting the species;
- Structure, function and supporting processes of habitats supporting the species; and
- No significant disturbance of the species.

~~9.13.2~~9.14.2 Assessment: Array Areas

~~9.13.2.1~~9.14.2.1 Kittiwake

~~747.~~828. Kittiwake has been screened into the assessment to assess the impacts from collision risk in the operation phase.

~~9.13.2.1.1~~9.14.2.1.1 Status

~~748.~~829. Kittiwake is listed as a designated species of the East Caithness Cliffs SPA.

~~749.~~830. The SPA breeding population at classification in 1996 was cited as 32,500 pairs (SNH, 2009). Burnell *et al*. (2023) give an updated count of 24,479 individuals which has been used in this assessment.

~~9.13.2.1.2~~9.14.2.1.2 Connectivity to the Projects

~~750.~~831. DBS East and DBS West are 517km and 485km respectively from East Caithness Cliffs SPA. The mean maximum foraging range of kittiwake is 300.6km (156.1km + 144.5km, Woodward *et al*., 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding kittiwake from East Caithness Cliffs SPA there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

~~751.~~832. Outside the breeding season breeding kittiwakes, including those from East Caithness Cliffs SPA, are not constrained by requirements to visit nests to incubate eggs or provision chicks. At this time, they are assumed to range more widely and to mix with kittiwakes of all age classes from breeding colonies in the UK and further afield. The background population during these seasons is the UK North Sea BDMPS. This consists of 829,937 individuals during the autumn migration season (August to December), and 627,816 individuals during the spring migration season (January to April) (Furness, 2015).

~~752.~~833. It is estimated that 5.8% and 7.7% of birds present in the Project array areas in the autumn and spring migration seasons respectively are considered to be breeding adults from East Caithness Cliffs SPA. Note, these percentages have been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

~~9.13.2.1.3~~9.14.2.1.3 Assessment of Potential Effects of the Projects alone and Together

~~9.13.2.1.3.1~~9.14.2.1.3.1 Potential Effects During Operation: Collision risk

Table 9-94 Summary of kittiwake total collisions and apportioned to the East Caithness Cliffs SPA.

Site	Season	Collision mortality			SPA %	Adult %	Collisions apportioned to SPA		
		Lower 95% c.i.	Mean	Upper 95% c.i.			Lower 95% c.i.	Mean	Upper 95% c.i.
DBS East	Breeding	42.3	83.3	168.5	0	53	0	0	0
	Autumn	14.6	41.4	82.9	5.8	100	0.8	2.4	4.8
	Spring	6.8	14.6	28.0	7.7	100	0.5	1.1	2.2
	Annual	66.9	139.3	261.3	-	-	1.4	3.5	7.0
DBS West	Breeding	36.9	107.8	280.8	0	53	0	0	0
	Autumn	9.5	37.9	81.9	5.8	100	0.6	2.2	4.8
	Spring	7.1	14.9	26.5	7.7	100	0.5	1.1	2.0
	Annual	55.9	160.6	327.0	-	-	1.1	3.3	6.8
DBS East + DBS West	Breeding	96.2	191.1	378.4	0	53	0	0	0
	Autumn	30.5	79.3	143.1	5.8	100	1.8	4.6	8.3
	Spring	16.9	29.5	47.3	7.7	100	1.3	2.3	3.6
	Annual	150.9	299.9	540.5	-	-	3.1	6.9	11.9

~~9.13.2.1.3.1.1~~9.14.2.1.3.1.1 DBS East in Isolation

~~753.~~834. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-7**) the number of individuals from the East Caithness Cliffs SPA population expected to die is 7,148 (48,958 x 0.146) adults per annum. The predicted annual impacts from DBS East alone on the breeding kittiwake population is 3.6 birds per annum (**Table 9-94**). This results in a predicted change in adult mortality rate of 0.05% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.13.2.1.3.1.2~~9.14.2.1.3.1.2 DBS West in Isolation

~~754.~~835. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-7**) the number of individuals from the East Caithness Cliffs SPA population expected to die is 7,148 (48,958 x 0.146) adults per annum. The predicted annual impacts from DBS West alone on the breeding kittiwake population is 3.3 birds per annum (**Table 9-94**). This results in a predicted change in adult mortality rate of 0.05% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.13.2.1.3.1.3~~9.14.2.1.3.1.3 DBS East and West Together

~~755.~~836. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-7**) the number of individuals from the East Caithness Cliffs SPA population expected to die is 7,148 (48,958 x 0.146) adults per annum. The predicted annual impacts from DBS East and DBS West on the breeding kittiwake population is 6.9 birds per annum (**Table 9-94**). This results in a predicted change in adult mortality rate of 0.1% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.13.2.1.4~~9.14.2.1.4 Summary

~~9.13.2.1.5 Summary~~

~~756.~~837. A table summarising the kittiwake operational collision risk assessment for DBS East and DBS West together is provided below (**Table 9-95**).

~~757.~~838. It is concluded that predicted kittiwake mortality due to operational phase collision risk at DBS East, DBS West, and the Projects together would **not adversely affect the integrity of the East Caithness Cliffs SPA**.

Table 9-95 Summary of predicted Kittiwake collision mortality from East Caithness Cliffs SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations for the Worst Case Wind Turbine Scenario.

Kittiwake		**Collisions**		
Potential Effects During Operation: Collision Risk				
Collision mortality		Lower c.i.	Mean	Upper c.i.
Breeding season		-	-	-
Autumn		1.8	4.6	8.3
Spring		1.3	2.3	3.6
Annual		3.1	6.9	11.9
Effect	Reference population			48,958
	Increase in background mortality (%)	0.03	0.1	0.22

~~9.13.2.1.6~~9.14.2.1.5 Assessment of potential effects of the Projects in combination with other plans and projects

~~758.~~839. Given that no measurable increase in the East Caithness Cliffs SPA kittiwake mortality is predicted as a result of DBS East and DBS West combined (e.g. with total collision mortality of only 6.9 birds per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted kittiwake mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the East Caithness Cliffs SPA**.

~~9.13.2.2~~9.14.2.2 Guillemot

~~759.~~840. Guillemot has been screened into the assessment to assess the impacts from disturbance / displacement in the construction and operation phase.

~~9.13.2.2.1~~9.14.2.2.1 Status

~~760.~~841. Guillemot is listed as a designated species of the East Caithness Cliffs SPA. The SPA breeding population at classification in 1996 was cited as 106,700 individuals (SNH, 2009). Burnell *et al.* (2023) give an updated count of 149,228 individuals which has been used in this assessment.

~~9.13.2.2.2~~9.14.2.2.2 Connectivity to the Projects

~~761.~~842. DBS East and DBS West are 517km and 485km respectively from East Caithness Cliffs SPA. The mean maximum foraging range of guillemot is 153.7km (73.2km + 80.5km, Woodward *et al.*, 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding guillemot from East Caithness Cliffs SPA, there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only. Outside the breeding season, breeding guillemots from East Caithness Cliffs SPA are assumed to range widely and to mix with guillemots from breeding colonies in the UK and beyond. The relevant non-breeding season reference population is the UK North Sea and Channel BDMPS, consisting of 1,617,306 individuals (August to February) (Furness, 2015). It is estimated that 9.2% of birds present at the Projects are considered to be breeding adults from East Caithness Cliffs SPA. Note, this percentage has been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

~~9.13.2.2.3~~9.14.2.2.3 Assessment of Potential Effects of the Projects alone and Together

Table 9-96 Summary of guillemot density and abundance estimates and SPA apportioning rates and used in the operation and construction displacement assessment for East Caithness Cliffs SPA. Note that displacement from the wind farm has been estimated as 15%-35%, half the operational rates.

Site	Season	Peak no.	SPA %	Adult %	No. apportioned to SPA	Wind farm operation displacement mortality to SPA			Wind farm construction displacement mortality to SPA			Peak density (birds / km²)	Total vessel displacement mortality (2km around 3 vessels, 1% mortality)	Vessel mortality to SPA	Total construction displacement mortality to SPA		
						30-1	50-1	70-10	15-1	25 - 1	35-10				15-1 & vessel	25 – 1 & vessel	35-10 & vessel
DBS East	Breeding	9030.5	0	55.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.71	6.7	0.0	0.0	0.0	0.0
	Nonbreeding	12551.8	9.2	100	1154.8	3.5	5.8	80.8	1.7	2.9	40.4	24.62	9.3	0.9	2.6	3.7	41.3
	Annual				1154.8	3.5	5.8	80.8	1.7	2.9	40.4	-	16	0.9	2.6	3.7	41.3
DBS West	Breeding	8783.5	0	55.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.92	6.4	0.0	0.0	0.0	0.0
	Nonbreeding	12498.4	9.2	100	1149.9	3.4	5.7	80.5	1.7	2.9	40.2	24.08	9.1	0.8	2.6	3.7	41.1
	Annual				1149.9	3.4	5.7	80.5	1.7	2.9	40.2	-	15.5	0.8	2.6	3.7	41.1
DBS East + DBS West	Breeding	~~14927.7~~17815	0	55.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0		13.0	0.0	0.0	0.0	0.0
	Nonbreeding	~~20136.0~~25050	9.2	100	~~1852.5~~2304.6	~~5.~~6.9	~~9.3~~11.5	~~129.7~~161.3	~~2.8~~3.5	~~4.6~~5.8	~~64.8~~80.7	-	18.4	1.7	~~4.~~5.2	~~6.3~~7.5	~~66.5~~82.4
	Annual				~~1852.5~~2304.6	~~5.~~6.9	~~9.3~~11.5	~~129.7~~161.3	~~2.8~~3.5	~~4.6~~5.8	~~64.8~~80.7		31.4	1.7	~~4.~~5.2	~~6.3~~7.5	~~66.5~~82.4

~~9.13.2.2.3.1~~9.14.2.2.3.1 *Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines*

~~9.13.2.2.3.1.1~~9.14.2.2.3.1.1 *DBS East in Isolation*

~~762.~~843. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the East Caithness Cliffs SPA population expected to die is 9,103 (149,228 x 0.061) adults per annum. The predicted annual construction impact from DBS East alone on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 41.3 birds per annum (**Table 9-96**). This would result in a predicted change in adult mortality rate of 0.4%. The equivalent mortality assuming 35% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 8.3 which would increase the background mortality rate by 0.09%.

~~763.~~844. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~764.~~845. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the East Caithness Cliffs SPA (3.7) would increase the predicted annual mortality by 0.04% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.13.2.2.3.1.2~~9.14.2.2.3.1.2 *DBS West in Isolation*

~~765.~~846. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the East Caithness Cliffs SPA population expected to die is 9,103 (149,228 x 0.061) adults per annum. The predicted annual construction impact from DBS West alone on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 41.1 birds per annum (**Table 9-96**). This would result in a predicted change in adult mortality rate of 0.4%. The equivalent mortality assuming 35% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 8.2 which would increase the background mortality rate by 0.09%.

~~766.~~847. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~767.~~848. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the East Caithness Cliffs SPA (3.7) would increase the predicted annual mortality by 0.04% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.13.2.2.3.1.3~~9.14.2.2.3.1.3 DBS East and West Together

849. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the East Caithness Cliffs SPA population expected to die is 9,103 (149,228 x 0.061) adults per annum. The predicted annual construction impact from DBS East and DBS West on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is ~~66.5~~82.4 birds per annum (**Table 9-96**). This would result in a predicted change in adult mortality rate of 0.9%. The equivalent mortality assuming 35% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 16.5 which would increase the background mortality rate by 0.18%.

~~768.~~ There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. ~~7%.~~

~~769.~~850. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~770.~~851. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the East Caithness Cliffs SPA (~~6.3~~7.5) would increase the predicted annual mortality by 0.~~07~~08% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.13.2.2.3.2~~9.14.2.2.3.2 Potential Effects During Operation: Disturbance and Displacement

~~9.13.2.2.3.2.1~~9.14.2.2.3.2.1 DBS East in Isolation

~~771.~~852. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the East Caithness Cliffs SPA population expected to die is 9,103 (149,228 x 0.061) adults per annum. The predicted annual operation impact from DBS East alone on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 80.8 birds per annum (**Table 9-96**). This would result in a predicted change in adult mortality rate of 0.9%. The equivalent mortality assuming 70% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 16.2 which would increase the background mortality rate by 0.18%.

~~772.~~853. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~773.~~854. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the East Caithness Cliffs SPA (5.8) would increase the predicted annual mortality by 0.06% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.13.2.2.3.2.2~~9.14.2.2.3.2.2 *DBS West in Isolation*

~~774.~~855. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the East Caithness Cliffs SPA population expected to die is 9,103 (149,228 x 0.061) adults per annum. The predicted annual operation impact from DBS West alone on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 80.5 birds per annum (**Table 9-96**). This would result in a predicted change in adult mortality rate of 0.9%. The equivalent mortality assuming 70% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 16.1 which would increase the background mortality rate by 0.18%.

~~775.~~856. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~776.~~857. At a more appropriate (construction) displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the East Caithness Cliffs SPA (5.7) would increase the predicted annual mortality by 0.06% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.13.2.2.3.2.3~~9.14.2.2.3.2.3 *DBS East and West Together*

~~777.~~858. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the East Caithness Cliffs SPA population expected to die is 9,103 (149,228 x 0.061) adults per annum. The predicted annual operation impact from DBS East and DBS West on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is ~~129.7~~161.3 birds per annum (**Table 9-96**). This would result in a predicted change in adult mortality rate of 1.~~4~~8% but is based on highly precautionary impact rates. The equivalent mortality assuming 35% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1])was 32.3 which would increase the background mortality rate by 0.35%. A reduction in either the displacement rate (e.g. to ~~49~~40%) or the mortality rate (e.g. to ~~7~~5%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in both together).

~~778.~~859. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~779.~~860. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the East Caithness Cliffs SPA (~~9.3~~11.5) would increase the predicted annual mortality by 0.~~1~~13% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.13.2.2.4~~9.14.2.2.4 *Summary*

861. A matrix of the annual operational displacement estimates for DBS East and DBS West is provided in **Table 9-97**.

Table 9-97 Displacement matrix for annual project alone (DBS East plus DBS West) guillemot apportioned to East Caithness Cliffs SPA adult population.

Mortality %	**Displacement %**									
	10	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**
1	2	5	7	9	12	14	16	18	21	23
2	5	9	14	18	23	28	32	37	41	46
3	7	14	21	28	35	41	48	55	62	69
4	9	18	28	37	46	55	65	74	83	92
5	12	23	35	46	58	69	81	92	104	115
6	14	28	41	55	69	83	97	111	124	138
7	16	32	48	65	81	97	113	129	145	161
8	18	37	55	74	92	111	129	147	166	184
9	21	41	62	83	104	124	145	166	187	207
10	23	46	69	92	115	138	161	184	207	230
20	46	92	138	184	230	277	323	369	415	461
30	69	138	207	277	346	415	484	553	622	691
50	115	230	346	461	576	691	807	922	1037	1152
75	173	346	519	691	864	1037	1210	1383	1556	1728
100	230	461	691	922	1152	1383	1613	1844	2074	2305

~~780.~~862. A table summarising the guillemot construction and operational disturbance and displacement assessment for DBS East and DBS West together is provided below (**Table 9-98)**.

~~781.~~863. It is concluded that predicted guillemot mortality due to construction and operational phase disturbance and displacement impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the East Caithness Cliffs SPA**.

Table 9-98 Summary of predicted guillemot displacement mortality from East Caithness Cliffs SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.

Guillemot		**Displacement**		
Potential Effects During Construction: Disturbance and Displacement				
Displacement mortality		Mean (@25% x 1%)	Mean (@35% x ~~10~~2%)	Mean (@~~25~~35% x ~~1~~10%)
Breeding season		0	0	0
Nonbreeding season		~~66~~7.5	~~6.3~~16.5	82.4
Annual		~~66~~7.5	~~6.3~~16.5	82.4
Effect	Reference population	149,228		
	Increase in back-ground mortality (%)	0.~~7~~08	0.~~07~~18	0.9
Potential Effects During Operation: Disturbance and Displacement				
Displacement mortality		Mean (@50% x 1%)	Mean (@70% x ~~10~~2%)	Mean (@~~50~~70% x ~~1~~10%)
Breeding season		0	0	0
Nonbreeding season		~~129.7~~11.5	~~9~~32.3	161.3
Annual		~~129.7~~11.5	~~9~~32.3	161.3
Effect	Reference population	149,228		
	Increase in back-ground mortality (%)	~~1.4~~0.13	0.~~1~~35	1.77

~~9.13.2.2.5~~9.14.2.2.5 *Assessment of potential effects of the Projects in combination with other plans and projects*

~~782.~~864. Given that no measurable increase in the East Caithness Cliffs SPA guillemot mortality is predicted as a result of DBS East and DBS West combined (e.g. with realistic displacement mortality of only ~~10~~11 birds per year during operation from a population of almost 150,000), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted guillemot mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the East Caithness Cliffs SPA**.

~~9.13.2.3~~9.14.2.3 Razorbill

~~783.~~865. Razorbill has been screened into the assessment to assess the impacts from disturbance / displacement in the construction and operation phase.

~~9.13.2.3.1~~9.14.2.3.1 *Status*

~~784.~~866. Razorbill is listed as a designated species of the East Caithness Cliffs SPA.

~~785.~~867. The SPA breeding population at classification in 1996 was cited as 15,800 individuals (SNH, 2009). Burnell *et al*. (2023) give an updated count of 30,129 individuals which has been used in this assessment.

~~9.13.2.3.2~~9.14.2.3.2 *Connectivity to the Projects*

~~786.~~868. DBS East and DBS West are 517km and 485km respectively from East Caithness Cliffs SPA. The mean maximum foraging range of razorbill is 164.6km (88.7 + 75.9km, Woodward *et al*., 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding razorbill from East Caithness Cliffs SPA, there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

~~787.~~869. Outside the breeding season, breeding razorbills from East Caithness Cliffs SPA are assumed to range widely and to mix with razorbills from breeding colonies in the UK and further afield. The relevant background population is considered to be the UK North Sea and Channel BDMPS, consisting of 591,874 individuals during autumn and spring passage periods (August to October and January to March), and 218,622 individuals during winter (November and December) (Furness, 2015).

~~788.~~870. During the autumn and spring migration it is estimated that East Caithness Cliffs birds make up 4.2% of the BDMPS population, and during the winter 1.3% of the BDMPS population. Note, these percentages have been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

~~9.13.2.3.3~~9.14.2.3.3 Assessment of Potential Effects of the Projects alone and Together

Table 9-99 Summary of razorbill density and abundance estimates and SPA apportioning rates and used in the operation and construction displacement assessment for East Caithness Cliffs SPA. Note that displacement from the wind farm has been estimated as 15%-35%, half the operational rates.

Site	Season	Peak no.	SPA %	Adult %	No. apportioned to SPA	Wind farm operation displacement mortality to SPA			Wind farm construction displacement mortality to SPA			Peak density (birds / km²)	Total vessel displacement mortality (2km around 3 vessels, 1% mortality)	Vessel mortality to SPA	Total construction displacement mortality to SPA		
						30-1	50-1	70-10	15-1	25 - 1	35-10				15-1 & vessel	25 – 1 & vessel	35-10 & vessel
DBS East	Breeding	555.1	0	100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.4	0.00	0.00	0.00	0.00
	Autumn	4685.3	4.2	100	196.8	0.6	1.0	13.8	0.3	0.5	6.9	9.2	3.5	0.15	0.44	0.64	7.03
	Winter	3376.7	1.3	100	43.9	0.1	0.2	3.1	0.1	0.1	1.5	6.6	2.5	0.03	0.10	0.14	1.57
	Spring	3578.5	4.2	100	150.3	0.5	0.8	10.5	0.2	0.4	5.3	7.0	2.6	0.11	0.34	0.49	5.37
	Annual				391	1.2	2	27.4	0.6	1	13.7	-	9	0.29	0.88	1.27	13.97
DBS West	Breeding	2280.6	0	100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.4	1.7	0.00	0.00	0.00	0.00
	Autumn	4886.9	4.2	100	205.2	0.6	1.0	14.4	0.3	0.5	7.2	9.4	3.5	0.15	0.46	0.66	7.33
	Winter	5066.2	1.3	100	65.9	0.2	0.3	4.6	0.1	0.2	2.3	9.7	3.7	0.05	0.15	0.21	2.35
	Spring	4454.6	4.2	100	187.1	0.6	0.9	13.1	0.3	0.5	6.5	8.6	3.2	0.14	0.42	0.60	6.68
	Annual				458.2	1.4	2.3	32.1	0.7	1.1	16.0	-	10.4	0.34	1.03	1.47	16.36
DBS East + DBS West	Breeding	~~2826.1~~2835.7	0	100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	2.1	0.00	0.00	0.00	0.00
	Autumn	~~6349.6~~9572.2	4.2	100	~~266.7~~402.0	~~0.8~~1.2	~~1.3~~2.0	~~18.7~~28.1	0.~~4~~6	1.0~~.7~~	~~9.3~~14.1		7.0	0.29	0.~~69~~89	~~0.96~~1.30	~~9.63~~14.36
	Winter	~~5823.7~~8442.9	1.3	100	~~75.7~~109.8	0.~~2~~3	0.~~4~~5	~~5.3~~7.7	0.~~1~~2	0.~~2~~3	~~2.6~~3.8		6.1	0.08	0.~~19~~24	0.~~27~~35	~~2.73~~3.92
	Spring	~~6302.5~~8033.1	4.2	100	~~264.7~~337.4	1.0~~.8~~	1.~~3~~7	~~18.5~~23.6	0.~~4~~5	0.~~7~~8	~~9.3~~11.8		5.9	0.25	0.~~64~~76	1.09	~~9.51~~12.06
	Annual				~~607.1~~849.2	~~1.8~~2.5	~~3.0~~4.2	~~42.5~~59.4	~~0.9~~1.3	2.1~~.5~~	~~21.2~~29.7		21.1	0.62	1.~~52~~89	2.~~14~~74	~~21.87~~30.34

~~9.13.2.3.3.1~~9.14.2.3.3.1 *Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines*

~~9.13.2.3.3.1.1~~9.14.2.3.3.1.1 *DBS East in Isolation*

~~789.~~871. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-7**) the number of individuals from the East Caithness Cliffs SPA population expected to die is 3,163 (30,129 x 0.105) adults per annum. The predicted annual construction impact from DBS East alone on the breeding razorbill population applying highly precautionary rates of 35% displacement and 10% mortality plus vessel displacement is 14.0 (7.0, 1.6, 5.4 in autumn winter and spring respectively) birds per annum (**Table 9-99)**. This would result in a predicted change in adult mortality rate of 0.44%. The equivalent mortality assuming 35% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 2.8 which would increase the background mortality rate by 0.09%.

~~790.~~872. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~791.~~873. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the East Caithness Cliffs SPA (1.3) would increase the predicted annual mortality by 0.04% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.13.2.3.3.1.2~~9.14.2.3.3.1.2 *DBS West in Isolation*

~~792.~~874. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-7**) the number of individuals from the East Caithness Cliffs SPA population expected to die is 3,163 (30,129 x 0.105) adults per annum. The predicted annual construction impact from DBS West alone on the breeding razorbill population applying highly precautionary rates of 35% displacement and 10% mortality plus vessel displacement is 16.4 (7.3, 2.4, 6.7 in autumn winter and spring respectively) birds per annum (**Table 9-99**). This would result in a predicted change in adult mortality rate of 0.52%. The equivalent mortality assuming 35% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 3.3 which would increase the background mortality rate by 0.10%.

~~793.~~875. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~794.~~876. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the East Caithness Cliffs SPA (1.5) would increase the predicted annual mortality by 0.04% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.13.2.3.3.1.3~~9.14.2.3.3.1.3 *DBS East and West Together*

~~795.~~ At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-7**) the number of individuals from the East Caithness Cliffs SPA population expected to die is 3,163 (30,129 x 0.105) adults per annum. The predicted annual construction impact from DBS East and DBS West on the breeding razorbill population applying highly precautionary rates of 35% displacement and 10% mortality plus vessel displacement is ~~21~~30.3 (14.4, 3.9 ~~(9.6, 2.7, 9.5,~~ 12.1 in autumn, winter and spring respectively) birds per annum (**Table 9-99**). This would result in a predicted change in adult mortality rate of 0.~~7%.~~

877. ~~There is no evidence in support of either the (operational) 70~~96%. The equivalent mortality assuming 35% displacement and 2% mortality (the latter rate ~~or~~ as accepted in the ~~10%~~assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 6.1 which would increase the background mortality rate by 0.19%.

~~796.~~878. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. ~~.~~In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~797.~~879. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the East Caithness Cliffs SPA (~~1~~2.7) would increase the predicted annual mortality by 0.~~05~~09% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.13.2.3.3.2~~9.14.2.3.3.2 Potential Effects During Operation: Disturbance and Displacement

~~9.13.2.3.3.2.1~~9.14.2.3.3.2.1 DBS East in Isolation

~~798.~~880. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-7**) the number of individuals from the East Caithness Cliffs SPA population expected to die is 3,163 (30,129 x 0.105) adults per annum. The predicted annual operation impact from DBS East alone on the breeding razorbill population applying highly precautionary rates of 70% displacement and 10% mortality is 27.4 (13.8, 3.0, 10.6 in autumn winter and spring respectively) birds per annum (**Table 9-99**). This would result in a predicted change in adult mortality rate of 0.87%. The equivalent mortality assuming 70% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 5.5 which would increase the background mortality rate by 0.17%.

~~799.~~881. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~800.~~882. At a more appropriate operational displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the East Caithness Cliffs SPA (2.0) would increase the predicted annual mortality by 0.06% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.13.2.3.3.2.2~~9.14.2.3.3.2.2 DBS West in Isolation

~~801.~~883. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-7**) the number of individuals from the East Caithness Cliffs SPA population expected to die is 3,163 (30,129 x 0.105) adults per annum. The predicted annual operation impact from DBS West alone on the breeding razorbill population applying highly precautionary rates of 70% displacement and 10% mortality is 32.1 (14.4, 4.6, 13.1 in autumn winter and spring respectively) birds per annum (**Table 9-99**). This would result in a predicted change in adult mortality rate of 1.0%. The equivalent mortality assuming 35% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 6.4 which would increase the background mortality rate by 0.20%.

~~802.~~884. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~803.~~885. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the East Caithness Cliffs SPA (2.3) would increase the predicted annual mortality by 0.07% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.13.2.3.3.2.3~~9.14.2.3.3.2.3 *DBS East and West Together*

~~804.~~886. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-7**) the number of individuals from the East Caithness Cliffs SPA population expected to die is 3,163 (30,129 x 0.105) adults per annum. The predicted annual construction impact from DBS East and DBS West on the breeding razorbill population applying highly precautionary rates of 70% displacement and 10% mortality is ~~42.5 (18.~~59.4 (28.1, 7~~, 5.3, 18.~~5.7, 23.6 in autumn winter and spring respectively) birds per annum (**Table 9-99**). This would result in a predicted change in adult mortality rate of 1.3% but is based on highly precautionary impact rates. The equivalent mortality assuming 70% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 11.9 which would increase the background mortality rate by 0.37%. A reduction in either the displacement rate (e.g. to ~~52~~37%) or the mortality rate (e.g. to ~~7.4~~5.3%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in both together).here is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~805.~~887. At a more appropriate operational displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the East Caithness Cliffs SPA (4.2~~.9~~) would increase the predicted annual mortality by 0.~~09~~13% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.13.2.3.4~~9.14.2.3.4 *Summary*

888. A matrix of the annual operational displacement estimates for DBS East and DBS West is provided in **Table 9-100**.

Table 9-100 Displacement matrix for annual project alone (DBS East plus DBS West) razorbill apportioned to East Caithness Cliffs SPA adult population.

Mortality %	**Displacement %**									
	10	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**
1	1	2	3	3	4	5	6	7	8	8
2	2	3	5	7	8	10	12	14	15	17
3	3	5	8	10	13	15	18	20	23	25
4	3	7	10	14	17	20	24	27	31	34
5	4	8	13	17	21	25	30	34	38	42
6	5	10	15	20	25	31	36	41	46	51
7	6	12	18	24	30	36	42	48	53	59
8	7	14	20	27	34	41	48	54	61	68
9	8	15	23	31	38	46	53	61	69	76
10	8	17	25	34	42	51	59	68	76	85
20	17	34	51	68	85	102	119	136	153	170
30	25	51	76	102	127	153	178	204	229	255
50	42	85	127	170	212	255	297	340	382	425
75	64	127	191	255	318	382	446	510	573	637
100	85	170	255	340	425	510	594	679	764	849

~~806.~~889. A table summarising the razorbill construction and operational disturbance and displacement assessment for DBS East and DBS West together is provided below (**Table 9-101)**.

~~807.~~890. It is concluded that predicted razorbill mortality due to construction and operational phase disturbance and displacement impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the East Caithness Cliffs SPA**.

Table 9-101 Summary of predicted razorbill displacement mortality from East Caithness Cliffs SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.

~~Guillemot~~Razorbill		**Displacement**		
Potential Effects During Construction: Disturbance and Displacement				
Displacement mortality		Mean (@25% x 1%)	Mean (@35% x ~~10~~2%)	Mean (@~~25~~35% x ~~1~~10%)
Breeding season		0	0	0
Autumn		~~9.63~~1.30	~~0.96~~2.87	14.36
Winter		~~2.73~~0.35	0.~~27~~78	3.92
Spring		~~9.51~~1.09	~~0.91~~2.52	12.06
Annual		2.~~14~~74	6.07	30.34
Effect	Reference population	30,129		
	Increase in back-ground mortality (%)	0.~~7~~09	0.~~07~~19	0.96
Potential Effects During Operation: Disturbance and Displacement				
Displacement mortality		Mean (@50% x 1%)	Mean (@70% x ~~10~~2%)	Mean (@~~50~~70% x ~~1~~10%)
Breeding season		0	0	0
Autumn		~~18.7~~2.0	5.62	28.1~~.3~~
Winter		0.~~4~~5	1.5	7.7
Spring		1.~~3~~7	4.7	23.6
Annual		~~42.5~~4.2	~~3.0~~11.9	59.4
Effect	Reference population	30,129		
	Increase in back-ground mortality (%)	~~1.3~~0.13	0.~~09~~37	1.88

~~9.13.2.3.5~~9.14.2.3.5 *Assessment of potential effects of the Projects in combination with other plans and projects*

~~808.~~891. Given that no measurable increase in the East Caithness Cliffs SPA razorbill mortality is predicted as a result of DBS East and DBS West combined (e.g. with realistic displacement mortality of ~~3~~4 birds per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted razorbill mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the East Caithness Cliffs SPA**.

~~9.14~~9.15 North Caithness Cliffs SPA

~~9.14.1~~9.15.1 Site Description

~~809.~~892. The North Caithness Cliffs SPA is of special nature conservation and scientific importance within Britain and Europe for supporting very large populations of several breeding seabird species.

~~810.~~893. The seaward extension of the SPA extends 2km into the marine environment and includes the seabed, water column and surface. Seabirds included within the designation feed both inside and outside the SPA in nearby waters, as well as more distantly in the wider North Sea.

~~9.14.1.1~~9.15.1.1 Qualifying Features

~~811.~~894. The qualifying features of the North Caithness Cliffs SPA screened into the assessment are listed in Table 4-7 of **RIAA HRA Part 1 of 4 – Introduction and Terrestrial Ecology (application ref: 6.1)**. These are breeding guillemot and three named components of the breeding seabird assemblage (kittiwake, razorbill and puffin).

~~9.14.1.2~~9.15.1.2 Conservation Objectives

~~812.~~895. The over-arching conservation objectives of the site are:

- To avoid deterioration of the habitats of the qualifying species or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained; and
- To ensure for the qualifying species that the following are maintained in the long term:
    - Population of the species as a viable component of the site;
    - Distribution of the species within site;
    - Distribution and extent of habitats supporting the species;

- Structure, function and supporting processes of habitats supporting the species; and
- No significant disturbance of the species.

~~9.14.2~~9.15.2 Assessment: Array Areas

~~9.14.2.1~~9.15.2.1 Kittiwake

~~813.~~896. Kittiwake has been screened into the assessment to assess the impacts from collision risk in the operation phase.

~~9.14.2.1.1~~9.15.2.1.1 Status

~~814.~~897. Kittiwake is listed as a named component of the breeding seabird assemblage of North Caithness Cliffs SPA.

~~815.~~898. The SPA breeding population at classification in 1996 was cited as 13,100 pairs (SNH, 2009). Burnell *et al*. (2023) give an updated count of 5,571 AON which has been used in this assessment.

~~9.14.2.1.2~~9.15.2.1.2 Connectivity to the Projects

~~816.~~899. DBS East and DBS West are 536km and 506km respectively from North Caithness Cliffs SPA. The mean maximum foraging range of kittiwake is 300.6km (156.1km + 144.5km, Woodward *et al*., 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding kittiwake from North Caithness Cliffs SPA there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

~~817.~~900. Outside the breeding season breeding kittiwakes, including those from North Caithness Cliffs SPA, are not constrained by requirements to visit nests to incubate eggs or provision chicks. At this time, they are assumed to range more widely and to mix with kittiwakes of all age classes from breeding colonies in the UK and further afield. The background population during these seasons is the UK North Sea BDMPS. This consists of 829,937 individuals during the autumn migration season (August to December), and 627,816 individuals during the spring migration season (January to April) (Furness, 2015).

~~818.~~901. It is estimated that 1.5% and 1.9% of birds present in the Project array areas in the autumn and spring migration seasons respectively are considered to be breeding adults from North Caithness Cliffs SPA. Note, these percentages have been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

~~9.14.2.1.3~~9.15.2.1.3 Assessment of Potential Effects of the Projects alone and Together

~~9.14.2.1.3.1~~9.15.2.1.3.1 Potential Effects During Operation: Collision risk

Table 9-102 Summary of kittiwake total collisions and apportioned to the North Caithness Cliffs SPA.

Site	Season	Collision mortality			SPA %	Adult %	Collisions apportioned to SPA		
		Lower 95% c.i.	Mean	Upper 95% c.i.			Lower 95% c.i.	Mean	Upper 95% c.i.
DBS East	Breeding	42.3	83.3	168.5	0	53	0	0	0
	Autumn	14.6	41.4	82.9	1.5	100	0.2	0.6	1.2
	Spring	6.8	14.6	28.0	1.9	100	0.1	0.3	0.5
	Annual	66.9	139.3	261.3	-	-	0.3	0.9	1.8
DBS West	Breeding	36.9	107.8	280.8	0	53	0	0	0
	Autumn	9.5	37.9	81.9	1.5	100	0.1	0.6	1.2
	Spring	7.1	14.9	26.5	1.9	100	0.1	0.3	0.5
	Annual	55.9	160.6	327.0	-	-	0.3	0.9	1.7
DBS East + DBS West	Breeding	96.2	191.1	378.4	0	53	0	0	0
	Autumn	30.5	79.3	143.1	1.5	100	0.5	1.2	2.1
	Spring	16.9	29.5	47.3	1.9	100	0.3	0.6	0.9
	Annual	150.9	299.9	540.5	-	-	0.8	1.8	3.0

~~9.14.2.1.3.1.1~~9.15.2.1.3.1.1 *DBS East in Isolation*

~~819.~~902. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-7**) the number of individuals from the North Caithness Cliffs SPA population expected to die is 1,627 (11,142 x 0.146) adults per annum. The predicted annual impacts from DBS East alone on the breeding kittiwake population is 0.9 birds per annum (**Table 9-102**). This results in a predicted change in adult mortality rate of 0.06% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.14.2.1.3.1.2~~9.15.2.1.3.1.2 *DBS West in Isolation*

~~820.~~903. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-7**) the number of individuals from the North Caithness Cliffs SPA population expected to die is 1,627 (11,142 x 0.146) adults per annum. ~~The predicted annual impacts from DBS East alone on the breeding kittiwake population is 0.9 birds per annum (**Table 9-79**At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-5**) the number of individuals from the North Caithness Cliffs SPA population expected to die is 1,627 (11,142 x 0.146) adults per annum.~~ The predicted annual impacts from DBS West alone on the breeding kittiwake population is 0.9 birds per annum (**Table 9-102**). This results in a predicted change in adult mortality rate of 0.06% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.14.2.1.3.1.3~~9.15.2.1.3.1.3 *DBS East and West Together*

~~821.~~904. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-7**) the number of individuals from the North Caithness Cliffs SPA population expected to die is 1,627 (11,142 x 0.146) adults per annum. The predicted annual impacts from DBS East and DBS West on the breeding kittiwake population is 1.8 birds per annum (**Table 9-102**). This results in a predicted change in adult mortality rate of 0.11% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~*9.14.2.1.4 Summary*~~

~~9.14.2.1.5~~9.15.2.1.4 *Summary*

~~822.~~905. A table summarising the kittiwake operational collision risk assessment for DBS East and DBS West together is provided below (**Table 9-103**).

~~823.~~906. It is concluded that predicted kittiwake mortality due to operational phase collision risk at DBS East, DBS West, and the Projects together would **not adversely affect the integrity of the North Caithness Cliffs SPA**.

Table 9-103 Summary of predicted Kittiwake collision mortality from North Caithness Cliffs SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations for the Worst Case Wind Turbine Scenario.

Kittiwake		**Collisions**		
Potential Effects During Operation: Collision Risk				
Collision mortality		Lower c.i.	Mean	Upper c.i.
Breeding season		-	-	-
Autumn		0.5	1.2	2.1
Spring		0.3	0.6	0.9
Annual		0.8	1.8	3.0
Effect	Reference population	11,142		
	Increase in background mortality (%)	0.05	0.11	0.18

~~9.14.2.1.6~~9.15.2.1.5 *Assessment of potential effects of the Projects in combination with other plans and projects*

~~824.~~907. Given that no measurable increase in the North Caithness Cliffs SPA kittiwake mortality is predicted as a result of DBS East and DBS West combined (e.g. with total collision mortality of only 1.7 birds per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted kittiwake mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the North Caithness Cliffs SPA**.

~~9.14.2.2~~9.15.2.2 Guillemot

~~825.~~908. Guillemot has been screened into the assessment to assess the impacts from disturbance / displacement in the construction and operation phase.

~~9.14.2.2.1~~9.15.2.2.1 *Status*

~~826.~~909. Guillemot is listed as a designated species of the North Caithness Cliffs SPA.

~~827.~~910. The SPA breeding population at classification in 1996 was cited as 38,300 individuals (SNH, 2009). Burnell *et al.* (2023) give an updated count of 38,898 individuals which has been used in this assessment.

~~9.14.2.2.2~~9.15.2.2.2 Connectivity to the Projects

~~828.~~911. DBS East and DBS West are 536km and 506km respectively from North Caithness Cliffs SPA. The mean maximum foraging range of guillemot is 153.7km (73.2km + 80.5km, Woodward *et al.*, 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding guillemot from North Caithness Cliffs SPA, there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

~~829.~~912. Outside the breeding season, breeding guillemots from North Caithness Cliffs SPA are assumed to range widely and to mix with guillemots from breeding colonies in the UK and beyond. The relevant non-breeding season reference population is the UK North Sea and Channel BDMPS, consisting of 1,617,306 individuals (August to February) (Furness, 2015).

~~830.~~913. It is estimated that 4.1% of birds present at the Projects are considered to be breeding adults from North Caithness Cliffs SPA. Note, this percentage has been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

~~9.14.2.2.3~~9.15.2.2.3 Assessment of Potential Effects of the Projects alone and Together

Table 9-104 Summary of guillemot density and abundance estimates and SPA apportioning rates and used in the operation and construction displacement assessment for North Caithness Cliffs SPA. Note that displacement from the wind farm has been estimated as 15%-35%, half the operational rates.

Site	Season	Peak no.	SPA %	Adult %	No. apportioned to SPA	Wind farm operation displacement mortality to SPA			Wind farm construction displacement mortality to SPA			Peak density (birds/km²)	Total vessel displacement mortality (2km around 3 vessels, 1% mortality)	Vessel mortality to SPA	Total construction displacement mortality to SPA		
						30-1	50-1	70-10	15-1	25 - 1	35-10				15-1 & vessel	25 – 1 & vessel	35-10 & vessel
DBS East	Breeding	9030.5	0	55.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.71	6.7	0.0	0.0	0.0	0.0
	Nonbreeding	12551.8	4.1	100	514.6	1.5	2.6	36.0	0.8	1.3	18.0	24.62	9.3	0.4	1.2	1.7	18.4
	Annual				514.6	1.5	2.6	36.0	0.8	1.3	18.0	-	16	0.4	1.2	1.7	18.4
DBS West	Breeding	8783.5	0	55.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.92	6.4	0.0	0.0	0.0	0.0
	Nonbreeding	12498.4	4.1	100	512.4	1.5	2.6	35.9	0.8	1.3	17.9	24.08	9.1	0.4	1.1	1.7	18.3
	Annual				512.4	1.5	2.6	35.9	0.8	1.3	17.9	-	15.5	0.4	1.1	1.7	18.3
DBS East + DBS West	Breeding	~~14927.7~~17815	0	55.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	13.0	0.0	0.0	0.0	0.0
	Nonbreeding	~~20136.0~~25050	4.1	100	~~825.6~~1027.1	~~2.5~~3.1	~~4~~5.1	~~57.8~~71.9	1.~~2~~5	2.~~1~~6	~~28~~35.9		18.4	0.8	2.~~0~~3	~~2.8~~3.4	~~29.6~~36.7
	Annual				~~825.6~~1027.1	~~2.5~~3.1	~~4~~5.1	~~57.8~~71.9	1.~~2~~5	2.~~1~~6	~~28~~35.9		31.4	0.8	2.~~0~~3	~~2.8~~3.4	~~29.6~~36.7

~~9.14.2.2.3.1~~9.15.2.2.3.1 Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines

~~9.14.2.2.3.1.1~~9.15.2.2.3.1.1 DBS East in Isolation

~~831.~~914. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the North Caithness Cliffs SPA population expected to die is 2,373 (38,898 x 0.061) adults per annum. The predicted annual construction impact from DBS East alone on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 18.4 birds per annum (**Table 9-104**). This would result in a predicted change in adult mortality rate of 0.7%. The equivalent mortality assuming 35% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 3.7 which would increase the background mortality rate by 0.15%.

~~832.~~915. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~833.~~916. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the North Caithness Cliffs SPA (1.7) would increase the predicted annual mortality by 0.07% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.14.2.2.3.1.2~~9.15.2.2.3.1.2 *DBS West in Isolation*

~~834.~~917. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the North Caithness Cliffs SPA population expected to die is 2,373 (38,898 x 0.061) adults per annum. The predicted annual construction impact from DBS West alone on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 18.3 birds per annum (**Table 9-104**). This would result in a predicted change in adult mortality rate of 0.7%. The equivalent mortality assuming 35% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 3.7 which would increase the background mortality rate by 0.15%.

~~835.~~918. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~836.~~919. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the North Caithness Cliffs SPA (1.7) would increase the predicted annual mortality by 0.07% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.14.2.2.3.1.3~~9.15.2.2.3.1.3 DBS East and West Together

~~837.~~920. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the North Caithness Cliffs SPA population expected to die is 2,373 (38,898 x 0.061) adults per annum. The predicted annual construction impact from DBS East and DBS West on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is ~~29.6~~36.7 birds per annum (**Table 9-104**). This would result in a predicted change in adult mortality rate of 1.~~2~~6% but is based on highly precautionary impact rates. The equivalent mortality assuming 35% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 7.3 which would increase the background mortality rate by 0.31%. A reduction in either the displacement rate (e.g. to ~~56~~43%) or the mortality rate (e.g. to ~~8~~6%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in both together).

~~838.~~921. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~839.~~922. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the North Caithness Cliffs SPA (~~2.8~~3.4) would increase the predicted annual mortality by 0.~~11~~14% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.14.2.2.3.2~~9.15.2.2.3.2 Potential Effects During Operation: Disturbance and Displacement

~~9.14.2.2.3.2.1~~9.15.2.2.3.2.1 DBS East in Isolation

~~840.~~923. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the North Caithness Cliffs SPA population expected to die is 2,373 (38,898 x 0.061) adults per annum. The predicted annual operation impact from DBS East alone on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 36 birds per annum (**Table 9-104**). This would result in a predicted change in adult mortality rate of 1.5% but is based on highly precautionary impact rates. The equivalent mortality assuming 70% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 7.2 which would increase the background mortality rate by 0.30%. A reduction in either the displacement rate (e.g. to 46%) or the mortality rate (e.g. to 6%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in both together).

~~841.~~924. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~842.~~925. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the North Caithness Cliffs SPA (2.6) would increase the predicted annual mortality by 0.1% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.14.2.2.3.2.2~~9.15.2.2.3.2.2 *DBS West in Isolation*

~~843.~~926. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the North Caithness Cliffs SPA population expected to die is 2,373 (38,898 x 0.061) adults per annum. The predicted annual operation impact from DBS West alone on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 35.9 birds per annum (**Table 9-104**). This would result in a predicted change in adult mortality rate of 1.5% but is based on highly precautionary impact rates. The equivalent mortality assuming 70% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 7.2 which would increase the background mortality rate by 0.30%. A reduction in either the displacement rate (e.g. to 46%) or the mortality rate (e.g. to 6%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in both together).

~~844.~~927. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~845.~~928. At a more appropriate (construction) displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the North Caithness Cliffs SPA (2.6) would increase the predicted annual mortality by 0.1% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.14.2.2.3.2.3~~9.15.2.2.3.2.3 *DBS East and West Together*

~~846.~~929. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the North Caithness Cliffs SPA population expected to die is 2,373 (38,898 x 0.061) adults per annum. The predicted annual operation impact from DBS East and DBS West on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is ~~57.8~~71.9 birds per annum (**Table 9-104**). This would result in a predicted change in adult mortality rate of ~~2.4~~3.0% but is based on highly precautionary impact rates. The equivalent mortality assuming 70% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 14.4 which would increase the background mortality rate by 0.61%. A reduction in the mortality rate alone to ~~4~~3% or to ~~5~~4% together with a displacement rate of 57% would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in both together).

~~847.~~930. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~848.~~931. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the North Caithness Cliffs SPA (~~4~~5.1) would increase the predicted annual mortality by 0.~~17~~22% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.14.2.2.4~~9.15.2.2.4 *Summary*

932. A matrix of the annual operational displacement estimates for DBS East and DBS West is provided in **Table 9-105**.

Table 9-105 Displacement matrix for annual project alone (DBS East plus DBS West) guillemot apportioned to North Caithness Cliffs SPA adult population.

Mortality %	Displacement %									
	10	20	30	40	50	60	70	80	90	100
1	1	2	3	4	5	6	7	8	9	10
2	2	4	6	8	10	12	14	16	18	21
3	3	6	9	12	15	18	22	25	28	31
4	4	8	12	16	21	25	29	33	37	41
5	5	10	15	21	26	31	36	41	46	51
6	6	12	18	25	31	37	43	49	55	62
7	7	14	22	29	36	43	50	58	65	72
8	8	16	25	33	41	49	58	66	74	82
9	9	18	28	37	46	55	65	74	83	92
10	10	21	31	41	51	62	72	82	92	103
20	21	41	62	82	103	123	144	164	185	205
30	31	62	92	123	154	185	216	247	277	308
50	51	103	154	205	257	308	359	411	462	514
75	77	154	231	308	385	462	539	616	693	770
100	103	205	308	411	514	616	719	822	924	1027

~~849.~~933. A table summarising the guillemot construction and operational disturbance and displacement assessment for DBS East and DBS West together is provided below (**Table 9-106)**.

~~850.~~934. It is concluded that predicted guillemot mortality due to construction and operational phase disturbance and displacement impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the North Caithness Cliffs SPA**.

Table 9-106 Summary of predicted guillemot displacement mortality from North Caithness Cliffs SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.

Guillemot		Displacement		
Potential Effects During Construction: Disturbance and Displacement				
Displacement mortality		Mean (@25% x 1%)	Mean (@35% x ~~10~~2%)	Mean (@~~25~~35% x ~~1~~10%)
Breeding season		0	0	0
Nonbreeding season		~~29.6~~3.4	~~2.8~~7.3	36.7
Annual		~~29.6~~3.4	~~2.8~~7.3	36.7
Effect	Reference population	38,898		
	Increase in back-ground mortality (%)	~~1.24~~0.14	0.~~11~~31	1.55
Potential Effects During Operation: Disturbance and Displacement				
Displacement mortality		Mean (@50% x 1%)	Mean (@70% x ~~10~~2%)	Mean (@~~50~~70% x ~~1~~10%)
Breeding season		0	0	0
Nonbreeding season		~~4~~5.1	14.4	71.9
Annual		~~4~~5.1	14.4	71.9
Effect	Reference population	39,898		
	Increase in back-ground mortality (%)	~~2.4~~0.22	0.~~17~~61	3.03

~~9.14.2.2.5~~9.15.2.2.5 Assessment of potential effects of the Projects in combination with other plans and projects

~~851.~~935. Given that no measurable increase in the North Caithness Cliffs SPA guillemot mortality is predicted as a result of DBS East and DBS West combined (e.g. with realistic displacement mortality of only ~~4~~5 birds per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted guillemot mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the North Caithness Cliffs SPA**.

~~9.14.2.3~~9.15.2.3 Razorbill

~~852.~~936. Razorbill has been screened into the assessment to assess the impacts from disturbance / displacement in the construction and operation phase.

~~9.14.2.3.1~~9.15.2.3.1 Status

~~853.~~937. Razorbill is listed as a named component of the breeding seabird assemblage of North Caithness Cliffs SPA.

~~854.~~938. The SPA breeding population at classification in 1996 was cited as 4,000 individuals (SNH, 2009). Burnell *et al*. (2023) give an updated count of 3,579 individuals which has been used in this assessment.

~~9.14.2.3.2~~9.15.2.3.2 Connectivity to the Projects

~~855.~~939. DBS East and DBS West are 536km and 506km respectively from North Caithness Cliffs SPA. The mean maximum foraging range of razorbill is 164.6km (88.7 + 75.9km, Woodward *et al*., 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding razorbill from North Caithness Cliffs SPA, there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

~~856.~~940. Outside the breeding season, breeding razorbills from North Caithness Cliffs SPA are assumed to range widely and to mix with razorbills from breeding colonies in the UK and further afield. The relevant background population is considered to be the UK North Sea and Channel BDMPS, consisting of 591,874 individuals during autumn and spring passage periods (August to October and January to March), and 218,622 individuals during winter (November and December) (Furness, 2015).

~~857.~~941. During the autumn and spring migration it is estimated that East Caithness Cliffs birds make up 0.5% of the BDMPS population, and during the winter 0.2% of the BDMPS population. Note, these percentages have been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

~~9.14.2.3.3~~9.15.2.3.3 Assessment of Potential Effects of the Projects alone and Together

Table 9-107 Summary of razorbill density and abundance estimates and SPA apportioning rates and used in the operation and construction displacement assessment for North Caithness Cliffs SPA. Note that displacement from the wind farm has been estimated as 15%-35%, half the operational rates.

Site	Season	Peak no.	SPA %	Adult %	No. apportioned to SPA	Wind farm operation displacement mortality to SPA			Wind farm construction displacement mortality to SPA			Peak density (birds/ km^2)	Total vessel displacement mortality (2km around 3 vessels, 1% mortality)	Vessel mortality to SPA	Total construction displacement mortality to SPA		
						30-1	50-1	70-10	15-1	25 - 1	35-10				15-1 & vessel	25 – 1 & vessel	35-10 & vessel
DBS East	Breeding	555.1	0	100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.4	0.00	0.00	0.00	0.00
	Autumn	4685.3	0.5	100	23.4	0.1	0.1	1.6	0.0	0.1	0.8	9.2	3.5	0.02	0.05	0.08	0.84
	Winter	3376.7	0.2	100	6.8	0.0	0.0	0.5	0.0	0.0	0.2	6.6	2.5	0.00	0.02	0.02	0.24
	Spring	3578.5	0.5	100	17.9	0.1	0.1	1.3	0.0	0.0	0.6	7.0	2.6	0.01	0.04	0.06	0.64
	Annual				48.1	0.2	0.2	3.4	0	0.1	1.6	-	9	0.03	0.11	0.16	1.72
DBS West	Breeding	2280.6	0	100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.4	1.7	0.00	0.00	0.00	0.00
	Autumn	4886.9	0.5	100	24.4	0.1	0.1	1.7	0.0	0.1	0.9	9.4	3.5	0.02	0.05	0.08	0.87
	Winter	5066.2	0.2	100	10.1	0.0	0.1	0.7	0.0	0.0	0.4	9.7	3.7	0.01	0.02	0.03	0.36
	Spring	4454.6	0.5	100	22.3	0.1	0.1	1.6	0.0	0.1	0.8	8.6	3.2	0.02	0.05	0.07	0.80
	Annual				56.8	0.2	0.3	4.0	0.1	0.1	2.0	-	10.4	0.05	0.12	0.18	2.03
DBS East + DBS West	Breeding	~~2826.1~~2835.7	0	100	0.0	0.0	0.0	0.0	0.0	0.0	0.0		2.1	0.00	0.00	0.00	0.00
	Autumn	~~6349.6~~9572.2	0.5	100	~~31.7~~47.9	0.1	0.2	~~2.2~~3.4	0.~~0~~1	0.1	1.~~1~~7		7.0	0.04	0.~~08~~11	0.~~11~~16	1.~~15~~72
	Winter	~~5283.7~~8442.9	0.2	100	~~11.6~~16.9	0.~~0~~1	0.1	~~0.8~~1.2	0.0	0.0	0.~~4~~6		6.1	0.01	0.~~03~~04	0.~~04~~05	0.~~42~~60
	Spring	~~6302.5~~8033.1	0.5	100	~~31.5~~40.2	0.1	0.2	2.~~2~~8	0.~~0~~1	0.1	1.~~1~~4		5.9	0.03	0.~~08~~09	0.~~11~~13	1.~~13~~44
	Annual				~~74.8~~104.9	0.~~2~~3	0.~~4~~5	~~5.2~~7.3	0.~~1~~2	0.~~2~~3	~~2.6~~3.7	-	21.1	0.08	0.~~19~~24	0.~~26~~34	~~2.7~~3.75

~~9.14.2.3.3.1~~9.15.2.3.3.1 *Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines*

~~9.14.2.3.3.1.1~~9.15.2.3.3.1.1 *DBS East in Isolation*

~~858.~~942. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-7**) the number of individuals from the North Caithness Cliffs SPA population expected to die is 376 (3,579 x 0.105) adults per annum. The predicted annual construction impact from DBS East alone on the breeding razorbill population applying highly precautionary rates of 35% displacement and 10% mortality plus vessel displacement is 1.7 (0.84, 0.24, 0.64 in autumn winter and spring respectively) birds per annum (**Table 9-107)**. This would result in a predicted change in adult mortality rate of 0.44%. The equivalent mortality assuming 35% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 0.34 which would increase the background mortality rate by 0.09%.

~~859.~~943. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~860.~~944. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the North Caithness Cliffs SPA (0.2) would increase the predicted annual mortality by 0.04% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.14.2.3.3.1.2~~9.15.2.3.3.1.2 *DBS West in Isolation*

~~861.~~945. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-7**) the number of individuals from the North Caithness Cliffs SPA population expected to die is 376 (3,579 x 0.105) adults per annum. The predicted annual construction impact from DBS West alone on the breeding razorbill population applying highly precautionary rates of 35% displacement and 10% mortality plus vessel displacement is 2.0 (0.9, 0.4, 0.8 in autumn winter and spring respectively) birds per annum (**Table 9-107**). This would result in a predicted change in adult mortality rate of 0.53%. The equivalent mortality assuming 35% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 0.4 which would increase the background mortality rate by 0.05%.

~~862.~~946. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~863.~~947. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the North Caithness Cliffs SPA (0.2) would increase the predicted annual mortality by 0.04% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.14.2.3.3.1.3~~9.15.2.3.3.1.3 DBS East and West Together

~~864.~~948. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-7**) the number of individuals from the North Caithness Cliffs SPA population expected to die is 376 (3,579 x 0.105) adults per annum. The predicted annual construction impact from DBS East and DBS West on the breeding razorbill population applying highly precautionary rates of 35% displacement and 10% mortality plus vessel displacement is ~~2~~3.7 (1.~~1~~7, 0.6, 1.4~~, 1.1~~ in autumn, winter and spring respectively) birds per annum (**Table 9-107**). This would result in a predicted change in adult mortality rate of 1.0~~.72~~%. The equivalent mortality assuming 35% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 0.74 which would increase the background mortality rate by 0.20%.

~~865.~~949. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~866.~~950. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the North Caithness Cliffs SPA (0.~~3~~34) would increase the predicted annual mortality by 0.~~08~~09% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.14.2.3.3.2~~9.15.2.3.3.2 *Potential Effects During Operation: Disturbance and Displacement*

~~9.14.2.3.3.2.1~~9.15.2.3.3.2.1 *DBS East in Isolation*

~~867.~~951. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-7**) the number of individuals from the North Caithness Cliffs SPA population expected to die is 376 (3,579 x 0.105) adults per annum. The predicted annual operation impact from DBS East alone on the breeding razorbill population applying highly precautionary rates of 70% displacement and 10% mortality is 3.4 (1.6, 0.5, 1.2 in autumn winter and spring respectively) birds per annum (**Table 9-107**). This would result in a predicted change in adult mortality rate of 0.9%. The equivalent mortality assuming 70% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 0.68 which would increase the background mortality rate by 0.18%.

~~868.~~952. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~869.~~953. At a more appropriate operational displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the North Caithness Cliffs SPA (0.2) would increase the predicted annual mortality by 0.06% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.14.2.3.3.2.2~~9.15.2.3.3.2.2 DBS West in Isolation

~~870.~~954. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-7**) the number of individuals from the North Caithness Cliffs SPA population expected to die is 376 (3,579 x 0.105) adults per annum. The predicted annual operation impact from DBS West alone on the breeding razorbill population applying highly precautionary rates of 70% displacement and 10% mortality is 4.0 (1.7, 0.7, 1.6 in autumn winter and spring respectively) birds per annum (**Table 9-107**). This would result in a predicted change in adult mortality rate of 1.1%. The equivalent mortality assuming 70% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 0.8 which would increase the background mortality rate by 0.21%.

~~871.~~955. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~872.~~956. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the North Caithness Cliffs SPA (0.3) would increase the predicted annual mortality by 0.08% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.14.2.3.3.2.3~~9.15.2.3.3.2.3 *DBS East and West Together*

~~873.~~957. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-7**) the number of individuals from the North Caithness Cliffs SPA population expected to die is 376 (3,579 x 0.105) adults per annum. The predicted annual construction impact from DBS East and DBS West on the breeding razorbill population applying highly precautionary rates of 70% displacement and 10% mortality is ~~5~~7.3 (3.4, 1.2~~(,~~ 2.~~2, 0.~~8~~, 2.2~~ in autumn winter and spring respectively) birds per annum (**Table 9-107**). This would result in a predicted change in adult mortality rate of 1.~~3~~9% but is based on highly precautionary impact rates. The equivalent mortality assuming 70% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 1.5 which would increase the background mortality rate by 0.39%. A reduction in either the ~~displacement~~mortality rate (e.g. to ~~50%) or the mortality rate (e.g. to 7.2~~5.1%) would reduce the impact below the 1% threshold of detectability~~ (and this also applies for smaller reductions in both together).~~.

~~874.~~958. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~875.~~959. At a more appropriate operational displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the North Caithness Cliffs SPA (0.~~4~~5) would increase the predicted annual mortality by 0.~~09~~14% which is below the 1% threshold for detectability and therefore no further assessment was required.

9.15.2.3.4 Summary

960. A matrix of the annual operational displacement estimates for DBS East and DBS West is provided in **Table 9-108**.

Table 9-108 Displacement matrix for annual project alone (DBS East plus DBS West) razorbill apportioned to North Caithness Cliffs SPA adult population.

Mortality %	Displacement %									
	10	20	30	40	50	60	70	80	90	100
1	0	0	0	0	1	1	1	1	1	1
2	0	0	1	1	1	1	1	2	2	2
3	0	1	1	1	2	2	2	3	3	3
4	0	1	1	2	2	3	3	3	4	4
5	1	1	2	2	3	3	4	4	5	5
6	1	1	2	3	3	4	4	5	6	6
7	1	1	2	3	4	4	5	6	7	7
8	1	2	3	3	4	5	6	7	8	8
9	1	2	3	4	5	6	7	8	8	9
10	1	2	3	4	5	6	7	8	9	10
20	2	4	6	8	10	13	15	17	19	21
30	3	6	9	13	16	19	22	25	28	31
50	5	10	16	21	26	31	37	42	47	52
75	8	16	24	31	39	47	55	63	71	79
100	10	21	31	42	52	63	73	84	94	105

~~876.~~961. A table summarising the razorbill construction and operational disturbance and displacement assessment for DBS East and DBS West together is provided below (**Table 9-109**).

~~877.~~962. It is concluded that predicted razorbill mortality due to construction and operational phase disturbance and displacement impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the North Caithness Cliffs SPA**.

Table 9-109 Summary of predicted razorbill displacement mortality from North Caithness Cliffs SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.

~~Guillemot~~Razorbill		Displacement		
Potential Effects During Construction: Disturbance and Displacement				
Displacement mortality		Mean (@25% x 1%)	Mean (@35% x ~~10~~2%)	Mean (@~~25~~35% x ~~1~~10%)
Breeding season		0	0	0
Autumn		~~1.15~~0.16	0.~~11~~34	1.72
Winter		0.~~42~~05	0.~~04~~12	0.60
Spring		~~1~~0.13	0.~~11~~29	1.44
Annual		~~2.7~~0.34	0.~~26~~75	3.75
Effect	Reference population	3,579		
	Increase in back-ground mortality (%)	0.~~72~~09	0.~~07~~20	1.0
Potential Effects During Operation: Disturbance and Displacement				
Displacement mortality		Mean (@50% x 1%)	Mean (@70% x 10%)	Mean (@~~50~~70% x ~~1~~10%)
Breeding season		0	0	0
Autumn		~~2~~0.2	0.~~2~~68	3.4
Winter		0.~~8~~1	0.~~1~~24	1.2
Spring		~~2~~0.2	0.~~2~~56	2.8
Annual		0.~~40~~5	1.5	7.3
Effect	Reference population	3,579		
	Increase in back-ground mortality (%)	~~1.3~~0.14	0.~~1~~39	1.95

~~9.14.2.3.4~~9.15.2.3.5 *Assessment of potential effects of the Projects in combination with other plans and projects*

~~878.~~963. Given that no measurable increase in the North Caithness Cliffs SPA razorbill mortality is predicted as a result of DBS East and DBS West combined (e.g. with realistic displacement mortality of 0.4 birds per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted guillemot mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the North Caithness Cliffs SPA**.

~~9.14.2.4~~9.15.2.4 Puffin

~~879.~~964. Puffin has been screened into the assessment to assess the impacts from disturbance / displacement in the construction and operation phase.

~~9.14.2.4.1~~9.15.2.4.1 *Status*

~~880.~~965. Puffin is listed as a named component of the breeding seabird assemblage of North Caithness Cliffs SPA. The SPA breeding population at classification in 1996 was cited as 2,080 pairs (SNH, 2009). Burnell *et al.* (2023) give an updated count of 3,039 AOB which has been used in this assessment.

~~9.14.2.4.2~~9.15.2.4.2 *Connectivity to the Projects*

~~881.~~966. DBS East and DBS West are 536km and 506km respectively from North Caithness Cliffs SPA. The mean maximum foraging range of puffin is 265.4km (137.1km +128.3km, Woodward *et al.*, 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding puffin from North Caithness Cliffs SPA, there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only. Outside the breeding season, breeding puffins from North Caithness Cliffs SPA are assumed to range widely and to mix with puffins from breeding colonies in the UK and further afield. The relevant non-breeding season reference population is the UK North Sea and Channel BDMPS, consisting of 231,957 individuals (mid-August to March) (Furness, 2015). It is estimated that 0.1% of birds present at the Projects are breeding adults from North Caithness Cliffs SPA. Note, this percentage has been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

~~9.14.2.4.3~~9.15.2.4.3 *Assessment of Potential Effects of the Projects alone and Together*

Table 9-110 Summary of puffin density and abundance estimates and SPA apportioning rates and used in the operation and construction displacement assessment for North Caithness Cliffs SPA. Note that displacement from the wind farm has been estimated as 15%-35%, half the operational rates.

Site	Season	Peak no.	SPA %	Adult %	No. apportioned to SPA	Wind farm operation displacement mortality to SPA			Wind farm construction displacement mortality to SPA			Peak density (birds/ km^2)	Total vessel displacement mortality (2km around 3 vessels, 1% mortality)	Vessel mortality to SPA	Total construction displacement mortality to SPA		
						30-1	50-1	70-10	15-1	25 - 1	35-10				15-1 & vessel	25 – 1 & vessel	35-10 & vessel
DBS East	Breeding	62.60	0	0.543	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.05	0.00	0.00	0.00	0.00
	Nonbreeding	178.70	0.~~0011~~1	1	0.2	0.00	0.00	0.01	0.00	0.00	0.01	0.35	0.13	0.00	0.00	0.00	0.01
	Annual				0.2	0.00	0.00	0.01	0.00	0.00	0.01	-	0.18	0.00	0.00	0.00	0.01
DBS West	Breeding	109.3	0	0.543	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.21	0.08	0.00	0.00	0.00	0.00
	Nonbreeding	198.2	0.~~0011~~1	1	0.2	0.00	0.00	0.01	0.00	0.00	0.01	0.38	0.14	0.00	0.00	0.00	0.01
	Annual				0.2	0.00	0.00	0.01	0.00	0.00	0.01	-	0.22	0.00	0.00	0.00	0.01
DBS East + DBS West	Breeding	~~146.60~~171.9	0	0.543	0.0	0.00	0.00	0.00	0.00	0.00	0.00	-	0.12	0.00	0.00	0.00	0.00
	Nonbreeding	~~372.70~~376.9	0.~~0011~~1	1	0.4	0.00	0.00	0.03	0.00	0.00	0.01		0.28	0.00	0.00	0.00	0.01
	Annual				0.4	0.00	0.00	0.03	0.00	0.00	0.01		0.4	0.00	0.00	0.00	0.01

~~9.14.2.4.3.1~~9.15.2.4.3.1 *Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines*

~~9.14.2.4.3.1.1~~9.15.2.4.3.1.1 *DBS East in Isolation*

~~882.~~967. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-7**) the number of individuals from the North Caithness Cliffs SPA population expected to die is 571 (6,078 x 0.094) adults per annum. The predicted annual construction impact from DBS East alone on the breeding puffin population applying highly precautionary rates of 35% displacement and 10% mortality is 0.01 birds per annum (**Table 9-110**). This would result in a predicted change in adult mortality rate of <0.01%.

~~883.~~968. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that puffins avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is equivalent to the natural adult background mortality rate of 9.4%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of puffin populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~884.~~969. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the North Caithness Cliffs SPA (<0.01) would increase the predicted annual mortality by <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.14.2.4.3.1.2~~9.15.2.4.3.1.2 *DBS West in Isolation*

~~885.~~970. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-7**) the number of individuals from the North Caithness Cliffs SPA population expected to die is 571 (6,078 x 0.094) adults per annum. The predicted annual construction impact from DBS West alone on the breeding puffin population applying highly precautionary rates of 35% displacement and 10% mortality is 0.01 birds per annum (**Table 9-110**). This would result in a predicted change in adult mortality rate of <0.01%.

~~886.~~971. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that puffins avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is equivalent to the natural adult background mortality rate of 9.4%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of puffin populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~887.~~972. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the North Caithness Cliffs SPA (<0.01) would increase the predicted annual mortality by <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.14.2.4.3.1.3~~9.15.2.4.3.1.3 *DBS East and West Together*

~~888.~~973. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-7**) the number of individuals from the North Caithness Cliffs SPA population expected to die is 571 (6,078 x 0.094) adults per annum. The predicted annual construction impact from DBS East and DBS West on the breeding puffin population applying highly precautionary rates of 35% displacement and 10% mortality is 0.01 birds per annum (**Table 9-110**). This would result in a predicted change in adult mortality rate of <0.01%.

~~889.~~974. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that puffins avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is equivalent to the natural adult background mortality rate of 9.4%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of puffin populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~890.~~975. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the North Caithness Cliffs SPA (<0.01) would increase the predicted annual mortality by <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.14.2.4.3.2~~9.15.2.4.3.2 *Potential Effects During Operation: Disturbance and Displacement*

~~9.14.2.4.3.2.1~~9.15.2.4.3.2.1 *DBS East in Isolation*

~~891.~~976. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-7**) the number of individuals from the North Caithness Cliffs SPA population expected to die is 571 (6,078 x 0.094) adults per annum. The predicted annual operation impact from DBS East alone on the breeding puffin population applying highly precautionary rates of 70% displacement and 10% mortality is 0.01 birds per annum (**Table 9-110**). This would result in a predicted change in adult mortality rate of <0.01%.

~~892.~~977. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that puffins avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is equivalent to the natural adult background mortality rate of 9.4%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of puffin populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~893.~~978. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the North Caithness Cliffs SPA (<0.01) would increase the predicted annual mortality by <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.14.2.4.3.2.2~~9.15.2.4.3.2.2 *DBS West in Isolation*

~~894.~~979. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-7**) the number of individuals from the North Caithness Cliffs SPA population expected to die is 571 (6,078 x 0.094) adults per annum. The predicted annual operation impact from DBS West alone on the breeding puffin population applying highly precautionary rates of 70% displacement and 10% mortality is 0.01 birds per annum (**Table 9-110**). This would result in a predicted change in adult mortality rate of <0.01%.

~~895.~~980. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that puffins avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is equivalent to the natural adult background mortality rate of 9.4%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of puffin populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~896.~~981. At a more appropriate (construction) displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the North Caithness Cliffs SPA (<0.01) would increase the predicted annual mortality by <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.14.2.4.3.2.3~~9.15.2.4.3.2.3 *DBS East and West Together*

~~897.~~982. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-7**) the number of individuals from the North Caithness Cliffs SPA population expected to die is 571 (6,078 x 0.094) adults per annum. The predicted annual operation impact from DBS East and DBS West on the breeding puffin population applying highly precautionary rates of 70% displacement and 10% mortality is 0.03 birds per annum (**Table 9-110**). This would result in a predicted change in adult mortality rate of <0.01%.

~~898.~~983. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that puffins avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is equivalent to the natural adult background mortality rate of 9.4%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of puffin populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~899.~~984. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the North Caithness Cliffs SPA (<0.01) would increase the predicted annual mortality by <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.14.2.4.4~~9.15.2.4.4 *Summary*

~~900.~~985. A table summarising the puffin construction and operational disturbance and displacement assessment for DBS East and DBS West together is provided below (**Table 9-111**).

~~901.~~986. It is concluded that predicted puffin mortality due to construction and operational phase disturbance and displacement impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the North Caithness Cliffs SPA**.

Table 9-111 Summary of predicted puffin displacement mortality from North Caithness Cliffs SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.

~~Guillemot~~Puffin		**Displacement**	
Potential Effects During Construction: Disturbance and Displacement			
Displacement mortality		Mean (@~~35~~25% x ~~10~~1%)	Mean (@~~25~~35% x ~~1~~10%)
Breeding season		0	0
Nonbreeding season		<0.01	~~<~~0.01
Annual		<0.01	~~<~~0.01
Effect	Reference population	6,078	
	Increase in background mortality (%)	<0.01	<0.01

~~Guillemot~~Puffin		Displacement	
Potential Effects During Operation: Disturbance and Displacement			
Displacement mortality		Mean (@~~70~~50% x ~~10~~1%)	Mean (@~~50~~70% x ~~1~~10%)
Breeding season		0	0
Nonbreeding season		<0.~~03~~01	~~<~~0.~~01~~03
Annual		<0.~~03~~01	~~<~~0.~~01~~03
Effect	Reference population	6,078	
	Increase in background mortality (%)	<0.01	<0.01

~~9.14.2.4.5~~9.15.2.4.5 Assessment of potential effects of the Projects in combination with other plans and projects

~~902.~~987. Given that no measurable increase in the North Caithness Cliffs SPA puffin mortality is predicted as a result of DBS East and DBS West combined (e.g. with realistic displacement mortality of less than 0.01 birds per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted puffin mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the North Caithness Cliffs SPA**.

~~9.15~~9.16 Copinsay SPA

~~9.15.1~~9.16.1 Site Description

~~903.~~988. The Copinsay SPA was designated in 1994. The site comprises a group of islands 4km off the east coast of Orkney Mainland. The islands have a cliffed rocky coastline and maritime vegetation that support large colonies of breeding seabirds.

~~904.~~989. The boundary of the SPA encompasses Copinsay SSSI, and the seaward extension extends approximately 2km into the marine environment to include the seabed, water column and surface.

~~9.15.1.1~~9.16.1.1 Qualifying Features

~~905.~~990. The qualifying features of the Copinsay Cliffs SPA screened into the assessment are listed in Table 4-7 of **RIAA HRA Part 1 of 4 – Introduction and Terrestrial Ecology (application ref: 6.1)**. These are two named components of the breeding seabird assemblage (kittiwake and guillemot).

~~9.15.1.2~~9.16.1.2 Conservation Objectives

~~906.~~991. The over-arching conservation objectives of the site are:

- To avoid deterioration of the habitats of the qualifying species or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained; and
- To ensure for the qualifying species that the following are maintained in the long term:
    - Population of the species as a viable component of the site;
    - Distribution of the species within site;
    - Distribution and extent of habitats supporting the species;
    - Structure, function and supporting processes of habitats supporting the species; and
    - No significant disturbance of the species.

~~9.15.2~~9.16.2 Assessment

~~9.15.2.1~~9.16.2.1 Kittiwake

~~907.~~992. Kittiwake has been screened into the assessment to assess the impacts from collision risk in the operation phase.

~~9.15.2.1.1~~9.16.2.1.1 Status

~~908.~~993. Kittiwake is listed as a named component of the breeding seabird assemblage of Copinsay SPA.

~~909.~~994. The SPA breeding population at classification in 1994 was cited as 9,550 pairs (SNH, 2009). Burnell *et al*. (2023) give an updated count of 955 AON which has been used in this assessment.

~~9.15.2.1.2~~9.16.2.1.2 Connectivity to the Projects

~~910.~~995. DBS East and DBS West are 537km and 520km respectively from Copinsay SPA. The mean maximum foraging range of kittiwake is 300.6km (156.1km + 144.5km, Woodward *et al*., 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding kittiwake from Copinsay SPA there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

~~911.~~996. Outside the breeding season breeding kittiwakes, including those from Copinsay SPA, are not constrained by requirements to visit nests to incubate eggs or provision chicks. At this time, they are assumed to range more widely and to mix with kittiwakes of all age classes from breeding colonies in the UK and further afield. The background population during these seasons is the UK North Sea BDMPS. This consists of 829,937 individuals during the autumn migration season (August to December), and 627,816 individuals during the spring migration season (January to April) (Furness, 2015).

~~912.~~997. It is estimated that 0.1% of birds present in the Project array areas in both the autumn and spring migration seasons are breeding adults from Copinsay SPA. Note, these percentages have been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

~~9.15.2.1.3~~9.16.2.1.3 *Assessment of Potential Effects of the Projects alone and Together*

~~9.15.2.1.3.1~~9.16.2.1.3.1 *Potential Effects During Operation: Collision risk*

Table 9-112 Summary of kittiwake total collisions and apportioned to the Copinsay SPA.

Site	Season	Collision mortality			SPA %	Adult %	Collisions apportioned to SPA		
		Lower 95% c.i.	Mean	Upper 95% c.i.			Lower 95% c.i.	Mean	Upper 95% c.i.
DBS East	Breeding	42.3	83.3	168.5	0	53	0	0	0
	Autumn	14.6	41.4	82.9	0.1	100	0.0	0.0	0.1
	Spring	6.8	14.6	28.0	0.1	100	0.0	0.0	0.0
	Annual	66.9	139.3	261.3	-	-	0.0	0.1	0.1
DBS West	Breeding	36.9	107.8	280.8	0	53	0.0	0.0	0.0
	Autumn	9.5	37.9	81.9	0.1	100	0.0	0.0	0.1
	Spring	7.1	14.9	26.5	0.1	100	0.0	0.0	0.0
	Annual	55.9	160.6	327.0	-	-	0.0	0.1	0.1
DBS East + DBS West	Breeding	96.2	191.1	378.4	0	53	0.0	0.0	0.0
	Autumn	30.5	79.3	143.1	0.1	100	0.0	0.1	0.1
	Spring	16.9	29.5	47.3	0.1	100	0.0	0.0	0.0
	Annual	150.9	299.9	540.5	-	-	0.0	0.1	0.2

~~9.15.2.1.3.1.1~~9.16.2.1.3.1.1 *DBS East in Isolation*

~~913.~~998. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-7**) the number of individuals from the Copinsay SPA population expected to die is 279 (1,910 x 0.146) adults per annum. The predicted annual impacts from DBS East alone on the breeding kittiwake population is 0.1 birds per annum (**Table 9-112**). This results in a predicted change in adult mortality rate of 0.03% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.15.2.1.3.1.2~~9.16.2.1.3.1.2 *DBS West in Isolation*

~~914.~~999. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-7**) the number of individuals from the Copinsay SPA population expected to die is 279 (1,910 x 0.146) adults per annum. The predicted annual impacts from DBS West alone on the breeding kittiwake population is 0.1 birds per annum (**Table 9-112**). This results in a predicted change in adult mortality rate of 0.03% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.15.2.1.3.1.3~~9.16.2.1.3.1.3 *DBS East and West Together*

~~915.~~1000. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-7**) the number of individuals from the Copinsay SPA population expected to die is 4279 (1,910 x 0.146) adults per annum. The predicted annual impacts from DBS East and DBS West on the breeding kittiwake population is 0.11 birds per annum (**Table 9-112**). This results in a predicted change in adult mortality rate of 0.04% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.15.2.1.4~~9.16.2.1.4 *Summary*

~~916.~~1001. A table summarising the kittiwake operational collision risk assessment for DBS East and DBS West together is provided below (**Table 9-113**).

~~917.~~1002. It is concluded that predicted kittiwake mortality due to operational phase collision risk at DBS East, DBS West, and the Projects together would **not adversely affect the integrity of the Copinsay SPA**.

Table 9-113 Summary of predicted Kittiwake collision mortality from Copinsay SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations for the Worst Case Wind Turbine Scenario.

Kittiwake	Collisions		
Potential Effects During Operation: Collision Risk			
Collision mortality	Lower c.i.	Mean	Upper c.i.
Breeding season	-	-	-

Kittiwake		Collisions		
Autumn		0.0	0.1	0.1
Spring		0.0	0.0	0.0
Annual		0.0	0.1	0.2
Effect	Reference population	1,910		
	Increase in background mortality (%)	<0.01	0.04	0.06

~~9.15.2.1.5~~9.16.2.1.5 *Assessment of potential effects of the Projects in combination with other plans and projects*

~~918.~~1003. Given that no measurable increase in the Copinsay SPA kittiwake mortality is predicted as a result of DBS East and DBS West combined (e.g. with total collision mortality of only 0.11 birds per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted kittiwake mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Copinsay SPA**.

~~9.15.2.2~~9.16.2.2 Guillemot

~~919.~~1004. Guillemot has been screened into the assessment to assess the impacts from disturbance / displacement in the construction and operation phase.

~~9.15.2.2.1~~9.16.2.2.1 *Status*

~~920.~~1005. Guillemot is listed as a named component of the breeding seabird assemblage of Copinsay SPA.

~~921.~~1006. The SPA breeding population at classification in 1994 was cited as 29,450 individuals (SNH, 2009). Burnell *et al.* (2023) give an updated count of 18,479 individuals which has been used in this assessment.

~~9.15.2.2.2~~9.16.2.2.2 *Connectivity to the Projects*

~~922.~~1007. DBS East and DBS West are 537km and 520km respectively from Copinsay SPA. The mean maximum foraging range of guillemot is 153.7km (73.2km + 80.5km, Woodward *et al.*, 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding guillemot from Copinsay SPA, there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

~~923.~~1008. Outside the breeding season, breeding guillemots from Copinsay SPA are assumed to range widely and to mix with guillemots from breeding colonies in the UK and beyond. The relevant non-breeding season reference population is the UK North Sea and Channel BDMPS, consisting of 1,617,306 individuals (August to February) (Furness, 2015).

~~924.~~1009. It is estimated that 0.5% of birds present at the Projects are considered to be breeding adults from Copinsay SPA. Note, this percentage has been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

~~9.15.2.2.3~~9.16.2.2.3 *Assessment of Potential Effects of the Projects alone and Together*

Table 9-114 Summary of guillemot density and abundance estimates and SPA apportioning rates and used in the operation and construction displacement assessment for Copinsay SPA. Note that displacement from the wind farm has been estimated as 15%-35%, half the operational rates.

Site	Season	Peak no.	SPA %	Adult %	No. apportioned to SPA	Wind farm operation displacement mortality to SPA			Wind farm construction displacement mortality to SPA			Peak density (birds/ km^2)	Total vessel displacement mortality (2km around 3 vessels, 1% mortality)	Vessel mortality to SPA	Total construction displacement mortality to SPA		
						30-1	50-1	70-10	15-1	25 - 1	35-10				15-1 & vessel	25 – 1 & vessel	35-10 & vessel
DBS East	Breeding	9030.5	0	55.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.71	6.7	0.0	0.0	0.0	0.0
	Nonbreeding	12551.8	0.5	100	62.8	0.2	0.3	4.4	0.1	0.2	2.2	24.62	9.3	0.0	0.1	0.2	2.2
	Annual				62.8	0.2	0.3	4.4	0.1	0.2	2.2	-	16	0.0	0.1	0.2	2.2
DBS West	Breeding	8783.5	0	55.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.92	6.4	0.0	0.0	0.0	0.0
	Nonbreeding	12498.4	0.5	100	62.5	0.2	0.3	4.4	0.1	0.2	2.2	24.08	9.1	0.0	0.1	0.2	2.2
	Annual				62.5	0.2	0.3	4.4	0.1	0.2	2.2	-	15.5	0.0	0.1	0.2	2.2
DBS East + DBS West	Breeding	~~14927.7~~17815	0	55.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	13.0	0.0	0.0	0.0	0.0
	Nonbreeding	~~20136.0~~25050	0.5	100	~~100.7~~125.3	0.~~3~~4	0.~~5~~6	~~7.0~~8.8	0.2	0.3	~~3.5~~4.4		18.4	0.1	0.~~2~~3	0.~~3~~4	~~3.6~~4.5
	Annual				~~100.7~~125.3	0.~~3~~4	0.~~5~~6	~~7.0~~8.8	0.2	0.3	~~3.5~~4.4		31.4	0.1	0.~~2~~3	0.~~3~~4	~~3.6~~4.5

~~9.15.2.2.3.1~~9.16.2.2.3.1 *Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines*

~~9.15.2.2.3.1.1~~9.16.2.2.3.1.1 *DBS East in Isolation*

~~925.~~1010. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Copinsay SPA population expected to die is 1,127 (18,479 x 0.061) adults per annum. The predicted annual construction impact from DBS East alone on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 2.2 birds per annum (**Table 9-114**). This would result in a predicted change in adult mortality rate of 0.2%. The equivalent mortality assuming 35% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 0.44 which would increase the background mortality rate by 0.04%.

~~926.~~1011. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~927.~~1012. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Copinsay SPA (0.2) would increase the predicted annual mortality by 0.02% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.15.2.2.3.1.2~~9.16.2.2.3.1.2 DBS West in Isolation

~~928.~~1013. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Copinsay SPA population expected to die is 1,127 (18,479 x 0.061) adults per annum. The predicted annual construction impact from DBS West alone on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 2.2 birds per annum (**Table 9-114)**. This would result in a predicted change in adult mortality rate of 0.2%. The equivalent mortality assuming 35% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 0.44 which would increase the background mortality rate by 0.04%.

~~929.~~1014. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~930.~~1015. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Copinsay SPA (0.2) would increase the predicted annual mortality by 0.02% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.15.2.2.3.1.3~~9.16.2.2.3.1.3 DBS East and West Together

~~931.~~1016. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Copinsay SPA population expected to die is 1,127 (18,479 x 0.061) adults per annum. The predicted annual construction impact from DBS East and DBS West on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is ~~3.6~~4.5 birds per annum (**Table 9-114**). This would result in a predicted change in adult mortality rate of 0.~~3%.~~ 4%. The equivalent mortality assuming 35% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 0.9 which would increase the background mortality rate by 0.08%.

~~932.~~1017. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~933.~~1018. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Copinsay SPA (0.~~3~~4) would increase the predicted annual mortality by 0.~~03~~04% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.15.2.2.3.2~~9.16.2.2.3.2 Potential Effects During Operation: Disturbance and Displacement

~~9.15.2.2.3.2.1~~9.16.2.2.3.2.1 DBS East in Isolation

~~934.~~1019. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Copinsay SPA population expected to die is 1,127 (18,479 x 0.061) adults per annum. The predicted annual operation impact from DBS East alone on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 4.4 birds per annum (**Table 9-114**). This would result in a predicted change in adult mortality rate of 0.4%. The equivalent mortality assuming 70% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 0.9 which would increase the background mortality rate by 0.08%.

~~935.~~1020. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~936.~~1021. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Copinsay SPA (0.3) would increase the predicted annual mortality by 0.03% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.15.2.2.3.2.2~~9.16.2.2.3.2.2 DBS West in Isolation

~~937.~~1022. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Copinsay SPA population expected to die is 1,127 (18,479 x 0.061) adults per annum. The predicted annual operation impact from DBS West alone on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 4.4 birds per annum (**Table 9-114**). This would result in a predicted change in adult mortality rate of 0.4%. The equivalent mortality assuming 70% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 0.9 which would increase the background mortality rate by 0.08%.

~~938.~~1023. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~939.~~1024. At a more appropriate (construction) displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Copinsay SPA (0.3) would increase the predicted annual mortality by 0.03% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.15.2.2.3.2.3~~9.16.2.2.3.2.3 DBS East and West Together

~~940.~~1025. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Copinsay SPA population expected to die is 1,127 (18,479 x 0.061) adults per annum. The predicted annual operation impact from DBS East and DBS West on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is ~~7~~8.8 birds per annum (**Table 9-114**). This would result in a predicted change in adult mortality rate of 0.~~6%.~~ 8%. The equivalent mortality assuming 70% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 1.8 which would increase the background mortality rate by 0.16%.

~~941.~~1026. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~942.~~1027. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Copinsay SPA (0.~~5~~6) would increase the predicted annual mortality by 0.~~04~~06% which is below the 1% threshold for detectability and therefore no further assessment was required.

9.16.2.2.4 Summary

~~943.~~1028. A matrix of the annual operational displacement estimates for DBS East and DBS West is provided in **Table 9-115**.

Table 9-115 Displacement matrix for annual project alone (DBS East plus DBS West) guillemot apportioned to Copinsay SPA adult population.

Mortality %	Displacement %									
	10	20	30	40	50	60	70	80	90	100
1	0	0	0	1	1	1	1	1	1	1
2	0	1	1	1	1	2	2	2	2	3
3	0	1	1	2	2	2	3	3	3	4
4	1	1	2	2	3	3	4	4	5	5
5	1	1	2	3	3	4	4	5	6	6
6	1	2	2	3	4	5	5	6	7	8
7	1	2	3	4	4	5	6	7	8	9
8	1	2	3	4	5	6	7	8	9	10
9	1	2	3	5	6	7	8	9	10	11
10	1	3	4	5	6	8	9	10	11	13
20	3	5	8	10	13	15	18	20	23	25
30	4	8	11	15	19	23	26	30	34	38
50	6	13	19	25	31	38	44	50	56	63
75	9	19	28	38	47	56	66	75	85	94
100	13	25	38	50	63	75	88	100	113	125

~~944.~~1029. A table summarising the guillemot construction and operational disturbance and displacement assessment for DBS East and DBS West together is provided below (**Table 9-116**).

~~945.~~1030. It is concluded that predicted guillemot mortality due to construction and operational phase disturbance and displacement impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the Copinsay SPA**.

Table 9-116 Summary of predicted guillemot displacement mortality from Copinsay SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.

Guillemot		**Displacement**		
Potential Effects During Construction: Disturbance and Displacement				
Displacement mortality		Mean (@25% x 1%)	Mean (@35% x ~~10~~2%)	Mean (@~~25~~35% x ~~1~~10%)
Breeding season		0	0	0
Nonbreeding season		~~2.2~~0.4	0.~~2~~9	4.5
Annual		~~2.2~~0.4	0.~~2~~9	4.5
Effect	Reference population	18,479		
	Increase in back-ground mortality (%)	0.~~3~~04	0.~~03~~08	0.4
Potential Effects During Operation: Disturbance and Displacement				
Displacement mortality		Mean (@50% x 1%)	Mean (@70% x ~~10~~2%)	Mean (@~~50~~70% x ~~1~~10%)
Breeding season		0	0	0
Nonbreeding season		0.~~5~~6	1.76	8.8
Annual		0.~~5~~6	1.76	8.8
Effect	Reference population	18,479		
	Increase in back-ground mortality (%)	0.~~6~~06	0.~~04~~16	0.78

~~9.15.2.2.4~~9.16.2.2.5 *Assessment of potential effects of the Projects in combination with other plans and projects*

~~946.~~1031. Given that no measurable increase in the Copinsay SPA guillemot mortality is predicted as a result of DBS East and DBS West combined (e.g. with realistic displacement mortality of less than 1 bird per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted guillemot mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Copinsay SPA**.

~~9.16~~9.17 Hoy SPA

~~9.16.1~~9.17.1 Site Description

~~947.~~1032. Hoy is a mountainous island at the south-western end of the Orkney archipelago. Hoy SPA covers the northern and western two-thirds of Hoy island and adjacent coastal waters. These upland areas and the high sea cliffs at the coast support an important assemblage of moorland breeding birds and breeding seabirds.

~~948.~~1033. The seaward extension of the SPA extends 2km into the marine environment and includes the seabed, water column and surface. Seabirds included within the designation feed both inside and outside the SPA in nearby waters, as well as more distantly in the wider North Sea.

~~9.16.1.1~~9.17.1.1 Qualifying Features

~~949.~~1034. The qualifying features of the Hoy SPA screened into the assessment are listed in Table 4-7 of **RIAA HRA Part 1 of 4 – Introduction and Terrestrial Ecology (application ref: 6.1)**. These are three named components of the breeding seabird assemblage (kittiwake, guillemot and puffin).

~~9.16.1.2~~9.17.1.2 Conservation Objectives

~~950.~~1035. The over-arching conservation objectives of the site are:

- To avoid deterioration of the habitats of the qualifying species or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained; and
- To ensure for the qualifying species that the following are maintained in the long term:
  - Population of the species as a viable component of the site;
  - Distribution of the species within site;
  - Distribution and extent of habitats supporting the species;
  - Structure, function and supporting processes of habitats supporting the species; and
  - No significant disturbance of the species.

~~9.16.2~~9.17.2 Assessment: Array Areas

~~9.16.2.1~~9.17.2.1 Kittiwake

~~951.~~1036. Kittiwake has been screened into the assessment to assess the impacts from collision risk in the operation phase.

~~9.16.2.1.1~~9.17.2.1.1 *Status*

~~952.~~1037. Kittiwake is listed as a named component of the breeding seabird assemblage of Hoy SPA.

~~953.~~1038. The SPA breeding population at classification in 2000 was cited as 3,000 pairs (SNH, 2009). Burnell *et al*. (2023) give an updated count of 266 AON which has been used in this assessment.

~~9.16.2.1.2~~9.17.2.1.2 *Connectivity to the Projects*

~~954.~~1039. DBS East and DBS West are 561km and 530km respectively from Hoy SPA. The mean maximum foraging range of kittiwake is 300.6km (156.1km + 144.5km, Woodward *et al*., 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding kittiwake from Hoy SPA there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

~~955.~~1040. Outside the breeding season breeding kittiwakes, including those from Hoy SPA, are not constrained by requirements to visit nests to incubate eggs or provision chicks. At this time, they are assumed to range more widely and to mix with kittiwakes of all age classes from breeding colonies in the UK and further afield. The background population during these seasons is the UK North Sea BDMPS. This consists of 829,937 individuals during the autumn migration season (August to December), and 627,816 individuals during the spring migration season (January to April) (Furness, 2015).

~~956.~~1041. It is estimated that 0.1% of birds present in the Project array areas in both the autumn and spring migration seasons are breeding adults from Hoy SPA. Note, these percentages have been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

~~9.16.2.1.3~~9.17.2.1.3 *Assessment of Potential Effects of the Projects alone and Together*

~~9.16.2.1.3.1~~9.17.2.1.3.1 *Potential Effects During Operation: Collision risk*

Table 9-117 Summary of kittiwake total collisions and apportioned to the Hoy SPA.

Site	Season	Collision mortality			SPA %	Adult %	Collisions apportioned to SPA		
		Lower 95% c.i.	Mean	Upper 95% c.i.			Lower 95% c.i.	Mean	Upper 95% c.i.
DBS East	Breeding	42.3	83.3	168.5	0	53	0	0	0
	Autumn	14.6	41.4	82.9	0.1	100	0.0	0.0	0.1
	Spring	6.8	14.6	28.0	0.1	100	0.0	0.0	0.0
	Annual	66.9	139.3	261.3	-	-	0.0	0.1	0.1
DBS West	Breeding	36.9	107.8	280.8	0	53	0.0	0.0	0.0
	Autumn	9.5	37.9	81.9	0.1	100	0.0	0.0	0.1
	Spring	7.1	14.9	26.5	0.1	100	0.0	0.0	0.0
	Annual	55.9	160.6	327.0	-	-	0.0	0.1	0.1
DBS East + DBS West	Breeding	96.2	191.1	378.4	0	53	0.0	0.0	0.0
	Autumn	30.5	79.3	143.1	0.1	100	0.0	0.1	0.1
	Spring	16.9	29.5	47.3	0.1	100	0.0	0.0	0.0
	Annual	150.9	299.9	540.5	-	-	0.0	0.1	0.2

~~9.16.2.1.3.1.1~~9.17.2.1.3.1.1 *DBS East in Isolation*

~~957.~~1042. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-7**) the number of individuals from the Hoy SPA population expected to die is 78 (532 x 0.146) adults per annum. The predicted annual impacts from DBS East alone on the breeding kittiwake population is 0.1 birds per annum (**Table 9-117**). This results in a predicted change in adult mortality rate of 0.1% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.16.2.1.3.1.2~~9.17.2.1.3.1.2 *DBS West in Isolation*

~~958.~~1043. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-7**) the number of individuals from the Hoy SPA population expected to die is 78 (532 x 0.146) adults per annum. The predicted annual impacts from DBS West alone on the breeding kittiwake population is 0.1 birds per annum (**Table 9-117**). This results in a predicted change in adult mortality rate of 0.1% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.16.2.1.3.1.3~~9.17.2.1.3.1.3 *DBS East and West Together*

~~959.~~1044. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-7**) the number of individuals from the Hoy SPA population expected to die is 78 (532 x 0.146) adults per annum. The predicted annual impacts from DBS East and DBS West on the breeding kittiwake population is 0.1 birds per annum (**Table 9-117**). This results in a predicted change in adult mortality rate of 0.1% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.16.2.1.4~~9.17.2.1.4 *Summary*

~~960.~~1045. A table summarising the kittiwake operational collision risk assessment for DBS East and DBS West together is provided below (**Table 9-118**).

~~961.~~1046. It is concluded that predicted kittiwake mortality due to operational phase collision risk at DBS East, DBS West, and the Projects together would **not adversely affect the integrity of the Hoy SPA**.

Table 9-118 Summary of predicted Kittiwake collision mortality from Hoy SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations for the Worst Case Wind Turbine Scenario.

Kittiwake		**Collisions**		
Potential Effects During Operation: Collision Risk				
Collision mortality		Lower c.i.	Mean	Upper c.i.
Breeding season		-	-	-
Autumn		0.0	0.1	0.1
Spring		0.0	0.0	0.0
Annual		0.0	0.1	0.2
Effect	Reference population	532		
	Increase in background mortality (%)	<0.01	0.1	0.1

~~9.16.2.1.5~~9.17.2.1.5 *Assessment of potential effects of the Projects in combination with other plans and projects*

~~962.~~1047. Given that no measurable increase in the Hoy SPA kittiwake mortality is predicted as a result of DBS East and DBS West combined (e.g. with total collision mortality of only 0.07 birds per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted kittiwake mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Hoy SPA**.

~~9.16.2.2~~9.17.2.2 Guillemot

~~963.~~1048. Guillemot has been screened into the assessment to assess the impacts from disturbance / displacement in the construction and operation phase.

~~9.16.2.2.1~~9.17.2.2.1 Status

~~964.~~1049. Guillemot is listed as a named component of the breeding seabird assemblage of Hoy SPA.

~~965.~~1050. The SPA breeding population at classification in 2000 was cited as 13,400 pairs (SNH, 2009). Burnell *et al*. (2023) give an updated count of 9,246 individuals which has been used in this assessment.

~~9.16.2.2.2~~9.17.2.2.2 Connectivity to the Projects

~~966.~~1051. DBS East and DBS West are 561km and 530km respectively from Hoy SPA. The mean maximum foraging range of guillemot is 153.7km (73.2km + 80.5km, Woodward *et al*., 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding guillemot from Hoy SPA, there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

~~967.~~1052. Outside the breeding season, breeding guillemots from Hoy SPA are assumed to range widely and to mix with guillemots from breeding colonies in the UK and beyond. The relevant non-breeding season reference population is the UK North Sea and Channel BDMPS, consisting of 1,617,306 individuals (August to February) (Furness, 2015).

~~968.~~1053. It is estimated that 0.5% of birds present at the Projects are considered to be breeding adults from Hoy SPA. Note, this percentage has been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

~~9.16.2.2.3~~9.17.2.2.3 Assessment of Potential Effects of the Projects alone and Together

Table 9-119 Summary of guillemot density and abundance estimates and SPA apportioning rates and used in the operation and construction displacement assessment for Hoy SPA. Note that displacement from the wind farm has been estimated as 15%-35%, half the operational rates.

Site	Season	Peak no.	SPA %	Adult %	No. apportioned to SPA	Wind farm operation displacement mortality to SPA			Wind farm construction displacement mortality to SPA			Peak density (birds/ km²)	Total vessel displacement mortality (2km around 3 vessels, 1% mortality)	Vessel mortality to SPA	Total construction displacement mortality to SPA		
						30-1	50-1	70-10	15-1	25 - 1	35-10				15-1 & vessel	25 – 1 & vessel	35-10 & vessel
DBS East	Breeding	9030.5	0	55.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.71	6.7	0.0	0.0	0.0	0.0
	Nonbreeding	12551.8	0.5	100	62.8	0.2	0.3	4.4	0.1	0.2	2.2	24.62	9.3	0.0	0.1	0.2	2.2
	Annual				62.8	0.2	0.3	4.4	0.1	0.2	2.2	-	16	0.0	0.1	0.2	2.2
DBS West	Breeding	8783.5	0	55.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.92	6.4	0.0	0.0	0.0	0.0
	Nonbreeding	12498.4	0.5	100	62.5	0.2	0.3	4.4	0.1	0.2	2.2	24.08	9.1	0.0	0.1	0.2	2.2
	Annual				62.5	0.2	0.3	4.4	0.1	0.2	2.2	-	15.5	0.0	0.1	0.2	2.2
DBS East + DBS West	Breeding	~~14927.7~~17815	0	55.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	13.0	0.0	0.0	0.0	0.0
	Nonbreeding	~~20136.0~~25050	0.5	100	~~100.7~~125.3	0.~~3~~4	0.~~5~~6	~~7.0~~8.8	0.2	0.3	~~3.5~~4.4		18.4	0.1	0.~~2~~3	0.~~3~~4	~~3.6~~4.5
	Annual				~~100.7~~125.3	0.~~3~~4	0.~~5~~6	~~7.0~~8.8	0.2	0.3	~~3.5~~4.4		31.4	0.1	0.~~2~~3	0.~~3~~4	~~3.6~~4.5

~~9.16.2.2.3.1~~9.17.2.2.3.1 *Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines*

~~9.16.2.2.3.1.1~~9.17.2.2.3.1.1 *DBS East in Isolation*

~~969.~~1054. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Hoy SPA population expected to die is 564 (9,246 x 0.061) adults per annum. The predicted annual construction impact from DBS East alone on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 2.2 birds per annum (**Table 9-119**). This would result in a predicted change in adult mortality rate of 0.4%. The equivalent mortality assuming 35% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 0.44 which would increase the background mortality rate by 0.08%.

~~970.~~1055. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~971.~~1056. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Hoy SPA (0.2) would increase the predicted annual mortality by 0.04% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.16.2.2.3.1.2~~9.17.2.2.3.1.2 DBS West in Isolation

~~972.~~1057. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Hoy SPA population expected to die is 564 (9,246 x 0.061) adults per annum. The predicted annual construction impact from DBS West alone on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 2.2 birds per annum (**Table 9-119)**. This would result in a predicted change in adult mortality rate of 0.4%. The equivalent mortality assuming 35% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 0.44 which would increase the background mortality rate by 0.08%.

~~973.~~1058. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~974.~~1059. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Hoy SPA (0.2) would increase the predicted annual mortality by 0.03% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.16.2.2.3.1.3~~9.17.2.2.3.1.3 *DBS East and West Together*

1060. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Hoy SPA population expected to die is 564 (9,246 x 0.061) adults per annum. The predicted annual construction impact from DBS East and DBS West on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 4.5 birds per annum (**Table 9-119**). This would result in a predicted change in adult mortality rate of 0.8%. The equivalent mortality assuming 35% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 0.9 which would increase the background mortality rate by 0.16%.

~~975.~~1061. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1062. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Hoy SPA (0.4) would increase the predicted annual mortality by 0.07% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.16.2.2.3.2~~9.17.2.2.3.2 *Potential Effects During Operation: Disturbance and Displacement*

~~9.16.2.2.3.2.1~~9.17.2.2.3.2.1 *DBS East in Isolation*

~~976.~~ At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Hoy SPA population expected to die is 564 (9,246 x 0.061) adults per annum. ~~The predicted annual construction impact from DBS East and DBS West on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 3.6 birds per annum (**Table 9-93**). This would result in a predicted change in adult mortality rate of 0.6%.~~

~~977. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 20233) would increase the predicted annual mortality by 0.06% which is below the 1% threshold for detectability and therefore no further assessment was required.~~

~~978.~~1063. ~~At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Hoy SPA population expected to die is 564 (9,246 x 0.061) adults per annum.~~ The predicted annual operation impact from DBS East alone on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 4.4 birds per annum (**Table 9-119**). This would result in a predicted change in adult mortality rate of 0.8%. The equivalent mortality assuming 70% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 0.9 which would increase the background mortality rate by 0.16%.

~~979.~~ There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.~~

~~980. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Hoy SPA (0.3) would increase the predicted annual mortality by 0.05% which is below the 1% threshold for detectability and therefore no further assessment was required.~~

~~*9.16.2.2.3.2.2 DBS West in Isolation*~~

~~981. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Hoy SPA population expected to die is 564 (9,246 x 0.061) adults per annum. The predicted annual operation impact from DBS West alone on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 4.4 birds per annum (**Table 9-93**). This would result in a predicted change in adult mortality rate of 0.8%.~~

~~982.~~1064. Trinder *et al*. 2024~~In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023~~) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~983.~~1065. At a more appropriate ~~(construction)~~ displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Hoy SPA (0.3) would increase the predicted annual mortality by 0.05% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.16.2.2.3.2.3~~9.17.2.2.3.2.2 DBS ~~East and~~ West ~~Together~~in Isolation

~~984.~~1066. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Hoy SPA population expected to die is 564 (9,246 x 0.061) adults per annum. The predicted annual operation impact from DBS ~~East and DBS~~ West alone on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is ~~7~~4.4 birds per annum (**Table 9-119**). This would result in a predicted change in adult mortality rate of ~~1.~~0.8%. The equivalent mortality assuming 70% displacement and 2% ~~but is based on highly precautionary impact rates. A reduction in either~~ mortality (the ~~displacement~~latter rate ~~(e.g. to 56%) or~~ as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 0.9 which would increase the background mortality rate ~~(e.g. to 8%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in both together).~~ by 0.16%.

~~985.~~1067. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~986.~~1068. At a more appropriate (construction) displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Hoy SPA (0.~~5~~3) would increase the predicted annual mortality by 0.~~09~~05% which is below the 1% threshold for detectability and therefore no further assessment was required.

9.17.2.2.3.2.3 DBS East and West Together

1069. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Hoy SPA population expected to die is 564 (9,246 x 0.061) adults per annum. The predicted annual operation impact from DBS East and DBS West on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 8.8 birds per annum (**Table 9-119**). This would result in a predicted change in adult mortality rate of 1.5% but is based on highly precautionary impact rates. The equivalent mortality assuming 70% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 1.76 which would increase the background mortality rate by 0.31%. A reduction in either the displacement rate (e.g. to 45%) or the mortality rate (e.g. to 6%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in both together).

1070. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1071. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Hoy SPA (0.6) would increase the predicted annual mortality by 0.11% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.16.2.2.4~~9.17.2.2.4 *Summary*

~~987.~~1072. A matrix of the annual operational displacement estimates for DBS East and DBS West is provided in **Table 9-120**.

Table 9-120 Displacement matrix for annual project alone (DBS East plus DBS West) guillemot apportioned to Hoy SPA adult population.

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

Mortality %	Displacement %									
	10	20	30	40	50	60	70	80	90	100
9	1	2	3	5	6	7	8	9	10	11
10	1	3	4	5	6	8	9	10	11	13
20	3	5	8	10	13	15	18	20	23	25
30	4	8	11	15	19	23	26	30	34	38
50	6	13	19	25	31	38	44	50	56	63
75	9	19	28	38	47	56	66	75	85	94
100	13	25	38	50	63	75	88	100	113	125

~~988.~~1073. A table summarising the guillemot construction and operational disturbance and displacement assessment for DBS East and DBS West together is provided below (**Table 9-121**).

~~989.~~1074. It is concluded that predicted guillemot mortality due to construction and operational phase disturbance and displacement impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the Hoy SPA**.

Table 9-121 Summary of predicted guillemot displacement mortality from Hoy SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.

Guillemot		**Displacement**		
Potential Effects During Construction: Disturbance and Displacement				
Displacement mortality		Mean (@25% x 1%)	Mean (@35% x ~~10~~2%)	Mean (@~~25~~35% x ~~1~~10%)
Breeding season		0	0	0
Nonbreeding season		~~2.2~~0.4	0.~~2~~9	4.5
Annual		~~2.2~~0.4	0.~~2~~9	4.5
Effect	Reference population	9,246		
	Increase in background mortality (%)	0.07	0.16	0.79
Potential Effects During Operation: Disturbance and Displacement				

Guillemot		Displacement		
Displacement mortality		Mean (@50% x 1%)		Mean (@70% x 10%)
Breeding season		0	0	0
Nonbreeding season		0.6	1.76	8.8
Annual		0.6	1.76	8.8
Effect	Reference population			9,246
	Increase in background mortality (%)	0.~~64~~11	0.~~06~~31	1.55
~~**Potential Effects During Operation: Disturbance and Displacement**~~				
~~Displacement mortality~~		~~Mean (@70% x 10%)~~		
~~Breeding season~~		~~0~~		~~0~~
~~Nonbreeding season~~		~~7.0~~		~~0.5~~
~~Annual~~		~~7.0~~		~~0.5~~
~~Effect~~	~~Reference population~~			~~9,246~~
	~~Increase in background mortality (%)~~	~~1.24~~		~~0.09~~

~~9.16.2.2.5~~9.17.2.2.5 Assessment of potential effects of the Projects in combination with other plans and projects

~~990.~~1075. Given that no measurable increase in the Hoy SPA guillemot mortality is predicted as a result of DBS East and DBS West combined (e.g. with realistic displacement mortality of less than 1 bird per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted guillemot mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Hoy SPA**.

~~9.16.2.3~~9.17.2.3 Puffin

~~991.~~1076. Puffin has been screened into the assessment to assess the impacts from disturbance / displacement in the construction and operation phase.

~~9.16.2.3.1~~9.17.2.3.1 Status

~~992.~~1077. Puffin is listed as a named component of the breeding seabird assemblage of Hoy SPA. The SPA breeding population at classification in 2000 was cited as 3,500 pairs (SNH, 2009). Burnell *et al.* (2023) give an updated count of 430 AOB which has been used in this assessment.

~~9.16.2.3.2~~9.17.2.3.2 Connectivity to the Projects

~~993.~~1078. DBS East and DBS West are 561km and 530km respectively from Hoy SPA. The mean maximum foraging range of puffin is 265.4km (137.1km +128.3km, Woodward *et al*., 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding puffin from Hoy SPA, there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

~~994.~~1079. Outside the breeding season, breeding puffins from Hoy SPA are assumed to range widely and to mix with puffins from breeding colonies in the UK and further afield. The relevant non-breeding season reference population is the UK North Sea and Channel BDMPS, consisting of 231,957 individuals (mid-August to March) (Furness, 2015).

~~995.~~1080. It is estimated that 0.5% of birds present at the Projects are breeding adults from Hoy SPA. Note, this percentage has been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

~~9.16.2.3.3~~9.17.2.3.3 Assessment of Potential Effects of the Projects alone and Together

Table 9-122 Summary of puffin density and abundance estimates and SPA apportioning rates and used in the operation and construction displacement assessment for Hoy SPA. Note that displacement from the wind farm has been estimated as 15%-35%, half the operational rates.

Site	Season	Peak no.	SPA %	Adult %	No. apportioned to SPA	Wind farm operation displacement mortality to SPA			Wind farm construction displacement mortality to SPA			Peak density (birds/ km²)	Total vessel displacement mortality (2km around 3 vessels, 1% mortality)	Vessel mortality to SPA	Total construction displacement mortality to SPA		
						30-1	50-1	70-10	15-1	25 - 1	35-10				15-1 & vessel	25 – 1 & vessel	35-10 & vessel
DBS East	Breeding	62.60	0	0.543	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.05	0.00	0.00	0.00	0.00
	Nonbreeding	178.70	0.5	1	0.9	0.00	0.00	0.06	0.00	0.00	0.03	0.35	0.13	0.00	0.00	0.00	0.03
	Annual				0.9	0.00	0.00	0.06	0.00	0.00	0.03	-	0.18	0.00	0.00	0.00	0.03
DBS West	Breeding	109.3	0	0.543	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.21	0.08	0.00	0.00	0.00	0.00
	Nonbreeding	198.2	0.5	1	1.0	0.00	0.00	0.07	0.00	0.00	0.03	0.38	0.14	0.00	0.00	0.00	0.04
	Annual				1.0	0.00	0.00	0.07	0.00	0.00	0.03	-	0.22	0.00	0.00	0.00	0.04
DBS East + DBS West	Breeding	~~146.60~~171.9	0	0.543	1.0	0.00	0.00	0.07	0.00	0.00	0.03	-	0.12	0.00	0.00	0.00	0.00
	Nonbreeding	~~372.70~~376.9	0.5	1	1.9	0.01	0.01	0.13	0.00	0.00	0.07		0.28	0.00	0.00	0.01	0.07
	Annual				1.9	0.01	0.01	0.13	0.00	0.00	0.07		0.4	0.00	0.00	0.01	0.07

~~9.16.2.3.3.1~~9.17.2.3.3.1 *Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines*

~~9.16.2.3.3.1.1~~9.17.2.3.3.1.1 *DBS East in Isolation*

~~996.~~1081. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-7**) the number of individuals from the Hoy SPA population expected to die is 81 (860 x 0.094) adults per annum. The predicted annual construction impact from DBS East alone on the breeding puffin population applying highly precautionary rates of 35% displacement and 10% mortality is 0.03 birds per annum (**Table 9-122)**. This would result in a predicted change in adult mortality rate of 0.04%.

~~997.~~1082. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that puffins avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is equivalent to the natural adult background mortality rate of 9.4%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of puffin populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~998.~~1083. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Hoy SPA (<0.01) would increase the predicted annual mortality by <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.16.2.3.3.1.2~~9.17.2.3.3.1.2 *DBS West in Isolation*

~~999.~~1084. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-7**) the number of individuals from the Hoy SPA population expected to die is 81 (860 x 0.094) adults per annum. The predicted annual construction impact from DBS West alone on the breeding puffin population applying highly precautionary rates of 35% displacement and 10% mortality is 0.04 birds per annum (**Table 9-122**). This would result in a predicted change in adult mortality rate of 0.04%.

~~1000.~~1085. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that puffins avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is equivalent to the natural adult background mortality rate of 9.4%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of puffin populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1001.~~1086. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Hoy SPA (<0.01) would increase the predicted annual mortality by <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.16.2.3.3.1.3~~9.17.2.3.3.1.3 DBS East and West Together

~~1002.~~1087. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-7**) the number of individuals from the Hoy SPA population expected to die is 81 (860 x 0.094) adults per annum. The predicted annual construction impact from DBS East and DBS West on the breeding puffin population applying highly precautionary rates of 35% displacement and 10% mortality is 0.07 birds per annum (**Table 9-122**). This would result in a predicted change in adult mortality rate of 0.08%.

~~1003.~~1088. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that puffins avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is equivalent to the natural adult background mortality rate of 9.4%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of puffin populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1004.~~1089. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Hoy SPA (0.01) would increase the predicted annual mortality by <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.16.2.3.3.2~~9.17.2.3.3.2 *Potential Effects During Operation: Disturbance and Displacement*

~~9.16.2.3.3.2.1~~9.17.2.3.3.2.1 *DBS East in Isolation*

~~1005.~~1090. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-7**) the number of individuals from the Hoy SPA population expected to die is 81 (860 x 0.094) adults per annum. The predicted annual operation impact from DBS East alone on the breeding puffin population applying highly precautionary rates of 70% displacement and 10% mortality is 0.06 birds per annum (**Table 9-122**). This would result in a predicted change in adult mortality rate of 0.08%.

~~1006.~~1091. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that puffins avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is equivalent to the natural adult background mortality rate of 9.4%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of puffin populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1007.~~1092. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Hoy SPA (<0.01) would increase the predicted annual mortality by <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.16.2.3.3.2.2~~9.17.2.3.3.2.2 DBS West in Isolation

~~1008.~~1093. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-7**) the number of individuals from the Hoy SPA population expected to die is 81 (860 x 0.094) adults per annum. The predicted annual operation impact from DBS West alone on the breeding puffin population applying highly precautionary rates of 70% displacement and 10% mortality is 0.07 birds per annum (**Table 9-122**). This would result in a predicted change in adult mortality rate of 0.08%.

~~1009.~~1094. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that puffins avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is equivalent to the natural adult background mortality rate of 9.4%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of puffin populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1010.~~1095. At a more appropriate (construction) displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Hoy SPA (<0.01) would increase the predicted annual mortality by <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.16.2.3.3.2.3~~9.17.2.3.3.2.3 DBS East and West Together

~~1011.~~1096. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-7**) the number of individuals from the Hoy SPA population expected to die is 81 (860 x 0.094) adults per annum. The predicted annual operation impact from DBS East and DBS West on the breeding puffin population applying highly precautionary rates of 70% displacement and 10% mortality is 0.13 birds per annum (**Table 9-122**). This would result in a predicted change in adult mortality rate of 0.16%.

~~1012.~~1097. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that puffins avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is equivalent to the natural adult background mortality rate of 9.4%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of puffin populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1013.~~1098. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Hoy SPA (0.01) would increase the predicted annual mortality by 0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.16.2.3.4~~9.17.2.3.4 Summary

~~1014.~~1099. A table summarising the puffin construction and operational disturbance and displacement assessment for DBS East and DBS West together is provided below (**Table 9-123**).

~~1015.~~1100. It is concluded that predicted puffin mortality due to construction and operational phase disturbance and displacement impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the Hoy SPA**.

Table 9-123 Summary of predicted puffin displacement mortality from Hoy SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.

~~Guillemot~~Puffin		**Displacement**	
Potential Effects During Construction: Disturbance and Displacement			
Displacement mortality		Mean (@~~35~~25% x ~~10~~1%)	Mean (@~~25~~35% x ~~1~~10%)
Breeding season		0	0
Nonbreeding season		<0.~~07~~01	~~<~~0.~~01~~07
Annual		<0.~~07~~01	~~<~~0.~~01~~07
Effect	Reference population	860	
	Increase in background mortality (%)	<0.~~08~~01	~~<~~0.~~01~~08
Potential Effects During Operation: Disturbance and Displacement			
Displacement mortality		Mean (@~~70~~50% x ~~10~~1%)	Mean (@~~50~~70% x ~~1~~10%)

~~Guillemot~~Puffin		Displacement	
Breeding season		0	0
Nonbreeding season		0.~~13~~01	0.~~01~~13
Annual		0.~~13~~01	0.~~01~~13
Effect	Reference population	860	
	Increase in background mortality (%)	0.~~16~~01	0.~~01~~16

~~9.16.2.3.5~~9.17.2.3.5 *Assessment of potential effects of the Projects in combination with other plans and projects*

~~1016.~~1101. Given that no measurable increase in the Hoy SPA puffin mortality is predicted as a result of DBS East and DBS West combined (e.g. with realistic displacement mortality of less than 0.01 birds per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted puffin mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Hoy SPA**.

~~9.17~~9.18 Rousay SPA

~~9.17.1~~9.18.1 Site Description

~~1017.~~1102. Rousay SPA was designated in 2000. Rousay is an island off the north-east coast of Mainland, Orkney. The SPA consists of sea cliffs and areas of maritime heath and grassland in the northwest and northeast of the island.

~~1018.~~1103. The boundary of the Special Protection Area overlaps with the boundary of Rousay SSSI, and the seaward extension extends approximately 2km into the marine environment to include the seabed, water column and surface.

~~9.17.1.1~~9.18.1.1 Qualifying Features

~~1019.~~1104. The qualifying features of the Rousay SPA screened into the assessment are listed in Table 4-7 of **RIAA HRA Part 1 of 4 – Introduction and Terrestrial Ecology (application ref: 6.1)**. These are two named components of the breeding seabird assemblage (kittiwake and guillemot).

~~9.17.1.2~~9.18.1.2 Conservation Objectives

~~1020.~~1105. The over-arching conservation objectives of the site are:

- To avoid deterioration of the habitats of the qualifying species or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained; and
- To ensure for the qualifying species that the following are maintained in the long term:
    - Population of the species as a viable component of the site;
    - Distribution of the species within site;
    - Distribution and extent of habitats supporting the species;
    - Structure, function and supporting processes of habitats supporting the species; and
    - No significant disturbance of the species.

~~9.17.2~~9.18.2 Assessment: Array Areas

~~9.17.2.1~~9.18.2.1 Kittiwake

~~1021.~~1106. Kittiwake has been screened into the assessment to assess the impacts from collision risk in the operation phase.

~~9.17.2.1.1~~9.18.2.1.1 Status

~~1022.~~1107. Kittiwake is listed as a named component of the breeding seabird assemblage of Rousay SPA.

~~1023.~~1108. The SPA breeding population at classification in 2000 was cited as 4,900 pairs (SNH, 2009). Burnell *et al.* (2023) give an updated count of 330 AON which has been used in this assessment.

~~9.17.2.1.2~~9.18.2.1.2 Connectivity to the Projects

~~1024.~~1109. DBS East and DBS West are 557km and 540km respectively from Rousay SPA. The mean maximum foraging range of kittiwake is 300.6km (156.1km + 144.5km, Woodward *et al.*, 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding kittiwake from Rousay SPA there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

~~1025.~~1110. Outside the breeding season breeding kittiwakes, including those from Rousay SPA, are not constrained by requirements to visit nests to incubate eggs or provision chicks. At this time, they are assumed to range more widely and to mix with kittiwakes of all age classes from breeding colonies in the UK and further afield. The background population during these seasons is the UK North Sea BDMPS. This consists of 829,937 individuals during the autumn migration season (August to December), and 627,816 individuals during the spring migration season (January to April) (Furness, 2015).

~~1026.~~1111. It is estimated that 0.3% of birds present in the Project array areas in both the autumn and spring migration seasons are breeding adults from Rousay SPA. Note, these percentages have been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

~~9.17.2.1.3~~9.18.2.1.3 Assessment of Potential Effects of the Projects alone and Together

~~9.17.2.1.3.1~~9.18.2.1.3.1 Potential Effects During Operation: Collision risk

Table 9-124 Summary of kittiwake total collisions and apportioned to the Rousay SPA.

Site	Season	Collision mortality			SPA %	Adult %	Collisions apportioned to SPA		
		Lower 95% c.i.	Mean	Upper 95% c.i.			Lower 95% c.i.	Mean	Upper 95% c.i.
DBS East	Breeding	42.3	83.3	168.5	0	53	0	0	0
	Autumn	14.6	41.4	82.9	0.3	100	0.0	0.1	0.2
	Spring	6.8	14.6	28.0	0.3	100	0.0	0.0	0.1
	Annual	66.9	139.3	261.3	-	-	0.1	0.2	0.3
DBS West	Breeding	36.9	107.8	280.8	0	53	0	0	0
	Autumn	9.5	37.9	81.9	0.3	100	0.0	0.1	0.2
	Spring	7.1	14.9	26.5	0.3	100	0.0	0.0	0.1
	Annual	55.9	160.6	327.0	-	-	0.0	0.2	0.3
DBS East + DBS West	Breeding	96.2	191.1	378.4	0	53	0	0	0
	Autumn	30.5	79.3	143.1	0.3	100	0.1	0.2	0.4
	Spring	16.9	29.5	47.3	0.3	100	0.1	0.1	0.1
	Annual	150.9	299.9	540.5	-	-	0.1	0.3	0.6

~~9.17.2.1.3.1.1~~9.18.2.1.3.1.1 *DBS East in Isolation*

~~1027.~~1112. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-7**) the number of individuals from the Rousay SPA population expected to die is 96 (660 x 0.146) adults per annum. The predicted annual impacts from DBS East alone on the breeding kittiwake population is 0.2 birds per annum (**Table 9-124**). This results in a predicted change in adult mortality rate of 0.16% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.17.2.1.3.1.2~~9.18.2.1.3.1.2 *DBS West in Isolation*

~~1028.~~1113. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-7**) the number of individuals from the Rousay SPA population expected to die is 96 (660 x 0.146) adults per annum. The predicted annual impacts from DBS West alone on the breeding kittiwake population is 0.2 birds per annum (**Table 9-124**). This results in a predicted change in adult mortality rate of 0.15% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.17.2.1.3.1.3~~9.18.2.1.3.1.3 *DBS East and West Together*

~~1029.~~1114. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-7**) the number of individuals from the Rousay SPA population expected to die is 96 (660 x 0.146) adults per annum. The predicted annual impacts from DBS East and DBS West on the breeding kittiwake population is 0.3 birds per annum (**Table 9-124**). This results in a predicted change in adult mortality rate of 0.31% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~*9.17.2.1.4 Summary*~~

~~9.17.2.1.5~~9.18.2.1.4 *Summary*

~~1030.~~1115. A table summarising the kittiwake operational collision risk assessment for DBS East and DBS West together is provided below (**Table 9-125**).

~~1031.~~1116. It is concluded that predicted kittiwake mortality due to operational phase collision risk at DBS East, DBS West, and the Projects together would **not adversely affect the integrity of the Rousay SPA**.

Table 9-125 Summary of predicted Kittiwake collision mortality from Rousay SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations for the Worst Case Wind Turbine Scenario.

Kittiwake	**Collisions**		
Potential Effects During Operation: Collision Risk			
Collision mortality	Lower c.i.	Mean	Upper c.i.

Kittiwake		Collisions		
Breeding season		-	-	-
Autumn		0.1	0.2	0.4
Spring		0.1	0.1	0.1
Annual		0.1	0.3	0.6
Effect	Reference population	660		
	Increase in background mortality (%)	0.1	0.31	0.6

~~9.17.2.1.6~~9.18.2.1.5 Assessment of potential effects of the Projects in combination with other plans and projects

~~1032.~~1117. Given that no measurable increase in the Rousay SPA kittiwake mortality is predicted as a result of DBS East and DBS West combined (e.g. with total collision mortality of only 0.3 birds per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted kittiwake mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Rousay SPA**.

~~9.17.2.2~~9.18.2.2 Guillemot

~~1033.~~1118. Guillemot has been screened into the assessment to assess the impacts from disturbance / displacement in the construction and operation phase.

~~9.17.2.2.1~~9.18.2.2.1 Status

~~1034.~~1119. Guillemot is listed as a named component of the breeding seabird assemblage of Rousay SPA. The SPA breeding population at classification in 2000 was cited as 10,600 pairs (SNH, 2009). Burnell *et al.* (2023) give an updated count of 5,911 individuals which has been used in this assessment.

~~9.17.2.2.2~~9.18.2.2.2 Connectivity to the Projects

~~1035.~~1120. DBS East and DBS West are 557km and 540km respectively from Rousay SPA. The mean maximum foraging range of guillemot is 153.7km (73.2km + 80.5km, Woodward *et al.*, 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding guillemot from Rousay SPA, there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

~~1036.~~1121. Outside the breeding season, breeding guillemots from Rousay SPA are assumed to range widely and to mix with guillemots from breeding colonies in the UK and beyond. The relevant non-breeding season reference population is the UK North Sea and Channel BDMPS, consisting of 1,617,306 individuals (August to February) (Furness, 2015).

~~1037.~~1122. It is estimated that 0.1% of birds present at the Projects are considered to be breeding adults from Rousay SPA. Note, this percentage has been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

~~9.17.2.2.3~~9.18.2.2.3 Assessment of Potential Effects of the Projects alone and Together

Table 9-126 Summary of guillemot density and abundance estimates and SPA apportioning rates and used in the operation and construction displacement assessment for Rousay SPA. Note that displacement from the wind farm has been estimated as 15%-35%, half the operational rates.

Site	Season	Peak no.	SPA %	Adult %	No. apportioned to SPA	Wind farm operation displacement mortality to SPA			Wind farm construction displacement mortality to SPA			Peak density (birds/ km^2)	Total vessel displacement mortality (2km around 3 vessels, 1% mortality)	Vessel mortality to SPA	Total construction displacement mortality to SPA		
						30-1	50-1	70-10	15-1	25 - 1	35-10				15-1 & vessel	25 – 1 & vessel	35-10 & vessel
DBS East	Breeding	9030.5	0	55.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.71	6.7	0.00	0.00	0.00	0.00
	Nonbreeding	12551.8	0.5	100	12.6	0.0	0.1	0.9	0.0	0.0	0.4	24.62	9.3	0.01	0.03	0.04	0.45
	Annual				12.6	0.0	0.1	0.9	0.0	0.0	0.4	-	16	0.01	0.03	0.04	0.45
DBS West	Breeding	8783.5	0	55.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.92	6.4	0.00	0.00	0.00	0.00
	Nonbreeding	12498.4	0.5	100	12.5	0.0	0.1	0.9	0.0	0.0	0.4	24.08	9.1	0.01	0.03	0.04	0.45
	Annual				12.5	0.0	0.1	0.9	0.0	0.0	0.4	-	15.5	0.01	0.03	0.04	0.45
DBS East + DBS West	Breeding	~~14927.7~~17815	0	55.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	13.0	0.00	0.00	0.00	0.00
	Nonbreeding	~~20136.0~~25050	0.~~5~~1	100	~~20~~25.1	0.1	0.1	1.~~4~~8	0.0	0.1	0.~~7~~9		18.4	0.02	0.~~05~~1	0.~~07~~1	0.~~72~~9
	Annual				~~20~~25.1	0.1	0.1	1.~~4~~8	0.0	0.1	0.~~7~~9		31.4	0.02	0.~~05~~1	0.~~07~~1	0.~~72~~9

~~9.17.2.2.3.1~~9.18.2.2.3.1 *Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines*

~~9.17.2.2.3.1.1~~9.18.2.2.3.1.1 *DBS East in Isolation*

~~1038.~~1123. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Rousay SPA population expected to die is 361 (5,911 x 0.061) adults per annum. The predicted annual construction impact from DBS East alone on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 0.45 birds per annum (**Table 9-126**). This would result in a predicted change in adult mortality rate of 0.1%. The equivalent mortality assuming 35% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 0.09 which would increase the background mortality rate by 0.02%.

~~9.17.2.2.3.1.2~~ *There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023DBS West in Isolation~~*

~~1039. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Rousay SPA population expected to die is 361 (5,911 x 0.061) adults per annum. The predicted annual construction impact from DBS West alone on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 0.45 birds per annum (**Table 9-99**~~Trinder *et al*. 2024

~~1040.~~1124. ~~In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023~~) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1041.~~1125. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Rousay SPA (0.04) would increase the predicted annual mortality by 0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.17.2.2.3.1.3~~9.18.2.2.3.1.2 DBS ~~East and~~ West ~~Together~~in Isolation

1126. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Rousay SPA population expected to die is 361 (5,911 x 0.061) adults per annum. The predicted annual construction impact from DBS West alone on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 0.45 birds per annum (**Table 9-126)**. This would result in a predicted change in adult mortality rate of 0.1%. The equivalent mortality assuming 35% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 0.09 which would increase the background mortality rate by 0.02%.

~~1042.~~1127. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1043.~~1128. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Rousay SPA (0.04) would increase the predicted annual mortality by 0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

9.18.2.2.3.1.3 DBS East and West Together

~~1044.~~1129. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Rousay SPA population expected to die is 361 (5,911 x 0.061) adults per annum. The predicted annual construction impact from DBS East and DBS West on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 0.~~72~~9 birds per annum (**Table 9-126**). This would result in a predicted change in adult mortality rate of 0.25%. The equivalent mortality assuming 35% displacement and 2~~%.~~ % mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 0.18 which would increase the background mortality rate by 0.05%.

~~1045.~~1130. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1046.~~1131. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Rousay SPA (0.~~07~~1) would increase the predicted annual mortality by 0.02 which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.17.2.2.3.2~~9.18.2.2.3.2 *Potential Effects During Operation: Disturbance and Displacement*

~~9.17.2.2.3.2.1~~9.18.2.2.3.2.1 *DBS East in Isolation*

~~1047.~~1132. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Rousay SPA population expected to die is 361 (5,911 x 0.061) adults per annum. The predicted annual operation impact from DBS East alone on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 0.9 birds per annum (**Table 9-126**). This would result in a predicted change in adult mortality rate of 0.2%. The equivalent mortality assuming 70% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 0.18 which would increase the background mortality rate by 0.05%.

~~1048.~~ There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.~~

~~1049. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Rousay SPA (0.1) would increase the predicted annual mortality by 0.02% which is below the 1% threshold for detectability and therefore no further assessment was required.~~

~~9.17.2.2.3.2.2 *DBS West in Isolation*~~

~~1050. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Rousay SPA population expected to die is 361 (5,911 x 0.061) adults per annum. The predicted annual operation impact from DBS West alone on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 0.9 birds per annum (**Table 9-99**). This would result in a predicted change in adult mortality rate of 0.2%.~~

~~1051.~~1133. Trinder *et al*. 2024~~In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023~~) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1052.~~1134. At a more appropriate ~~(construction)~~ displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Rousay SPA (0.1) would increase the predicted annual mortality by 0.02% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.17.2.2.3.2.3~~9.18.2.2.3.2.2 DBS ~~East and~~ West ~~Together~~in Isolation

~~1053.~~1135. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Rousay SPA population expected to die is 361 (5,911 x 0.061) adults per annum. The predicted annual operation impact from DBS ~~East and DBS~~ West alone on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is ~~1.4~~0.9 birds per annum (**Table 9-126**). This would result in a predicted change in adult mortality rate of 0.~~4%.~~ 2%. The equivalent mortality assuming 70% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 0.18 which would increase the background mortality rate by 0.05%.

~~1054.~~1136. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1055.~~1137. At a more appropriate (construction) displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Rousay SPA (0.1) would increase the predicted annual mortality by 0.~~03~~02% which is below the 1% threshold for detectability and therefore no further assessment was required.

9.18.2.2.3.2.3 DBS East and West Together

1138. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Rousay SPA population expected to die is 361 (5,911 x 0.061) adults per annum. The predicted annual operation impact from DBS East and DBS West on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 1.8 birds per annum (**Table 9-126**). This would result in a predicted change in adult mortality rate of 0.5%. The equivalent mortality assuming 70% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 0.36 which would increase the background mortality rate by 0.10%.

1139. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1140. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Rousay SPA (0.1) would increase the predicted annual mortality by 0.03% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.17.2.2.4~~9.18.2.2.4 Summary

1141. A matrix of the annual operational displacement estimates for DBS East and DBS West is provided in **Table 9-127**.

Table 9-127 Displacement matrix for annual project alone (DBS East plus DBS West) guillemot apportioned to Rousay SPA adult population.

Mortality %	**Displacement %**									
	10	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**
1	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	1
3	0	0	0	0	0	0	1	1	1	1
4	0	0	0	0	1	1	1	1	1	1
5	0	0	0	1	1	1	1	1	1	1
6	0	0	0	1	1	1	1	1	1	2
7	0	0	1	1	1	1	1	1	2	2
8	0	0	1	1	1	1	1	2	2	2
9	0	0	1	1	1	1	2	2	2	2
10	0	1	1	1	1	2	2	2	2	3
20	1	1	2	2	3	3	4	4	5	5
30	1	2	2	3	4	5	5	6	7	8
50	1	3	4	5	6	8	9	10	11	13
75	2	4	6	8	9	11	13	15	17	19
100	3	5	8	10	13	15	18	20	23	25

1142.

~~1056.~~1143. A table summarising the guillemot construction and operational disturbance and displacement assessment for DBS East and DBS West together is provided below (**Table 9-128**).

~~1057.~~1144. It is concluded that predicted guillemot mortality due to construction and operational phase disturbance and displacement impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the Rousay SPA**.

Table 9-128 Summary of predicted guillemot displacement mortality from Rousay SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.

Guillemot		**Displacement**	
Potential Effects During Construction: Disturbance and Displacement			
~~Displacement mortality~~		~~Mean (@35% x 10%)~~	~~Mean (@25% x 1%)~~
Displacement mortality		Mean (@25% x 1%)	Mean (@35% x 10%)
Breeding season		0	0
Nonbreeding season		0.~~72~~1	0.~~07~~9
Annual		0.~~72~~1	0.~~07~~9
Effect	Reference population	5,911	
	Increase in background mortality (%)	0.~~2~~02	0.~~02~~25
Potential Effects During Operation: Disturbance and Displacement			
Displacement mortality		Mean (@~~70~~50% x ~~10~~1%)	Mean (@~~50~~70% x ~~1~~10%)
Breeding season		0	0
Nonbreeding season		0.1~~.4~~	~~0.~~1.8
Annual		0.1~~.4~~	~~0.~~1.8
Effect	Reference population	5,911	
	Increase in background mortality (%)	0.~~4~~03	0.~~03~~49

~~9.17.2.2.5~~9.18.2.2.5 Assessment of potential effects of the Projects in combination with other plans and projects

~~1058.~~1145. Given that no measurable increase in the Rousay SPA guillemot mortality is predicted as a result of DBS East and DBS West combined (e.g. with realistic displacement mortality of less than 0.1 bird per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted guillemot mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Rousay SPA**.

~~9.18~~9.19 Calf of Eday SPA

~~9.18.1~~9.19.1 Site Description

~~1059.~~1146. Calf of Eday SPA was designated in 1998.

~~1060.~~1147. The site is a small maritime island to the north of Eday in Orkney. Calf of Eday has a rocky shoreline with cliffs to the north and the west. The island is covered by maritime heath and grassland. The boundary of the SPA encompasses the boundary of the Calf of Eday SSSI, and the seaward extension extends approximately 2km into the marine environment to include the seabed, water column and surface.

~~9.18.1.1~~9.19.1.1 Qualifying Features

~~1061.~~1148. The qualifying features of the Calf of Eday SPA screened into the assessment are listed in Table 4-7 of **RIAA HRA Part 1 of 4 – Introduction and Terrestrial Ecology (application ref: 6.1)**. These are two named components of the breeding seabird assemblage (kittiwake and guillemot).

~~9.18.1.2~~9.19.1.2 Conservation Objectives

~~1062.~~1149. The over-arching conservation objectives of the site are:

- To avoid deterioration of the habitats of the qualifying species or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained; and
- To ensure for the qualifying species that the following are maintained in the long term:
  - Population of the species as a viable component of the site;
  - Distribution of the species within site;
  - Distribution and extent of habitats supporting the species;
  - Structure, function and supporting processes of habitats supporting the species; and
  - No significant disturbance of the species.

~~9.18.2~~9.19.2 Assessment: Array Areas

~~9.18.2.1~~9.19.2.1 Kittiwake

~~1063.~~1150. Kittiwake has been screened into the assessment to assess the impacts from collision risk in the operation phase.

~~9.18.2.1.1~~9.19.2.1.1 Status

~~1064.~~1151. Kittiwake is listed as a named component of the breeding seabird assemblage of the Calf of Eday SPA.

~~1065.~~1152. The SPA breeding population at classification in 1998 was cited as 1,717 pairs (SNH, 2009). Burnell *et al*. (2023) give an updated count of 336 AON which has been used in this assessment.

~~9.18.2.1.2~~9.19.2.1.2 *Connectivity to the Projects*

~~1066.~~1153. DBS East and DBS West are 550km and 533km respectively from the Calf of Eday SPA. The mean maximum foraging range of kittiwake is 300.6km (156.1km + 144.5km, Woodward *et al*., 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding kittiwake from the Calf of Eday SPA there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

~~1067.~~1154. Outside the breeding season breeding kittiwakes, including those from the Calf of Eday SPA, are not constrained by requirements to visit nests to incubate eggs or provision chicks. At this time, they are assumed to range more widely and to mix with kittiwakes of all age classes from breeding colonies in the UK and further afield. The background population during these seasons is the UK North Sea BDMPS. This consists of 829,937 individuals during the autumn migration season (August to December), and 627,816 individuals during the spring migration season (January to April) (Furness, 2015).

~~1068.~~1155. It is estimated that 0.1% of birds present in the Project array areas in both the autumn and spring migration seasons are considered to be breeding adults from Calf of Eday SPA. Note, these percentages have been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

~~9.18.2.1.3~~9.19.2.1.3 *Assessment of Potential Effects of the Projects alone and Together*

~~9.18.2.1.3.1~~9.19.2.1.3.1 *Potential Effects During Operation: Collision risk*

Table 9-129 Summary of kittiwake total collisions and apportioned to the Calf of Eday SPA.

Site	Season	Collision mortality			SPA %	Adult %	Collisions apportioned to SPA		
		Lower 95% c.i.	Mean	Upper 95% c.i.			Lower 95% c.i.	Mean	Upper 95% c.i.
DBS East	Breeding	42.3	83.3	168.5	0	53	0.0	0.0	0.0
	Autumn	14.6	41.4	82.9	0.1	100	0.0	0.0	0.1
	Spring	6.8	14.6	28.0	0.1	100	0.0	0.0	0.0

Site	Season	Collision mortality			SPA %	Adult %	Collisions apportioned to SPA		
		Lower 95% c.i.	Mean	Upper 95% c.i.			Lower 95% c.i.	Mean	Upper 95% c.i.
	Annual	66.9	139.3	261.3	-	-	0.0	0.1	0.1
DBS West	Breeding	36.9	107.8	280.8	0	53	0.0	0.0	0.0
	Autumn	9.5	37.9	81.9	0.1	100	0.0	0.0	0.1
	Spring	7.1	14.9	26.5	0.1	100	0.0	0.0	0.0
	Annual	55.9	160.6	327.0	-	-	0.0	0.1	0.1
DBS East + DBS West	Breeding	96.2	191.1	378.4	0	53	0.0	0.0	0.0
	Autumn	30.5	79.3	143.1	0.1	100	0.0	0.1	0.1
	Spring	16.9	29.5	47.3	0.1	100	0.0	0.0	0.0
	Annual	150.9	299.9	540.5	-	-	0.0	0.1	0.2

~~9.18.2.1.3.1.1~~9.19.2.1.3.1.1 DBS East in Isolation

~~1069.~~1156. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-7**) the number of individuals from the Calf of Eday SPA population expected to die is 98 (672 x 0.146) adults per annum. The predicted annual impacts from DBS East alone on the breeding kittiwake population is 0.1 birds per annum ((**Table 9-129**). This results in a predicted change in adult mortality rate of 0.07% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.18.2.1.3.1.2~~9.19.2.1.3.1.2 DBS West in Isolation

~~1070.~~1157. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-7**) the number of individuals from the Calf of Eday SPA population expected to die is 98 (672 x 0.146) adults per annum. The predicted annual impacts from DBS West alone on the breeding kittiwake population is 0.1 birds per annum ((**Table 9-129**). This results in a predicted change in adult mortality rate of 0.06% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.18.2.1.3.1.3~~9.19.2.1.3.1.3 DBS East and West Together

~~1071.~~1158. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-7**) the number of individuals from the Calf of Eday SPA population expected to die is 98 (672 x 0.146) adults per annum. The predicted annual impacts from DBS East and DBS West on the breeding kittiwake population is 0.1 birds per annum (**Table 9-129**). This results in a predicted change in adult mortality rate of 0.13% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.18.2.1.4 Summary~~

~~9.18.2.1.5~~9.19.2.1.4 Summary

~~1072.~~1159. A table summarising the kittiwake operational collision risk assessment for DBS East and DBS West together is provided below (**Table 9-130**).

~~1073.~~1160. It is concluded that predicted kittiwake mortality due to operational phase collision risk at DBS East, DBS West, and the Projects together would **not adversely affect the integrity of the Calf of Eday SPA**.

Table 9-130 Summary of predicted Kittiwake collision mortality from Calf of Eday SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations for the Worst Case Wind Turbine Scenario.

Kittiwake		**Collisions**		
Potential Effects During Operation: Collision Risk				
Collision mortality		Lower c.i.	Mean	Upper c.i.
Breeding season		-	-	-
Autumn		0.0	0.1	0.1
Spring		0.0	0.0	0.0
Annual		0.0	0.1	0.2
Effect	Reference population	672		
	Increase in background mortality (%)	<0.01	0.13	0.2

~~9.18.2.1.6~~9.19.2.1.5 Assessment of potential effects of the Projects in combination with other plans and projects

~~1074.~~1161. Given that no measurable increase in the Calf of Eday SPA kittiwake mortality is predicted as a result of DBS East and DBS West combined (e.g. with total collision mortality of only 0.13 birds per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted kittiwake mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Calf of Eday SPA**.

~~9.18.2.2~~9.19.2.2 Guillemot

~~1075.~~1162. Guillemot has been screened into the assessment to assess the impacts from disturbance / displacement in the construction and operation phase.

~~9.18.2.2.1~~9.19.2.2.1 Status

~~1076.~~1163. Guillemot is listed as a named component of the breeding seabird assemblage of the Calf of Eday SPA. The SPA breeding population at classification in 1998 was cited as 12,645 individuals (SNH, 2009). Burnell *et al*. (2023) give an updated count of 3,493 individuals which has been used in this assessment.

~~9.18.2.2.2~~9.19.2.2.2 Connectivity to the Projects

~~1077.~~1164. DBS East and DBS West are 550km and 533km respectively from the Calf of Eday SPA. The mean maximum foraging range of guillemot is 153.7km (73.2km + 80.5km, Woodward *et al*., 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding guillemot from Calf of Eday SPA, there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only. Outside the breeding season, breeding guillemots from Calf of Eday SPA are assumed to range widely and to mix with guillemots from breeding colonies in the UK and beyond. The relevant non-breeding season reference population is the UK North Sea and Channel BDMPS, consisting of 1,617,306 individuals (August to February) (Furness, 2015). It is estimated that 0.5% of birds present at the Projects are considered to be breeding adults from Calf of Eday SPA. Note, this percentage has been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

~~9.18.2.2.3~~9.19.2.2.3 Assessment of Potential Effects of the Projects alone and Together

Table 9-131 Summary of guillemot density and abundance estimates and SPA apportioning rates and used in the operation and construction displacement assessment for Calf of Eday SPA. Note that displacement from the wind farm has been estimated as 15%-35%, half the operational rates.

Site	Season	Peak no.	SPA %	Adult %	No. apportioned to SPA	Wind farm operation displacement mortality to SPA			Wind farm construction displacement mortality to SPA			Peak density (birds/ km^2)	Total vessel displacement mortality (2km around 3 vessels, 1% mortality)	Vessel mortality to SPA	Total construction displacement mortality to SPA		
						30-1	50-1	70-10	15-1	25 - 1	35-10				15-1 & vessel	25 – 1 & vessel	35-10 & vessel
DBS East	Breeding	9030.5	0	55.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.71	6.7	0.00	0.00	0.00	0.00
	Nonbreeding	12551.8	0.5	100	62.8	0.2	0.3	4.4	0.1	0.2	2.2	24.62	9.3	0.05	0.14	0.20	2.24
	Annual				62.8	0.2	0.3	4.4	0.1	0.2	2.2	-	16	0.05	0.14	0.20	2.24
DBS West	Breeding	8783.5	0	55.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.92	6.4	0.00	0.00	0.00	0.00
	Nonbreeding	12498.4	0.5	100	62.5	0.2	0.3	4.4	0.1	0.2	2.2	24.08	9.1	0.05	0.14	0.20	2.23
	Annual				62.5	0.2	0.3	4.4	0.1	0.2	2.2	-	15.5	0.05	0.14	0.20	2.23
DBS East + DBS West	Breeding	~~14927.7~~17815	0	55.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	13.0	0.00	0.00	0.00	0.00
	Nonbreeding	~~20136.0~~25050	0.5	100	~~100.7~~125.3	0.~~3~~4	0.~~5~~6	~~7.0~~8.8	0.2	0.3	~~3.5~~4.4		18.4	0.09	0.~~24~~3	0.~~34~~4	~~3.62~~4.5
	Annual				~~100.7~~125.3	0.~~3~~4	0.~~5~~6	~~7.0~~8.8	0.2	0.3	~~3.5~~4.4		31.4	0.09	0.~~24~~3	0.~~34~~4	~~3.62~~4.5

~~9.18.2.2.3.1~~9.19.2.2.3.1 *Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines*

~~9.18.2.2.3.1.1~~9.19.2.2.3.1.1 *DBS East in Isolation*

1165. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Calf of Eday SPA population expected to die is 213 (3,493 x 0.061) adults per annum. The predicted annual construction impact from DBS East alone on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 2.2 birds per annum (**Table 9-131**). This would result in a predicted change in adult mortality rate of 1.0% but is based on highly precautionary impact rates. The equivalent mortality assuming 35% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 0.44 which would increase the background mortality rate by 0.21%. A reduction in either the displacement rate (e.g. to 68%) or the mortality rate (e.g. to 9%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in both together).

~~1078.~~1166. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1167. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Calf of Eday SPA (0.2) would increase the predicted annual mortality by 0.1% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.18.2.2.3.1.2~~9.19.2.2.3.1.2 *DBS West in Isolation*

~~1079.~~1168. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Calf of Eday SPA population expected to die is 213 (3,493 x 0.061) adults per annum. The predicted annual construction impact from DBS West alone on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 2.2 birds per annum (**Table 9-131**). This would result in a predicted change in adult mortality rate of 10%, but is based on highly precautionary impact rates. The equivalent mortality assuming 35% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 0.44 which would increase the background mortality rate by 0.21%. A reduction in either the displacement rate (e.g. to 68%) or the mortality rate (e.g. to 9%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in both together).

~~1080.~~1169. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1081.~~1170. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Calf of Eday SPA (0.2) would increase the predicted annual mortality by 0.1% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.18.2.2.3.1.3~~9.19.2.2.3.1.3 *DBS East and West Together*

~~1082.~~1171. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Calf of Eday SPA population expected to die is 213 (3,493 x 0.061) adults per annum. The predicted annual construction impact from DBS East and DBS West ~~alone~~ on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is ~~2.2~~4.5 birds per annum (**Table 9-131**). This would result in a predicted change in adult mortality rate of 2.1~~.0%,~~% but is based on highly precautionary impact rates. The equivalent mortality assuming 35% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 0.9 which would increase the background mortality rate by 0.42%. A reduction in either the displacement rate (e.g. to ~~68~~33%) or the mortality rate (e.g. to ~~9~~4.8%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in both together).

~~1083.~~1172. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1084.~~1173. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Calf of Eday SPA (0.~~2~~4) would increase the predicted annual mortality by 0.~~1%~~19 which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.18.2.2.3.2~~9.19.2.2.3.2 Potential Effects During Operation: Disturbance and Displacement

9.19.2.2.3.2.1 DBS East in Isolation

~~1085.~~1174. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Calf of Eday SPA population expected to die is 213 (3,493 x 0.061) adults per annum. The predicted annual ~~construction~~operation impact from DBS East ~~and DBS West~~alone on the breeding guillemot population applying highly precautionary rates of ~~35~~70% displacement and 10% mortality is ~~3.6~~4.4 birds per annum (**Table 9-131**). This would result in a predicted change in adult mortality rate of 2.1~~.7~~% but is based on highly precautionary impact rates. The equivalent mortality assuming 70% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 0.88 which would increase the background mortality rate by 0.41%. A reduction in ~~either~~ the ~~displacement~~mortality rate (e.g. to 4~~1%) or the mortality rate (e.g. to 5.8~~%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in ~~both together~~mortality with a reduction in displacement).

~~1086.~~1175. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1087.~~1176. At a more appropriate ~~(construction)~~ displacement rate of ~~25~~50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Calf of Eday SPA (0.~~34~~3) would increase the predicted annual mortality by 0.~~16~~14% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.18.2.2.3.3 Potential Effects During Operation: Disturbance and Displacement~~

~~9.18.2.2.3.3.1~~9.19.2.2.3.2.2 DBS ~~East~~West in Isolation

~~1088.~~1177. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Calf of Eday SPA population expected to die is 213 (3,493 x 0.061) adults per annum. The predicted annual operation impact from DBS ~~East~~West alone on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 4.4 birds per annum (**Table 9-131**). This would result in a predicted change in adult mortality rate of 2.~~1%~~0%, but is based on highly precautionary impact rates. The equivalent mortality assuming 70% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 0.88 which would increase the background mortality rate by 0.41%. A reduction in the mortality rate (e.g. to 4%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in mortality with a reduction in displacement).

~~1089.~~1178. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1090.~~1179. At a more appropriate (construction) displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Calf of Eday SPA (0.3) would increase the predicted annual mortality by 0.~~14~~15% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.18.2.2.3.3.2~~9.19.2.2.3.2.3 DBS East and West ~~in Isolation~~ Together

~~1091.~~1180. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Calf of Eday SPA population expected to die is 213 (3,493 x 0.061) adults per annum. The predicted annual operation impact from DBS East and DBS West ~~alone~~ on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is ~~4.4~~8.8 birds per annum (**Table 9-131**). This would result in a predicted change in adult mortality rate of ~~2.0~~4.1%, but is based on highly precautionary impact rates. The equivalent mortality assuming 70% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 1.76 which would increase the background mortality rate by 0.83%. A reduction in the mortality rate (e.g. to ~~4~~2.5%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in mortality with a reduction in displacement).

~~1092.~~1181. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1093.~~1182. At a more appropriate ~~(construction)~~ displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Calf of Eday SPA (0.~~3~~6) would increase the predicted annual mortality by 0.~~15~~29% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.18.2.2.3.3.3 DBS East and West Together~~

~~1094. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Calf of Eday SPA population expected to die is 213 (3,493 x 0.061) adults per annum. The predicted annual operation impact from DBS East and DBS West on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 7.0 birds per annum (**Table 9-103**). This would result in a predicted change in adult mortality rate of 3.3%, but is based on highly precautionary impact rates. A reduction in the mortality rate (e.g. to 3%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in mortality with a reduction in displacement).~~

~~1095. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Calf of Eday SPA (0.5) would increase the predicted annual mortality by 0.23% which is below the 1% threshold for detectability and therefore no further assessment was required.~~

~~9.18.2.2.4 Summary~~

9.19.2.2.4 Summary

~~1096.~~1183. A matrix of the annual operational displacement estimates for DBS East and DBS West is provided in **Table 9-132**.

Table 9-132 Displacement matrix for annual project alone (DBS East plus DBS West) guillemot apportioned to Calf of Eday SPA adult population.

Mortality %	**Displacement %**									
	10	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**
1	0	0	0	1	1	1	1	1	1	1
2	0	1	1	1	1	2	2	2	2	3
3	0	1	1	2	2	2	3	3	3	4
4	1	1	2	2	3	3	4	4	5	5
5	1	1	2	3	3	4	4	5	6	6
6	1	2	2	3	4	5	5	6	7	8

Mortality %	Displacement %									
	10	20	30	40	50	60	70	80	90	100
7	1	2	3	4	4	5	6	7	8	9
8	1	2	3	4	5	6	7	8	9	10
9	1	2	3	5	6	7	8	9	10	11
10	1	3	4	5	6	8	9	10	11	13
20	3	5	8	10	13	15	18	20	23	25
30	4	8	11	15	19	23	26	30	34	38
50	6	13	19	25	31	38	44	50	56	63
75	9	19	28	38	47	56	66	75	85	94
100	13	25	38	50	63	75	88	100	113	125

~~1097.~~1184.A table summarising the guillemot construction and operational disturbance and displacement assessment for DBS East and DBS West together is provided below (**Table 9-133)**.

~~1098.~~1185.It is concluded that predicted guillemot mortality due to construction and operational phase disturbance and displacement impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the Calf of Eday SPA**.

Table 9-133 Summary of predicted guillemot displacement mortality from Calf of Eday SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.

Guillemot	Displacement		
Potential Effects During Construction: Disturbance and Displacement			
~~Displacement mortality~~		~~Mean (@35% x 10%)~~	~~Mean (@25% x 1%)~~
~~Breeding season~~		~~0~~	~~0~~
~~Nonbreeding season~~		~~3.6~~	~~0.34~~
~~Annual~~		~~3.6~~	~~0.34~~
Displacement mortality	Mean (@25% x 1%)	Mean (@35% x 2%)	Mean (@35% x 10%)

Guillemot		Displacement		
Breeding season		0	0	0
Nonbreeding season		0.4	0.9	4.5
Annual		0.4	0.9	4.5
Effect	Reference population	3,493		
	~~Increase in background mortality (%)~~	~~1.7~~	~~0.16~~	
	Increase in back-ground mortality (%)	0.19	0.42	2.10
Potential Effects During Operation: Disturbance and Displacement				
~~Displacement mortality~~		~~Mean (@70% x 10%)~~	~~Mean (@50% x 1%)~~	
~~Breeding season~~		~~0~~	~~0~~	
~~Nonbreeding season~~		~~7.0~~	~~0.5~~	
~~Annual~~		~~7.0~~	~~0.5~~	
Displacement mortality		Mean (@50% x 1%)	Mean (@70% x 2%)	Mean (@70% x 10%)
Breeding season		0	0	0
Nonbreeding season		0.6	1.76	8.8
Annual		0.6	1.76	8.8
Effect	Reference population	3,493		
	Increase in back-ground mortality (%)	~~3.3~~0.29	0.~~23~~83	4.11

~~9.18.2.2.5~~9.19.2.2.5 *Assessment of potential effects of the Projects in combination with other plans and projects*

~~1099.~~1186. Given that no measurable increase in the Calf of Eday SPA guillemot mortality is predicted as a result of DBS East and DBS West combined (e.g. with realistic displacement mortality of less than 1 bird per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted guillemot mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Calf of Eday SPA**.

~~9.19~~9.20 Marwick Head SPA

~~9.19.1~~9.20.1 Site Description

~~1100.~~1187. Marwick Head SPA was designated in 1994. The SPA is a 2km stretch of sea cliffs, and adjacent coastal waters, along the west coast of Orkney Mainland. The cliffs support large colonies of breeding seabirds.

~~9.19.1.1~~9.20.1.1 Qualifying Features

~~1101.~~1188. The qualifying features of Marwick Head SPA screened into the assessment are listed in Table 4-7 of **RIAA HRA Part 1 of 4 – Introduction and Terrestrial Ecology (application ref: 6.1)**. These are breeding guillemot one named component of the breeding seabird assemblage (kittiwake).

~~9.19.1.2~~9.20.1.2 Conservation Objectives

~~1102.~~1189. The over-arching conservation objectives of the site are:

- To avoid deterioration of the habitats of the qualifying species or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained; and
- To ensure for the qualifying species that the following are maintained in the long term:
  - Population of the species as a viable component of the site;
  - Distribution of the species within site;
  - Distribution and extent of habitats supporting the species;
  - Structure, function and supporting processes of habitats supporting the species; and
  - No significant disturbance of the species.

~~9.19.2~~9.20.2 Assessment: Array Areas

~~9.19.2.1~~9.20.2.1 Kittiwake

~~1103.~~1190. Kittiwake has been screened into the assessment to assess the impacts from collision risk in the operation phase.

~~9.19.2.1.1~~9.20.2.1.1 Status

~~1104.~~1191. Kittiwake is listed as a named component of the breeding seabird assemblage of Marwick Head SPA.

~~1105.~~1192. The SPA breeding population at classification in 1994 was cited as 7,700 pairs (SNH, 2009). Burnell *et al.* (2023) give an updated count of 906 AON which has been used in this assessment.

~~9.19.2.1.2~~9.20.2.1.2 Connectivity to the Projects

~~1106.~~1193. DBS East and DBS West are 595km and 564km respectively from Marwick Head SPA. The mean maximum foraging range of kittiwake is 300.6km (156.1km + 144.5km, Woodward *et al*., 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding kittiwake from Marwick Head SPA there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

~~1107.~~1194. Outside the breeding season breeding kittiwakes, including those from Marwick Head SPA, are not constrained by requirements to visit nests to incubate eggs or provision chicks. At this time, they are assumed to range more widely and to mix with kittiwakes of all age classes from breeding colonies in the UK and further afield. The background population during these seasons is the UK North Sea BDMPS. This consists of 829,937 individuals during the autumn migration season (August to December), and 627,816 individuals during the spring migration season (January to April) (Furness, 2015).

~~1108.~~1195. It is estimated that 0.1% of birds present in the Project array areas in both the autumn and spring migration seasons are considered to be breeding adults from Marwick Head SPA. Note, these percentages have been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

~~9.19.2.1.3~~9.20.2.1.3 Assessment of Potential Effects of the Projects alone and Together

~~9.19.2.1.3.1~~9.20.2.1.3.1 Potential Effects During Operation: Collision risk

Table 9-134 Summary of kittiwake total collisions and apportioned to the Marwick Head *SPA.*

Site	Season	Collision mortality			SPA %	Adult %	Collisions apportioned to SPA		
		Lower 95% c.i.	Mean	Upper 95% c.i.			Lower 95% c.i.	Mean	Upper 95% c.i.
DBS East	Breeding	42.3	83.3	168.5	0	53	0.0	0.0	0.0
	Autumn	14.6	41.4	82.9	0.1	100	0.0	0.0	0.1
	Spring	6.8	14.6	28.0	0.1	100	0.0	0.0	0.0
	Annual	66.9	139.3	261.3	-	-	0.0	0.1	0.1
DBS West	Breeding	36.9	107.8	280.8	0	53	0.0	0.0	0.0
	Autumn	9.5	37.9	81.9	0.1	100	0.0	0.0	0.1

Site	Season	Collision mortality			SPA %	Adult %	Collisions apportioned to SPA		
		Lower 95% c.i.	Mean	Upper 95% c.i.			Lower 95% c.i.	Mean	Upper 95% c.i.
	Spring	7.1	14.9	26.5	0.1	100	0.0	0.0	0.0
	Annual	55.9	160.6	327.0	-	-	0.0	0.1	0.1
DBS East + DBS West	Breeding	96.2	191.1	378.4	0	53	0.0	0.0	0.0
	Autumn	30.5	79.3	143.1	0.1	100	0.0	0.1	0.1
	Spring	16.9	29.5	47.3	0.1	100	0.0	0.0	0.0
	Annual	150.9	299.9	540.5	-	-	0.0	0.1	0.2

~~9.19.2.1.3.1.1~~9.20.2.1.3.1.1 DBS East in Isolation

~~1109.~~1196. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-7**) the number of individuals from the Marwick Head SPA population expected to die is 265 (1,812 x 0.146) adults per annum. The predicted annual impacts from DBS East alone on the breeding kittiwake population is 0.1 birds per annum (**Table 9-134**). This results in a predicted change in adult mortality rate of 0.02% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.19.2.1.3.1.2~~9.20.2.1.3.1.2 DBS West in Isolation

~~1110.~~1197. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-7**) the number of individuals from the Marwick Head SPA population expected to die is 265 (1,812 x 0.146) adults per annum. The predicted annual impacts from DBS West alone on the breeding kittiwake population is 0.1 birds per annum (**Table 9-134**). This results in a predicted change in adult mortality rate of 0.02% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.19.2.1.3.1.3~~9.20.2.1.3.1.3 DBS East and West Together

~~1111.~~1198. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-7**) the number of individuals from the Marwick Head SPA population expected to die is 265 (1,812 x 0.146) adults per annum. The predicted annual impacts from DBS East and DBS West on the breeding kittiwake population is 0.1 birds per annum Table 9-74 (**Table 9-134**). This results in a predicted change in adult mortality rate of 0.3% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.19.2.1.4~~9.20.2.1.4 *Summary*

~~1112.~~1199. A table summarising the kittiwake operational collision risk assessment for DBS East and DBS West together is provided below (**Table 9-135**).

~~1113.~~1200. It is concluded that predicted kittiwake mortality due to operational phase collision risk at DBS East, DBS West, and the Projects together would **not adversely affect the integrity of the Marwick Head SPA**.

Table 9-135 Summary of predicted Kittiwake collision mortality from Marwick Head SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations for the Worst Case Wind Turbine Scenario.

Kittiwake		**Collisions**		
Potential Effects During Operation: Collision Risk				
Collision mortality		Lower c.i.	Mean	Upper c.i.
Breeding season		-	-	-
Autumn		0.0	0.1	0.1
Spring		0.0	0.0	0.0
Annual		0.0	0.1	0.2
Effect	Reference population	1,812		
	Increase in background mortality (%)	<0.01	0.03	0.08

~~9.19.2.1.5~~9.20.2.1.5 *Assessment of potential effects of the Projects in combination with other plans and projects*

~~1114.~~1201. Given that no measurable increase in the Marwick Head SPA kittiwake mortality is predicted as a result of DBS East and DBS West combined (e.g. with total collision mortality of only 0.09 birds per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted kittiwake mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Marwick Head SPA**.

~~9.19.2.2~~9.20.2.2 Guillemot

~~1115.~~1202. Guillemot has been screened into the assessment to assess the impacts from disturbance / displacement in the construction and operation phase.

~~9.19.2.2.1~~9.20.2.2.1 *Status*

~~1116.~~1203. Guillemot is listed as a designated species of Marwick Head SPA. The SPA breeding population at classification in 1994 was cited as 37,700 individuals (SNH, 2009). Burnell *et al.* (2023) give an updated count of 11,905 individuals which has been used in this assessment.

~~9.19.2.2.2~~9.20.2.2.2 Connectivity to the Projects

~~1117.~~1204. DBS East and DBS West are 595km and 564km respectively from Marwick Head SPA. The mean maximum foraging range of guillemot is 153.7km (73.2km + 80.5km, Woodward *et al*., 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding guillemot from Marwick Head SPA, there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only. Outside the breeding season, breeding guillemots from Marwick Head SPA are assumed to range widely and to mix with guillemots from breeding colonies in the UK and beyond. The relevant non-breeding season reference population is the UK North Sea and Channel BDMPS, consisting of 1,617,306 individuals (August to February) (Furness, 2015). It is estimated that 1% of birds present at the Projects are considered to be breeding adults from Marwick Head SPA. Note, this percentage has been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

~~9.19.2.2.3~~9.20.2.2.3 Assessment of Potential Effects of the Projects alone and Together

Table 9-136 Summary of guillemot density and abundance estimates and SPA apportioning rates and used in the operation and construction displacement assessment for Marwick Head SPA. Note that displacement from the wind farm has been estimated as 15%-35%, half the operational rates.

Site	Season	Peak no.	SPA %	Adult %	No. apportioned to SPA	Wind farm operation displacement mortality to SPA			Wind farm construction displacement mortality to SPA			Peak density (birds/ km^2)	Total vessel displacement mortality (2km around 3 vessels, 1% mortality)	Vessel mortality to SPA	Total construction displacement mortality to SPA		
						30-1	50-1	70-10	15-1	25 - 1	35-10				15-1 & vessel	25 – 1 & vessel	35-10 & vessel
DBS East	Breeding	9030.5	0	55.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.71	6.7	0.00	0.00	0.00	0.00
	Nonbreeding	12551.8	1	100	125.5	0.4	0.6	8.8	0.2	0.3	4.4	24.62	9.3	0.09	0.28	0.41	4.49
	Annual				125.5	0.4	0.6	8.8	0.2	0.3	4.4	-	16	0.09	0.28	0.41	4.49
DBS West	Breeding	8783.5	0	55.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.92	6.4	0.00	0.00	0.00	0.00
	Nonbreeding	12498.4	1	100	125.0	0.4	0.6	8.7	0.2	0.3	4.4	24.08	9.1	0.09	0.28	0.40	4.47
	Annual				125.0	0.4	0.6	8.7	0.2	0.3	4.4	-	15.5	0.09	0.28	0.40	4.47
DBS East + DBS West	Breeding	~~14927.7~~17815	0	55.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	13.0	0.00	0.00	0.00	0.00
	Nonbreeding	~~20136.0~~25050	1	100	~~201.4~~250.5	0.~~6~~8	1.~~0~~3	~~14.1~~17.5	0.~~3~~4	0.~~5~~6	~~7.0~~8.8		18.4	0.18	0.~~49~~6	0.~~69~~8	~~7.23~~8.9
	Annual				~~201.4~~250.5	0.~~6~~8	1.~~0~~3	~~14.1~~17.5	0.~~3~~4	0.~~5~~6	~~7.0~~8.8		31.4	0.18	0.~~49~~6	0.~~69~~8	~~7.23~~8.9

~~9.19.2.2.3.1~~9.20.2.2.3.1 *Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines*

~~9.19.2.2.3.1.1~~9.20.2.2.3.1.1 *DBS East in Isolation*

~~1118.~~1205. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Marwick Head SPA population expected to die is 731 (11,985 x 0.061) adults per annum. The predicted annual construction impact from DBS East alone on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 4.5 birds per annum (**Table 9-136**). This would result in a predicted change in adult mortality rate of 0.6%. The equivalent mortality assuming 35% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 0.9 which would increase the background mortality rate by 0.12%.

~~1119.~~1206. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1207. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green ~~2023~~(2019b), the annual displacement mortality apportioned to the Marwick Head SPA (0.41) would increase the predicted annual mortality by 0.05% which is below the 1% threshold for detectability and therefore no further assessment was required.

9.20.2.2.3.1.2 DBS West in Isolation

1208. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Marwick Head SPA population expected to die is 731 (11,985 x 0.061) adults per annum. The predicted annual construction impact from DBS West alone on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 4.5 birds per annum (**Table 9-136**). This would result in a predicted change in adult mortality rate of 0.6%. The equivalent mortality assuming 35% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 0.9 which would increase the background mortality rate by 0.12%.

~~1120.~~1209. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1121.~~1210. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Marwick Head SPA (0.~~41~~4) would increase the predicted annual mortality by 0.05% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.19.2.2.3.1.2~~9.20.2.2.3.1.3 DBS East and West ~~in Isolation~~ Together

~~1122.~~1211. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Marwick Head SPA population expected to die is 731 (11,985 x 0.061) adults per annum. The predicted annual construction impact from DBS East and DBS West ~~alone~~ on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is ~~4.5~~8.9 birds per annum (**Table 9-136**). This would result in a predicted change in adult mortality rate of ~~0.6%.~~ 1.2%. The equivalent mortality assuming 35% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 1.78 which would increase the background mortality rate by 0.24%.

~~1123.~~1212. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1124.~~1213. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Marwick Head SPA (0.~~4~~8) would increase the predicted annual mortality by 0.~~05%~~11 which is below the 1% threshold for detectability and therefore no further assessment was required.

9.20.2.2.3.2 Potential Effects During Operation: Disturbance and Displacement

~~9.19.2.2.3.1.3~~9.20.2.2.3.2.1 DBS East ~~and West Together~~in Isolation

~~1125.~~ At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Marwick Head SPA population expected to die is 731 (11,985 x 0.061) adults per annum. The predicted annual ~~construction~~operation impact from DBS East ~~and DBS West~~alone on the breeding guillemot population applying highly precautionary rates of ~~35~~70% displacement and 10% mortality is ~~7.2~~8.8 birds per annum (**Table 9-136**). This would result in a predicted change in adult mortality rate of ~~0.9%.~~

~~1126.~~1214. ~~There~~1.2% but is ~~no evidence in support of either the (operational)~~based on highly precautionary impact rates. The equivalent mortality assuming 70% displacement and 2% mortality (the latter rate ~~or~~as accepted in the ~~10%~~assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 1.76 which would increase the background mortality rate by 0.24%. A reduction in either the displacement rate (e.g. to 58%) or the mortality rate (e.g. to 8%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in both together).

~~1127.~~1215. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. ~~.~~In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1128.~~1216. At a more appropriate ~~(construction)~~ displacement rate of ~~25~~50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Marwick Head SPA (0.~~69~~6) would increase the predicted annual mortality by 0.~~09~~08% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.19.2.2.3.2Potential Effects During Operation: Disturbance and Displacement~~

~~9.19.2.2.3.2.1~~9.20.2.2.3.2.2 DBS ~~East~~West in Isolation

~~1129.~~1217. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Marwick Head SPA population expected to die is 731 (11,985 x 0.061) adults per annum. The predicted annual operation impact from DBS ~~East~~West alone on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 8.~~8~~7 birds per annum (**Table 9-136**). This would result in a predicted change in adult mortality rate of 1.2% but is based on highly precautionary impact rates. The equivalent mortality assuming 70% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 1.74 which would increase the background mortality rate by 0.24%. A reduction in either the displacement rate (e.g. to ~~58~~59%) or the mortality rate (e.g. to 8%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in both together).

~~1130.~~1218. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1131.~~1219. At a more appropriate (construction) displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Marwick Head SPA (0.6) would increase the predicted annual mortality by 0.08% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.19.2.2.3.2.2~~9.20.2.2.3.2.3 DBS East and West ~~in Isolation~~ Together

~~1132.~~1220. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Marwick Head SPA population expected to die is 731 (11,985 x 0.061) adults per annum. The predicted annual operation impact from DBS East and DBS West ~~alone~~ on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is ~~8.7~~17.5 birds per annum (**Table 9-136**). This would result in a predicted change in adult mortality rate of ~~1.~~2.4% but is based on highly precautionary impact rates. The equivalent mortality assuming 70% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 3.5 which would increase the background mortality rate by 0.48%. A reduction in either the displacement rate (e.g. to ~~59~~30%) or the mortality rate (e.g. to ~~8~~4%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in both together).

~~1133.~~1221. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1134.~~1222. At a more appropriate ~~(construction)~~ displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Marwick Head SPA (~~0.6~~1.3) would increase the predicted annual mortality by 0.~~08~~17% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.19.2.2.3.2.3 DBS East and West Together~~

~~1135. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Marwick Head SPA population expected to die is 731 (11,985 x 0.061) adults per annum. The predicted annual operation impact from DBS East and DBS West on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 14.1 birds per annum (**Table 9-107**). This would result in a predicted change in adult mortality rate of 1.9% but is based on highly precautionary impact rates. A reduction in either the displacement rate (e.g. to 36%) or the mortality rate (e.g. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Marwick Head SPA (1.0) would increase the predicted annual mortality by 0.14% which is below the 1% threshold for detectability and therefore no further assessment was required.~~

9.20.2.2.4 Summary

~~1136.~~1223. A matrix of the annual operational displacement estimates for DBS East and DBS West is provided in **Table 9-137**.

Table 9-137 Displacement matrix for annual project alone (DBS East plus DBS West) guillemot apportioned to Marwick Head SPA adult population.

Mortality %	**Displacement %**									
	10	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**
1	0	1	1	1	1	2	2	2	2	3
2	1	1	2	2	3	3	4	4	5	5
3	1	2	2	3	4	5	5	6	7	8
4	1	2	3	4	5	6	7	8	9	10
5	1	3	4	5	6	8	9	10	11	13
6	2	3	5	6	8	9	11	12	14	15
7	2	4	5	7	9	11	12	14	16	18
8	2	4	6	8	10	12	14	16	18	20

Mortality %	Displacement %									
	10	20	30	40	50	60	70	80	90	100
9	2	5	7	9	11	14	16	18	20	23
10	3	5	8	10	13	15	18	20	23	25
20	5	10	15	20	25	30	35	40	45	50
30	8	15	23	30	38	45	53	60	68	75
50	13	25	38	50	63	75	88	100	113	125
75	19	38	56	75	94	113	132	150	169	188
100	25	50	75	100	125	150	175	200	225	251

~~1137.~~1224. A table summarising the guillemot construction and operational disturbance and displacement assessment for DBS East and DBS West together is provided below (**Table 9-138)**.

~~1138.~~1225. It is concluded that predicted guillemot mortality due to construction and operational phase disturbance and displacement impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the Marwick Head SPA**.

Table 9-138 Summary of predicted guillemot displacement mortality from Marwick Head SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.

Guillemot	Displacement		
Potential Effects During Construction: Disturbance and Displacement			
~~Displacement mortality~~	~~Mean (@35% x 10%)~~		~~Mean (@25% x 1%)~~
~~Breeding season~~	~~0~~		~~0~~
~~Nonbreeding season~~	~~7.23~~		~~0.69~~
~~Annual~~	~~7.23~~		~~0.69~~
Displacement mortality	Mean (@25% x 1%)	Mean (@35% x 2%)	Mean (@35% x 10%)
Breeding season	0	0	0

Guillemot		Displacement		
Nonbreeding season		0.8	1.78	8.9
Annual		0.8	1.78	8.9
Ef-fect	Reference population	11,985		
	Increase in background mortality (%)	~~1.2~~0.11	0.~~08~~24	1.22
Potential Effects During Operation: Disturbance and Displacement				
Displacement mortality		Mean (@50% x 1%)	Mean (@70% x ~~10~~2%)	Mean (@~~50~~70% x ~~1~~10%)
Breeding season		0	0	0
Nonbreeding season		1.~~0~~3	3.5	17.5
Annual		1.~~0~~3	3.5	17.5
Ef-fect	Reference population	11,985		
	Increase in background mortality (%)	~~1.9~~0.17	0.~~14~~48	2.40

~~9.19.2.2.4~~9.20.2.2.5 Assessment of potential effects of the Projects in combination with other plans and projects

~~1139.~~1226. Given that no measurable increase in the Marwick Head SPA guillemot mortality is predicted as a result of DBS East and DBS West combined (e.g. with realistic displacement mortality of 1 bird per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted guillemot mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Marwick Head SPA**.

~~9.20~~9.21 West Westray SPA

~~9.20.1~~9.21.1 Site Description

~~1140.~~1227. West Westray SPA is an 8km stretch of sea cliffs, adjacent grassland and heathland, along the west coast of the island of Westray in Orkney. The cliffs support large colonies of breeding auks and kittiwakes while the grassland and heathland areas support breeding colonies of skuas and terns.

~~1141.~~1228. The seaward extension of the SPA extends approximately 2km into the marine environment and includes the seabed, water column and surface. Seabirds included within the designation feed both inside and outside the SPA in nearby waters, as well as more distantly in the wider North Sea.

~~9.20.1.1~~9.21.1.1 Qualifying Features

~~1142.~~1229. The qualifying features of the West Westray SPA screened into the assessment are listed in Table 4-7 of **RIAA HRA Part 1 of 4 – Introduction and Terrestrial Ecology (application ref: 6.1)**. These are breeding guillemot and two named components of the breeding seabird assemblage (kittiwake and razorbill).

~~9.20.1.2~~9.21.1.2 Conservation Objectives

~~1143.~~1230. The over-arching conservation objectives of the site are:

- To avoid deterioration of the habitats of the qualifying species or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained; and
- To ensure for the qualifying species that the following are maintained in the long term:
  - Population of the species as a viable component of the site;
  - Distribution of the species within site;
  - Distribution and extent of habitats supporting the species;
  - Structure, function and supporting processes of habitats supporting the species; and
  - No significant disturbance of the species.

~~9.20.2~~9.21.2 Assessment: Array Areas

~~9.20.2.1~~9.21.2.1 Kittiwake

~~1144.~~1231. Kittiwake has been screened into the assessment to assess the impacts from collision risk in the operation phase.

~~9.20.2.1.1~~9.21.2.1.1 Status

~~1145.~~1232. Kittiwake is listed as a named component of the breeding seabird assemblage of the West Westray SPA.

~~1146.~~1233. The SPA breeding population at classification in 1996 was cited as 23,900 pairs (SNH, 2009). Burnell *et al.* (2023) give an updated count of 2,755 AON which has been used in this assessment.

~~9.20.2.1.2~~9.21.2.1.2 Connectivity to the Projects

~~1147.~~1234. DBS East and DBS West are 599km and 570km respectively from West Westray SPA. The mean maximum foraging range of kittiwake is 300.6km (156.1km + 144.5km, Woodward *et al*., 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding kittiwake from West Westray SPA there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

~~1148.~~1235. Outside the breeding season breeding kittiwakes, including those from West Westray SPA, are not constrained by requirements to visit nests to incubate eggs or provision chicks. At this time, they are assumed to range more widely and to mix with kittiwakes of all age classes from breeding colonies in the UK and further afield. The background population during these seasons is the UK North Sea BDMPS. This consists of 829,937 individuals during the autumn migration season (August to December), and 627,816 individuals during the spring migration season (January to April) (Furness, 2015).

~~1149.~~1236. It is estimated that 1.7% and 2.3% of birds present in the Project array areas in the autumn and spring migration seasons respectively are considered to be breeding adults from West Westray SPA. Note, these percentages have been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

~~9.20.2.1.3~~9.21.2.1.3 Assessment of Potential Effects of the Projects alone and Together

~~9.20.2.1.3.1~~9.21.2.1.3.1 Potential Effects During Operation: Collision risk

Table 9-139 Summary of kittiwake total collisions and apportioned to the West Westray *SPA.*

Site	Season	Collision mortality			SPA %	Adult %	Collisions apportioned to SPA		
		Lower 95% c.i.	Mean	Upper 95% c.i.			Lower 95% c.i.	Mean	Upper 95% c.i.
DBS East	Breeding	42.3	83.3	168.5	0	53	0.0	0.0	0.0
	Autumn	14.6	41.4	82.9	1.7	100	0.2	0.7	1.4
	Spring	6.8	14.6	28.0	2.3	100	0.2	0.3	0.6
	Annual	66.9	139.3	261.3	-	-	0.4	1.0	2.1
DBS West	Breeding	36.9	107.8	280.8	0	53	0.0	0.0	0.0
	Autumn	9.5	37.9	81.9	1.7	100	0.2	0.6	1.4

Site	Season	Collision mortality			SPA %	Adult %	Collisions apportioned to SPA		
		Lower 95% c.i.	Mean	Upper 95% c.i.			Lower 95% c.i.	Mean	Upper 95% c.i.
	Spring	7.1	14.9	26.5	2.3	100	0.2	0.3	0.6
	Annual	55.9	160.6	327.0	-	-	0.3	1.0	2.0
DBS East + DBS West	Breeding	96.2	191.1	378.4	0	53	0.0	0.0	0.0
	Autumn	30.5	79.3	143.1	1.7	100	0.5	1.3	2.4
	Spring	16.9	29.5	47.3	2.3	100	0.4	0.7	1.1
	Annual	150.9	299.9	540.5	-	-	0.9	2.0	3.5

~~9.20.2.1.3.1.1~~9.21.2.1.3.1.1 DBS East in Isolation

~~1150.~~1237. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-7**) the number of individuals from the West Westray SPA population expected to die is 804 (5,510 x 0.146) adults per annum. The predicted annual impacts from DBS East alone on the breeding kittiwake population is 1.0 birds per annum (**Table 9-139**). This results in a predicted change in adult mortality rate of 0.13% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.20.2.1.3.1.2~~9.21.2.1.3.1.2 DBS West in Isolation

~~1151.~~1238. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-7**) the number of individuals from the West Westray SPA population expected to die 804 (5,510 x 0.146) adults per annum. The predicted annual impacts from DBS West alone on the breeding kittiwake population is 1 bird per annum (**(Table 9-139**). This results in a predicted change in adult mortality rate of 0.12% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.20.2.1.3.1.3~~9.21.2.1.3.1.3 DBS East and West Together

~~1152.~~1239. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-7**) the number of individuals from the West Westray SPA population expected to die is 804 (5,510 x 0.146) adults per annum. The predicted annual impacts from DBS East and DBS West on the breeding kittiwake population is 2.0 birds per annum **(Table 9-139**). This results in a predicted change in adult mortality rate of 0.25% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.20.2.1.4 Summary~~

~~9.20.2.1.5~~9.21.2.1.4 Summary

~~1153.~~1240.A table summarising the kittiwake operational collision risk assessment for DBS East and DBS West together is provided below (**Table 9-140**).

~~1154.~~1241.It is concluded that predicted kittiwake mortality due to operational phase collision risk at DBS East, DBS West, and the Projects together would **not adversely affect the integrity of the West Westray SPA**.

Table 9-140 Summary of predicted Kittiwake collision mortality from West Westray SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations for the Worst Case Wind Turbine Scenario.

Kittiwake		**Collisions**		
Potential Effects During Operation: Collision Risk				
Collision mortality		Lower c.i.	Mean	Upper c.i.
Breeding season		-	-	-
Autumn		0.5	1.3	2.4
Spring		0.4	0.7	1.1
Annual		0.9	2.0	3.5
Effect	Reference population	5,510		
	Increase in background mortality (%)	0.1	0.25	0.43

~~9.20.2.1.6~~9.21.2.1.5 Assessment of potential effects of the Projects in combination with other plans and projects

~~1155.~~1242.Given that no measurable increase in the West Westray SPA kittiwake mortality is predicted as a result of DBS East and DBS West combined (e.g. with total collision mortality of only 2 birds per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted kittiwake mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the West Westray SPA**.

~~9.20.2.2~~9.21.2.2 Guillemot

~~1156.~~1243.Guillemot has been screened into the assessment to assess the impacts from disturbance / displacement in the construction and operation phase.

~~9.20.2.2.1~~9.21.2.2.1 Status

~~1157.~~1244. Guillemot is listed as a designated species of the West Westray SPA. The SPA breeding population at classification in 1996 was cited as 42,150 individuals (SNH, 2009). Burnell *et al*. (2023) give an updated count of 28,697 individuals which has been used in this assessment.

~~9.20.2.2.2~~9.21.2.2.2 Connectivity to the Projects

~~1158.~~1245. DBS East and DBS West are 599km and 570km respectively from West Westray SPA. The mean maximum foraging range of guillemot is 153.7km (73.2km + 80.5km, Woodward *et al*., 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding guillemot from the West Westray SPA, there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only. Outside the breeding season, breeding guillemots from West Westray SPA are assumed to range widely and to mix with guillemots from breeding colonies in the UK and beyond. The relevant non-breeding season reference population is the UK North Sea and Channel BDMPS, consisting of 1,617,306 individuals (August to February) (Furness, 2015). It is estimated that 2.9% of birds present at the Projects are considered to be breeding adults from West Westray SPA. Note, this percentage has been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

~~9.20.2.2.3~~9.21.2.2.3 Assessment of Potential Effects of the Projects alone and Together

Table 9-141 Summary of guillemot density and abundance estimates and SPA apportioning rates and used in the operation and construction displacement assessment for West Westray SPA. Note that displacement from the wind farm has been estimated as 15%-35%, half the operational rates.

Site	Season	Peak no.	SPA %	Adult %	No. apportioned to SPA	Wind farm operation displacement mortality to SPA			Wind farm construction displacement mortality to SPA			Peak density (birds/km^2)	Total vessel displacement mortality (2km around 3 vessels, 1% mortality)	Vessel mortality to SPA	Total construction displacement mortality to SPA		
						30-1	50-1	70-10	15-1	25 - 1	35-10				15-1 & vessel	25 – 1 & vessel	35-10 & vessel
DBS East	Breeding	9030.5	0	55.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.71	6.7	0.00	0.00	0.00	0.00
	Nonbreeding	12551.8	2.9	100	364.0	1.1	1.8	25.5	0.5	0.9	12.7	24.62	9.3	0.27	0.82	1.18	13.01
	Annual				364.0	1.1	1.8	25.5	0.5	0.9	12.7	-	16	0.27	0.82	1.18	13.01
DBS West	Breeding	8783.5	0	55.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.92	6.4	0.00	0.00	0.00	0.00
	Nonbreeding	12498.4	2.9	100	362.5	1.1	1.8	25.4	0.5	0.9	12.7	24.08	9.1	0.26	0.81	1.17	12.95
	Annual				362.5	1.1	1.8	25.4	0.5	0.9	12.7	-	15.5	0.26	0.81	1.17	12.95
DBS East + DBS West	Breeding	~~14927.7~~17815	0	55.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	13.0	0.00	0.00	0.00	0.00
	Nonbreeding	~~20136.0~~25050	2.9	100	~~583.9~~726.5	~~1.8~~2.2	~~2.9~~3.6	~~40~~50.9	~~0.9~~1.1	1.~~5~~8	~~20~~25.4		18.4	0.53	1.~~41~~6	~~1.99~~2.3	~~20.97~~26.0
	Annual				~~583.9~~726.5	~~1.8~~2.2	~~2.9~~3.6	~~40~~50.9	~~0.9~~1.1	1.~~5~~8	~~20~~25.4		31.4	0.53	1.~~41~~6	~~1.99~~2.3	~~20.97~~26.0

~~9.20.2.2.3.1~~9.21.2.2.3.1 *Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines*

~~9.20.2.2.3.1.1~~9.21.2.2.3.1.1 *DBS East in Isolation*

~~1159.~~1246. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the West Westray SPA population expected to die is 1,750 (28,697 x 0.061) adults per annum. The predicted annual construction impact from DBS East alone on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 13.0 birds per annum (**Table 9-141**). This would result in a predicted change in adult mortality rate of 0.7%. The equivalent mortality assuming 35% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 2.6 which would increase the background mortality rate by 0.15%.

~~1160.~~1247. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1248. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the West Westray SPA (1.2) would increase the predicted annual mortality by 0.06% which is below the 1% threshold for detectability and therefore no further assessment was required.

9.21.2.2.3.1.2 DBS West in Isolation

~~1161.~~1249. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the West Westray SPA population expected to die is 1,750 (28,697 x 0.061) adults per annum. The predicted annual construction impact from DBS West alone on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 12.9 birds per annum (**Table 9-141**). This would result in a predicted change in adult mortality rate of 0.7%. The equivalent mortality assuming 35% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 2.6 which would increase the background mortality rate by 0.15%.

~~1162.~~1250. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. ~~2023~~In a study conducted over two breeding seasons conducted at the Beatrice wind farm (Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1163.~~1251. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the West Westray SPA (1.2) would increase the predicted annual mortality by 0.06% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.20.2.2.3.1.2~~9.21.2.2.3.1.3 DBS East and West ~~in Isolation~~ Together

~~1164.~~1252. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the West Westray SPA population expected to die is 1,750 (28,697 x 0.061) adults per annum. The predicted annual construction impact from DBS East and DBS West ~~alone~~ on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is ~~12.9~~26.0 birds per annum (**Table 9-141**). This would result in a predicted change in adult mortality rate of 1.5% but is based on highly precautionary impact rates. The equivalent mortality assuming 35% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 5.2 which would increase the background mortality rate by 0.30%. A reduction in either the displacement rate (e.g. ~~0.7%.~~to 47%) or the mortality rate (e.g. to 6.5%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in both together).

~~1165.~~1253. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1166.~~1254. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the West Westray SPA (~~1.~~2.3) would increase the predicted annual mortality by 0.~~06%~~13 which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.20.2.2.3.2~~9.21.2.2.3.2 *Potential Effects During Operation: Disturbance and Displacement*

~~9.20.2.2.3.2.1~~9.21.2.2.3.2.1 *DBS East ~~and West Together~~in Isolation*

1255. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the West Westray SPA population expected to die is 1,750 (28,697 x 0.061) adults per annum. The predicted annual ~~construction~~operation impact from DBS East ~~and DBS West~~alone on the breeding guillemot population applying highly precautionary rates of ~~35~~70% displacement and 10% mortality is ~~20.9~~25.5 birds per annum (**Table 9-141**). This would result in a predicted change in adult mortality rate of 1.4% but is based on highly precautionary impact rates. The equivalent mortality assuming 70% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 5.1 which would increase the background mortality rate by 0.29%. A reduction in either the displacement rate (e.g. to 48%) or the mortality rate (e.g. to 6.8%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in both together).

~~1167.~~1256. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. ~~**Table 9-111**).~~In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1168.~~1257. At a more appropriate ~~(construction)~~ displacement rate of ~~25~~50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the West Westray SPA (~~2.0~~1.8) would increase the predicted annual mortality by 0.~~11~~1 which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.20.2.2.3.2.2~~9.21.2.2.3.2.2 DBS ~~East~~West in Isolation

~~1169.~~1258.At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the West Westray SPA population expected to die is 1,750 (28,697 x 0.061) adults per annum. The predicted annual operation impact from DBS ~~East~~West alone on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 25.~~5~~4 birds per annum (**Table 9-141**). This would result in a predicted change in adult mortality rate of 1.4% but is based on highly precautionary impact rates. The equivalent mortality assuming 70% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 5.1 which would increase the background mortality rate by 0.29%. A reduction in either the displacement rate (e.g. to 48%) or the mortality rate (e.g. to 6.8%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in both together).

~~1170.~~1259.There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1171.~~1260.At a more appropriate (construction) displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the West Westray SPA (1.8) would increase the predicted annual mortality by 0.1% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.20.2.2.3.2.3~~9.21.2.2.3.2.3 DBS East and West ~~in Isolation~~ Together

~~1172.~~1261. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the West Westray SPA population expected to die is 1,750 (28,697 x 0.061) adults per annum. The predicted annual operation impact from DBS East and DBS West ~~alone~~ on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is ~~25.4~~50.9 birds per annum (**Table 9-141**). This would result in a predicted change in adult mortality rate of ~~1.4%~~2.9%, but is based on highly precautionary impact rates. ~~A reduction in either the~~ The equivalent mortality assuming 35% displacement ~~rate (e.g. to 48%) or~~ and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 10.2 which would increase the background mortality rate by 0.58%. A reduction in the mortality rate (e.g. to ~~6.8~~3.4%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in both together).

~~1173.~~1262. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1174.~~1263. At a more appropriate ~~(construction)~~ displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the West Westray SPA (~~1.8~~3.6) would increase the predicted annual mortality by 0.~~1~~21% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~*9.20.2.2.3.2.4 DBS East and West Together*~~

~~1175. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the West Westray SPA population expected to die is 1,750 (28,697 x 0.061) adults per annum. The predicted annual operation impact from DBS East and DBS West on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 41 birds per annum (**Table 9-111**). This would result in a predicted change in adult mortality rate of 2.3%, but is based on highly precautionary impact rates.to 30%) or the mortality rate (e.g. to 4.3%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in both together).~~

~~1176. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the West Westray SPA (2.9) would increase the predicted annual mortality by 0.17% which is below the 1% threshold for detectability and therefore no further assessment was required.~~

9.21.2.2.4 Summary

~~1177.~~1264. A matrix of the annual operational displacement estimates for DBS East and DBS West is provided in **Table 9-142**.

Table 9-142 Displacement matrix for annual project alone (DBS East plus DBS West) guillemot apportioned to West Westray SPA adult population.

Mortality %	**Displacement %**									
	10	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**
1	1	1	2	3	4	4	5	6	7	7
2	1	3	4	6	7	9	10	12	13	15
3	2	4	7	9	11	13	15	17	20	22
4	3	6	9	12	15	17	20	23	26	29
5	4	7	11	15	18	22	25	29	33	36
6	4	9	13	17	22	26	31	35	39	44
7	5	10	15	20	25	31	36	41	46	51

Mortality %	Displacement %									
	10	20	30	40	50	60	70	80	90	100
8	6	12	17	23	29	35	41	46	52	58
9	7	13	20	26	33	39	46	52	59	65
10	7	15	22	29	36	44	51	58	65	73
20	15	29	44	58	73	87	102	116	131	145
30	22	44	65	87	109	131	153	174	196	218
50	36	73	109	145	182	218	254	291	327	363
75	54	109	163	218	272	327	381	436	490	545
100	73	145	218	291	363	436	509	581	654	727

~~1178.~~1265. A table summarising the guillemot construction and operational disturbance and displacement assessment for DBS East and DBS West together is provided below (**Table 9-143)**.

~~1179.~~1266. It is concluded that predicted guillemot mortality due to construction and operational phase disturbance and displacement impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the West Westray SPA**.

Table 9-143 Summary of predicted guillemot displacement mortality from West Westray SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.

Guillemot		Displacement		
Potential Effects During Construction: Disturbance and Displacement				
Displacement mortality		Mean (@25% x 1%)	Mean (@35% x ~~10~~2%)	Mean (@~~25~~35% x ~~1~~10%)
Breeding season		0	0	0
Nonbreeding season		~~20.97~~2.3	~~1.99~~5.2	26.0
Annual		~~20.97~~2.3	~~1.99~~5.2	26.0
Effect	Reference population	28,697		
	Increase in back-ground mortality (%)	~~1.19~~0.13	0.~~11~~30	1.48

Guillemot		Displacement		
Potential Effects During Operation: Disturbance and Displacement				
Displacement mortality		Mean (@50% x 1%)	Mean (@70% x ~~10~~2%)	Mean (@~~50~~70% x ~~1~~10%)
Breeding season		0	0	0
Nonbreeding season		~~40.9~~3.6	10.2	~~2~~50.9
Annual		~~40.9~~3.6	10.2	~~2~~50.9
Effect	Reference population	28,697		
	Increase in back-ground mortality (%)	~~2.33~~0.21	0.~~17~~58	2.90

~~9.20.2.2.4~~9.21.2.2.5 *Assessment of potential effects of the Projects in combination with other plans and projects*

~~1180.~~1267. Given that no measurable increase in the West Westray SPA guillemot mortality is predicted as a result of DBS East and DBS West combined (e.g. with realistic displacement mortality of 3.6 birds per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted guillemot mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the West Westray SPA**.

~~9.20.2.3~~9.21.2.3 Razorbill

~~9.20.2.3.1~~9.21.2.3.1 *Status*

~~1181.~~1268. Razorbill is listed as a named component of the breeding seabird assemblage of the West Westray SPA.

~~1182.~~1269. The SPA breeding population at classification in 1996 was cited as 1,946 individuals (SNH, 2009). Burnell *et al.* (2023) give an updated count of 2,159 individuals which has been used in this assessment.

~~9.20.2.3.2~~9.21.2.3.2 *Connectivity to the Projects*

~~1183.~~1270. DBS East and DBS West are 599km and 570km respectively from West Westray SPA. The mean maximum foraging range of razorbill is 164.6km (88.7 + 75.9km, Woodward *et al.*, 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding razorbill from West Westray SPA, there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

~~1184.~~1271. Outside the breeding season, breeding razorbills from West Westray SPA are assumed to range widely and to mix with razorbills from breeding colonies in the UK and further afield. The relevant background population is considered to be the UK North Sea and Channel BDMPS, consisting of 591,874 individuals during autumn and spring passage periods (August to October and January to March), and 218,622 individuals during winter (November and December) (Furness, 2015).

~~1185.~~1272. During the autumn and spring migration it is estimated that East Caithness Cliffs birds make up 0.2% of the BDMPS population, and during the winter 0.1% of the BDMPS population. Note, these percentages have been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

~~9.20.2.3.3~~9.21.2.3.3 *Assessment of Potential Effects of the Projects alone and Together*

Table 9-144 Summary of razorbill density and abundance estimates and SPA apportioning rates and used in the operation and construction displacement assessment for West Westray SPA. Note that displacement from the wind farm has been estimated as 15%-35%, half the operational rates.

Site	Season	Peak no.	SPA %	Adult %	No. apportioned to SPA	Wind farm operation displacement mortality to SPA			Wind farm construction displacement mortality to SPA			Peak density (birds/ km^2)	Total vessel displacement mortality (2km around 3 vessels, 1% mortality)	Vessel mortality to SPA	Total construction displacement mortality to SPA		
						30-1	50-1	70-10	15-1	25 - 1	35-10				15-1 & vessel	25 – 1 & vessel	35-10 & vessel
DBS East	Breeding	555.1	0	100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.4	0.00	0.00	0.00	0.00
	Autumn	4685.3	0.2	100	9.4	0.0	0.0	0.7	0.0	0.0	0.3	9.2	3.5	0.01	0.02	0.03	0.33
	Winter	3376.7	0.1	100	3.4	0.0	0.0	0.2	0.0	0.0	0.1	6.6	2.5	0.00	0.01	0.01	0.12
	Spring	3578.5	0.2	100	7.2	0.0	0.0	0.5	0.0	0.0	0.3	7.0	2.6	0.01	0.02	0.02	0.26
	Annual				20	0	0	1.4	0	0	0.7	-	9	0.02	0.05	0.06	0.71
DBS West	Breeding	2280.6	0	100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.4	1.7	0.00	0.00	0.00	0.00
	Autumn	4886.9	0.2	100	9.8	0.0	0.0	0.7	0.0	0.0	0.3	9.4	3.5	0.01	0.02	0.03	0.35
	Winter	5066.2	0.1	100	5.1	0.0	0.0	0.4	0.0	0.0	0.2	9.7	3.7	0.00	0.01	0.02	0.18
	Spring	4454.6	0.2	100	8.9	0.0	0.0	0.6	0.0	0.0	0.3	8.6	3.2	0.01	0.02	0.03	0.32
	Annual				23.8	0.1	0.1	1.7	0.0	0.1	0.8	-	10.4	0.02	0.05	0.08	0.85
DBS East + DBS West	Breeding	~~2826.1~~2835.7	0	100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	2.1	0.00	0.00	0.00	0.00
	Autumn	~~6349.6~~9572.2	0.2	100	~~12.7~~19.1	0.~~0~~1	0.1	~~0.9~~1.3	0.0	0.0	0.~~4~~7		7.0	0.01	0.~~03~~04	0.~~05~~06	0.~~46~~68
	Winter	~~5823.7~~8442.9	0.1	100	~~5.~~8.4	0.0	0.0	0.~~4~~6	0.0	0.0	0.~~2~~3		6.1	0.01	0.~~01~~02	0.~~02~~03	0.~~21~~31
	Spring	~~6302.5~~8033.1	0.2	100	~~12.6~~16.1	0.0	0.1	~~0.9~~1.1	0.0	0.0	0.~~4~~6		5.9	0.01	0.03	0.~~04~~05	0.~~45~~57
	Annual				~~31.1~~43.7	0.1	0.2	~~2.2~~3.1	0.~~0~~1	0.1	1.~~1~~5		21.1	0.03	0.~~07~~10	0.~~11~~14	1.~~12~~56

~~9.20.2.3.3.1~~9.21.2.3.3.1 *Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines*

~~9.20.2.3.3.1.1~~9.21.2.3.3.1.1 *DBS East in Isolation*

~~1186.~~1273. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-7**) the number of individuals from the West Westray SPA population expected to die is 227 (2,159 x 0.105) adults per annum. The predicted annual construction impact from DBS East alone on the breeding razorbill population applying highly precautionary rates of 35% displacement and 10% mortality plus vessel displacement is 0.7 (0.33, 0.12, 0.26 in autumn winter and spring respectively) birds per annum (**Table 9-144)**. This would result in a predicted change in adult mortality rate of 0.31%. The equivalent mortality assuming 35% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 0.14 which would increase the background mortality rate by 0.06%.

~~1187.~~1274. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1188.~~1275. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the West Westray SPA (0.06) would increase the predicted annual mortality by 0.03% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.20.2.3.3.1.2~~9.21.2.3.3.1.2 DBS West in Isolation

~~1189.~~1276. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-7**) the number of individuals from the West Westray SPA population expected to die is 227 (2,159 x 0.105) adults per annum. The predicted annual construction impact from DBS West alone on the breeding razorbill population applying highly precautionary rates of 35% displacement and 10% mortality plus vessel displacement is 0.8 (0.35, 0.18, 0.32 in autumn winter and spring respectively) birds per annum (**Table 9-144**). This would result in a predicted change in adult mortality rate of 0.3%. The equivalent mortality assuming 35% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 0.16 which would increase the background mortality rate by 0.07%.

~~1190.~~1277. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (Trinder *et al*. 2024) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1191.~~ At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the ~~MacArthur Green 2023) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.~~

~~1192.~~1278.~~At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the~~ West Westray SPA (0.08) would increase the predicted annual mortality by 0.03% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.20.2.3.3.1.3~~9.21.2.3.3.1.3 *DBS East and West Together*

~~1193.~~1279.At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-7**) the number of individuals from the West Westray SPA population expected to die is 227 (2,159 x 0.105) adults per annum. The predicted annual construction impact from DBS East and DBS West on the breeding razorbill population applying highly precautionary rates of 35% displacement and 10% mortality plus vessel displacement is 1.~~1~~6 (0.~~46~~7, 0.~~21~~3, 0.~~45~~6 in autumn, winter and spring respectively) birds per annum (**Table 9-144**). This would result in a predicted change in adult mortality rate of 0.~~48~~69%. The equivalent mortality assuming 35% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 0.32 which would increase the background mortality rate by 0.14%.

~~1194.~~1280.There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (Trinder *et al*. 2024) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1195.~~1281.At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the ~~MacArthur Green 2023MacArthur Green (2019b), the annual displacement mortality apportioned to the~~ West Westray SPA (0.~~1~~14) would increase the predicted annual mortality by 0.~~05~~06% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.20.2.3.3.2~~9.21.2.3.3.2 Potential Effects During Operation: Disturbance and Displacement

~~9.20.2.3.3.2.1~~9.21.2.3.3.2.1 DBS East in Isolation

~~1196.~~1282. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-7**) the number of individuals from the West Westray SPA population expected to die is 227 (2,159 x 0.105) adults per annum. The predicted annual operation impact from DBS East alone on the breeding razorbill population applying highly precautionary rates of 70% displacement and 10% mortality is 1.4 (0.7, 0.2, 0.5 in autumn winter and spring respectively) birds per annum (**Table 9-144**). This would result in a predicted change in adult mortality rate of 0.6%. The equivalent mortality assuming 70% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 0.28 which would increase the background mortality rate by 0.12%.

~~1197.~~1283. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1198.~~1284. At a more appropriate operational displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the West Westray SPA (0.1) would increase the predicted annual mortality by 0.04% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.20.2.3.3.2.2~~9.21.2.3.3.2.2 DBS West in Isolation

~~1199.~~1285. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-7**) the number of individuals from the West Westray SPA population expected to die is 227 (2,159 x 0.105) adults per annum. The predicted annual operation impact from DBS West alone on the breeding razorbill population applying highly precautionary rates of 70% displacement and 10% mortality is 1.7 (0.7, 0.4, 0.6 in autumn winter and spring respectively) birds per annum (**Table 9-144**). This would result in a predicted change in adult mortality rate of 0.7%. The equivalent mortality assuming 70% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 0.34 which would increase the background mortality rate by 0.15%.

~~1200.~~1286. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (Trinder *et al*. 2024) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1201. MacArthur Green 2023~~

~~1202.~~1287. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the West Westray SPA (0.1) would increase the predicted annual mortality by 0.04% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.20.2.3.3.2.3~~9.21.2.3.3.2.3 *DBS East and West Together*

~~1203.~~1288. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-7**) the number of individuals from the West Westray SPA population expected to die is 227 (2,159 x 0.105) adults per annum. The predicted annual construction impact from DBS East and DBS West on the breeding razorbill population applying highly precautionary rates of 70% displacement and 10% mortality is ~~2.2 (~~3.1 (1.3, 0.~~9, 0.4, 0.96,~~ 1.1 in autumn winter and spring respectively) birds per annum (**Table 9-144**). This would result in a predicted change in adult mortality rate of ~~0.97~~1.3%. The equivalent mortality assuming 70% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 0.62 which would increase the background mortality rate by 0.27%.

~~1204.~~1289. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (Trinder *et al*. 2024) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1205.~~1290. At a more appropriate operational displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the ~~MacArthur Green 2023MacArthur Green (2019b), the annual displacement mortality apportioned to the~~ West Westray SPA (0.2) would increase the predicted annual mortality by 0.~~09~~10% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.20.2.3.4~~9.21.2.3.4 *Summary*

~~1206.~~1291. A matrix of the annual operational displacement estimates for DBS East and DBS West is provided in **Table 9-145**.

Table 9-145 Displacement matrix for annual project alone (DBS East plus DBS West) razorbill apportioned to West Westray SPA adult population.

Mortality %	**Displacement %**									
	10	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**
1	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	1	1	1	1	1
3	0	0	0	1	1	1	1	1	1	1
4	0	0	1	1	1	1	1	1	2	2
5	0	0	1	1	1	1	2	2	2	2
6	0	1	1	1	1	2	2	2	2	3
7	0	1	1	1	2	2	2	2	3	3
8	0	1	1	1	2	2	2	3	3	3
9	0	1	1	2	2	2	3	3	4	4
10	0	1	1	2	2	3	3	3	4	4
20	1	2	3	3	4	5	6	7	8	9
30	1	3	4	5	7	8	9	10	12	13
50	2	4	7	9	11	13	15	17	20	22
75	3	7	10	13	16	20	23	26	29	33
100	4	9	13	17	22	26	31	35	39	44

~~1207.~~1292. A table summarising the razorbill construction and operational disturbance and displacement assessment for DBS East and DBS West together is provided below **(Table 9-146)**.

~~1208.~~1293. It is concluded that predicted razorbill mortality due to construction and operational phase disturbance and displacement impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the West Westray SPA**.

Table 9-146 Summary of predicted razorbill displacement mortality from West Westray SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.

~~Guillemot~~Razorbill		Displacement		
Potential Effects During Construction: Disturbance and Displacement				
Displacement mortality		Mean (@25% x 1%)	Mean (@35% x ~~10~~2%)	Mean (@~~25~~35% x ~~1~~10%)
Breeding season		0	0	0
Autumn		0.~~46~~06	0.~~05~~14	0.68
Winter		0.~~21~~03	0.~~02~~06	0.31
Spring		0.~~45~~05	0.~~04~~11	0.57
Annual		~~1.12~~0.14	0.~~11~~31	1.56
Effect	Reference population	2,159		
	Increase in back-ground mortality (%)	0.~~5~~06	0.~~04~~14	0.69
Potential Effects During Operation: Disturbance and Displacement				
Displacement mortality		Mean (@50% x 1%)	Mean (@70% x ~~10~~2%)	Mean (@~~50~~70% x ~~1~~10%)
Breeding season		0	0	0
Autumn		0.~~9~~1	0.~~1~~26	1.3
Winter		0.~~4~~0	0.~~0~~12	0.6
Spring		0.~~9~~1	0.22	~~0~~1.1
Annual		~~2~~0.2	0.~~2~~62	3.1
Effect	Reference population	2,159		
	Increase in back-ground mortality (%)	0.~~97~~10	0.~~09~~27	1.35

~~9.20.2.3.5~~9.21.2.3.5 *Assessment of potential effects of the Projects in combination with other plans and projects*

~~1209.~~1294. Given that no measurable increase in the West Westray SPA razorbill mortality is predicted as a result of DBS East and DBS West combined (e.g. with realistic displacement mortality of 0.2 birds per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted guillemot mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the West Westray SPA**.

~~9.21~~9.22 Fair Isle SPA

~~9.21.1~~9.22.1 Site Description

~~1210.~~1295. Fair Isle SPA is situated on the most southerly island of the Shetland group, lying halfway between Mainland and Orkney. It has a rocky, cliff coastline and supports a wide range of breeding seabird populations of international importance.

~~1211.~~1296. The seaward extension of the SPA extends approximately 2km into the marine environment and includes the seabed, water column and surface. Seabirds included within the designation feed both inside and outside the SPA in nearby waters, as well as more distantly in the wider North Sea.

~~9.21.1.1~~9.22.1.1 Qualifying Features

~~1212.~~1297. The qualifying features of the Fair Isle SPA screened into the assessment are listed in Table 4-7 of **RIAA HRA Part 1 of 4 – Introduction and Terrestrial Ecology (application ref: 6.1)**. These are breeding guillemot and four named components of the breeding seabird assemblage (kittiwake, razorbill, puffin and gannet).

~~9.21.1.2~~9.22.1.2 Conservation Objectives

~~1213.~~1298. The over-arching conservation objectives of the site are:

- To avoid deterioration of the habitats of the qualifying species or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained; and
- To ensure for the qualifying species that the following are maintained in the long term:
    - Population of the species as a viable component of the site;
    - Distribution of the species within site;
    - Distribution and extent of habitats supporting the species;

- Structure, function and supporting processes of habitats supporting the species; and
- No significant disturbance of the species.

~~9.21.2~~9.22.2 Assessment: Array Areas

~~9.21.2.1~~9.22.2.1 Gannet

~~1214.~~1299. Gannet has been screened into the assessment to assess the impacts from disturbance / displacement and collision risk in the construction and operation phase.

~~9.21.2.1.1~~9.22.2.1.1 Status

~~1215.~~1300. Gannet is listed as a named component of the breeding seabird assemblage of the Fair Isle SPA.

~~1216.~~1301. The SPA breeding population at classification in 1994 was cited as 1,166 pairs (SNH, 2009). Burnell *et al*. (2023) give an updated count of 4,971 AON which has been used in this assessment.

~~9.21.2.1.2~~9.22.2.1.2 Connectivity to the Projects

~~1217.~~1302. DBS East and DBS West are 585km and 559km respectively from the Fair Isle SPA. The mean maximum foraging range of gannet is 509.4km (315.2 + 194.2km, Woodward *et al*., 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding gannet from the Fair Isle SPA there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

~~1218.~~1303. Outside the breeding season breeding gannets, including those from the Fair Isle SPA, are not constrained by requirements to visit nests to incubate eggs or provision chicks. At this time, they are assumed to range more widely and to mix with gannets of all age classes from breeding colonies in the UK and further afield. The background population during these seasons is the UK North Sea BDMPS. This consists of 456,298 individuals during autumn migration (September to November), and 248,385 individuals during spring migration (December to March) (Furness, 2015).

~~1219.~~1304. During the autumn migration and spring migration seasons it is estimated that 1.4% and 2.2% of birds respectively present in the Project array areas are considered to be breeding adults from the Fair Isle SPA. Note, these percentages have been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

~~9.21.2.1.3~~9.22.2.1.3 Assessment of Potential Effects of the Projects alone and Together

~~1220.~~1305.The seasonal peak total number of gannets recorded in DBS East and DBS West and the number apportioned to Fair Isle SPA is provided in **Table 9-147**.

~~1221.~~1306.Construction displacement has been estimated on the basis this operates across half the wind farm. Thus, gannet displacement was calculated using 30% and 40% displacement rates (i.e. half the operational values) and 1% mortality. These were then added to the number of birds expected to be displaced by up to three construction vessels (assuming 100% displacement within 2km of each vessel and 1% mortality), calculated from the seasonal densities (**Table 9-147**).

Table 9-147 Summary of gannet density and abundance estimates and SPA apportioning rates and used in the operation and construction displacement assessment for Fair Isle SPA. Note that displacement from the wind farm has been estimated as 30%-40%, half the operational rates.

Site	Season	Peak no. (mean)	SPA %	Adult %	No. apportioned to SPA	Wind farm operation displacement mortality to SPA		Wind farm construction displacement mortality to SPA		Peak density (birds/ km^2)	Total vessel displacement mortality (2km around 3 vessels, 1% mortality)	Vessel mortality to SPA	Total construction displacement mortality to SPA	
						60-1	80-1	30-1	40-1				30-1 & vessel	40-1 & vessel
DBS East	Breeding	754.9	0	60	0.0	0.00	0.00	0.00	0.00	1.48	0.56	0.00	0.00	0.00
	Autumn	776.1	1.4	100	10.9	0.07	0.09	0.03	0.04	1.52	0.57	0.01	0.04	0.05
	Spring	75.1	6.2	100	1.7	0.01	0.01	0.00	0.01	0.15	0.06	0.00	0.01	0.01
	Annual				12.6	0.08	0.1	0.03	0.05	-	1.19	0.01	0.05	0.06
DBS West	Breeding	805.3	0	60	0.0	0.00	0.00	0.00	0.00	1.55	0.58	0.00	0.00	0.00
	Autumn	797.5	1.4	100	11.2	0.07	0.09	0.03	0.04	1.54	0.58	0.01	0.04	0.05
	Spring	86.2	2.2	100	1.9	0.01	0.02	0.01	0.01	0.17	0.06	0.00	0.01	0.01
	Annual				13.1	0.08	0.11	0.04	0.05	-	1.22	0.01	0.05	0.06
DBS East + DBS West	Breeding	1560.2	0	60	0.0	0.00	0.00	0.00	0.00	-	1.14	0.00	0.00	0.00
	Autumn	1573.6	1.4	100	22.0	0.13	0.18	0.07	0.09		1.15	0.02	0.08	0.10
	Spring	161.3	2.2	100	3.5	0.02	0.03	0.01	0.01		0.12	0.00	0.01	0.02
	Annual				25.5	0.15	0.21	0.08	0.1		2.41	0.02	0.09	0.12

~~9.21.2.1.3.1.1~~9.22.2.1.3.1.1 *DBS East in Isolation*

~~1222.~~1307. At the baseline mortality rate for adult gannet of 0.088 (**Table 9-7**) the number of adults from Fair Isle SPA population expected to die per year is 875 (9,942 x 0.088). The predicted annual construction mortality impacts from DBS East alone on the breeding gannet population is 0.6 birds per annum (**Table 9-147**). This results in a predicted change in adult mortality rate of <0.01% which is below the 1% threshold for detectability and therefore no further assessment is required.

~~9.21.2.1.3.1.2~~9.22.2.1.3.1.2 *DBS West in Isolation*

~~1223.~~1308. At the baseline mortality rate for adult gannet of 0.088 (**Table 9-7**) the number of adults from Fair Isle SPA population expected to die per year is 875 (9,942 x 0.088). The predicted annual construction mortality impacts from DBS West alone on the breeding gannet population is 0.6 birds per annum (**Table 9-147**). This results in a predicted change in adult mortality rate of <0.01% which is below the 1% threshold for detectability and therefore no further assessment is required.

~~9.21.2.1.3.1.3~~9.22.2.1.3.1.3 *DBS East and West Together*

~~1224.~~1309. At the baseline mortality rate for adult gannet of 0.088 (**Table 9-7**) the number of adults from Fair Isle SPA population expected to die per year is 875 (9,942 x 0.088). The predicted annual construction mortality impacts from DBS East and DBS West on the breeding gannet population is 0.12 birds per annum (**Table 9-147**). This results in a predicted change in adult mortality rate of 0.01% which is below the 1% threshold for detectability and therefore no further assessment is required.

~~9.21.2.1.3.2~~9.22.2.1.3.2 *Potential Effects During Operation: Disturbance and Displacement*

~~9.21.2.1.3.2.1~~9.22.2.1.3.2.1 *DBS East in Isolation*

~~1225.~~1310. At the baseline mortality rate for adult gannet of 0.088 (**Table 9-7**) the number of individuals from Fair Isle SPA population expected to die per year is 875 (9,942 x 0.088). The predicted annual impacts from DBS East alone on the breeding gannet population is 0.1 birds per annum (**Table 9-147**). This results in a predicted change in adult mortality rate of 0.01% which is below the 1% threshold for detectability and therefore no further assessment is required.

~~9.21.2.1.3.2.2~~9.22.2.1.3.2.2 *DBS West in Isolation*

~~1226.~~1311. At the baseline mortality rate for adult gannet of 0.088 (**Table 9-7**) the number of individuals from Fair Isle SPA population expected to die per year is 875 (9,942 x 0.088). The predicted annual impacts from DBS West alone on the breeding gannet population is 0.11 birds per annum (**Table 9-147**). This results in a predicted change in adult mortality rate of 0.01% which is below the 1% threshold for detectability and therefore no further assessment is required.

~~9.21.2.1.3.2.3~~9.22.2.1.3.2.3 *DBS East and West Together*

~~1227.~~1312. At the baseline mortality rate for adult gannet of 0.088 (**Table 9-7**) the number of individuals from Fair Isle SPA population expected to die per year is 875 (9,942 x 0.088). The predicted annual impacts from DBS West alone on the breeding gannet population is 0.21 birds per annum (**Table 9-147**). This results in a predicted change in adult mortality rate of 0.02% which is below the 1% threshold for detectability and therefore no further assessment is required.

~~9.21.2.1.3.3~~9.22.2.1.3.3 *Potential Effects During Operation: Collision Risk*

Table 9-148 Summary of gannet total collisions and apportioned to Fair Isle SPA.

Site	Season	Collision mortality			SPA %	Adult %	Collisions apportioned to SPA		
		Lower 95% c.i.	Mean	Upper 95% c.i.			Lower 95% c.i.	Mean	Upper 95% c.i.
DBS East	Breeding	0.7	3.4	7.8	0	60	0.0	0.0	0.0
	Autumn	0.3	1.6	3.8	1.4	100	0.0	0.0	0.1
	Spring	0.0	0.1	0.6	2.2	100	0.0	0.0	0.0
	Annual	1.1	5.1	12.2	-	-	0.0	0.0	0.1
DBS West	Breeding	0.6	4.9	15.3	0	60	0.0	0.0	0.0
	Autumn	0.3	2.1	6.0	1.4	100	0.0	0.0	0.1
	Spring	0.0	0.1	0.7	2.2	100	0.0	0.0	0.0
	Annual	1.5	7.1	17.7	-	-	0.0	0.0	0.1
DBS East + DBS West	Breeding	0.9	8.4	26.5	0	60	0.0	0.0	0.0
	Autumn	0.5	3.7	10.8	1.4	100	0.0	0.1	0.2
	Spring	0.0	0.3	1.3	2.2	100	0.0	0.0	0.0
	Annual	2.7	12.4	29.8	-	-	0.0	0.1	0.2

~~9.21.2.1.3.3.1~~9.22.2.1.3.3.1 *DBS East in Isolation*

~~1228.~~1313. At the baseline mortality rate for adult gannet of 0.088 (**Table 9-7**) the number of individuals from Fair Isle SPA population expected to die per year is 875 (9,942 x 0.088) adults per annum. The predicted impacts from DBS East alone on the breeding gannet population is 0.02 (0.0 to 0.1) birds per annum (**Table 9-148**). This results in a predicted change in adult mortality rate of <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.21.2.1.3.3.2~~9.22.2.1.3.3.2 *DBS West in Isolation*

~~1229.~~1314. At the baseline mortality rate for adult gannet of 0.088 (**Table 9-7**) the number of individuals from Fair Isle SPA population expected to die per year is 875 (9,942 x 0.088) adults per annum. The predicted impacts from DBS West alone on the breeding gannet population is 0.03 (0.0 to 0.1) birds per annum (**Table 9-148**). This results in a predicted change in adult mortality rate of <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.21.2.1.3.3.3~~9.22.2.1.3.3.3 *DBS East and West Together*

~~1230.~~1315. At the baseline mortality rate for adult gannet of 0.088 (**Table 9-7**) the number of individuals from Fair Isle SPA population expected to die per year is 875 (9,942 x 0.088) adults per annum. The predicted impacts from DBS East and DBS West on the breeding gannet population is 0.1 (0.0 to 0.2) birds per annum (**Table 9-148**). This results in a predicted change in adult mortality rate of 0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.21.2.1.3.4~~9.22.2.1.3.4 *Potential Effects During Operation: Combined Operational Displacement and Collision Risk*

~~9.21.2.1.3.4.1~~9.22.2.1.3.4.1 *DBS East in Isolation*

~~1231.~~1316. Since the estimated impacts from DBS East on the Fair Isle SPA population due to operational displacement and collision risk were extremely small, there is no risk of a combined impact from both together.

~~9.21.2.1.3.4.2~~9.22.2.1.3.4.2 *DBS West in Isolation*

~~1232.~~1317. Since the estimated impacts from DBS West on the Fair Isle SPA population due to operational displacement and collision risk were extremely small, there is no risk of a combined impact from both together.

~~9.21.2.1.3.4.3~~9.22.2.1.3.4.3 *DBS East and West Together*

~~1233.~~1318. Since the estimated impacts from DBS East and DBS West on the Fair Isle SPA population due to operational displacement and collision risk were extremely small, there is no risk of a combined impact from both together.

~~9.21.2.1.4~~9.22.2.1.4 Summary

~~1234.~~1319. A table summarising the gannet construction and operational disturbance / displacement, as well as operational collision risk and finally the combination of operational disturbance and displacement with collision risk assessment for DBS East and DBS West together is provided below (**Table 9-149)**.

~~1235.~~1320. It is concluded that predicted gannet mortality due to construction and operational phase displacement, as well as operational collision risk and finally the combination of operational disturbance and displacement with collision risk impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the Fair Isle SPA**.

Table 9-149 Summary of predicted gannet construction and operational displacement and operational collision risk mortality from Fair Isle SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.

Gannet				
Potential Effects During Construction: Disturbance and Displacement				
Displacement mortality (80% + 1%)		Mean	Lower c.i.	Upper c.i.
Breeding season		0	-	-
Autumn		0.10	-	-
Spring		0.02	-	-
Annual		0.12		
Effect	Reference population	9,942	-	-
	Increase in background mortality (%)	<0.01	-	-
Potential Effects During Operation: Disturbance and Displacement				
Displacement mortality (80% + 1%)		Mean	Lower c.i.	Upper c.i.
Breeding season		0	-	-
Autumn		0.18	-	-
Spring		0.03	-	-
Annual		0.21		
Effect	Reference population	9,942	-	-
	Increase in background mortality (%)	<0.01	-	-
Potential Effects During Operation: Collision Risk				
Collision mortality		Lower c.i.	Mean	Upper c.i.
Breeding season		0.0	0.0	0.0
Autumn		0.1	0.9	2.6
Spring		0.0	0.1	0.4
Annual		0.1	1.0	3.0
Effect	Reference population	9,942		
	Increase in background mortality (%)	<0.01	<0.01	0.01

Gannet				
Potential Effects During Operation: Combined Disturbance and Displacement and Collision Risk				
Combined Displacement and Collision mortality		Mean	Lower c.i.	Upper c.i.
Breeding season		0	-	-
Autumn		0.23	-	-
Spring		0.04	-	-
Annual		0.27		
Effect	Reference population	9.942	-	-
	Increase in background mortality (%)	<0.01	-	-

~~9.21.2.1.5~~9.22.2.1.5 *Assessment of potential effects of the Projects in combination with other plans and projects*

~~1236.~~1321. Given that no measurable increase in the Fair Isle SPA gannet mortality is predicted as a result of DBS East and DBS West combined (e.g. with total displacement and collision mortality of only 0.27 birds per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted gannet mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Fair Isle SPA**.

~~9.21.2.2~~9.22.2.2 Kittiwake

~~1237.~~1322. Kittiwake has been screened into the assessment to assess the impacts from collision risk in the operation phase.

~~9.21.2.2.1~~9.22.2.2.1 *Status*

~~1238.~~1323. Kittiwake is listed as a named component of the breeding seabird assemblage of the Fair Isle SPA.

~~1239.~~1324. The SPA breeding population at classification in 1994 was cited as 18,160 pairs (SNH, 2009). Burnell *et al.* (2023) give an updated count of 488 AON which has been used in this assessment.

~~9.21.2.2.2~~9.22.2.2.2 *Connectivity to the Projects*

~~1240.~~1325. DBS East and DBS West are 585km and 559km respectively from the Fair Isle SPA. The mean maximum foraging range of kittiwake is 300.6km (156.1km + 144.5km, Woodward *et al.*, 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding kittiwake from the Fair Isle SPA there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

~~1241.~~1326. Outside the breeding season breeding kittiwakes, including those from the Fair Isle SPA, are not constrained by requirements to visit nests to incubate eggs or provision chicks. At this time, they are assumed to range more widely and to mix with kittiwakes of all age classes from breeding colonies in the UK and further afield. The background population during these seasons is the UK North Sea BDMPS. This consists of 829,937 individuals during the autumn migration season (August to December), and 627,816 individuals during the spring migration season (January to April) (Furness, 2015).

~~1242.~~1327. It is estimated that 0.1% of birds present in the Project array areas in both the autumn and spring migration seasons are considered to be breeding adults from the Fair Isle SPA. Note, these percentages have been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

~~9.21.2.2.3~~9.22.2.2.3 *Assessment of Potential Effects of the Projects alone and Together*

~~9.21.2.2.3.1~~9.22.2.2.3.1 *Potential Effects During Operation: Collision risk*

Table 9-150 Summary of kittiwake total collisions and apportioned to the Fair Isle *SPA.*

Site	Season	Collision mortality			SPA %	Adult %	Collisions apportioned to SPA		
		Lower 95% c.i.	Mean	Upper 95% c.i.			Lower 95% c.i.	Mean	Upper 95% c.i.
DBS East	Breeding	42.3	83.3	168.5	0	53	0.0	0.0	0.0
	Autumn	14.6	41.4	82.9	0.1	100	0.0	0.0	0.1
	Spring	6.8	14.6	28.0	0.1	100	0.0	0.0	0.0
	Annual	66.9	139.3	261.3	-	-	0.0	0.1	0.1
DBS West	Breeding	36.9	107.8	280.8	0	53	0.0	0.0	0.0
	Autumn	9.5	37.9	81.9	0.1	100	0.0	0.0	0.1
	Spring	7.1	14.9	26.5	0.1	100	0.0	0.0	0.0
	Annual	55.9	160.6	327.0	-	-	0.0	0.1	0.1
DBS East + DBS West	Breeding	96.2	191.1	378.4	0	53	0.0	0.0	0.0
	Autumn	30.5	79.3	143.1	0.1	100	0.0	0.1	0.1
	Spring	16.9	29.5	47.3	0.1	100	0.0	0.0	0.0
	Annual	150.9	299.9	540.5	-	-	0.0	0.1	0.2

~~9.21.2.2.3.1.1~~9.22.2.2.3.1.1 *DBS East in Isolation*

~~1243.~~1328. At the baseline mortality rate for adult kittiwake of 0.146 (Table 9-7) the number of individuals from the Fair Isle SPA population expected to die is 131 (896 x 0.146) adults per annum. The predicted annual impacts from DBS East alone on the breeding kittiwake population is 0.1 birds per annum (**Table 9-150**). This results in a predicted change in adult mortality rate of 0.05% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.21.2.2.3.1.2~~9.22.2.2.3.1.2 *DBS West in Isolation*

~~1244.~~1329. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-7**) the number of individuals from the Fair Isle SPA population expected to die is 131 (896 x 0.146) adults per annum. The predicted annual impacts from DBS West alone on the breeding kittiwake population is 0.1 birds per annum (**Table 9-150**). This results in a predicted change in adult mortality rate of 0.05% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.21.2.2.3.1.3~~9.22.2.2.3.1.3 *DBS East and West Together*

~~1245.~~1330. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-7**) the number of individuals from the Fair Isle SPA population expected to die is is 131 (896 x 0.146) adults per annum. The predicted annual impacts from DBS East and DBS West on the breeding kittiwake population is 0.1 birds per annum (**Table 9-150**). This results in a predicted change in adult mortality rate of 0.08% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.21.2.2.4~~9.22.2.2.4 *Summary*

~~1246.~~1331. A table summarising the kittiwake operational collision risk assessment for DBS East and DBS West together is provided below (**Table 9-151**).

~~1247.~~1332. It is concluded that predicted kittiwake mortality due to operational phase collision risk at DBS East, DBS West, and the Projects together would **not adversely affect the integrity of the Fair Isle SPA**.

Table 9-151 Summary of predicted Kittiwake collision mortality from Fair Isle SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations for the Worst Case Wind Turbine Scenario.

Kittiwake	Collisions		
Potential Effects During Operation: Collision Risk			
Collision mortality	Lower c.i.	Mean	Upper c.i.
Breeding season	-	-	-

Kittiwake		Collisions		
Autumn		0.0	0.1	0.1
Spring		0.0	0.0	0.0
Annual		0.0	0.1	0.2
Effect	Reference population	896		
	Increase in background mortality (%)	<0.01	0.08	0.20

~~9.21.2.2.5~~9.22.2.2.5 *Assessment of potential effects of the Projects in combination with other plans and projects*

~~1248.~~1333. Given that no measurable increase in the Fair Isle SPA kittiwake mortality is predicted as a result of DBS East and DBS West combined (e.g. with total collision mortality of only 0.11 birds per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted kittiwake mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Fair Isle SPA**.

~~9.21.2.3~~9.22.2.3 Guillemot

~~1249.~~1334. Guillemot has been screened into the assessment to assess the impacts from disturbance / displacement in the construction and operation phase.

~~9.21.2.3.1~~9.22.2.3.1 *Status*

~~1250.~~1335. Guillemot is listed as a designated species of the Fair Isle SPA.

~~1251.~~1336. The SPA breeding population at classification in 1994 was cited as 32,300 individuals (SNH, 2009). Burnell *et al*. (2023) give an updated count of 18,295 individuals which has been used in this assessment.

~~9.21.2.3.2~~9.22.2.3.2 *Connectivity to the Projects*

~~1252.~~1337. DBS East and DBS West are 585km and 559km respectively from the Fair Isle SPA. The mean maximum foraging range of guillemot is 153.7km (73.2km + 80.5km, Woodward *et al*., 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding guillemot from the Fair Isle SPA, there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

~~1253.~~1338. Outside the breeding season, breeding guillemots from the Fair Isle SPA are assumed to range widely and to mix with guillemots from breeding colonies in the UK and beyond. The relevant non-breeding season reference population is the UK North Sea and Channel BDMPS, consisting of 1,617,306 individuals (August to February) (Furness, 2015).

~~1254.~~1339. During the non-breeding season, 70% of Fair Isle SPA breeding adults are assumed to be present in the BDMPS. It is estimated that 1.1% of birds present at the Projects are considered to be breeding adults from the Fair Isle SPA, and impacts are apportioned accordingly (**Table 9-152**). Note, this percentage has been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

~~1255.~~1340. It is estimated that 1.1% of birds present at the Projects are considered to be breeding adults from Fair Isle SPA. Note, this percentage has been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

~~9.21.2.3.3~~9.22.2.3.3 *Assessment of Potential Effects of the Projects alone and Together*

Table 9-152 Summary of guillemot density and abundance estimates and SPA apportioning rates and used in the operation and construction displacement assessment for Fair Isle SPA. Note that displacement from the wind farm has been estimated as 15%-35%, half the operational rates.

Site	Season	Peak no.	SPA %	Adult %	No. apportioned to SPA	Wind farm operation displacement mortality to SPA			Wind farm construction displacement mortality to SPA			Peak density (birds/ km²)	Total vessel displacement mortality (2km around 3 vessels, 1% mortality)	Vessel mortality to SPA	Total construction displacement mortality to SPA		
						30-1	50-1	70-10	15-1	25 - 1	35-10				15-1 & vessel	25 – 1 & vessel	35-10 & vessel
DBS East	Breeding	9030.5	0	55.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.71	6.7	0.00	0.00	0.00	0.00
	Nonbreeding	12551.8	1.1	100	138.1	0.4	0.7	9.7	0.2	0.3	4.8	24.62	9.3	0.10	0.31	0.45	4.93
	Annual					0.4	0.7	9.7	0.2	0.3	4.8	-	16	0.10	0.31	0.45	4.93
DBS West	Breeding	8783.5	0	55.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.92	6.4	0.00	0.00	0.00	0.00
	Nonbreeding	12498.4	1.1	100	137.5	0.4	0.7	9.6	0.2	0.3	4.8	24.08	9.1	0.10	0.31	0.44	4.91
	Annual				137.5	0.4	0.7	9.6	0.2	0.3	4.8	-	15.5	0.10	0.31	0.44	4.91
DBS East + DBS West	Breeding	~~14927.7~~17815	0	55.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	13.0	0.00	0.00	0.00	0.00
	Nonbreeding	~~20136.0~~25050	1.1	100	~~221.5~~275.6	0.~~7~~8	1.~~1~~4	~~15.5~~19.3	0.~~3~~4	0.~~6~~7	~~7.8~~9.6		18.4	0.20	0.~~53~~6	0.~~76~~9	~~7.95~~9.8
	Annual				~~221.5~~275.6	0.~~7~~8	1.~~1~~4	~~15.5~~19.3	0.~~3~~4	0.~~6~~7	~~7.8~~9.6		31.4	0.20	0.~~53~~6	0.~~76~~9	~~7.95~~9.8

~~9.21.2.3.3.1~~9.22.2.3.3.1 *Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines*

~~9.21.2.3.3.1.1~~9.22.2.3.3.1.1 *DBS East in Isolation*

~~1256.~~1341. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Fair Isle SPA population expected to die is 1,~~750 (28,697~~116 (18,295 x 0.061) adults per annum. The predicted annual construction impact from DBS East alone on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 4.93 birds per annum (**Table 9-152**). This would result in a predicted change in adult mortality rate of 0.44%. The equivalent mortality assuming 35% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 0.99 which would increase the background mortality rate by 0.09%.

~~1257.~~1342. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1343. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Fair Isle SPA (0.45) would increase the predicted annual mortality by 0.04% which is below the 1% threshold for detectability and therefore no further assessment was required.

9.22.2.3.3.1.2 DBS West in Isolation

1344. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Fair Isle SPA population expected to die is 1,116 (18,295 x 0.061) adults per annum. The predicted annual construction impact from DBS West alone on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 4.91 birds per annum (**Table 9-152**). This would result in a predicted change in adult mortality rate of 0.44%. The equivalent mortality assuming 35% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 0.98 which would increase the background mortality rate by 0.09%.

~~1258.~~1345. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. ~~2023~~In a study conducted over two breeding seasons conducted at the Beatrice wind farm (Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1259.~~1346. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Fair Isle SPA (0.~~45~~44) would increase the predicted annual mortality by 0.04% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.21.2.3.3.1.2~~9.22.2.3.3.1.3 DBS East and West ~~in Isolation~~ Together

~~1260.~~1347. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Fair Isle SPA population expected to die is 1,~~750 (28,697~~116 (18,295 x 0.061) adults per annum. The predicted annual construction impact from DBS East and DBS West ~~alone~~ on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is ~~4.91~~9.8 birds per annum (**Table 9-152**). This would result in a predicted change in adult mortality rate of 0.~~44%.~~ 88%. The equivalent mortality assuming 35% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 1.96 which would increase the background mortality rate by 0.17%.

~~1261.~~1348. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1262.~~1349. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Fair Isle SPA (0.~~44~~9) would increase the predicted annual mortality by 0.~~04%~~08 which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.21.2.3.3.2~~9.22.2.3.3.2 *Potential Effects During Operation: Disturbance and Displacement*

~~9.21.2.3.3.2.1~~9.22.2.3.3.2.1 *DBS East ~~and West Together~~in Isolation*

~~1263.~~1350. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Fair Isle SPA population expected to die is 1,~~750 (28,697~~116 (18,295 x 0.061) adults per annum. The predicted annual ~~construction~~operation impact from DBS East ~~and DBS West~~alone on the breeding guillemot population applying highly precautionary rates of ~~35~~70% displacement and 10% mortality is 9.7~~.95~~ birds per annum (**Table 9-152)**. This would result in a predicted change in adult mortality rate of 0.~~71%.~~ 86%. The equivalent mortality assuming 70% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 1.94 which would increase the background mortality rate by 0.17%.

~~1264.~~1351. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1265.~~1352. At a more appropriate ~~(construction)~~ displacement rate of ~~25~~50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Fair Isle SPA (0.~~76~~7) would increase the predicted annual mortality by 0.~~07~~06 which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.21.2.3.3.2.2~~9.22.2.3.3.2.2 DBS ~~East~~West in Isolation

~~1266.~~1353. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Fair Isle SPA population expected to die is 1,116 (18,295 x 0.061) adults per annum. The predicted annual operation impact from DBS ~~East~~West alone on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 9.~~7~~6 birds per annum (**Table 9-152**). This would result in a predicted change in adult mortality rate of 0.86%. The equivalent mortality assuming 70% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 1.92 which would increase the background mortality rate by 0.17%.

~~1267.~~1354. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1268.~~1355. At a more appropriate (construction) displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Fair Isle SPA (0.7) would increase the predicted annual mortality by 0.06% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.21.2.3.3.2.3~~9.22.2.3.3.2.3 DBS East and West ~~in Isolation~~ Together

~~1269.~~1356. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Fair Isle SPA population expected to die is 1,116 (18,295 x 0.061) adults per annum. The predicted annual operation impact from DBS East and DBS West ~~alone~~ on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is ~~9.6~~19.3 birds per annum (**Table 9-152**). This would result in a predicted change in adult mortality rate of 1.73% but is based on highly precautionary impact rates. The equivalent mortality assuming 70% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 3.9 which would increase the background mortality rate by 0.35%. A reduction in either the displacement rate (e.g. ~~0.86%.~~to 40%) or the mortality rate (e.g. to 5.5%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in both together).

~~1270.~~1357. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1271.~~1358. At a more appropriate ~~(construction)~~ displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Fair Isle SPA (~~0.7~~1.4) would increase the predicted annual mortality by 0.~~06~~12% which is below the 0.1% threshold for detectability and therefore no further assessment was required.

~~*9.21.2.3.3.2.4 DBS East and West Together*~~

~~1272. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Fair Isle SPA population expected to die is 1,116 (18,295 x 0.061) adults per annum. The predicted annual operation impact from DBS East and DBS West on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 15.5 birds per annum (**Table 9-120**). This would result in a predicted change in adult mortality rate of 1.38% but is based on highly precautionary impact rates. to 50%) or the mortality rate (e.g. to 7%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in both together).~~

~~1273. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Fair Isle SPA (1.1) would increase the predicted annual mortality by 0.17% which is below the 0.1% threshold for detectability and therefore no further assessment was required.~~

9.22.2.3.4 Summary

~~1274.~~1359. A matrix of the annual operational displacement estimates for DBS East and DBS West is provided in **Table 9-153**.

Table 9-153 Displacement matrix for annual project alone (DBS East plus DBS West) guillemot apportioned to Fair Isle SPA adult population.

Mortality %	**Displacement %**									
	10	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**
1	0	1	1	1	1	2	2	2	2	3
2	1	1	2	2	3	3	4	4	5	6
3	1	2	2	3	4	5	6	7	7	8
4	1	2	3	4	6	7	8	9	10	11
5	1	3	4	6	7	8	10	11	12	14
6	2	3	5	7	8	10	12	13	15	17
7	2	4	6	8	10	12	14	15	17	19

Mortality %	Displacement %									
	10	20	30	40	50	60	70	80	90	100
8	2	4	7	9	11	13	15	18	20	22
9	2	5	7	10	12	15	17	20	22	25
10	3	6	8	11	14	17	19	22	25	28
20	6	11	17	22	28	33	39	44	50	55
30	8	17	25	33	41	50	58	66	74	83
50	14	28	41	55	69	83	96	110	124	138
75	21	41	62	83	103	124	145	165	186	207
100	28	55	83	110	138	165	193	220	248	276

~~1275.~~1360. A table summarising the guillemot construction and operational disturbance and displacement assessment for DBS East and DBS West together is provided below (**Table 9-154**).

~~1276.~~1361. It is concluded that predicted guillemot mortality due to construction and operational phase disturbance and displacement impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the Fair Isle SPA**.

Table 9-154 Summary of predicted guillemot displacement mortality from Fair Isle SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.

Guillemot		Displacement		
Potential Effects During Construction: Disturbance and Displacement				
Displacement mortality		Mean (@25% x 1%)	Mean (@35% x ~~10~~2%)	Mean (@~~25~~35% x ~~1~~10%)
Breeding season		0	0	0
Nonbreeding season		0.~~76~~9	1.96	9.8
Annual		0.~~76~~9	1.96	9.8
Effect	Reference population	18,295		

Guillemot		Displacement		
	Increase in back-ground mortality (%)	0.~~71~~08	0.~~07~~17	0.88
Potential Effects During Operation: Disturbance and Displacement				
Displacement mortality		Mean (@50% x 1%)	Mean (@70% x ~~10~~2%)	Mean (@~~50~~70% x ~~1~~10%)
Breeding season		0	0	0
Nonbreeding season		1.~~1~~4	3.9	19.3
Annual		1.~~1~~4	3.9	19.3
Effect	Reference population	18,295		
	Increase in back-ground mortality (%)	~~1.38~~0.12	0.~~10~~35	1.73

~~9.21.2.3.4~~9.22.2.3.5 Assessment of potential effects of the Projects in combination with other plans and projects

~~1277.~~1362. Given that no measurable increase in the Fair Isle SPA guillemot mortality is predicted as a result of DBS East and DBS West combined (e.g. with realistic displacement mortality of 1.~~1~~4 birds per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted guillemot mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Fair Isle SPA**.

~~9.21.2.4~~9.22.2.4 Razorbill

~~1278.~~1363. Razorbill has been screened into the assessment to assess the impacts from disturbance / displacement in the construction and operation phase.

~~9.21.2.4.1~~9.22.2.4.1 Status

~~1279.~~1364. Razorbill is listed as a named component of the breeding seabird assemblage of the Fair Isle SPA.

~~1280.~~1365. The SPA breeding population at classification in 1994 was cited as 3,400 individuals (SNH, 2009). Burnell *et al.* (2023) give an updated count of 1,925 individuals which has been used in this assessment.

~~9.21.2.4.2~~9.22.2.4.2 Connectivity to the Projects

~~1281.~~1366. DBS East and DBS West are 585km and 559km respectively from Fair Isle SPA. The mean maximum foraging range of razorbill is 164.6km (88.7 + 75.9km, Woodward *et al.*, 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding razorbill from Fair Isle SPA, there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

~~1282.~~1367. Outside the breeding season, breeding razorbills from Fair Isle SPA are assumed to range widely and to mix with razorbills from breeding colonies in the UK and further afield. The relevant background population is considered to be the UK North Sea and Channel BDMPS, consisting of 591,874 individuals during autumn and spring passage periods (August to October and January to March), and 218,622 individuals during winter (November and December) (Furness, 2015).

~~1283.~~1368. During the autumn and spring migration it is estimated that Fair Isle birds make up 0.3% of the BDMPS population, and during the winter 0.3% of the BDMPS population. Note, these percentages have been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

~~9.21.2.4.3~~9.22.2.4.3 Assessment of Potential Effects of the Projects alone and Together

Table 9-155 Summary of razorbill density and abundance estimates and SPA apportioning rates and used in the operation and construction displacement assessment for Fair Isle SPA. Note that displacement from the wind farm has been estimated as 15%-35%, half the operational rates.

Site	Season	Peak no.	SPA %	Adult %	No. apportioned to SPA	Wind farm operation displacement mortality to SPA			Wind farm construction displacement mortality to SPA			Peak density (birds/ km²)	Total vessel displacement mortality (2km around 3 vessels, 1% mortality)	Vessel mortality to SPA	Total construction displacement mortality to SPA		
						30-1	50-1	70-10	15-1	25 - 1	35-10				15-1 & vessel	25 – 1 & vessel	35-10 & vessel
DBS East	Breeding	555.1	0	100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.4	0.00	0.00	0.00	0.00
	Autumn	4685.3	0.3	100	14.1	0.0	0.1	1.0	0.0	0.0	0.5	9.2	3.5	0.01	0.03	0.05	0.50
	Winter	3376.7	0.3	100	10.1	0.0	0.1	0.7	0.0	0.0	0.4	6.6	2.5	0.01	0.02	0.03	0.36
	Spring	3578.5	0.3	100	10.7	0.0	0.1	0.8	0.0	0.0	0.4	7.0	2.6	0.01	0.02	0.03	0.38
	Annual				34.9	0	0.3	2.5	0	0	1.3	-	9	0.03	0.07	0.11	1.24
DBS West	Breeding	2280.6	0	100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.4	1.7	0.00	0.00	0.00	0.00
	Autumn	4886.9	0.3	100	14.7	0.0	0.1	1.0	0.0	0.0	0.5	9.4	3.5	0.01	0.03	0.05	0.52
	Winter	5066.2	0.3	100	15.2	0.0	0.1	1.1	0.0	0.0	0.5	9.7	3.7	0.01	0.03	0.05	0.54
	Spring	4454.6	0.3	100	13.4	0.0	0.1	0.9	0.0	0.0	0.5	8.6	3.2	0.01	0.03	0.04	0.48
	Annual				43.3	0.1	0.2	3.0	0.1	0.1	1.5	-	9.1	0.03	0.09	0.14	1.54
DBS East + DBS West	Breeding	~~2826.1~~2835.7	0	100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	2.1	0.00	0.00	0.00	0.00
	Autumn	~~6349.6~~9572.2	0.3	100	~~19.0~~28.7	0.1	0.1	~~1.3~~2.0	0.0	0.~~0~~1	1.0~~.7~~		7.0	0.02	0.~~05~~06	0.~~07~~09	~~0.69~~1.03
	Winter	~~5823.7~~8442.9	0.3	100	~~17.5~~25.3	0.1	0.1	1.~~2~~8	0.0	0.~~0~~1	0.~~6~~9		6.1	0.02	0.~~04~~06	0.~~06~~08	0.~~63~~91
	Spring	~~6302.5~~8033.1	0.3	100	~~18.9~~24.1	0.1	0.1	1.~~3~~7	0.0	0.~~0~~1	0.~~7~~8		5.9	0.02	0.~~05~~06	0.~~06~~08	0.~~68~~86
	Annual				~~55.4~~78.1	0.2	0.~~3~~4	~~3.9~~5.5	0.1	0.~~1~~2	~~1.9~~2.7		18.2	0.06	0.~~14~~18	0.~~19~~26	2.~~0~~80

~~9.21.2.4.3.1~~9.22.2.4.3.1 *Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines*

~~9.21.2.4.3.1.1~~9.22.2.4.3.1.1 *DBS East in Isolation*

~~1284.~~1369. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-7**) the number of individuals from the Fair Isle SPA population expected to die is 202 (1,925 x 0.105) adults per annum. The predicted annual construction impact from DBS East alone on the breeding razorbill population applying highly precautionary rates of 35% displacement and 10% mortality is 1.2 (0.5, 0.4, 0.4 in autumn winter and spring respectively) birds per annum (**Table 9-155**). This would result in a predicted change in adult mortality rate of 0.6%. The equivalent mortality assuming 35% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 0.24 which would increase the background mortality rate by 0.12%.

~~1285.~~1370. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (Trinder *et al*. 2024) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1286.~~1371. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green ~~2023~~(2019b), the annual displacement mortality apportioned to the Fair Isle SPA (0.1) would increase the predicted annual mortality by 0.05% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.21.2.4.3.1.2~~9.22.2.4.3.1.2 *DBS West in Isolation*

~~1287.~~1372. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-7**) the number of individuals from the Fair Isle SPA population expected to die is 202 (1,925 x 0.105) adults per annum. The predicted annual construction impact from DBS West alone on the breeding razorbill population applying highly precautionary rates of 35% displacement and 10% mortality is 1.5 (0.5, 0.5, 0.5 in autumn winter and spring respectively) birds per annum (**Table 9-155**). This would result in a predicted change in adult mortality rate of 0.7%. The equivalent mortality assuming 35% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 0.3 which would increase the background mortality rate by 0.15%.

~~1288.~~1373. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (Trinder *et al*. 2024) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1289.~~1374. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the ~~MacArthur Green 2023~~Fair Isle SPA (0.1) would increase the predicted annual mortality by 0.07% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.21.2.4.3.1.3~~9.22.2.4.3.1.3 DBS East and West Together

~~1290.~~ At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-7**~~) the number of individuals from the Fair Isle SPA population expected to die is 202 (1,925 x 0.105) adults per annum. The predicted annual construction impact from DBS East and DBS West on the breeding razorbill population applying highly precautionary rates of 35% displacement and 10% mortality is 2.0 (0.7, 0.6, 0.7 in autumn winter and spring respectively) birds per annum (**Table 9-122**). This would result in a predicted change in adult mortality rate of 0.9In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 20232) would increase the predicted annual mortality by 0.1% which is below the 1% threshold for detectability and therefore no further assessment was required.~~

1375. ~~At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-5**~~) the number of individuals from the Fair Isle SPA population expected to die is 202 (1,925 x 0.105) adults per annum. The predicted annual construction impact from DBS East and DBS West on the breeding razorbill population applying highly precautionary rates of 35% displacement and 10% mortality is 2.8 (1.0, 0.9, 0.9 in autumn winter and spring respectively) birds per annum (**Table 9-155**). This would result in a predicted change in adult mortality rate of 1.4%. The equivalent mortality assuming 35% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 0.56 which would increase the background mortality rate by 0.28%.

~~1291.~~1376. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (Trinder *et al*. 2024) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1377. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Fair Isle SPA (0.3) would increase the predicted annual mortality by 0.13% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.21.2.4.3.2~~9.22.2.4.3.2 *Potential Effects During Operation: Disturbance and Displacement*

~~9.21.2.4.3.2.1~~9.22.2.4.3.2.1 *DBS East in Isolation*

~~1292.~~1378. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-7**) the number of individuals from the Fair Isle SPA population expected to die is 202 (1,925 x 0.105) adults per annum. The predicted annual operation impact from DBS East alone on the breeding razorbill population applying highly precautionary rates of 70% displacement and 10% mortality is 2.4 (1.0, 0.7, 0.8 in autumn winter and spring respectively) birds per annum (**Table 9-155**). This would result in a predicted change in adult mortality rate of 1.2% but is based on highly precautionary impact rates. ~~**Table 9-122**).~~ ~~This would result in a predicted change in adult~~ The equivalent mortality assuming 70% displacement and 2% mortality (the latter rate ~~of 1.2% but is based on highly precautionary impact rates.~~as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 0.48 which would increase the background mortality rate by 0.24%. A reduction in either the displacement rate (e.g. to 59%) or the mortality rate (e.g. to 8%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in both together).

~~1293.~~1379. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. ~~In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023~~In a study conducted over two breeding seasons conducted at the Beatrice wind farm (Trinder *et al*. 2024) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1294.~~1380. At a more appropriate operational displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Fair Isle SPA (0.2) would increase the predicted annual mortality by 0.08% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.21.2.4.3.2.2~~9.22.2.4.3.2.2 *DBS West in Isolation*

1381. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-7**) the number of individuals from the Fair Isle SPA population expected to die is 202 (1,925 x 0.105) adults per annum. The predicted annual operation impact from DBS West alone on the breeding razorbill population applying highly precautionary rates of 70% displacement and 10% mortality is 3.0 (1.0, 1.1, 0.9 in autumn winter and spring respectively) birds per annum (**Table 9-155**). This would result in a predicted change in adult mortality rate of 1.5% but is based on highly precautionary impact rates. The equivalent mortality assuming 70% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 0.6 which would increase the background mortality rate by 0.30%. A reduction in either the displacement rate (e.g. to 47%) or the mortality rate (e.g. to 6.7%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in both together).

1382. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. ~~to 6~~In a study conducted over two breeding seasons conducted at the Beatrice wind farm (Trinder *et al*. 2024) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1383. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Fair Isle SPA (0.2) would increase the predicted annual mortality by 0.1% which is below the 1% threshold for detectability and therefore no further assessment was required.

9.22.2.4.3.2.3 DBS East and West Together

~~1295.~~1384. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-7**) the number of individuals from the Fair Isle SPA population expected to die is 202 (1,925 x 0.105) adults per annum. The predicted annual construction impact from DBS East and DBS West on the breeding razorbill population applying highly precautionary rates of 70% displacement and 10% mortality is 5.5 (2.0, 1.8, 1.7 in autumn winter and spring respectively) birds per annum (**Table 9-155**). This would result in a predicted change in adult mortality rate of 2.7% but is based on highly precautionary impact rates. The equivalent mortality assuming 70% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 1.10 which would increase the background mortality rate by 0.54%. A reduction the mortality rate (e.g. to 3.7%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in ~~both together).~~ mortality combined with reduced displacement).

~~1296.~~1385. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (Trinder *et al*. 2024) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1297.~~1386. At a more appropriate operational displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the ~~MacArthur Green 2023At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the~~ Fair Isle SPA (0.~~2~~4) would increase the predicted annual mortality by 0.~~1~~2% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.21.2.4.4~~9.22.2.4.4 Summary

~~9.21.2.4.4.1.1 DBS East and West Together~~

1387. ~~At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-5**) the number of individuals from the Fair Isle SPA population expected to die is 202 (1,925 x 0.105) adults per annum. The predicted annual construction impact from DBS East and DBS West on the breeding razorbill population applying highly precautionary rates of 70% displacement and 10% mortality is 3.9 (1.3, 1.2, 1.3 in autumn winter and spring respectively) birds per annum (**Table 9-122**). This would result in a predicted change in adult mortality rate of 1.9% but is based on highly precautionary impact rates.~~ A matrix of the annual operational displacement estimates for DBS East and DBS West is provided in **Table 9-156**.

Table 9-156 Displacement matrix for annual project alone (DBS East plus DBS West) razorbill apportioned to Fair Isle SPA adult population.

Mortality %	**Displacement %**									
	10	20	30	40	50	60	70	80	90	100
1	0	0	0	0	0	0	1	1	1	1
2	0	0	0	1	1	1	1	1	1	2
3	0	0	1	1	1	1	2	2	2	2
4	0	1	1	1	2	2	2	2	3	3
5	0	1	1	2	2	2	3	3	4	4
6	0	1	1	2	2	3	3	4	4	5
7	1	1	2	2	3	3	4	4	5	5
8	1	1	2	2	3	4	4	5	6	6
9	1	1	2	3	4	4	5	6	6	7
10	1	2	2	3	4	5	5	6	7	8
20	2	3	5	6	8	9	11	12	14	16
30	2	5	7	9	12	14	16	19	21	23

Mortality %	Displacement %									
	10	20	30	40	50	60	70	80	90	100
50	4	8	12	16	20	23	27	31	35	39
75	6	12	18	23	29	35	41	47	53	59
100	8	16	23	31	39	47	55	62	70	78

~~1298. to 5.2%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in both together).~~

~~1299. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023Fair Isle SPA (0.3) would increase the predicted annual mortality by 0.1% which is below the 1% threshold for detectability and therefore no further assessment was required.~~

~~1300.~~1388. A table summarising the razorbill construction and operational disturbance and displacement assessment for DBS East and DBS West together is provided below (**Table 9-157**).

~~1301.~~1389. It is concluded that predicted razorbill mortality due to construction and operational phase disturbance and displacement impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the Fair Isle SPA**.

Table 9-157 Summary of predicted razorbill displacement mortality from Fair Isle SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.

~~Guillemot~~Razorbill		Displacement		
Potential Effects During Construction: Disturbance and Displacement				
Displacement mortality		Mean (@25% x 1%)	Mean (@35% x ~~10~~2%)	Mean (@~~25~~35% x ~~1~~10%)
Breeding season		0	0	0
Autumn		0.~~69~~09	0.~~07~~21	1.03
Winter		0.~~63~~08	0.~~06~~18	0.91
Spring		0.~~68~~08	0.~~06~~17	0.86
Annual		~~2.~~0.26	0.~~19~~56	2.80
Effect	Reference population	2,159		
	Increase in background mortality (%)	0.~~9~~13	0.~~09~~28	1.38

~~Guillemot~~Razorbill		Displacement		
Potential Effects During Operation: Disturbance and Displacement				
Displacement mortality		Mean (@50% x 1%)	Mean (@70% x ~~10~~2%)	Mean (@~~50~~70% x ~~1~~10%)
Breeding season		0	0	0
Autumn		0.1~~.3~~	0.~~1~~4	2.0
Winter		0.1~~.2~~	0.~~1~~36	1.8
Spring		0.1~~.3~~	0.~~1~~34	1.7
Annual		0.~~3~~4	1.1	5.5
Effect	Reference population	2,159		
	Increase in background mortality (%)	~~1.9~~0.19	0.~~1~~54	2.71

~~9.21.2.4.5~~9.22.2.4.5 Assessment of potential effects of the Projects in combination with other plans and projects

~~1302.~~1390. Given that no measurable increase in the Fair Isle SPA razorbill mortality is predicted as a result of DBS East and DBS West combined (e.g. with realistic displacement mortality of 0.3 birds per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted guillemot mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Fair Isle SPA**.

~~9.21.2.5~~9.22.2.5 Puffin

~~1303.~~1391. Puffin has been screened into the assessment to assess the impacts from disturbance / displacement in the construction and operation phase.

~~9.21.2.5.1~~9.22.2.5.1 Status

~~1304.~~1392. Puffin is listed as a named component of the breeding seabird assemblage of the Fair Isle SPA. The SPA breeding population at classification in 1994 was cited as 23,000 individuals (SNH, 2009). Burnell *et al*. (2023) give an updated count of 6,666 AOB which has been used in this assessment.

~~9.21.2.5.2~~9.22.2.5.2 Connectivity to the Projects

~~1305.~~1393. DBS East and DBS West are 585km and 559km respectively from Fair Isle SPA. The mean maximum foraging range of puffin is 265.4km (137.1km +128.3km, Woodward *et al*., 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding puffin from Fair Isle SPA, there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only. Outside the breeding season, breeding puffins from Fair Isle SPA are assumed to range widely and to mix with puffins from breeding colonies in the UK and further afield. The relevant non-breeding season reference population is the UK North Sea and Channel BDMPS, consisting of 231,957 individuals (mid-August to March) (Furness, 2015). It is estimated that 1.4% of birds present at the Projects are breeding adults from Fair Isle SPA. Note, this percentage has been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

~~9.21.2.5.3~~9.22.2.5.3 Assessment of Potential Effects of the Projects alone and Together

Table 9-158 Summary of puffin density and abundance estimates and SPA apportioning rates and used in the operation and construction displacement assessment for Fair Isle SPA. Note that displacement from the wind farm has been estimated as 15%-35%, half the operational rates.

Site	Season	Peak no.	SPA %	Adult %	No. apportioned to SPA	Wind farm operation displacement mortality to SPA			Wind farm construction displacement mortality to SPA			Peak density (birds/ km^2)	Total vessel displacement mortality (2km around 3 vessels, 1% mortality)	Vessel mortality to SPA	Total construction displacement mortality to SPA		
						30-1	50-1	70-10	15-1	25 - 1	35-10				15-1 & vessel	25 – 1 & vessel	35-10 & vessel
DBS East	Breeding	62.60	0	0.543	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.05	0.00	0.00	0.00	0.00
	Nonbreeding	178.70	1.4	1	2.5	0.01	0.01	0.18	0.00	0.01	0.09	0.35	0.13	0.00	0.01	0.01	0.09
	Annual				2.5	0.01	0.01	0.18	0.00	0.01	0.09	-	0.18	0.00	0.01	0.01	0.09
DBS West	Breeding	109.3	0	0.543	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.21	0.08	0.00	0.00	0.00	0.00
	Nonbreeding	198.2	1.4	1	2.8	0.01	0.01	0.19	0.00	0.01	0.10	0.38	0.14	0.00	0.01	0.01	0.10
	Annual				2.8	0.01	0.01	0.19	0.00	0.01	0.10	-	0.22	0.00	0.01	0.01	0.10
DBS East + DBS West	Breeding	~~146.60~~171.9	0	0.543	0.0	0.00	0.00	0.00	0.00	0.00	0.00	-	0.12	0.00	0.00	0.00	0.00
	Nonbreeding	~~372.70~~376.9	1.4	1	5.2	0.02	0.03	0.37	0.01	0.01	0.18		0.28	0.00	0.01	0.02	0.19
	Annual				5.2	0.02	0.03	0.37	0.01	0.01	0.18		0.4	0.00	0.01	0.02	0.19

~~9.21.2.5.3.1~~9.22.2.5.3.1 *Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines*

~~9.21.2.5.3.1.1~~9.22.2.5.3.1.1 *DBS East in Isolation*

~~1306.~~1394. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-7**) the number of individuals from the Fair Isle SPA population expected to die is 1,253 (13,332 x 0.094) adults per annum. The predicted annual construction impact from DBS East alone on the breeding puffin population applying highly precautionary rates of 35% displacement and 10% mortality is 0.09 birds per annum (**Table 9-158)**. This would result in a predicted change in adult mortality rate of <0.01%.

~~1307.~~1395. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that puffins avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is equivalent to the natural adult background mortality rate of 9.4%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of puffin populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1308.~~1396. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Fair Isle SPA (0.01) would increase the predicted annual mortality by <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.21.2.5.3.1.2~~9.22.2.5.3.1.2 *DBS West in Isolation*

~~1309.~~1397. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-7**) the number of individuals from the Fair Isle SPA population expected to die is 1,253 (13,332 x 0.094) adults per annum. The predicted annual construction impact from DBS West alone on the breeding puffin population applying highly precautionary rates of 35% displacement and 10% mortality is 0.1 birds per annum (**Table 9-158**). This would result in a predicted change in adult mortality rate of <0.01%.

~~1310.~~1398.There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that puffins avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is equivalent to the natural adult background mortality rate of 9.4%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of puffin populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1311.~~1399.At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Fair Isle SPA (0.01) would increase the predicted annual mortality by <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.21.2.5.3.1.3~~9.22.2.5.3.1.3 DBS East and West Together

~~1312.~~1400.At the baseline mortality rate for adult puffin of 0.094 (**Table 9-7**) the number of individuals from the Fair Isle SPA population expected to die is 1,253 (13,332 x 0.094) adults per annum. The predicted annual construction impact from DBS East and DBS West on the breeding puffin population applying highly precautionary rates of 35% displacement and 10% mortality is 0.19 birds per annum (**Table 9-158**). This would result in a predicted change in adult mortality rate of 0.01%.

~~1313.~~1401.There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that puffins avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is equivalent to the natural adult background mortality rate of 9.4%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of puffin populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1314.~~1402. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Fair Isle SPA (0.02) would increase the predicted annual mortality by <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.21.2.5.3.2~~9.22.2.5.3.2 *Potential Effects During Operation: Disturbance and Displacement*

~~9.21.2.5.3.2.1~~9.22.2.5.3.2.1 *DBS East in Isolation*

~~1315.~~1403. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-7**) the number of individuals from the Fair Isle SPA population expected to die is 1,253 (13,332 x 0.094) adults per annum. The predicted annual operation impact from DBS East alone on the breeding puffin population applying highly precautionary rates of 70% displacement and 10% mortality is 0.18 birds per annum (**Table 9-158**). This would result in a predicted change in adult mortality rate of 0.01%.

~~1316.~~1404. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that puffins avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is equivalent to the natural adult background mortality rate of 9.4%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of puffin populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1317.~~1405. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Fair Isle SPA (0.01) would increase the predicted annual mortality by <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.21.2.5.3.2.2~~9.22.2.5.3.2.2 *DBS West in Isolation*

~~1318.~~1406. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-7**) the number of individuals from the Fair Isle SPA population expected to die is 1,253 (13,332 x 0.094) adults per annum. The predicted annual operation impact from DBS West alone on the breeding puffin population applying highly precautionary rates of 70% displacement and 10% mortality is 0.19 birds per annum (**Table 9-158**). This would result in a predicted change in adult mortality rate of 0.01%.

~~1319.~~1407. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that puffins avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is equivalent to the natural adult background mortality rate of 9.4%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of puffin populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1320.~~1408. At a more appropriate (construction) displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Fair Isle SPA (0.01) would increase the predicted annual mortality by <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.21.2.5.3.2.3~~9.22.2.5.3.2.3 *DBS East and West Together*

~~1321.~~1409. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-7**) the number of individuals from the Fair Isle SPA population expected to die is 1,253 (13,332 x 0.094) adults per annum. The predicted annual operation impact from DBS East and DBS West on the breeding puffin population applying highly precautionary rates of 70% displacement and 10% mortality is 0.37 birds per annum (**Table 9-158**). This would result in a predicted change in adult mortality rate of 0.03%.

~~1322.~~1410.There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that puffins avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is equivalent to the natural adult background mortality rate of 9.4%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of puffin populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1323.~~1411.At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Fair Isle SPA (0.03) would increase the predicted annual mortality by <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.21.2.5.4~~9.22.2.5.4 Summary

~~1324.~~1412.A table summarising the puffin construction and operational disturbance and displacement assessment for DBS East and DBS West together is provided below (**Table 9-159)**.

~~1325.~~1413.It is concluded that predicted puffin mortality due to construction and operational phase disturbance and displacement impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the Fair Isle SPA**.

Table 9-159 Summary of predicted puffin displacement mortality from Fair Isle SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.

Puffin	**Displacement**	
Potential Effects During Construction: Disturbance and Displacement		
~~Displacement mortality~~	~~Mean (@35% x 10%)~~	~~Mean (@25% x 1%)~~
Displacement mortality	Mean (@25% x 1%)	Mean (@35% x 10%)
Breeding season	0	0
~~Nonbreeding season~~	~~0.19~~	~~0.02~~
~~Annual~~	~~0.19~~	~~0.02~~
Nonbreeding season	0.02	0.19
Annual	0.02	0.19

Puffin		**Displacement**	
Effect	Reference population	13,332	
	Increase in background mortality (%)	<0.~~015~~01	~~<~~0.~~01~~015
Potential Effects During Operation: Disturbance and Displacement			
Displacement mortality		Mean (@~~70~~50% x ~~10~~1%)	Mean (@~~50~~70% x ~~1~~10%)
Breeding season		0	0
Nonbreeding season		0.~~37~~03	0.~~03~~37
Annual		0.~~37~~03	0.~~03~~37
Effect	Reference population	13,332	
	Increase in background mortality (%)	<0.~~03~~01	~~<~~0.~~01~~03

~~9.21.2.5.5~~9.22.2.5.5 Assessment of potential effects of the Projects in combination with other plans and projects

~~1326.~~1414.Given that no measurable increase in the Fair Isle SPA puffin mortality is predicted as a result of DBS East and DBS West combined (e.g. with realistic displacement mortality of 0.03 birds per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted puffin mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Fair Isle SPA**.

~~9.22~~9.23 Sumburgh Head SPA

~~9.22.1~~9.23.1 Site Description

~~1327.~~1415.Sumburgh Head SPA was designated in 1996.

~~1328.~~1416.The site covers an area of cliffs and boulder beaches at the southern tip of Mainland, Shetland.

~~1329.~~1417.The boundary of the SPA is coincident with that of Sumburgh Head SSSI and the seaward extension extends approximately 2km into the marine environment to include the seabed, water column and surface.

~~9.22.1.1~~9.23.1.1 Qualifying Features

~~1330.~~1418.The qualifying features of the Sumburgh Head SPA screened into the assessment are listed in Table 4-7 of **RIAA HRA Part 1 of 4 – Introduction and Terrestrial Ecology (application ref: 6.1).**These are two named components of the breeding seabird assemblage (kittiwake and guillemot).

~~9.22.1.2~~9.23.1.2 Conservation Objectives

~~1331.~~1419. The over-arching conservation objectives of the site are:

- To avoid deterioration of the habitats of the qualifying species or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained; and
- To ensure for the qualifying species that the following are maintained in the long term:
  - Population of the species as a viable component of the site;
  - Distribution of the species within site;
  - Distribution and extent of habitats supporting the species;
  - Structure, function and supporting processes of habitats supporting the species; and
  - No significant disturbance of the species.

~~9.22.2~~9.23.2 Assessment: Array Areas

~~9.22.2.1~~9.23.2.1 Kittiwake

~~1332.~~1420. Kittiwake has been screened into the assessment to assess the impacts from collision risk in the operation phase.

~~9.22.2.1.1~~9.23.2.1.1 Status

~~1333.~~1421. Kittiwake is listed as a named component of the breeding seabird assemblage of the Sumburgh Head SPA.

~~1334.~~1422. The SPA breeding population at classification in 1996 was cited as 1,366 pairs (SNH, 2009). Burnell *et al*. (2023) give an updated count of 966 AON which has been used in this assessment.

~~9.22.2.1.2~~9.23.2.1.2 Connectivity to the Projects

~~1335.~~1423. DBS East and DBS West are 615km and 590km respectively from the Sumburgh Head SPA. The mean maximum foraging range of kittiwake is 300.6km (156.1km + 144.5km, Woodward *et al*., 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding kittiwake from the Sumburgh Head SPA there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

~~1336.~~1424. Outside the breeding season breeding kittiwakes, including those from the Sumburgh Head SPA, are not constrained by requirements to visit nests to incubate eggs or provision chicks. At this time, they are assumed to range more widely and to mix with kittiwakes of all age classes from breeding colonies in the UK and further afield. The background population during these seasons is the UK North Sea BDMPS. This consists of 829,937 individuals during the autumn migration season (August to December), and 627,816 individuals during the spring migration season (January to April) (Furness, 2015).

~~1337.~~1425. It is estimated that 0.03 and 0.04% of birds present in the Project array areas in the autumn and spring migration seasons respectively are considered to be breeding adults from Sumburgh Head SPA. Note, these percentages have been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

~~9.22.2.1.3~~9.23.2.1.3 *Assessment of Potential Effects of the Projects alone and Together*

~~9.22.2.1.3.1~~9.23.2.1.3.1 *Potential Effects During Operation: Collision risk*

Table 9-160 Summary of kittiwake total collisions and apportioned to the Sumburgh Head SPA.

Site	Season	Collision mortality			SPA %	Adult %	Collisions apportioned to SPA		
		Lower 95% c.i.	Mean	Upper 95% c.i.			Lower 95% c.i.	Mean	Upper 95% c.i.
DBS East	Breeding	42.3	83.3	168.5	0	53	0.0	0.0	0.0
	Autumn	14.6	41.4	82.9	0.03	100	0.0	0.0	0.0
	Spring	6.8	14.6	28.0	0.04	100	0.0	0.0	0.0
	Annual	66.9	139.3	261.3	-	-	0.0	0.0	0.0
DBS West	Breeding	36.9	107.8	280.8	0	53	0.0	0.0	0.0
	Autumn	9.5	37.9	81.9	0.03	100	0.0	0.0	0.0
	Spring	7.1	14.9	26.5	0.04	100	0.0	0.0	0.0
	Annual	55.9	160.6	327.0	-	-	0.0	0.0	0.0
DBS East +	Breeding	96.2	191.1	378.4	0	53	0.0	0.0	0.0

Site	Season	Collision mortality			SPA %	Adult %	Collisions apportioned to SPA		
		Lower 95% c.i.	Mean	Upper 95% c.i.			Lower 95% c.i.	Mean	Upper 95% c.i.
DBS West	Autumn	30.5	79.3	143.1	0.03	100	0.0	0.0	0.0
	Spring	16.9	29.5	47.3	0.04	100	0.0	0.0	0.0
	Annual	150.9	299.9	540.5	-	-	0.0	0.0	0.1

~~9.22.2.1.3.1.1~~9.23.2.1.3.1.1 DBS East in Isolation

~~1338.~~1426. At the baseline mortality rate for adult kittiwake of 0.146 (Table 9-7) the number of individuals from the Sumburgh Head SPA population expected to die is 282 (1,932 x 0.146) adults per annum. The predicted annual impacts from DBS East alone on the breeding kittiwake population is 0.02 birds per annum (**Table 9-160**). This results in a predicted change in adult mortality rate of 0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.22.2.1.3.1.2~~9.23.2.1.3.1.2 DBS West in Isolation

~~1339.~~1427. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-7**) the number of individuals from the Sumburgh Head SPA population expected to die is 282 (1,932 x 0.146) adults per annum. The predicted annual impacts from DBS West alone on the breeding kittiwake population is 0.02 birds per annum (**Table 9-160**). This results in a predicted change in adult mortality rate of 0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.22.2.1.3.1.3~~9.23.2.1.3.1.3 DBS East and West Together

~~1340.~~1428. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-7**) the number of individuals from the Sumburgh Head SPA population expected to die is 282 (1,932 x 0.146) adults per annum. The predicted annual impacts from DBS East and DBS West on the breeding kittiwake population is 0.04 birds per annum (**Table 9-160**). This results in a predicted change in adult mortality rate of 0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.22.2.1.4~~9.23.2.1.4 *Summary*

~~1341.~~1429. A table summarising the kittiwake operational collision risk assessment for DBS East and DBS West together is provided below (**Table 9-161)**.

~~1342.~~1430. It is concluded that predicted kittiwake mortality due to operational phase collision risk at DBS East, DBS West, and the Projects together would **not adversely affect the integrity of the Sumburgh Head SPA**.

Table 9-161 Summary of predicted Kittiwake collision mortality from Sumburgh Head SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations for the Worst Case Wind Turbine Scenario.

Kittiwake		**Collisions**		
Potential Effects During Operation: Collision Risk				
Collision mortality		Mean	Lower c.i.	Upper c.i.
Breeding season		-	-	-
Autumn		0.0	0.0	0.0
Spring		0.0	0.0	0.0
Annual		0.0	0.0	0.1
Effect	Reference population	1,932		
	Increase in background mortality (%)	<0.01	0.01	0.03

~~9.22.2.1.5~~9.23.2.1.5 *Assessment of potential effects of the Projects in combination with other plans and projects*

~~1343.~~1431. Given that no measurable increase in the Sumburgh Head SPA kittiwake mortality is predicted as a result of DBS East and DBS West combined (e.g. with total collision mortality of only 0.04 birds per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted kittiwake mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Sumburgh Head SPA**.

~~9.22.2.2~~9.23.2.2 Guillemot

~~1344.~~1432. Guillemot has been screened into the assessment to assess the impacts from disturbance / displacement in the construction and operation phase.

~~9.22.2.2.1~~9.23.2.2.1 *Status*

~~1345.~~1433. Guillemot is listed as a named component of the breeding seabird assemblage of the Sumburgh Head SPA.

~~1346.~~1434.The SPA breeding population at classification in 1996 was 16,000 individuals (SNH, 2009). Burnell *et al*. (2023) give an updated count of 17,810 individuals which has been used in this assessment.

~~9.22.2.2.2~~9.23.2.2.2 *Connectivity to the Projects*

~~1347.~~1435.DBS East and DBS West are 615km and 590km respectively from the Sumburgh Head SPA. The mean maximum foraging range of guillemot is 153.7km (73.2km + 80.5km, Woodward *et al*., 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding guillemot from the Sumburgh Head SPA, there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

~~1348.~~1436.Outside the breeding season, breeding guillemots from the SPA are assumed to range widely and to mix with guillemots from breeding colonies in the UK and beyond. The relevant non-breeding season reference population is the UK North Sea and Channel BDMPS, consisting of 1,617,306 individuals (August to February) (Furness, 2015).

~~1349.~~1437.During the non-breeding season, 70% of the Sumburgh Head SPA breeding adults are assumed to be present in the BDMPS. It is estimated that 0.4% of birds present at the Projects are considered to be breeding adults from the Sumburgh Head SPA, and impacts are apportioned accordingly **(Table 9-162**). Note, this percentage has been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

~~1350.~~1438.It is estimated that 0.4% of birds present at the Projects are considered to be breeding adults from Sumburgh Head SPA. Note, this percentage has been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

~~9.22.2.2.3~~9.23.2.2.3 *Assessment of Potential Effects of the Projects alone and Together*

Table 9-162 Summary of guillemot density and abundance estimates and SPA apportioning rates and used in the operation and construction displacement assessment for Sumburgh Head SPA. Note that displacement from the wind farm has been estimated as 15%-35%, half the operational rates.

Site	Season	Peak no.	SPA %	Adult %	No. apportioned to SPA	Wind farm operation displacement mortality to SPA			Wind farm construction displacement mortality to SPA			Peak density (birds/ km^2)	Total vessel displacement mortality (2km around 3 vessels, 1% mortality)	Vessel mortality to SPA	Total construction displacement mortality to SPA		
						30-1	50-1	70-10	15-1	25 - 1	35-10				15-1 & vessel	25 – 1 & vessel	35-10 & vessel
DBS East	Breeding	9030.5	0	55.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.71	6.7	0.00	0.00	0.00	0.00
	Nonbreeding	12551.8	0.4	100	50.2	0.2	0.3	3.5	0.1	0.1	1.8	24.62	9.3	0.04	0.11	0.16	1.79
	Annual				50.2	0.2	0.3	3.5	0.1	0.1	1.8	-	16	0.04	0.11	0.16	1.79
DBS West	Breeding	8783.5	0	55.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.92	6.4	0.00	0.00	0.00	0.00
	Nonbreeding	12498.4	0.4	100	50.0	0.1	0.2	3.5	0.1	0.1	1.7	24.08	9.1	0.04	0.11	0.16	1.79
	Annual				50.0	0.1	0.2	3.5	0.1	0.1	1.7	-	15.5	0.04	0.11	0.16	1.79
DBS East + DBS West	Breeding	~~14927.7~~17815	0	55.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	13.0	0.00	0.00	0.00	0.00
	Nonbreeding	~~20136.0~~25050	0.4	100	~~80.5~~100.2	0.~~2~~3	0.~~4~~5	~~5.6~~7.0	0.~~1~~2	0.~~2~~3	~~2.8~~3.5		18.4	0.07	0.~~19~~2	0.~~27~~3	~~2.89~~3.6
	Annual				~~80.5~~100.2	0.~~2~~3	0.~~4~~5	~~5.6~~7.0	0.~~1~~2	0.~~2~~3	~~2.8~~3.5		31.4	0.07	0.~~19~~2	0.~~27~~3	~~2.89~~3.6

~~9.22.2.2.3.1~~9.23.2.2.3.1 *Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines*

~~9.22.2.2.3.1.1~~9.23.2.2.3.1.1 *DBS East in Isolation*

~~1351.~~1439. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Sumburgh Head SPA population expected to die is 1,086 (17,810 x 0.061) adults per annum. The predicted annual construction impact from DBS East alone on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 1.79 birds per annum (**Table 9-162**). This would result in a predicted change in adult mortality rate of 0.16%. The equivalent mortality assuming 35% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 0.36 which would increase the background mortality rate by 0.03%.

~~1352.~~ There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder et al. 2024~~At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Sumburgh Head SPA population expected to die is 1,086 (17,810 x 0.061) adults per annum. The predicted annual construction impact from DBS West alone on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 1.79 birds per annum (**Table 9-128**). This would result in a predicted change in adult mortality rate of 0.16%.~~

~~1353.~~1440. ~~In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023~~) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1354.~~1441. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Sumburgh Head SPA (0.11) would increase the predicted annual mortality by 0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.22.2.2.3.1.2~~9.23.2.2.3.1.2 DBS West in Isolation

~~1355.~~1442. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Sumburgh Head SPA population expected to die is 1,086 (17,810 x 0.061) adults per annum. The predicted annual construction impact from DBS ~~East and DBS~~ West alone on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality ~~is2.89~~is 1.79 birds per annum (**Table 9-162)**. This would result in a predicted change in adult mortality rate of 0.~~26%.~~ 16%. The equivalent mortality assuming 35% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 0.36 which would increase the background mortality rate by 0.03%.

~~1356.~~1443. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1357.~~1444. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Sumburgh Head SPA (0.11) would increase the predicted annual mortality by 0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.22.2.2.3.1.3~~9.23.2.2.3.1.3 ~~MacArthur Green 2023~~DBS East and West Together

1445. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Sumburgh Head SPA population expected to die is 1,086 (17,810 x 0.061) adults per annum. The predicted annual construction impact from DBS East and DBS West on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 3.6 birds per annum (**Table 9-162**). This would result in a predicted change in adult mortality rate of 0.33%. The equivalent mortality assuming 35% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 0.72 which would increase the background mortality rate by 0.07%.

~~1358.~~1446. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1447. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Sumburgh Head SPA (0.3) would increase the predicted annual mortality by 0.03 which is below the 1% threshold for detectability and therefore no further assessment was required.

9.23.2.2.3.2 Potential Effects During Operation: Disturbance and Displacement

9.23.2.2.3.2.1 DBS East in Isolation

1448. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Sumburgh Head SPA population expected to die is 1,086 (17,810 x 0.061) adults per annum. The predicted annual operation impact from DBS East alone on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 3.5 birds per annum (**Table 9-162**). This would result in a predicted change in adult mortality rate of 0.32%. The equivalent mortality assuming 70% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 0.70 which would increase the background mortality rate by 0.06%.

~~1359.~~1449. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1360.~~1450. At a more appropriate ~~(construction)~~ displacement rate of ~~25~~50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Sumburgh Head SPA (0.~~19~~3) would increase the predicted annual mortality by 0.02 which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.22.2.2.3.1.4~~9.23.2.2.3.2.2 DBS ~~East~~West in Isolation

~~1361.~~1451. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Sumburgh Head SPA population expected to die is 1,086 (17,810 x 0.061) adults per annum. The predicted annual operation impact from DBS ~~East~~West alone on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 3.5 birds per annum (**Table 9-162**). This would result in a predicted change in adult mortality rate of 0.32%. The equivalent mortality assuming 70% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 0.7 which would increase the background mortality rate by 0.06%.

~~1362.~~1452. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1363.~~1453. At a more appropriate (construction) displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Sumburgh Head SPA (0.3) would increase the predicted annual mortality by 0.02% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.22.2.2.3.1.5~~9.23.2.2.3.2.3 DBS East and West ~~in Isolation~~ Together

~~1364.~~1455. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Sumburgh Head SPA population expected to die is 1,086 (17,810 x 0.061) adults per annum. The predicted annual operation impact from DBS East and DBS West ~~alone~~ on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is ~~3.5~~7.0 birds per annum (**Table 9-162**). This would result in a predicted change in adult mortality rate of 0.~~32%.~~ 65%. The equivalent mortality assuming 70% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 1.4 which would increase the background mortality rate by 0.13%.

~~1365.~~1456. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1366.~~1457. At a more appropriate ~~(construction)~~ displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Sumburgh Head SPA (0.~~3~~5) would increase the predicted annual mortality by 0.~~02~~05% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.22.2.2.3.1.6 DBS East and West Together~~

~~1367. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Sumburgh Head SPA population expected to die is 1,086 (17,810 x 0.061) adults per annum. The predicted annual operation impact from DBS East and DBS West on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 5.6 birds per annum (**Table 9-128**). This would result in a predicted change in adult mortality rate of 0.5%.~~

9.23.2.2.4 ~~In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023At a more appropriate~~Summary

1457. A matrix of the annual operational displacement ~~rate of 50% combined with 1% mortality, as recommended~~estimates for DBS East and DBS West is provided in ~~MacArthur Green (2019b), the annual displacement mortality~~**Table 9-163**.

Table 9-163 Displacement matrix for annual project alone (DBS East plus DBS West) guillemot apportioned to ~~the~~ Sumburgh Head SPA adult population.

Mortality %	**Displacement %**									
	10	20	30	40	50	60	70	80	90	100
1	0	0	0	0	1	1	1	1	1	1
2	0	0	1	1	1	1	1	2	2	2
3	0	1	1	1	2	2	2	2	3	3
4	0	1	1	2	2	2	3	3	4	4
5	1	1	2	2	3	3	4	4	5	5
6	1	1	2	2	3	4	4	5	5	6
7	1	1	2	3	4	4	5	6	6	7
8	1	2	2	3	4	5	6	6	7	8
9	1	2	3	4	5	5	6	7	8	9
10	1	2	3	4	5	6	7	8	9	10
20	2	4	6	8	10	12	14	16	18	20
30	3	6	9	12	15	18	21	24	27	30
50	5	10	15	20	25	30	35	40	45	50
75	8	15	23	30	38	45	53	60	68	75
100	10	20	30	40	50	60	70	80	90	100

~~1368.~~1458.A table summarising the guillemot construction and operational disturbance and displacement assessment for DBS East and DBS West together is provided below (**Table 9-164**).

~~1369.~~1459.It is concluded that predicted guillemot mortality due to construction and operational phase disturbance and displacement impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the Sumburgh Head SPA**.

Table 9-164 Summary of predicted guillemot displacement mortality from Sumburgh Head SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.

Guillemot		**Displacement**		
Potential Effects During Construction: Disturbance and Displacement				
~~Displacement mortality~~			~~Mean (@70% x 10%)~~	~~Mean (@50% x 1%)~~
~~Breeding season~~			~~0~~	~~0~~
~~Nonbreeding season~~			~~2.89~~	~~0.19~~
~~Annual~~			~~2.89~~	~~0.19~~
Displacement mortality		Mean (@50% x 1%)	Mean (@35% x 2%)	Mean (@35% x 10%)
Breeding season		0	0	0
Nonbreeding season		0.3	0.72	3.6
Annual		0.3	0.72	3.6
Effect	Reference population	17,810		
	Increase in back-ground mortality (%)	0.~~26~~03	0.~~02~~07	0.33
Potential Effects During Operation: Disturbance and Displacement				
Displacement mortality		Mean (@50% x 1%)	Mean (@70% x ~~10~~2%)	Mean (@~~50~~70% x ~~1~~10%)
Breeding season		0	0	0
Nonbreeding season		0.5~~.6~~	~~0~~1.4	7.0
Annual		0.5~~.6~~	~~0~~1.4	7.0
Effect	Reference population	17,810		
	Increase in back-ground mortality (%)	0.~~51~~05	0.~~04~~13	0.65

~~9.22.2.2.4~~9.23.2.2.5 *Assessment of potential effects of the Projects in combination with other plans and projects*

~~1370.~~1460. Given that no measurable increase in the Sumburgh Head SPA guillemot mortality is predicted as a result of DBS East and DBS West combined (e.g. with realistic displacement mortality of 0.~~2~~5 bird per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted guillemot mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Sumburgh Head SPA**.

~~9.23~~9.24 Noss SPA

~~9.23.1~~9.24.1 Site Description

~~1371.~~1461. Noss SPA is an offshore island lying 5km east of Lerwick, Shetland. It supports breeding seabirds on cliffs, inland heathlands and grasslands.

~~1372.~~1462. The seaward extension of the SPA extends approximately 2km into the marine environment and includes the seabed, water column and surface. Seabirds included within the designation feed both inside and outside the SPA in nearby waters, as well as more distantly in the wider North Sea.

~~9.23.1.1~~9.24.1.1 Qualifying Features

~~1373.~~1463. The qualifying features of the Noss SPA screened into the assessment are listed in Table 4-7 of **RIAA HRA Part 1 of 4 – Introduction and Terrestrial Ecology (application ref: 6.1)**. These are breeding gannet and guillemot and two named components of the breeding seabird assemblage (kittiwake and puffin).

~~9.23.1.2~~9.24.1.2 Conservation Objectives

~~1374.~~1464. The over-arching conservation objectives of the site are:

- To avoid deterioration of the habitats of the qualifying species or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained; and
- To ensure for the qualifying species that the following are maintained in the long term:
  - Population of the species as a viable component of the site;
  - Distribution of the species within site;
  - Distribution and extent of habitats supporting the species;
  - Structure, function and supporting processes of habitats supporting the species; and

- No significant disturbance of the species.

~~9.23.2~~9.24.2 Assessment: Array Areas

~~9.23.2.1~~9.24.2.1 Gannet

~~1375.~~1465. Gannet has been screened into the assessment to assess the impacts from disturbance / displacement and collision risk in the construction and operation phase.

~~9.23.2.1.1~~9.24.2.1.1 Status

~~1376.~~1466. Gannet is listed as a designated species of the Noss SPA.

~~1377.~~1467. The SPA breeding population at classification in 1996 was cited as 6,860 pairs (SNH, 2009). Burnell *et al*. (2023) give an updated count of 13,765 AON which has been used in this assessment.

~~9.23.2.1.2~~9.24.2.1.2 Connectivity to the Projects

~~1378.~~1468. DBS East and DBS West are 640km and 616km respectively from the Noss SPA. The mean maximum foraging range of gannet is 509.4km (315.2 + 194.2km, Woodward *et al*., 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding gannet from the Noss SPA there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

~~1379.~~1469. Outside the breeding season breeding gannets, including those from the Noss SPA, are not constrained by requirements to visit nests to incubate eggs or provision chicks. At this time, they are assumed to range more widely and to mix with gannets of all age classes from breeding colonies in the UK and further afield. The background population during these seasons is the UK North Sea BDMPS. This consists of 456,298 individuals during autumn migration (September to November), and 248,385 individuals during spring migration (December to March) (Furness, 2015).

~~1380.~~1470. During the autumn migration and spring migration seasons it is estimated that 3.4% and 5.5% of birds respectively present in the Project array areas are considered to be breeding adults from the Noss SPA. Note, these percentages have been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

~~9.23.2.1.3~~9.24.2.1.3 Assessment of Potential Effects of the Projects alone and Together

~~9.23.2.1.3.1~~9.24.2.1.3.1 Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines

~~1381.~~1471. The seasonal peak total number of gannets recorded in DBS East and DBS West and the number apportioned to Noss SPA is provided in **Table 9-165**.

~~1382.~~1472. Construction displacement has been estimated on the basis this operates across half the wind farm. Thus, gannet displacement was calculated using 30% and 40% displacement rates (i.e. half the operational values) and 1% mortality. These were then added to the number of birds expected to be displaced by up to three construction vessels (assuming 100% displacement within 2km of each vessel and 1% mortality), calculated from the seasonal densities (**Table 9-165**).

Table 9-165 Summary of gannet density and abundance estimates and SPA apportioning rates and used in the operation and construction displacement assessment for Noss SPA. Note that displacement from the wind farm has been estimated as 30%-40%, half the operational rates.

Site	Season	Peak no. (mean)	SPA %	Adult %	No. apportioned to SPA	Wind farm operation displacement mortality to SPA		Wind farm construction displacement mortality to SPA		Peak density (birds/ km^2)	Total vessel displacement mortality (2km around 3 vessels, 1% mortality)	Vessel mortality to SPA	Total construction displacement mortality to SPA	
						60-1	80-1	30-1	40-1				30-1 & vessel	40-1 & vessel
DBS East	Breeding	754.9	0	60	0.0	0.00	0.00	0.00	0.00	1.48	0.56	0.00	0.00	0.00
	Autumn	776.1	3.4	100	26.4	0.16	0.21	0.08	0.11	1.52	0.57	0.02	0.10	0.13
	Spring	75.1	5.5	100	4.1	0.02	0.03	0.01	0.02	0.15	0.06	0.00	0.02	0.02
	Annual				30.5	0.18	0.24	0.09	0.13	-	1.19	0.02	0.12	0.15
DBS West	Breeding	805.3	0	60	0.0	0.00	0.00	0.00	0.00	1.55	0.58	0.00	0.00	0.00
	Autumn	797.5	3.4	100	27.1	0.16	0.22	0.08	0.11	1.54	0.58	0.02	0.10	0.13
	Spring	86.2	5.5	100	4.7	0.03	0.04	0.01	0.02	0.17	0.06	0.00	0.02	0.02
	Annual				31.8	0.19	0.26	0.09	0.13	-	1.22	0.02	0.12	0.15
DBS East + DBS West	Breeding	1560.2	0	60	0.0	0.00	0.00	0.00	0.00	-	1.14	0.00	0.00	0.00
	Autumn	1573.6	3.4	100	53.5	0.32	0.43	0.16	0.21		1.15	0.04	0.20	0.25
	Spring	161.3	5.5	100	8.9	0.05	0.07	0.03	0.04		0.12	0.01	0.03	0.04
	Annual				62.4	0.37	0.5	0.19	0.25		2.41	0.05	0.23	0.29

~~9.23.2.1.3.1.1~~9.24.2.1.3.1.1 *DBS East in Isolation*

~~1383.~~1474. At the baseline mortality rate for adult gannet of 0.088 (**Table 9-7**) the number of adults from Noss SPA population expected to die per year is 2,423 (27,530 x 0.088). The predicted annual construction mortality impacts from DBS East alone on the breeding gannet population is 0.15 birds per annum (**Table 9-165**). This results in a predicted change in adult mortality rate of <0.01% which is below the 1% threshold for detectability and therefore no further assessment is required.

~~9.23.2.1.3.1.2~~9.24.2.1.3.1.2 *DBS West in Isolation*

~~1384.~~1474. At the baseline mortality rate for adult gannet of 0.088 (**Table 9-7**) the number of adults from Noss SPA population expected to die per year is 2,423 (27,530 x 0.088). The predicted annual construction mortality impacts from DBS West alone on the breeding gannet population is 0.15 birds per annum (**Table 9-165**). This results in a predicted change in adult mortality rate of <0.01% which is below the 1% threshold for detectability and therefore no further assessment is required.

~~9.23.2.1.3.1.3~~9.24.2.1.3.1.3 *DBS East and West Together*

~~1385.~~1475. At the baseline mortality rate for adult gannet of 0.088 (**Table 9-7**) the number of adults from Noss SPA population expected to die per year is 2,423 (27,530 x 0.088). The predicted annual construction mortality impacts from DBS East and DBS West on the breeding gannet population is 0.3 birds per annum (**Table 9-147**). This results in a predicted change in adult mortality rate of 0.01% which is below the 1% threshold for detectability and therefore no further assessment is required.

~~9.23.2.1.3.2~~9.24.2.1.3.2 *Potential Effects During Operation: Disturbance and Displacement*

~~9.23.2.1.3.2.1~~9.24.2.1.3.2.1 *DBS East in Isolation*

~~1386.~~1476. At the baseline mortality rate for adult gannet of 0.088 (**Table 9-7**) the number of individuals from Noss SPA population expected to die per year is 2,423 (27,530 x 0.088). The predicted annual impacts from DBS East alone on the breeding gannet population is 0.24 birds per annum (**Table 9-165**). This results in a predicted change in adult mortality rate of 0.01% which is below the 1% threshold for detectability and therefore no further assessment is required.

~~9.23.2.1.3.2.2~~9.24.2.1.3.2.2 *DBS West in Isolation*

~~1387.~~1477.At the baseline mortality rate for adult gannet of 0.088 (**Table 9-7**) the number of individuals from Noss SPA population expected to die per year is 2,423 (27,530 x 0.088). The predicted annual impacts from DBS West alone on the breeding gannet population is 0.25 birds per annum (**Table 9-165**). This results in a predicted change in adult mortality rate of 0.01% which is below the 1% threshold for detectability and therefore no further assessment is required.

~~9.23.2.1.3.2.3~~9.24.2.1.3.2.3 *DBS East and West Together*

~~1388.~~1478.At the baseline mortality rate for adult gannet of 0.088 (**Table 9-7**) the number of individuals from Noss SPA population expected to die per year is 2,423 (27,530 x 0.088). The predicted annual impacts from DBS West alone on the breeding gannet population is 0.5 birds per annum (**Table 9-165**). This results in a predicted change in adult mortality rate of 0.02% which is below the 1% threshold for detectability and therefore no further assessment is required.

~~9.23.2.1.3.3~~9.24.2.1.3.3 *Potential Effects During Operation: Collision Risk*

Table 9-166 Summary of gannet total collisions and apportioned to Noss SPA.

Site	Season	Collision mortality			SPA %	Adult %	Collisions apportioned to SPA		
		Lower 95% c.i.	Mean	Upper 95% c.i.			Lower 95% c.i.	Mean	Upper 95% c.i.
DBS East	Breeding	0.7	3.4	7.8	0	60	0.0	0.0	0.0
	Autumn	0.3	1.6	3.8	3.4	100	0.0	0.1	0.1
	Spring	0.0	0.1	0.6	5.5	100	0.0	0.0	0.0
	Annual	1.1	5.1	12.2	-	-	0.0	0.1	0.2
DBS West	Breeding	0.6	4.9	15.3	0	60	0.0	0.0	0.0
	Autumn	0.3	2.1	6.0	3.4	100	0.0	0.1	0.2
	Spring	0.0	0.1	0.7	5.5	100	0.0	0.0	0.0
	Annual	1.5	7.1	17.7	-	-	0.0	0.1	0.2
DBS East + DBS West	Breeding	0.9	8.4	26.5	0	60	0.0	0.0	0.0
	Autumn	0.5	3.7	10.8	3.4	100	0.0	0.1	0.4
	Spring	0.0	0.3	1.3	5.5	100	0.0	0.0	0.1
	Annual	2.7	12.4	29.8	-	-	0.0	0.1	0.4

~~9.23.2.1.3.3.1~~9.24.2.1.3.3.1 DBS East in Isolation

~~1389.~~ At the baseline mortality rate for adult gannet of 0.088 (**Table 9-7**) ~~the number of individuals from Noss SPA population expected to die per year is 2,423 (27,530 x 0.088) adults per annum. The predicted impacts from DBS East alone on the breeding gannet population is 0.1 (0.01 to 0.20) birds per annum (**Table 9-131**). This results in a predicted change in adult mortality rate of <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.~~

~~9.23.2.1.3.3.2 DBS West in Isolation~~

~~1390.~~1479. ~~At the baseline mortality rate for adult gannet of 0.088 (**Table 9-5**~~) the number of individuals from Noss SPA population expected to die per year is 2,423 (27,530 x 0.088) adults per annum. The predicted impacts from DBS ~~West~~East alone on the breeding gannet population is 0.1 (0.01 to 0.~~2~~20) birds per annum (**Table 9-166**). This results in a predicted change in adult mortality rate of <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.23.2.1.3.3.3~~9.24.2.1.3.3.2 DBS ~~East and~~ West ~~Together~~in Isolation

1480. At the baseline mortality rate for adult gannet of 0.088 (**Table 9-7**) the number of individuals from Noss SPA population expected to die per year is 2,423 (27,530 x 0.088) adults per annum. The predicted impacts from DBS West alone on the breeding gannet population is 0.1 (0.01 to 0.2) birds per annum (**Table 9-166**). This results in a predicted change in adult mortality rate of <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

9.24.2.1.3.3.3 DBS East and West Together

~~1391.~~1481. At the baseline mortality rate for adult gannet of 0.088 (**Table 9-7**) the number of individuals from Noss SPA population expected to die per year is 2,423 (27,530 x 0.088) adults per annum. The predicted impacts from DBS East and DBS West on the breeding gannet population is 0.1 (0.0 to 0.4) birds per annum (**Table 9-166**). This results in a predicted change in adult mortality rate of 0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.23.2.1.3.4~~9.24.2.1.3.4 Potential Effects During Operation: Combined Operational Displacement and Collision Risk

~~9.23.2.1.3.4.1~~9.24.2.1.3.4.1 DBS East in Isolation

~~1392.~~1482. Since the estimated impacts from DBS East on the Noss SPA population due to operational displacement and collision risk were extremely small, there is no risk of a combined impact from both together.

~~9.23.2.1.3.4.2~~9.24.2.1.3.4.2 *DBS West in Isolation*

~~1393.~~1483. Since the estimated impacts from DBS West on the Noss SPA population due to operational displacement and collision risk were extremely small, there is no risk of a combined impact from both together.

~~9.23.2.1.3.4.3~~9.24.2.1.3.4.3 *DBS East and West Together*

~~1394.~~1484. Since the estimated impacts from DBS East and DBS West on the Noss SPA population due to operational displacement and collision risk were extremely small, there is no risk of a combined impact from both together.

~~9.23.2.1.4~~9.24.2.1.4 *Summary*

~~1395.~~1485. A table summarising the gannet construction and operational disturbance / displacement, as well as operational collision risk and finally the combination of operational disturbance and displacement with collision risk assessment for DBS East and DBS West together is provided below (**Table 9-167**).

~~1396.~~1486. It is concluded that predicted gannet mortality due to construction and operational phase displacement , as well as operational collision risk and finally the combination of operational disturbance and displacement with collision risk impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the Noss SPA**.

Table 9-167 Summary of predicted gannet construction and operational displacement and operational collision risk mortality from Noss SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.

Gannet				
Potential Effects During Construction: Disturbance and Displacement				
Displacement mortality (80% + 1%)		Mean	Lower c.i.	Upper c.i.
Breeding season		0	-	-
Autumn		0.25	-	-
Spring		0.04	-	-
Annual		0.3		
Effect	Reference population	27,530	-	-
	Increase in background mortality (%)	0.01	-	-
Potential Effects During Operation: Disturbance and Displacement				
Displacement mortality (80% + 1%)		Mean	Lower c.i.	Upper c.i.
Breeding season		0	-	-
Autumn		0.43	-	-
Spring		0.07	-	-
Annual		0.5		
Effect	Reference population	27,530	-	-
	Increase in background mortality (%)	0.02	-	-

Gannet				
Potential Effects During Operation: Collision Risk				
Collision mortality		Lower c.i.	Mean	Upper c.i.
Breeding season		0.0	0.0	0.0
Autumn		0.0	0.1	0.4
Spring		0.0	0.0	0.1
Annual		0.0	0.1	0.4
Effect	Reference population	27,530		
	Increase in background mortality (%)	<0.01	0.01	0.02
Potential Effects During Operation: Combined Disturbance and Displacement and Collision Risk				
Combined Displacement and Collision mortality		Mean	Lower c.i.	Upper c.i.
Breeding season		0	-	-
Autumn		0.56	-	-
Spring		0.08	-	-
Annual		0.64		
Effect	Reference population	27,530	-	-
	Increase in background mortality (%)	0.02	-	-

~~9.23.2.1.5~~9.24.2.1.5 *Assessment of potential effects of the Projects in combination with other plans and projects*

~~1397.~~1487. Given that no measurable increase in the Noss SPA gannet mortality is predicted as a result of DBS East and DBS West combined (e.g. with total displacement and collision mortality of only 0.64 birds per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted gannet mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Noss SPA**.

~~9.23.2.2~~9.24.2.2 Kittiwake

~~1398.~~1488. Kittiwake has been screened into the assessment to assess the impacts from collision risk in the operation phase.

~~9.23.2.2.1~~9.24.2.2.1 *Status*

~~1399.~~1489. Kittiwake is listed as a named component of the breeding seabird assemblage of the Noss SPA.

~~1400.~~1490. The SPA breeding population at classification in 1996 was cited as 7,020 pairs (SNH, 2009). Burnell *et al.* (2023) give an updated count of 179 AON which has been used in this assessment.

~~9.23.2.2.2~~9.24.2.2.2 Connectivity to the Projects

~~1401.~~1491. DBS East and DBS West are 640km and 616km respectively from the Noss SPA. The mean maximum foraging range of kittiwake is 300.6km (156.1km + 144.5km, Woodward *et al.*, 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding kittiwake from the Noss SPA there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

~~1402.~~1492. Outside the breeding season breeding kittiwakes, including those from the Noss SPA, are not constrained by requirements to visit nests to incubate eggs or provision chicks. At this time, they are assumed to range more widely and to mix with kittiwakes of all age classes from breeding colonies in the UK and further afield. The background population during these seasons is the UK North Sea BDMPS. This consists of 829,937 individuals during the autumn migration season (August to December), and 627,816 individuals during the spring migration season (January to April) (Furness, 2015).

~~1403.~~1493. It is estimated that 0.1% of birds present in the Project array areas in both the autumn and spring migration seasons are considered to be breeding adults from Noss SPA. Note, these percentages have been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

~~9.23.2.2.3~~9.24.2.2.3 Assessment of Potential Effects of the Projects alone and Together

~~9.23.2.2.3.1~~9.24.2.2.3.1 Potential Effects During Operation: Collision risk

Table 9-168 Summary of kittiwake total collisions and apportioned to the Sumburgh Head SPA.

Site	Season	Collision mortality			SPA %	Adult %	Collisions apportioned to SPA		
		Lower 95% c.i.	Mean	Upper 95% c.i.			Lower 95% c.i.	Mean	Upper 95% c.i.
DBS East	Breeding	42.3	83.3	168.5	0	53	0.0	0.0	0.0
	Autumn	14.6	41.4	82.9	0.1	100	0.0	0.0	0.1
	Spring	6.8	14.6	28.0	0.1	100	0.0	0.0	0.0
	Annual	66.9	139.3	261.3	-	-	0.0	0.1	0.1
DBS West	Breeding	36.9	107.8	280.8	0	53	0.0	0.0	0.0
	Autumn	9.5	37.9	81.9	0.1	100	0.0	0.0	0.1
	Spring	7.1	14.9	26.5	0.1	100	0.0	0.0	0.0

Site	Season	Collision mortality			SPA %	Adult %	Collisions apportioned to SPA		
		Lower 95% c.i.	Mean	Upper 95% c.i.			Lower 95% c.i.	Mean	Upper 95% c.i.
	Annual	55.9	160.6	327.0	-	-	0.0	0.1	0.1
DBS East + DBS West	Breeding	96.2	191.1	378.4	0	53	0.0	0.0	0.0
	Autumn	30.5	79.3	143.1	0.1	100	0.0	0.1	0.1
	Spring	16.9	29.5	47.3	0.1	100	0.0	0.0	0.0
	Annual	150.9	299.9	540.5	-	-	0.0	0.1	0.2

~~9.23.2.2.3.1.1~~9.24.2.2.3.1.1 DBS East in Isolation

~~1404.~~1494. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-7**) the number of individuals from the Noss SPA population expected to die is 52 (358 x 0.146) adults per annum. The predicted annual impacts from DBS East alone on the breeding kittiwake population is 0.02 birds per annum (**Table 9-168**). This results in a predicted change in adult mortality rate of 0.04% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.23.2.2.3.1.2~~9.24.2.2.3.1.2 DBS West in Isolation

~~1405.~~1495. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-7**) the number of individuals from the Noss SPA population expected to die is 52 (358 x 0.146) adults per annum. The predicted annual impacts from DBS West alone on the breeding kittiwake population is 0.02 birds per annum (**Table 9-168**). This results in a predicted change in adult mortality rate of 0.03% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.23.2.2.3.1.3~~9.24.2.2.3.1.3 DBS East and West Together

~~1406.~~1496. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-7**) the number of individuals from the Noss SPA population expected to die is 52 (358 x 0.146) adults per annum. The predicted annual impacts from DBS East and DBS West on the breeding kittiwake population is 0.04 birds per annum (**Table 9-168**). This results in a predicted change in adult mortality rate of 0.07% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.23.2.2.4~~9.24.2.2.4 *Summary*

~~1407.~~1497. A table summarising the kittiwake operational collision risk assessment for DBS East and DBS West together is provided below (**Table 9-169**).

~~1408.~~1498. It is concluded that predicted kittiwake mortality due to operational phase collision risk at DBS East, DBS West, and the Projects together would **not adversely affect the integrity of the Noss SPA**.

Table 9-169 Summary of predicted Kittiwake collision mortality from Noss SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations for the Worst Case Wind Turbine Scenario.

Kittiwake		**Collisions**		
Potential Effects During Operation: Collision Risk				
Collision mortality		Lower c.i.	Mean	Upper c.i.
Breeding season		-	-	-
Autumn		0.0	0.1	0.1
Spring		0.0	0.0	0.0
Annual		0.0	0.1	0.2
Effect	Reference population	358		
	Increase in background mortality (%)	<0.01	0.07	0.16

~~9.23.2.2.5~~9.24.2.2.5 *Assessment of potential effects of the Projects in combination with other plans and projects*

~~1409.~~1499. Given that no measurable increase in the Noss SPA kittiwake mortality is predicted as a result of DBS East and DBS West combined (e.g. with total collision mortality of only 0.04 birds per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted kittiwake mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Noss SPA**.

~~9.23.2.3~~9.24.2.3 Guillemot

~~1410.~~1500. Guillemot has been screened in to assess the impacts from disturbance / displacement in the construction and operation phases.

~~1411.~~1501. The guillemot assessment is based on a displacement matrix approach presented in the EIA following statutory guidance (Joint SNCB Note, 2017) using displacement rates of 30% to 70% and mortality rates of 1% to 10%. At the upper end these rates represent a highly precautionary worst-case scenario (for further details on displacement rates and the matrix approach, refer to **Volume 7, Chapter 12 Offshore Ornithology (application ref: 7.12)**).

~~9.23.2.3.1~~9.24.2.3.1 *Status*

~~1412.~~1502. Guillemot is listed as a designated species of the Noss SPA.

~~1413.~~1503. The SPA breeding population at classification in 1996 was 38,970 individuals (SNH, 2009). Burnell *et al.* (2023) give an updated count of 24,456 individuals which has been used in this assessment.

~~9.23.2.3.2~~9.24.2.3.2 *Connectivity to the Projects*

~~1414.~~1504. DBS East and DBS West are 640km and 616km respectively from the Noss SPA. The mean maximum foraging range of guillemot is 153.7km (73.2km + 80.5km, Woodward *et al.*, 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding guillemot from the Noss SPA, there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

~~1415.~~1505. Outside the breeding season, breeding guillemots from the SPA are assumed to range widely and to mix with guillemots from breeding colonies in the UK and beyond. The relevant non-breeding season reference population is the UK North Sea and Channel BDMPS, consisting of 1,617,306 individuals (August to February) (Furness, 2015).

~~1416.~~1506. During the non-breeding season, 70% of the Foula SPA breeding adults are assumed to be present in the BDMPS. It is estimated that 1.3% of birds present at the Projects are considered to be breeding adults from the Noss SPA, and impacts are apportioned accordingly (**Table 9-170**). Note, this percentage has been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

~~1417.~~1507. It is estimated that 1.3% of birds present at the Projects are considered to be breeding adults from Noss SPA. Note, this percentage has been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

~~9.23.2.3.3~~9.24.2.3.3 *Assessment of Potential Effects of the Projects alone and Together*

Table 9-170 Summary of guillemot density and abundance estimates and SPA apportioning rates and used in the operation and construction displacement assessment for Noss SPA. Note that displacement from the wind farm has been estimated as 15%-35%, half the operational rates.

Site	Season	Peak no.	SPA %	Adult %	No. apportioned to SPA	Wind farm operation displacement mortality to SPA			Wind farm construction displacement mortality to SPA			Peak density (birds/ km2)	Total vessel displacement mortality (2km around 3 vessels, 1% mortality)	Vessel mortality to SPA	Total construction displacement mortality to SPA		
						30-1	50-1	70-10	15-1	25 - 1	35-10				15-1 & vessel	25 – 1 & vessel	35-10 & vessel
DBS East	Breeding	9030.5	0	55.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.71	6.7	0.00	0.00	0.00	0.00
	Nonbreeding	12551.8	1.3	100	163.2	0.5	0.8	11.4	0.2	0.4	5.7	24.62	9.3	0.12	0.37	0.53	5.83
	Annual				163.2	0.5	0.8	11.4	0.2	0.4	5.7	-	16	0.12	0.37	0.53	5.83
DBS West	Breeding	8783.5	0	55.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.92	6.4	0.00	0.00	0.00	0.00
	Nonbreeding	12498.4	1.3	100	162.5	0.5	0.8	11.4	0.2	0.4	5.7	24.08	9.1	0.12	0.36	0.52	5.80
	Annual				162.5	0.5	0.8	11.4	0.2	0.4	5.7	-	15.5	0.12	0.36	0.52	5.80
DBS East + DBS West	Breeding	~~14927.7~~17815	0	55.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	13.0	0.00	0.00	0.00	0.00
	Nonbreeding	~~20136.0~~25050	1.3	100	~~261.8~~325.7	1.0~~.8~~	1.~~3~~6	~~18.3~~22.8	0.~~4~~5	0.~~7~~8	~~9.2~~11.4		18.4	0.24	0.~~63~~7	~~0.89~~1.1	~~9.40~~11.6
	Annual				~~261.8~~325.7	1.0~~.8~~	1.~~3~~6	~~18.3~~22.8	0.~~4~~5	0.~~7~~8	11.4		31.4	0.24	0.~~63~~7	~~0.89~~1.1	~~9.40~~11.6

~~9.23.2.3.3.1~~9.24.2.3.3.1 *Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines*

~~9.23.2.3.3.1.1~~9.24.2.3.3.1.1 *DBS East in Isolation*

~~1418.~~1508. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Noss SPA population expected to die is 1,492 (24,456 x 0.061) adults per annum. The predicted annual construction impact from DBS East alone on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 5.83 birds per annum (**Table 9-170**). This would result in a predicted change in adult mortality rate of 0.39%. The equivalent mortality assuming 35% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 1.17 which would increase the background mortality rate by 0.08%.

~~1419.~~1509. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1510. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Noss SPA (0.53) would increase the predicted annual mortality by 0.35% which is below the 1% threshold for detectability and therefore no further assessment was required.

9.24.2.3.3.1.2 DBS West in Isolation

1511. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Noss SPA population expected to die is 1,492 (24,456 x 0.061) adults per annum. The predicted annual construction impact from DBS West alone on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 5.80 birds per annum (**Table 9-170**). This would result in a predicted change in adult mortality rate of 0.38%. The equivalent mortality assuming 35% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 1.16 which would increase the background mortality rate by 0.08%.

~~1420.~~1512. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. ~~2023~~In a study conducted over two breeding seasons conducted at the Beatrice wind farm (Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1421.~~1513. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Noss SPA (0.~~53~~52) would increase the predicted annual mortality by 0.35% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.23.2.3.3.1.2~~9.24.2.3.3.1.3 DBS East and West ~~in Isolation~~ Together

~~1422.~~1514. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Noss SPA population expected to die is 1,492 (24,456 x 0.061) adults per annum. The predicted annual construction impact from DBS East and DBS West ~~alone~~ on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is ~~5.80~~11.6 birds per annum (**Table 9-170**). This would result in a predicted change in adult mortality rate of 0.~~38%.~~ 78%. The equivalent mortality assuming 35% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 2.32 which would increase the background mortality rate by 0.16%.

~~1423.~~1515. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1424.~~1516. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Noss SPA (~~0.52~~1.1) would increase the predicted annual mortality by 0.~~35%~~07 which is below the 1% threshold for detectability and therefore no further assessment was required.

9.24.2.3.3.2 Potential Effects During Operation: Disturbance and Displacement

~~9.23.2.3.3.1.3~~9.24.2.3.3.2.1 DBS East ~~and West Together~~in Isolation

~~1425.~~1517. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Noss SPA population expected to die is 1,492 (24,456 x 0.061) adults per annum. The predicted annual ~~construction~~operation impact from DBS East ~~and DBS West~~alone on the breeding guillemot population applying highly precautionary rates of ~~35~~70% displacement and 10% mortality is ~~9~~11.4 birds per annum (**Table 9-170**). This would result in a predicted change in adult mortality rate of 0.~~63%.~~76%. The equivalent mortality assuming 70% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 2.28 which would increase the background mortality rate by 0.15%.

~~1426.~~1518. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1427.~~1519. At a more appropriate ~~(construction)~~ displacement rate of ~~25~~50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Noss SPA (0.~~89~~8) would increase the predicted annual mortality by 0.~~06~~05 which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.23.2.3.3.1.4~~9.24.2.3.3.2.2 DBS ~~East~~West in Isolation

~~1428.~~1520. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Noss SPA population expected to die is 1,492 (24,456 x 0.061) adults per annum. The predicted annual operation impact from DBS ~~East~~West alone on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 11.4 birds per annum (**Table 9-170**). This would result in a predicted change in adult mortality rate of 0.76%. The equivalent mortality assuming 70% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 2.28 which would increase the background mortality rate by 0.15%.

~~1429.~~1521. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1430.~~1522. At a more appropriate (construction) displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Noss SPA (0.8) would increase the predicted annual mortality by 0.05% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.23.2.3.3.1.5~~9.24.2.3.3.2.3 DBS East and West ~~in Isolation~~ Together

~~1431.~~1523. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Noss SPA population expected to die is 1,492 (24,456 x 0.061) adults per annum. The predicted annual operation impact from DBS East and DBS West ~~alone~~ on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is ~~11.4~~22.8 birds per annum (**Table 9-170**). This would result in a predicted change in adult mortality rate of 1.5% but is based on highly precautionary impact rates. The equivalent mortality assuming 70% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 4.56 which would increase the background mortality rate by 0.30%. A reduction in either the displacement rate (e.g. ~~0.76%.~~to 46%) or the mortality rate (e.g. to 6.5%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in both together).

~~1432.~~1524. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1433.~~1525. At a more appropriate ~~(construction)~~ displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Noss SPA (~~0.8~~1.6) would increase the predicted annual mortality by 0.~~05~~11% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~*9.23.2.3.3.1.6 DBS East and West Together*~~

~~*9.23.2.3.4*~~*9.24.2.3.4* ~~*At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Noss SPA population expected to die is 1,492 (24,456 x 0.061) adults per annum. The predicted annual operation impact from DBS East and DBS West on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 18.3 birds per annum (**Table 9-135**). This would result in a predicted change in adult mortality rate of 1.2% but is based on highly precautionary impact rates.to 57%) or the mortality rate (e.g. to 8%) would reduce the impact below the 1% threshold*~~*Summary*

~~1434.~~ A matrix of ~~detectability (and this also applies for smaller reductions in both together).~~

~~1435. There is no evidence in support of either the (~~the annual operational~~) 70%~~ displacement ~~rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Noss SPA (1.3) would increase the predicted annual mortality by 0.08% which is below the 0.1% threshold for detectability and therefore no further assessment was required.~~

~~1436.~~1526. estimates for DBS East and DBS West is provided in **Table 9-171**.

Table 9-171 Displacement matrix for annual project alone (DBS East plus DBS West) guillemot apportioned to Noss SPA adult population.

Mortality %	**Displacement %**									
	10	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**
1	0	1	1	1	2	2	2	3	3	3
2	1	1	2	3	3	4	5	5	6	7
3	1	2	3	4	5	6	7	8	9	10
4	1	3	4	5	7	8	9	10	12	13
5	2	3	5	7	8	10	11	13	15	16
6	2	4	6	8	10	12	14	16	18	20

Mortality %	Displacement %									
	10	20	30	40	50	60	70	80	90	100
7	2	5	7	9	11	14	16	18	21	23
8	3	5	8	10	13	16	18	21	23	26
9	3	6	9	12	15	18	21	23	26	29
10	3	7	10	13	16	20	23	26	29	33
20	7	13	20	26	33	39	46	52	59	65
30	10	20	29	39	49	59	68	78	88	98
50	16	33	49	65	81	98	114	130	147	163
75	24	49	73	98	122	147	171	195	220	244
100	33	65	98	130	163	195	228	261	293	326

~~1437.~~1527. A table summarising the guillemot construction and operational disturbance and displacement assessment for DBS East and DBS West together is provided below (**Table 9-172**).

~~1438.~~1528. It is concluded that predicted guillemot mortality due to construction and operational phase disturbance and displacement impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the Noss SPA**.

Table 9-172 Summary of predicted guillemot displacement mortality from Noss SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.

Guillemot	Displacement	
Potential Effects During Construction: Disturbance and Displacement		
~~Displacement mortality~~	~~Mean (@70% x 10%)~~	~~Mean (@50% x 1%)~~
~~Breeding season~~	~~0~~	~~0~~
~~Nonbreeding season~~	~~9.4~~	~~0.89~~
~~Annual~~	~~9.4~~	~~0.89~~

Guillemot		Displacement		
Displacement mortality		Mean (@50% x 1%)	Mean (@35% x 2%)	Mean (@35% x 10%)
Breeding season		0	0	0
Nonbreeding season		1.1	2.3	11.6
Annual		1.1	2.3	11.6
Ef-fect	Reference population	24,456		
	Increase in background mortality (%)	0.~~63~~07	0.~~06~~16	0.78
Potential Effects During Operation: Disturbance and Displacement				
Displacement mortality		Mean (@50% x 1%)	Mean (@70% x ~~10~~2%)	Mean (@~~50~~70% x ~~1~~10%)
Breeding season		0	0	0
Nonbreeding season		1.~~3~~6	4.6	22.8
Annual		1.~~3~~6	4.6	22.8
Ef-fect	Reference population	24,456		
	Increase in background mortality (%)	~~1.2~~0.11	0.~~08~~30	1.53

~~9.23.2.3.5~~9.24.2.3.5 *Assessment of potential effects of the Projects in combination with other plans and projects*

~~1439.~~1529. Given that no measurable increase in the Noss SPA guillemot mortality is predicted as a result of DBS East and DBS West combined (e.g. with realistic displacement mortality of 1.3 bird per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted guillemot mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Noss SPA**.

~~9.23.2.4~~9.24.2.4 Puffin

~~1440.~~1530. Puffin has been screened in to assess the impacts from disturbance / displacement in the construction and operation phases.

~~1441.~~1531. The puffin assessment is based on a displacement matrix approach presented in the EIA following statutory guidance (Joint SNCB Note, 2017) using displacement rates of 30% to 70% and mortality rates of 1% to 10%. At the upper end these rates represent a highly precautionary worst-case scenario (for further details on displacement rates and the matrix approach, refer to **Volume 7, Chapter 12 Offshore Ornithology (application ref: 7.12)**).

~~9.23.2.4.1~~9.24.2.4.1 *Status*

~~1442.~~1532. Puffin is listed as a named component of the breeding seabird assemblage of the Noss SPA.

~~1443.~~1533. The SPA breeding population at classification in 1995 was 48,000 pairs (SNH, 2009). Burnell *et al*. (2023) give an updated count of 1,174 AOB which has been used in this assessment.

~~9.23.2.4.2~~9.24.2.4.2 *Connectivity to the Projects*

~~1444.~~1534. DBS East and DBS West are 640km and 616km respectively from the Noss SPA. The mean maximum foraging range of puffin is 265.4km (137.1km +128.3km, Woodward *et al*., 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding puffin from the Noss SPA, there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

~~1445.~~1535. Outside the breeding season, breeding puffins from the SPA are assumed to range widely and to mix with puffins from breeding colonies in the UK and further afield. The relevant non-breeding season reference population is the UK North Sea and Channel BDMPS, consisting of 231,957 individuals (mid-August to March) (Furness, 2015).

~~1446.~~1536. It is estimated that 0.1% of birds present at the Projects are breeding adults from Noss SPA. Note, this percentage has been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

~~9.23.2.4.3~~9.24.2.4.3 *Assessment of Potential Effects of the Projects alone and Together*

Table 9-173 Summary of puffin density and abundance estimates and SPA apportioning rates and used in the operation and construction displacement assessment for Noss SPA. Note that displacement from the wind farm has been estimated as 15%-35%, half the operational rates.

Site	Season	Peak no.	SPA %	Adult %	No. apportioned to SPA	Wind farm operation displacement mortality to SPA			Wind farm construction displacement mortality to SPA			Peak density (birds/ km^2)	Total vessel displacement mortality (2km around 3 vessels, 1% mortality)	Vessel mortality to SPA	Total construction displacement mortality to SPA		
						30-1	50-1	70-10	15-1	25 - 1	35-10				15-1 & vessel	25 – 1 & vessel	35-10 & vessel
DBS East	Breeding	62.60	0	0.543	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.05	0.00	0.00	0.00	0.00
	Nonbreeding	178.70	0.1	1	0.2	0.00	0.00	0.01	0.00	0.00	0.01	0.35	0.13	0.00	0.00	0.00	0.01
	Annual				0.2	0.00	0.00	0.01	0.00	0.00	0.01	-	0.18	0.00	0.00	0.00	0.01
DBS West	Breeding	109.3	0	0.543	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.21	0.08	0.00	0.00	0.00	0.00
	Nonbreeding	198.2	0.1	1	0.2	0.00	0.00	0.01	0.00	0.00	0.01	0.38	0.14	0.00	0.00	0.00	0.01
	Annual				0.2	0.00	0.00	0.01	0.00	0.00	0.01	-	0.22	0.00	0.00	0.00	0.01
DBS East + DBS West	Breeding	~~146.60~~171.9	0	0.543	0.0	0.00	0.00	0.00	0.00	0.00	0.00	-	0.12	0.00	0.00	0.00	0.00
	Nonbreeding	~~372.70~~376.9	0.1	1	0.4	0.00	0.00	0.03	0.00	0.00	0.01		0.28	0.00	0.00	0.00	0.01
	Annual				0.4	0.00	0.00	0.03	0.00	0.00	0.01		0.4	0.00	0.00	0.00	0.01

~~9.23.2.4.3.1~~9.24.2.4.3.1 *Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines*

~~9.23.2.4.3.1.1~~9.24.2.4.3.1.1 *DBS East in Isolation*

~~1447.~~1537. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-7**) the number of individuals from the Noss SPA population expected to die is 221 (2,348 x 0.094) adults per annum. The predicted annual construction impact from DBS East alone on the breeding puffin population applying highly precautionary rates of 35% displacement and 10% mortality is 0.01 birds per annum (**Table 9-173)**. This would result in a predicted change in adult mortality rate of <0.01%.

~~1448.~~1538. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that puffins avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is equivalent to the natural adult background mortality rate of 9.4%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of puffin populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1449.~~1539. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Noss SPA (<0.01) would increase the predicted annual mortality by <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.23.2.4.3.1.2~~9.24.2.4.3.1.2 *DBS West in Isolation*

~~1450.~~1540. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-7**) the number of individuals from the Noss SPA population expected to die is 221 (2,348 x 0.094) adults per annum. The predicted annual construction impact from DBS West alone on the breeding puffin population applying highly precautionary rates of 35% displacement and 10% mortality is 0.1 birds per annum (**Table 9-173**). This would result in a predicted change in adult mortality rate of <0.01%.

~~1451.~~1541. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that puffins avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is equivalent to the natural adult background mortality rate of 9.4%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of puffin populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1452.~~1542. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Noss SPA (<0.01) would increase the predicted annual mortality by <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.23.2.4.3.1.3~~9.24.2.4.3.1.3 DBS East and West Together

~~1453.~~1543. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-7**) the number of individuals from the Noss SPA population expected to die is 221 (2,348 x 0.094) adults per annum. The predicted annual construction impact from DBS East and DBS West on the breeding puffin population applying highly precautionary rates of 35% displacement and 10% mortality is 0.01 birds per annum (**Table 9-173**). This would result in a predicted change in adult mortality rate of <0.01%.

~~1454.~~1544. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that puffins avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is equivalent to the natural adult background mortality rate of 9.4%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of puffin populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1455.~~1545. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Noss SPA (<0.01) would increase the predicted annual mortality by <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~*9.23.2.4.3.2*~~*9.24.2.4.3.2 Potential Effects During Operation: Disturbance and Displacement*

~~*9.23.2.4.3.2.1*~~*9.24.2.4.3.2.1 DBS East in Isolation*

~~1456.~~1546. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-7**) the number of individuals from the Noss SPA population expected to die is 221 (2,348 x 0.094) adults per annum. The predicted annual operation impact from DBS East alone on the breeding puffin population applying highly precautionary rates of 70% displacement and 10% mortality is 0.01 birds per annum (**Table 9-173**). This would result in a predicted change in adult mortality rate of <0.01%.

~~1457.~~1547. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that puffins avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is equivalent to the natural adult background mortality rate of 9.4%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of puffin populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1458.~~1548. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Noss SPA (<0.01) would increase the predicted annual mortality by <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.23.2.4.3.2.2~~9.24.2.4.3.2.2 *DBS West in Isolation*

~~1459.~~1549. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-7**) the number of individuals from the Noss SPA population expected to die is 221 (2,348 x 0.094) adults per annum. The predicted annual operation impact from DBS West alone on the breeding puffin population applying highly precautionary rates of 70% displacement and 10% mortality is 0.01 birds per annum (**Table 9-173**). This would result in a predicted change in adult mortality rate of <0.01%.

~~1460.~~1550. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that puffins avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is equivalent to the natural adult background mortality rate of 9.4%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of puffin populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1461.~~1551. At a more appropriate (construction) displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Noss SPA (<0.01) would increase the predicted annual mortality by <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.23.2.4.3.2.3~~9.24.2.4.3.2.3 *DBS East and West Together*

~~1462.~~1552. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-7**) the number of individuals from the Noss SPA population expected to die is 221 (2,348 x 0.094) adults per annum. The predicted annual operation impact from DBS East and DBS West on the breeding puffin population applying highly precautionary rates of 70% displacement and 10% mortality is 0.03 birds per annum (**Table 9-173**). This would result in a predicted change in adult mortality rate of 0.01%.

~~1463.~~1553. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that puffins avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is equivalent to the natural adult background mortality rate of 9.4%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of puffin populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1464.~~1554. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Noss SPA (<0.01) would increase the predicted annual mortality by <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.23.2.4.4~~9.24.2.4.4 Summary

~~1465.~~1555. A table summarising the puffin construction and operational disturbance and displacement assessment for DBS East and DBS West together is provided below (**Table 9-174)**.

~~1466.~~1556. It is concluded that predicted puffin mortality due to construction and operational phase disturbance and displacement impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the Noss SPA**.

Table 9-174 Summary of predicted puffin displacement mortality from Noss SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.

~~Guillemot~~Puffin		Displacement	
Potential Effects During Construction: Disturbance and Displacement			
Displacement mortality		Mean (@~~35~~25% x ~~10~~1%)	Mean (@~~25~~35% x ~~1~~10%)
Breeding season		0	0
Nonbreeding season		<0.01	~~<~~0.01
Annual		<0.01	~~<~~0.01
Effect	Reference population	2,348	
	Increase in background mortality (%)	<0.01	<0.01
Potential Effects During Operation: Disturbance and Displacement			
Displacement mortality		Mean (@~~70~~50% x ~~10~~1%)	Mean (@~~50~~70% x ~~1~~10%)

~~Guillemot~~Puffin		Displacement	
Breeding season		0	0
Nonbreeding season		<0.~~03~~01	~~<~~0.~~01~~03
Annual		<0.~~03~~01	~~<~~0.~~01~~03
Effect	Reference population	2,348	
	Increase in background mortality (%)	<0.01	~~<~~0.01

~~9.23.2.4.5~~9.24.2.4.5 *Assessment of potential effects of the Projects in combination with other plans and projects*

~~1467.~~1557. Given that no measurable increase in the Noss SPA puffin mortality is predicted as a result of DBS East and DBS West combined (e.g. with realistic displacement mortality of <0.01 birds per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted puffin mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Noss SPA**.

~~9.24~~9.25 Foula SPA

~~9.24.1~~9.25.1 Site Description

~~1468.~~1558. Foula is the most westerly of the Shetland Islands, lying 20km west of Shetland Mainland. It consists of a rocky coastline, large areas of mire, and adjacent coastal waters which support internationally important breeding populations of seabirds.

~~1469.~~1559. The boundary of the SPA extends approximately 2km into the marine environment to include the seabed, water column and surface.

~~9.24.1.1~~9.25.1.1 Qualifying Features

~~1470.~~1560. The qualifying features of the Foula SPA screened into the assessment are listed in Table 4-7 of **RIAA HRA Part 1 of 4 – Introduction and Terrestrial Ecology (application ref: 6.1).** These are breeding guillemot and puffin and two named components of the breeding seabird assemblage (kittiwake and razorbill).

~~9.24.1.2~~9.25.1.2 Conservation Objectives

~~1471.~~1561. The over-arching conservation objectives of the site are as follows:

- To avoid deterioration of the habitats of the qualifying species or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained; and
- To ensure for the qualifying species that the following are maintained in the long term:
  - Population of the species as a viable component of the site;
  - Distribution of the species within site;
  - Distribution and extent of habitats supporting the species;
  - Structure, function and supporting processes of habitats supporting the species; and
  - No significant disturbance of the species.

~~9.24.2~~9.25.2 Assessment: Array Areas

~~9.24.2.1~~9.25.2.1 Kittiwake

~~1472.~~1562. Kittiwake has been screened into the assessment to assess the impacts from collision risk in the operation phase.

~~9.24.2.1.1~~9.25.2.1.1 Status

~~1473.~~1563. Kittiwake is listed as a named component of the breeding seabird assemblage of the Foula SPA.

~~1474.~~1564. The SPA breeding population at classification in 1995 was cited as 3,840 pairs (SNH, 2009). Burnell *et al.* (2023) give an updated count of 425 AON which has been used in this assessment.

~~9.24.2.1.2~~9.25.2.1.2 Connectivity to the Projects

~~1475.~~1565. DBS East and DBS West are 657km and 630km respectively from the Foula SPA. The mean maximum foraging range of kittiwake is 300.6km (156.1km + 144.5km, Woodward *et al.*, 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding kittiwake from the Foula SPA there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

~~1476.~~1566. Outside the breeding season breeding kittiwakes, including those from the Foula SPA, are not constrained by requirements to visit nests to incubate eggs or provision chicks. At this time, they are assumed to range more widely and to mix with kittiwakes of all age classes from breeding colonies in the UK and further afield. The background population during these seasons is the UK North Sea BDMPS. This consists of 829,937 individuals during the autumn migration season (August to December), and 627,816 individuals during the spring migration season (January to April) (Furness, 2015).

~~1477.~~1567. It is estimated that 0.05% and 0.1% of birds present in the Project array areas in the autumn and spring migration seasons are considered to be breeding adults from Foula SPA. Note, these percentages have been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

~~9.24.2.1.3~~9.25.2.1.3 *Assessment of Potential Effects of the Projects alone and Together*

~~9.24.2.1.3.1~~9.25.2.1.3.1 *Potential Effects During Operation: Collision risk*

Table 9-175 Summary of kittiwake total collisions and apportioned to the Foula SPA.

Site	Season	Collision mortality			SPA %	Adult %	Collisions apportioned to SPA		
		Lower 95% c.i.	Mean	Upper 95% c.i.			Lower 95% c.i.	Mean	Upper 95% c.i.
DBS East	Breeding	42.3	83.3	168.5	0	53	0.0	0.0	0.0
	Autumn	14.6	41.4	82.9	0.05	100	0.0	0.0	0.0
	Spring	6.8	14.6	28.0	0.1	100	0.0	0.0	0.0
	Annual	66.9	139.3	261.3	-	-	0.0	0.0	0.1
DBS West	Breeding	36.9	107.8	280.8	0	53	0.0	0.0	0.0
	Autumn	9.5	37.9	81.9	0.05	100	0.0	0.0	0.0
	Spring	7.1	14.9	26.5	0.1	100	0.0	0.0	0.0
	Annual	55.9	160.6	327.0	-	-	0.0	0.0	0.1
DBS East + DBS West	Breeding	96.2	191.1	378.4	0	53	0.0	0.0	0.0
	Autumn	30.5	79.3	143.1	0.05	100	0.0	0.0	0.1
	Spring	16.9	29.5	47.3	0.1	100	0.0	0.0	0.0

Site	Season	Collision mortality			SPA %	Adult %	Collisions apportioned to SPA		
		Lower 95% c.i.	Mean	Upper 95% c.i.			Lower 95% c.i.	Mean	Upper 95% c.i.
	Annual	150.9	299.9	540.5	-	-	0.0	0.1	0.1

~~9.24.2.1.3.1.1~~9.25.2.1.3.1.1 DBS East in Isolation

~~1478.~~1568. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-7**) the number of individuals from the Foula SPA population expected to die is 124 (850 x 0.146) adults per annum. The predicted annual impacts from DBS East alone on the breeding kittiwake population is 0.03 birds per annum (**Table 9-175**). This results in a predicted change in adult mortality rate of 0.02% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.24.2.1.3.1.2~~9.25.2.1.3.1.2 DBS West in Isolation

~~1479.~~1569. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-7**) the number of individuals from the Foula SPA population expected to die is 124 (850 x 0.146) adults per annum. The predicted annual impacts from DBS West alone on the breeding kittiwake population is 0.06 birds per annum (**Table 9-175**). This results in a predicted change in adult mortality rate of 0.05% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.24.2.1.3.1.3~~9.25.2.1.3.1.3 DBS East and West Together

~~1480.~~1570. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-7**) the number of individuals from the Foula SPA population expected to die is 124 (850 x 0.146) adults per annum. The predicted annual impacts from DBS East and DBS West on the breeding kittiwake population is 0.04 birds per annum (**Table 9-175**). This results in a predicted change in adult mortality rate of 0.07% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.24.2.1.4~~9.25.2.1.4 Summary

~~1481.~~1571. A table summarising the kittiwake operational collision risk assessment for DBS East and DBS West together is provided below (**Table 9-176**).

~~1482.~~1572. It is concluded that predicted kittiwake mortality due to operational phase collision risk at DBS East, DBS West, and the Projects together would **not adversely affect the integrity of the Foula SPA**.

Table 9-176 Summary of predicted Kittiwake collision mortality from Foula SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations for the Worst Case Wind Turbine Scenario.

Kittiwake		**Collisions**		
Potential Effects During Operation: Collision Risk				
Collision mortality		Lower c.i.	Mean	Upper c.i.
Breeding season		-	-	-
Autumn		0.0	0.0	0.1
Spring		0.0	0.0	0.0
Annual		0.0	0.1	0.1
Effect	Reference population	850		
	Increase in background mortality (%)	0.01	0.05	0.10

~~9.24.2.1.5~~9.25.2.1.5 *Assessment of potential effects of the Projects in combination with other plans and projects*

~~1483.~~1573. Given that no measurable increase in the Foula SPA kittiwake mortality is predicted as a result of DBS East and DBS West combined (e.g. with total collision mortality of only 0.06 birds per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted kittiwake mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Foula SPA**.

~~9.24.2.2~~9.25.2.2 Guillemot

~~1484.~~1574. Guillemot has been screened into the assessment to assess the impacts from disturbance / displacement in the construction and operation phase.

~~9.24.2.2.1~~9.25.2.2.1 *Status*

~~1485.~~1575. Guillemot is listed as a designated species of the Foula SPA.

~~1486.~~1576. The SPA breeding population at classification in 1995 was 37,500 individuals (SNH, 2009). Burnell *et al.* (2023) give an updated count of 5,289 individuals which has been used in this assessment.

~~9.24.2.2.2~~9.25.2.2.2 *Connectivity to the Projects*

~~1487.~~1577. DBS East and DBS West are 657km and 630km respectively from the Foula SPA. The mean maximum foraging range of guillemot is 153.7km (73.2km + 80.5km, Woodward *et al*., 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding guillemot from the Foula SPA, there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

~~1488.~~1578. Outside the breeding season, breeding guillemots from the SPA are assumed to range widely and to mix with guillemots from breeding colonies in the UK and beyond. The relevant non-breeding season reference population is the UK North Sea and Channel BDMPS, consisting of 1,617,306 individuals (August to February) (Furness, 2015).

~~1489.~~1579. During the non-breeding season, 70% of the Foula SPA breeding adults are assumed to be present in the BDMPS. It is estimated that 1.4% of birds present at the Projects are considered to be breeding adults from the Foula SPA, and impacts are apportioned accordingly (**Table 9-177**). Note, this percentage has been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

~~1490.~~1580. It is estimated that 1.4% of birds present at the Projects are considered to be breeding adults from Foula SPA. Note, this percentage has been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

~~9.24.2.2.3~~9.25.2.2.3 *Assessment of Potential Effects of the Projects alone and Together*

Table 9-177 Summary of guillemot density and abundance estimates and SPA apportioning rates and used in the operation and construction displacement assessment for Foula SPA. Note that displacement from the wind farm has been estimated as 15%-35%, half the operational rates.

Site	Season	Peak no.	SPA %	Adult %	No. apportioned to SPA	Wind farm operation displacement mortality to SPA			Wind farm construction displacement mortality to SPA			Peak density (birds/km^2)	Total vessel displacement mortality (2km around 3 vessels, 1% mortality)	Vessel mortality to SPA	Total construction displacement mortality to SPA		
						30-1	50-1	70-10	15-1	25 - 1	35-10				15-1 & vessel	25 – 1 & vessel	35-10 & vessel
DBS East	Breeding	9030.5	0	55.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.71	6.7	0.00	0.00	0.00	0.00
	Nonbreeding	12551.8	1.4	100	175.7	0.5	0.9	12.3	0.3	0.4	6.2	24.62	9.3	0.13	0.39	0.57	6.28
	Annual				175.7	0.5	0.9	12.3	0.3	0.4	6.2	-	16	0.13	0.39	0.57	6.28
DBS West	Breeding	8783.5	0	55.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.92	6.4	0.00	0.00	0.00	0.00
	Nonbreeding	12498.4	1.4	100	175.0	0.5	0.9	12.2	0.3	0.4	6.1	24.08	9.1	0.13	0.39	0.56	6.25
	Annual				175.0	0.5	0.9	12.2	0.3	0.4	6.1	-	15.5	0.13	0.39	0.56	6.25
DBS East + DBS West	Breeding	~~14927.7~~17815	0	55.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	13.0	0.00	0.00	0.00	0.00
	Nonbreeding	~~20136.0~~25050	1.4	100	~~281.9~~350.7	~~0.8~~1.1	1.~~4~~8	~~19.7~~24.5	0.~~4~~5	0.~~7~~9	~~9.9~~12.3		18.4	0.26	0.~~68~~8	~~0.96~~1.1	~~10.~~12.5
	Annual				~~281.9~~350.7	~~0.8~~1.1	1.~~4~~8	~~19.7~~24.5	0.~~4~~5	0.~~7~~9	~~9.9~~12.3		31.4	0.26	0.~~68~~8	~~0.96~~1.1	~~10.~~12.5

~~9.24.2.2.3.1~~9.25.2.2.3.1 *Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines*

~~9.24.2.2.3.1.1~~9.25.2.2.3.1.1 *DBS East in Isolation*

~~1491.~~1581. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Foula SPA population expected to die is 323 (5,289 x 0.061) adults per annum. The predicted annual construction impact from DBS East alone on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 6.28 birds per annum (**Table 9-177**). This would result in a predicted change in adult mortality rate of 1.9% but is based on highly precautionary impact rates. The equivalent mortality assuming 35% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 1.26 which would increase the background mortality rate by 0.39%. A reduction in either the displacement rate (e.g. to 36%) or the mortality rate (e.g. to 5%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in both together).

~~1492.~~1582. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1583. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Foula SPA (0.57) would increase the predicted annual mortality by 0.17% which is below the 1% threshold for detectability and therefore no further assessment was required.

9.25.2.2.3.1.2 DBS West in Isolation

~~1493.~~1584. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Foula SPA population expected to die is 323 (5,289 x 0.061) adults per annum. The predicted annual construction impact from DBS West alone on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 6.25 birds per annum (**Table 9-177**). This would result in a predicted change in adult mortality rate of 1.93% but is based on highly precautionary impact rates. The equivalent mortality assuming 35% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 1.25 which would increase the background mortality rate by 0.39%. A reduction in either the displacement rate (e.g. to 36%) or the mortality rate (e.g. to 5%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in both together).

~~1494.~~1585. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1495.~~1586. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Foula SPA (0.~~57~~56) would increase the predicted annual mortality by 0.17% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.24.2.2.3.1.2~~9.25.2.2.3.1.3 DBS East and West ~~in Isolation~~ Together

~~1496.~~1587. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Foula SPA population expected to die is 323 (5,289 x 0.061) adults per annum. The predicted annual construction impact from DBS East and DBS West ~~alone~~ on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is ~~6.25~~12.5 birds per annum (**Table 9-177**). This would result in a predicted change in adult mortality rate of ~~1.93~~3.9% but is based on highly precautionary impact rates. ~~A reduction in either the~~ The equivalent mortality assuming 35% displacement ~~rate (e.g. to 36%) or~~ and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 2.5 which would increase the background mortality rate by 0.77%. A reduction in the mortality rate (e.g. to ~~5~~2.6%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in ~~both~~ mortality and displacement rate together).

~~1497.~~1588. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1498.~~1589. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Foula SPA (~~0.56~~1.1) would increase the predicted annual mortality by 0.~~17%~~35 which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.24.2.2.3.1.3 DBS East and West Together~~

~~9.24.2.2.3.2~~9.25.2.2.3.2 Potential Effects During Operation: Disturbance and Displacement

~~9.24.2.2.3.2.1~~9.25.2.2.3.2.1 DBS East in Isolation

~~1499.~~ At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Foula SPA population expected to die is 323 (5,289 x 0.061) adults per annum. ~~The predicted annual construction impact from DBS East and DBS West on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 10.12 birds per annum (**Table 9-141**). This would result in a predicted change in adult mortality rate of 3.13% but is based on highly precautionary impact rates. A reduction in the mortality rate (e.g. to 3%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in mortality and displacement rate together).~~

~~1500. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023Foula SPA (0.96) would increase the predicted annual mortality by 0.3 which is below the 1% threshold for detectability and therefore no further assessment was required.~~

~~1501. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Foula SPA population expected to die is 323 (5,289 x 0.061) adults per annum.~~ The predicted annual operation impact from DBS East alone on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 12.3 birds per annum (**Table 9-177**). This would result in a predicted change in adult mortality rate of 3.8% but is based on highly precautionary impact rates. ~~A reduction in the~~ The equivalent mortality ~~rate (e.g. to 2.6%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in mortality and displacement rate together.~~

~~1502. There is no evidence in support of either the (operational)~~assuming 70% displacement ~~rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023) no evidence~~and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was ~~found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult~~ 2.46 which would increase the background mortality rate ~~of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.~~

~~1503. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Foula SPA (by~~ 0.~~9) would increase the predicted annual mortality by 0.3 which is below the 1% threshold for detectability and therefore no further assessment was required.~~

~~*9.24.2.2.3.2.2 DBS West in Isolation*~~

~~1504.~~1590.~~At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Foula SPA population expected to die is 323 (5,289 x 0.061) adults per annum. The predicted annual operation impact from DBS West alone on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 12.2 birds per annum (**Table 9-141**). This would result in a predicted change in adult mortality rate of 3.8% but is based on highly precautionary impact rates.~~76%. A reduction in the mortality rate (e.g. to 2.6%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in mortality and displacement rate together.

~~1505.~~1591. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1592. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Foula SPA (0.9) would increase the predicted annual mortality by 0.3 which is below the 1% threshold for detectability and therefore no further assessment was required.

9.25.2.2.3.2.2 DBS West in Isolation

~~1506.~~1593. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Foula SPA population expected to die is 323 (5,289 x 0.061) adults per annum. The predicted annual operation impact from DBS ~~East and DBS~~ West alone on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is ~~19.7~~12.2 birds per annum (**Table 9-177**). This would result in a predicted change in adult mortality rate of ~~16.1~~3.8% but is based on highly precautionary impact rates. The equivalent mortality assuming 70% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 2.44 which would increase the background mortality rate by 0.75%. A reduction in the mortality rate (e.g. to 2.6%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in mortality and displacement rate together.

~~1507.~~1594. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1508.~~1595. At a more appropriate (construction) displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Foula SPA (0.9) would increase the predicted annual mortality by 0.3% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.24.2.2.3.2.3~~9.25.2.2.3.2.3 *DBS East and West Together*

1596. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Foula SPA population expected to die is 323 (5,289 x 0.061) adults per annum. The predicted annual operation impact from DBS East and DBS West on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 24.5 birds per annum (**Table 9-177**). This would result in a predicted change in adult mortality rate of 7.6% but is based on highly precautionary impact rates. The equivalent mortality assuming 70% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 4.9 which would increase the background mortality rate by 1.52%.

1597. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1509.~~1598.At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Foula SPA (1.~~4~~8) would increase the predicted annual mortality by 0.45% which is below the 0.~~1~~5% threshold for detectability and therefore no further assessment was required. Furthermore, given Foula SPA is over 600km from the Projects the likelihood of any connectivity is low, further highlighting the precaution in this assessment.

~~9.24.2.2.4~~9.25.2.2.4 *Summary*

~~1510.~~1599.A matrix of the annual operational displacement estimates for DBS East and DBS West is provided in **Table 9-178**.

Table 9-178 Displacement matrix for annual project alone (DBS East plus DBS West) guillemot apportioned to Foula SPA adult population.

Mortality %	**Displacement %**									
	10	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**
1	0	1	1	1	2	2	2	3	3	4
2	1	1	2	3	4	4	5	6	6	7
3	1	2	3	4	5	6	7	8	9	11
4	1	3	4	6	7	8	10	11	13	14
5	2	4	5	7	9	11	12	14	16	18
6	2	4	6	8	11	13	15	17	19	21
7	2	5	7	10	12	15	17	20	22	25
8	3	6	8	11	14	17	20	22	25	28
9	3	6	9	13	16	19	22	25	28	32
10	4	7	11	14	18	21	25	28	32	35
20	7	14	21	28	35	42	49	56	63	70
30	11	21	32	42	53	63	74	84	95	105
50	18	35	53	70	88	105	123	140	158	175

Mortality %	Displacement %									
	10	20	30	40	50	60	70	80	90	100
75	26	53	79	105	132	158	184	210	237	263
100	35	70	105	140	175	210	245	281	316	351

~~1511.~~1600. A table summarising the guillemot construction and operational disturbance and displacement assessment for DBS East and DBS West together is provided below (**Table 9-179**).

~~1512.~~1601. It is concluded that predicted guillemot mortality due to construction and operational phase disturbance and displacement impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the Foula SPA**.

Table 9-179 Summary of predicted guillemot displacement mortality from Foula SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.

Guillemot		Displacement		
Potential Effects During Construction: Disturbance and Displacement				
Displacement mortality		Mean (@~~70~~50% x ~~10~~1%)	Mean (@~~50~~35% x ~~1~~2%)	Mean (@70% x 10%)
Breeding season		0	0	0
Nonbreeding season		1.1	2.5	~~10.~~12.5
Annual		1.1	2.5	~~10.~~12.5
Effect	Reference population	5,289		
	Increase in back-ground mortality (%)	~~3.13~~0.35	0.~~3~~77	~~3.89~~3.89
Potential Effects During Operation: Disturbance and Displacement				
Displacement mortality		Mean (@50% x 1%)	Mean (@70% x ~~10~~2%)	Mean (@~~50~~70% x ~~1~~10%)
Breeding season		0	0	0
Nonbreeding season		1.~~4~~8	4.9	24.5
Annual		1.~~4~~8	4.9	24.5
Effect	Reference population	5,289		
	Increase in back-ground mortality (%)	0.~~45~~54	1.52	7.6

~~9.24.2.2.5~~9.25.2.2.5 Assessment of potential effects of the Projects in combination with other plans and projects

~~1513.~~1602. Given that no measurable increase in the Foula SPA guillemot mortality is predicted as a result of DBS East and DBS West combined (e.g. with realistic displacement mortality of 1.4 bird per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted guillemot mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Foula SPA**.

~~9.24.2.3~~9.25.2.3 Razorbill

~~1514.~~1603. Razorbill has been screened in to assess the impacts from disturbance / displacement in the construction and operation phases.

~~1515.~~1604. The razorbill assessment is based on a displacement matrix approach presented in the EIA following statutory guidance (Joint SNCB Note, 2017) using displacement rates of 30% to 70% and mortality rates of 1% to 10%. At the upper end these rates represent a highly precautionary worst-case scenario (for further details on displacement rates and the matrix approach, refer to **Volume 7, Chapter 12 Offshore Ornithology (application ref: 7.12)**).

~~9.24.2.3.1~~9.25.2.3.1 Status

~~1516.~~1605. Razorbill is listed as a named component of the breeding seabird assemblage of the Foula SPA. The SPA breeding population at classification in 1995 was 6,200 individuals (SNH, 2009). Burnell *et al*. (2023) give an updated count of 474 individuals which has been used in this assessment.

~~9.24.2.3.2~~9.25.2.3.2 Connectivity to the Projects

~~1517.~~1606. DBS East and DBS West are 657km and 630km respectively from the Foula SPA. The mean maximum foraging range of razorbill is 164.6km (88.7 + 75.9km, Woodward *et al*., 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding razorbill from the Foula SPA, there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

~~1518.~~1607. Outside the breeding season, breeding razorbills from the SPA are assumed to range widely and to mix with razorbills from breeding colonies in the UK and further afield. The relevant background population is considered to be the UK North Sea and Channel BDMPS, consisting of 591,874 individuals during autumn and spring passage periods (August to October and January to March), and 218,622 individuals during winter (November and December) (Furness, 2015).

~~1519.~~1608. During the autumn and spring migration it is estimated that Foula birds make up 0.1% of the BDMPS population, and during the winter 0.1% of the BDMPS population. Note, these percentages have been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

~~9.24.2.3.3~~9.25.2.3.3 *Assessment of Potential Effects of the Projects alone and Together*

Table 9-180 Summary of razorbill density and abundance estimates and SPA apportioning rates and used in the operation and construction displacement assessment for Foula SPA. Note that displacement from the wind farm has been estimated as 15%-35%, half the operational rates.

Site	Season	Peak no.	SPA %	Adult %	No. apportioned to SPA	Wind farm operation displacement mortality to SPA			Wind farm construction displacement mortality to SPA			Peak density (birds/ km²)	Total vessel displacement mortality (2km around 3 vessels, 1% mortality)	Vessel mortality to SPA	Total construction displacement mortality to SPA		
						30-1	50-1	70-10	15-1	25 - 1	35-10				15-1 & vessel	25 – 1 & vessel	35-10 & vessel
DBS East	Breeding	555.1	0	100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.4	0.00	0.00	0.00	0.00
	Autumn	4685.3	0.1	100	4.7	0.0	0.0	0.3	0.0	0.0	0.2	9.2	3.5	0.00	0.01	0.02	0.17
	Winter	3376.7	0.1	100	3.4	0.0	0.0	0.2	0.0	0.0	0.1	6.6	2.5	0.00	0.01	0.01	0.12
	Spring	3578.5	0.1	100	3.6	0.0	0.0	0.3	0.0	0.0	0.1	7.0	2.6	0.00	0.01	0.01	0.13
	Annual				11.7	0	0	0.8	0	0	0.4	-	9	0	0.03	0.04	0.42
DBS West	Breeding	2280.6	0	100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.4	1.7	0.00	0.00	0.00	0.00
	Autumn	4886.9	0.1	100	4.9	0.0	0.0	0.3	0.0	0.0	0.2	9.4	3.5	0.00	0.01	0.02	0.17
	Winter	5066.2	0.1	100	5.1	0.0	0.0	0.4	0.0	0.0	0.2	9.7	3.7	0.00	0.01	0.02	0.18
	Spring	4454.6	0.1	100	4.5	0.0	0.0	0.3	0.0	0.0	0.2	8.6	3.2	0.00	0.01	0.01	0.16
	Annual				14.5	0.0	0.1	1.0	0.0	0.0	0.5	-	9.1	0	0.03	0.05	0.51
DBS East + DBS West	Breeding	~~2826.1~~2835.7	0	100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	2.1	0.00	0.00	0.00	0.00
	Autumn	~~6349.6~~9572.2	0.1	100	9.6~~.3~~	0.0	0.0	0.~~4~~7	0.0	0.0	0.~~2~~3		7.0	0.01	0.02	0.~~02~~03	0.~~23~~35
	Winter	~~5823.7~~8442.9	0.1	100	~~5.~~8.4	0.0	0.0	0.~~4~~6	0.0	0.0	0.~~2~~3		6.1	0.01	0.~~01~~02	0.~~02~~03	0.~~21~~31
	Spring	~~6302.5~~8033.1	0.1	100	~~6.3~~8.0	0.0	0.0	0.~~4~~6	0.0	0.0	0.~~2~~3		5.9	0.01	0.02	0.~~02~~03	0.~~23~~29
	Annual				~~18.4~~26.0	0.1	0.1	1.~~3~~8	0.0	0.~~0~~1	0.~~6~~9		18.2	0.03	0.~~05~~07	0.~~06~~10	0.~~7~~94

~~9.24.2.3.3.1~~9.25.2.3.3.1 Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines

~~9.24.2.3.3.1.1~~9.25.2.3.3.1.1 DBS East in Isolation

~~1520.~~1609. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-7**) the number of individuals from the Foula SPA population expected to die is 50 (474 x 0.105) adults per annum. The predicted annual construction impact from DBS East alone on the breeding razorbill population applying highly precautionary rates of 35% displacement and 10% mortality is 0.4 (0.2, 0.1, 0.1 in autumn winter and spring respectively) birds per annum (**Table 9-180**). This would result in a predicted change in adult mortality rate of 0.8%. The equivalent mortality assuming 35% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 0.08 which would increase the background mortality rate by 0.16%.

~~1521.~~1610. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1522.~~1611. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Foula SPA (0.04) would increase the predicted annual mortality by 0.08% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.24.2.3.3.1.2~~9.25.2.3.3.1.2 DBS West in Isolation

~~1523.~~1612. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-7**) the number of individuals from the Foula SPA population expected to die is 50 (474 x 0.105) adults per annum. The predicted annual construction impact from DBS West alone on the breeding razorbill population applying highly precautionary rates of 35% displacement and 10% mortality is 0.5 (0.17, 0.18, 0.16 in autumn winter and spring respectively) birds per annum (**Table 9-180**). This would result in a predicted change in adult mortality rate of 1.0%. The equivalent mortality assuming 35% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 0.1 which would increase the background mortality rate by 0.2%.

1613. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (Trinder *et al*. 2024) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1524.~~1614. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green ~~2023~~(2019b), the annual displacement mortality apportioned to the Foula SPA (0.05) would increase the predicted annual mortality by 0.1% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.24.2.3.3.1.3~~9.25.2.3.3.1.3 *DBS East and West Together*

1615. At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-7**) the number of individuals from the Foula SPA population expected to die is 50 (474 x 0.105) adults per annum. The predicted annual construction impact from DBS East and DBS West on the breeding razorbill population applying highly precautionary rates of 35% displacement and 10% mortality is 0.9 (0.35, 0.31, 0.29 in autumn winter and spring respectively) birds per annum (**Table 9-180**). This would result in a predicted change in adult mortality rate of 1.4% but is based on highly precautionary impact rates. The equivalent mortality assuming 35% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 0.18 which would increase the background mortality rate by 0.36%. A reduction in either the displacement rate (e.g. to 37%) or the mortality rate (e.g. to 5%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in both together).

~~1525.~~1616. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (Trinder *et al*. 2024) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1617. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Foula SPA (0.1) would increase the predicted annual mortality by 0.2% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.24.2.3.3.2~~9.25.2.3.3.2 *Potential Effects During Operation: Disturbance and Displacement*

~~9.24.2.3.3.2.1~~9.25.2.3.3.2.1 *DBS East in Isolation*

~~1526.~~ At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-7**) the number of individuals from the Foula SPA population expected to die is 50 (474 x 0.105) adults per annum. ~~The predicted annual construction impact from DBS East and DBS West on the breeding razorbill population applying highly precautionary rates of 35% displacement and 10% mortality is 0.7 (0.23, 0.21, 0.23 in autumn winter and spring respectively) birds per annum (**Table 9-143**to 50%) or the mortality rate (e.g. to 7%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in both together).~~

~~1527. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 202306) would increase the predicted annual mortality by 0.1% which is below the 1% threshold for detectability and therefore no further assessment was required.~~

~~1528.~~1618. ~~At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-5**) the number of individuals from the Foula SPA population expected to die is 50 (474 x 0.105) adults per annum.~~ The predicted annual operation impact from DBS East alone on the breeding razorbill population applying highly precautionary rates of 70% displacement and 10% mortality is 0.8 (0.3, 0.2, 0.2 in autumn winter and spring respectively) birds per annum (**Table 9-180**). This would result in a predicted change in adult mortality rate of 1.6% but is based on highly precautionary impact rates. The equivalent mortality assuming 70% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 0.16 which would increase the background mortality rate by 0.32%. A reduction in either the displacement rate (e.g. to 49%) or the mortality rate (e.g. to 6%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in both together).

~~1529.~~1619.There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (Trinder *et al*. 2024) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1530.~~1620.At a more appropriate operational displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green ~~2023~~(2019b), the annual displacement mortality apportioned to the Foula SPA (0.06) would increase the predicted annual mortality by 0.11% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.24.2.3.3.2.2~~9.25.2.3.3.2.2 *DBS West in Isolation*

~~1531.~~1621.At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-7**) the number of individuals from the Foula SPA population expected to die is 50 (474 x 0.105) adults per annum. The predicted annual operation impact from DBS West alone on the breeding razorbill population applying highly precautionary rates of 70% displacement and 10% mortality is 1.0 (0.3, 0.4, 0.3 in autumn winter and spring respectively) birds per annum (**Table 9-180**). This would result in a predicted change in adult mortality rate of 2.0% but is based on highly precautionary impact rates. The equivalent mortality assuming 70% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 0.2 which would increase the background mortality rate by 0.4%. A reduction in either the displacement rate (e.g. to 35%) or the mortality rate (e.g. to 5%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in both together).

~~1532.~~1622.There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1533.~~1623.At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Foula SPA (0.1) would increase the predicted annual mortality by 0.2% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.24.2.3.3.2.3~~9.25.2.3.3.2.3 DBS East and West Together

~~1534.~~1624.At the baseline mortality rate for adult razorbill of 0.105 (**Table 9-7**) the number of individuals from the Foula SPA population expected to die is 50 (474 x 0.105) adults per annum. The predicted annual ~~construction~~ operation impact from DBS East and DBS West on the breeding razorbill population applying highly precautionary rates of 70% displacement and 10% mortality is 1.~~3~~8 (0.~~4~~7, 0.~~4~~6, 0.~~4~~6 in autumn winter and spring respectively) birds per annum (**Table 9-180**). This would result in a predicted change in adult mortality rate of ~~2.6~~3.7% but is based on highly precautionary impact rates. The equivalent mortality assuming 70% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 0.36 which would increase the background mortality rate by 0.72%. A reduction in the mortality rate (e.g. to ~~3.8~~2.7%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in mortality combined with reductions in the displacement rate).

~~1535.~~1625. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. ~~In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023~~In a study conducted over two breeding seasons conducted at the Beatrice wind farm (Trinder *et al*. 2024) no evidence was found that razorbills avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is the same as the existing natural adult background mortality rate (i.e. this would double the species mortality). If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of razorbill populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1536.~~1626. At a more appropriate operational displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Foula SPA (0.1) would increase the predicted annual mortality by 0.~~2~~3% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.24.2.3.4~~9.25.2.3.4 Summary

1627. A matrix of the annual operational displacement estimates for DBS East and DBS West is provided in **Table 9-181**.

Table 9-181 Displacement matrix for annual project alone (DBS East plus DBS West) razorbill apportioned to Foula SPA adult population.

Mortality %	Displacement %									
	10	20	30	40	50	60	70	80	90	100
1	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	1
3	0	0	0	0	0	0	1	1	1	1
4	0	0	0	0	1	1	1	1	1	1
5	0	0	0	1	1	1	1	1	1	1
6	0	0	0	1	1	1	1	1	1	2
7	0	0	1	1	1	1	1	1	2	2

Mortality %	Displacement %									
	10	20	30	40	50	60	70	80	90	100
8	0	0	1	1	1	1	1	2	2	2
9	0	0	1	1	1	1	2	2	2	2
10	0	1	1	1	1	2	2	2	2	3
20	1	1	2	2	3	3	4	4	5	5
30	1	2	2	3	4	5	5	6	7	8
50	1	3	4	5	7	8	9	10	12	13
75	2	4	6	8	10	12	14	16	18	20
100	3	5	8	10	13	16	18	21	23	26

~~1537.~~1628. A table summarising the razorbill construction and operational disturbance and displacement assessment for DBS East and DBS West together is provided below (**Table 9-182)**.

~~1538.~~1629. It is concluded that predicted razorbill mortality due to construction and operational phase disturbance and displacement impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the Foula SPA**.

Table 9-182 Summary of predicted razorbill displacement mortality from Foula SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.

Razorbill	**Displacement**		
Potential Effects During Construction: Disturbance and Displacement			
Displacement mortality	Mean (@25% x 1%)	Mean (@35% x ~~10~~2%)	Mean (@~~25~~35% x ~~1~~10%)
Breeding season	0	0	0
Autumn	0.~~23~~03	0.~~02~~07	0.35
Winter	0.~~21~~03	0.~~02~~06	0.31
Spring	0.~~23~~03	0.~~02~~06	0.29
Annual	0.~~7~~10	0.~~06~~19	0.94

Razorbill		**Displacement**		
Effect	Reference population	474		
	Increase in background mortality (%)	0.19	0.37	1.89
Potential Effects During Operation: Disturbance and Displacement				
Displacement mortality		Mean (@50% x 1%)	Mean (@70% x 2%)	Mean (@70% x 10%)
Breeding season		0	0	0
Autumn		0	0.14	0.7
Winter		0	0.12	0.6
Spring		0	0.12	0.6
Annual		0.1	0.36	1.8
Effect	Reference population	474		
	Increase in background mortality (%)	~~1.4~~0.26	0.~~1~~72	3.66
~~**Potential Effects During Operation: Disturbance and Displacement**~~				
~~Displacement mortality~~		~~Mean (@70% x 10%)~~		
~~Breeding season~~		~~0~~	~~0~~	
~~Autumn~~		~~0.4~~	~~0.03~~	
~~Winter~~		~~0.4~~	~~0.02~~	
~~Spring~~		~~0.4~~	~~0.03~~	
~~Annual~~		~~1.3~~	~~0.1~~	
~~Effect~~	~~Reference population~~	~~474~~		
		~~2.6~~	~~0.2~~	

~~9.24.2.3.5~~9.25.2.3.5 Assessment of potential effects of the Projects in combination with other plans and projects

~~1539.~~1630. Given that no measurable increase in the Foula SPA razorbill mortality is predicted as a result of DBS East and DBS West combined (e.g. with realistic displacement mortality of less than 0.1 bird per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted guillemot mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Foula SPA**.

~~9.24.2.4~~9.25.2.4 Puffin

~~1540.~~1631. Puffin has been screened in to assess the impacts from disturbance / displacement in the construction and operation phases.

~~1541.~~1632. The puffin assessment is based on a displacement matrix approach presented in the EIA following statutory guidance (Joint SNCB Note, 2017) using displacement rates of 30% to 70% and mortality rates of 1% to 10%. At the upper end these rates represent a highly precautionary worst-case scenario (for further details on displacement rates and the matrix approach, refer to **Volume 7, Chapter 12 Offshore Ornithology (application ref: 7.12)**).

~~9.24.2.4.1~~9.25.2.4.1 Status

~~1542.~~1633. Puffin is listed as a named component of the breeding seabird assemblage of the Noss SPA.

~~1543.~~1634. The SPA breeding population at classification in 1995 was 48,000 pairs (SNH, 2009). Burnell *et al*. (2023) give an updated count of 4,234 AOB which has been used in this assessment.

~~9.24.2.4.2~~9.25.2.4.2 Connectivity to the Projects

~~1544.~~1635. DBS East and DBS West are 657km and 630km respectively from the Foula SPA. The mean maximum foraging range of puffin is 265.4km (137.1km +128.3km, Woodward *et al*., 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding puffin from the Foula SPA, there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

~~1545.~~1636. Outside the breeding season, breeding puffins from the SPA are assumed to range widely and to mix with puffins from breeding colonies in the UK and further afield. The relevant non-breeding season reference population is the UK North Sea and Channel BDMPS, consisting of 231,957 individuals (mid-August to March) (Furness, 2015).

~~1546.~~1637. It is estimated that 2.9% of birds present at the Projects are breeding adults from Foula SPA. Note, this percentage has been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

~~9.24.2.4.3~~9.25.2.4.3 Assessment of Potential Effects of the Projects alone and Together

Table 9-183 Summary of puffin density and abundance estimates and SPA apportioning rates and used in the operation and construction displacement assessment for Foula SPA. Note that displacement from the wind farm has been estimated as 15%-35%, half the operational rates.

Site	Season	Peak no.	SPA %	Adult %	No. apportioned to SPA	Wind farm operation displacement mortality to SPA			Wind farm construction displacement mortality to SPA			Peak density (birds/ km²)	Total vessel displacement mortality (2km around 3 vessels, 1% mortality)	Vessel mortality to SPA	Total construction displacement mortality to SPA		
						30-1	50-1	70-10	15-1	25 - 1	35-10				15-1 & vessel	25 – 1 & vessel	35-10 & vessel
DBS East	Breeding	62.60	0	0.543	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.05	0.00	0.00	0.00	0.00
	Nonbreeding	178.70	2.9	1	5.2	0.02	0.03	0.36	0.01	0.01	0.18	0.35	0.13	0.00	0.01	0.02	0.19
	Annual				5.2	0.02	0.03	0.36	0.01	0.01	0.18	-	0.18	0.00	0.01	0.02	0.19
DBS West	Breeding	109.3	0	0.543	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.21	0.08	0.00	0.00	0.00	0.00
	Nonbreeding	198.2	2.9	1	5.7	0.02	0.03	0.40	0.01	0.01	0.20	0.38	0.14	0.00	0.01	0.02	0.21
	Annual				5.7	0.02	0.03	0.40	0.01	0.01	0.20	-	0.22	0.00	0.01	0.02	0.21
DBS East + DBS West	Breeding	~~146.60~~171.9	0	0.543	0.0	0.00	0.00	0.00	0.00	0.00	0.00	-	0.12	0.00	0.00	0.00	0.00
	Nonbreeding	~~372.70~~379.9	2.9	1	10.8	0.03	0.05	0.76	0.02	0.03	0.38		0.28	0.01	0.02	0.03	0.39
	Annual				10.8	0.03	0.05	0.76	0.02	0.03	0.38		0.4	0.01	0.02	0.03	0.39

~~9.24.2.4.3.1~~9.25.2.4.3.1 *Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines*

~~9.24.2.4.3.1.1~~9.25.2.4.3.1.1 *DBS East in Isolation*

~~1547.~~1638. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-7**) the number of individuals from the Foula SPA population expected to die is 796 (8,469 x 0.094) adults per annum. The predicted annual construction impact from DBS East alone on the breeding puffin population applying highly precautionary rates of 35% displacement and 10% mortality is 0.19 birds per annum (**Table 9-183)**. This would result in a predicted change in adult mortality rate of 0.02%.

~~1548.~~1639. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that puffins avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is equivalent to the natural adult background mortality rate of 9.4%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of puffin populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1549.~~1640. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Foula SPA (0.02) would increase the predicted annual mortality by <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.24.2.4.3.1.2~~9.25.2.4.3.1.2 *DBS West in Isolation*

~~1550.~~1641. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-7**) the number of individuals from the Foula SPA population expected to die is 796 (8,469 x 0.094) adults per annum. The predicted annual construction impact from DBS West alone on the breeding puffin population applying highly precautionary rates of 35% displacement and 10% mortality is 0.21 birds per annum (**Table 9-183**). This would result in a predicted change in adult mortality rate of 0.02%.

~~1551.~~1642. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that puffins avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is equivalent to the natural adult background mortality rate of 9.4%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of puffin populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1552.~~1643. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Foula SPA (0.02) would increase the predicted annual mortality by <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.24.2.4.3.1.3~~9.25.2.4.3.1.3 DBS East and West Together

~~1553.~~1644. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-7**) the number of individuals from the Foula SPA population expected to die is 796 (8,469 x 0.094) adults per annum. The predicted annual construction impact from DBS East and DBS West on the breeding puffin population applying highly precautionary rates of 35% displacement and 10% mortality is 0.39 birds per annum (**Table 9-183**). This would result in a predicted change in adult mortality rate of 0.05%.

~~1554.~~1645. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that puffins avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is equivalent to the natural adult background mortality rate of 9.4%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of puffin populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1555.~~1646.At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Foula SPA (0.03) would increase the predicted annual mortality by <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.24.2.4.3.2~~9.25.2.4.3.2 *Potential Effects During Operation: Disturbance and Displacement*

~~9.24.2.4.3.2.1~~9.25.2.4.3.2.1 *DBS East in Isolation*

~~1556.~~1647.At the baseline mortality rate for adult puffin of 0.094 (**Table 9-7**) the number of individuals from the Foula SPA population expected to die is 796 (8,469 x 0.094) adults per annum. The predicted annual operation impact from DBS East alone on the breeding puffin population applying highly precautionary rates of 70% displacement and 10% mortality is 0.36 birds per annum (**Table 9-183**). This would result in a predicted change in adult mortality rate of 0.04%.

~~1557.~~1648.There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that puffins avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is equivalent to the natural adult background mortality rate of 9.4%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of puffin populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1558.~~1649.At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Foula SPA (0.03) would increase the predicted annual mortality by <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.24.2.4.3.2.2~~9.25.2.4.3.2.2 DBS West in Isolation

~~1559.~~1650. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-7**) the number of individuals from the Foula SPA population expected to die is 796 (8,469 x 0.094) adults per annum. The predicted annual operation impact from DBS West alone on the breeding puffin population applying highly precautionary rates of 70% displacement and 10% mortality is 0.4 birds per annum (**Table 9-183**). This would result in a predicted change in adult mortality rate of 0.05%.

~~1560.~~1651. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that puffins avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is equivalent to the natural adult background mortality rate of 9.4%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of puffin populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1561.~~1652. At a more appropriate (construction) displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Foula SPA (0.03) would increase the predicted annual mortality by <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.24.2.4.3.2.3~~9.25.2.4.3.2.3 DBS East and West Together

~~1562.~~1653. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-7**) the number of individuals from the Foula SPA population expected to die is 796 (8,469 x 0.094) adults per annum. The predicted annual operation impact from DBS East and DBS West on the breeding puffin population applying highly precautionary rates of 70% displacement and 10% mortality is 0.76 birds per annum (**Table 9-183**). This would result in a predicted change in adult mortality rate of 0.09%.

~~1563.~~1654. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that puffins avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is equivalent to the natural adult background mortality rate of 9.4%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of puffin populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1564.~~1655. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Foula SPA (0.05) would increase the predicted annual mortality by <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.24.2.4.4~~9.25.2.4.4 *Summary*

~~1565.~~1656. A table summarising the puffin construction and operational disturbance and displacement assessment for DBS East and DBS West together is provided below (**Table 9-184**).

~~1566.~~1657. It is concluded that predicted puffin mortality due to construction and operational phase disturbance and displacement impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the Foula SPA**.

Table 9-184 Summary of predicted puffin displacement mortality from Foula SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.

~~Guillemot~~Puffin		**Displacement**	
Potential Effects During Construction: Disturbance and Displacement			
Displacement mortality		Mean (@~~35~~25% x ~~10~~1%)	Mean (@~~25~~35% x ~~1~~10%)
Breeding season		0	0
Nonbreeding season		0.~~39~~03	0.~~03~~39
Annual		0.~~39~~03	0.~~03~~39
Effect	Reference population	8,468	
	Increase in background mortality (%)	<0.~~05~~01	~~<~~0.~~01~~05
Potential Effects During Operation: Disturbance and Displacement			
Displacement mortality		Mean (@~~70~~50% x ~~10~~1%)	Mean (@~~50~~70% x ~~1~~10%)

~~Guillemot~~Puffin		Displacement	
Breeding season		0	0
Nonbreeding season		0.~~76~~05	0.~~05~~76
Annual		0.~~76~~05	0.~~05~~76
Effect	Reference population	8,468	
	Increase in background mortality (%)	<0.~~095~~01	~~<~~0.~~01~~095

~~9.24.2.4.5~~9.25.2.4.5 *Assessment of potential effects of the Projects in combination with other plans and projects*

~~1567.~~1658.Given that no measurable increase in the Foula SPA puffin mortality is predicted as a result of DBS East and DBS West combined (e.g. with realistic displacement mortality of 0.05 birds per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted puffin mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Foula SPA**.

~~9.25~~9.26 Hermaness, Saxa Vord and Valla Field SPA

~~9.25.1~~9.26.1 Site Description

~~1568.~~1659.Hermaness, Saxa Vord and Valla Field SPA lies in the north-west corner of the island of Unst, Shetland. It consists of 100m to 200m high sea cliffs and adjoining areas of grassland, heath and blanket bog. The seaward extension extends approximately 2km into the marine environment to include the seabed, water column and surface.

~~9.25.1.1~~9.26.1.1 Qualifying Features

~~1569.~~1660.The qualifying features of the Hermaness, Saxa Vord and Valla Field SPA screened into the assessment are listed in Table 4-7 of **RIAA HRA Part 1 of 4 – Introduction and Terrestrial Ecology (application ref: 6.1).** These are breeding gannet and puffin and two named components of the breeding seabird assemblage (kittiwake and guillemot).

~~9.25.1.2~~9.26.1.2 Conservation Objectives

~~1570.~~1661.The over-arching conservation objectives of the site are as follows:

- To avoid deterioration of the habitats of the qualifying species or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained; and

- To ensure for the qualifying species that the following are maintained in the long term:
  - Population of the species as a viable component of the site;
  - Distribution of the species within site;
  - Distribution and extent of habitats supporting the species;
  - Structure, function and supporting processes of habitats supporting the species; and
  - No significant disturbance of the species.

~~9.25.2~~9.26.2 Assessment: Array Areas

~~9.25.2.1~~9.26.2.1 Gannet

~~1571.~~1662. Gannet has been screened into the assessment to assess the impacts from disturbance / displacement and collision risk in the construction and operation phase.

~~9.25.2.1.1~~9.26.2.1.1 Status

~~1572.~~1663. Gannet is listed as a designated species of the Hermaness, Saxa Vord and Valla Field SPA.

~~1573.~~1664. The SPA breeding population at classification was cited as 16,400 pairs or 32,800 breeding adults in 1999 (SNH, 2009). Burnell *et al.* (2023) give an updated count of 29,562 AON which has been used in this assessment.

~~9.25.2.1.2~~9.26.2.1.2 Connectivity to the Projects

~~1574.~~1665. DBS East and DBS West are 705km and 681km respectively from the Hermaness, Saxa Vord and Valla Field SPA. The mean maximum foraging range of gannet is 509.4km (315.2 + 194.2km, Woodward *et al.*, 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding gannet from the Hermaness, Saxa Vord and Valla Field SPA there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

~~1575.~~1666. Outside the breeding season breeding gannets, including those from the Hermaness, Saxa Vord and Valla Field SPA, are not constrained by requirements to visit nests to incubate eggs or provision chicks. At this time, they are assumed to range more widely and to mix with gannets of all age classes from breeding colonies in the UK and further afield. The background population during these seasons is the UK North Sea BDMPS. This consists of 456,298 individuals during autumn migration (September to November), and 248,385 individuals during spring migration (December to March) (Furness, 2015).

~~1576.~~1667. During the autumn migration and spring migration seasons it is estimated that 8.5% and 13.7% of birds respectively present in the Project array areas are considered to be breeding adults from the Hermaness, Saxa Vord and Valla Field SPA. Note, these percentages have been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

~~9.25.2.1.3~~9.26.2.1.3 *Assessment of Potential Effects of the Projects alone and Together*

~~9.25.2.1.3.1~~9.26.2.1.3.1 *Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines*

~~1577.~~1668. The seasonal peak total number of gannets recorded in DBS East and DBS West and the number apportioned to Hermaness, Saxa Vord and Valla Field SPA is provided in **Table 9-185**.

~~1578.~~1669. Construction displacement has been estimated on the basis this operates across half the wind farm. Thus, gannet displacement was calculated using 30% and 40% displacement rates (i.e. half the operational values) and 1% mortality. These were then added to the number of birds expected to be displaced by up to three construction vessels (assuming 100% displacement within 2km of each vessel and 1% mortality), calculated from the seasonal densities (**Table 9-185**).

Table 9-185 Summary of gannet density and abundance estimates and SPA apportioning rates and used in the operation and construction displacement assessment for Hermaness, Saxa Vord and Valla Field SPA. Note that displacement from the wind farm has been estimated as 30%-40%, half the operational rates.

Site	Season	Peak no. (mean)	SPA %	Adult %	No. apportioned to SPA	Wind farm operation displacement mortality to SPA		Wind farm construction displacement mortality to SPA		Peak density (birds/ km^2)	Total vessel displacement mortality (2km around 3 vessels, 1% mortality)	Vessel mortality to SPA	Total construction displacement mortality to SPA	
						60-1	80-1	30-1	40-1				30-1 & vessel	40-1 & vessel
DBS East	Breeding	754.9	0	60	0.0	0.00	0.00	0.00	0.00	1.48	0.56	0.00	0.00	0.00
	Autumn	776.1	8.5	100	66.0	0.40	0.53	0.20	0.26	1.52	0.57	0.05	0.25	0.31
	Spring	75.1	13.7	100	10.3	0.06	0.08	0.03	0.04	0.15	0.06	0.01	0.04	0.05
	Annual				76.3	0.46	0.61	0.23	0.3	-	1.19	0.06	0.29	0.36
DBS West	Breeding	805.3	0	60	0.0	0.00	0.00	0.00	0.00	1.55	0.58	0.00	0.00	0.00
	Autumn	797.5	8.5	100	67.8	0.41	0.54	0.20	0.27	1.54	0.58	0.05	0.25	0.32
	Spring	86.2	13.7	100	11.8	0.07	0.09	0.04	0.05	0.17	0.06	0.01	0.04	0.06
	Annual				79.6	0.48	0.63	0.24	0.32	-	1.22	0.06	0.29	0.38
DBS East + DBS West	Breeding	1560.2	0	60	0.0	0.00	0.00	0.00	0.00	-	1.14	0.00	0.00	0.00
	Autumn	1573.6	8.5	100	133.8	0.80	1.07	0.40	0.54		1.15	0.10	0.50	0.63
	Spring	161.3	13.7	100	22.1	0.13	0.18	0.07	0.09		0.12	0.02	0.08	0.10
	Annual				155.9	0.93	1.25	0.47	0.63		2.41	0.12	0.58	0.73

~~9.25.2.1.3.1.1~~9.26.2.1.3.1.1 *DBS East in Isolation*

~~1579.~~ At the baseline mortality rate for adult gannet of 0.088 (**Table 9-7**) ~~the number of adults from Hermaness, Saxa Vord and Valla Field SPA population expected to die per year is 5,203 (59,124 x 0.088). The predicted annual construction mortality impacts from DBS East alone on the breeding gannet population is 0.36 birds per annum (**Table 9-147**). This results in a predicted change in adult mortality rate of <0.01% which is below the 1% threshold for detectability and therefore no further assessment is required.~~

~~*9.25.2.1.3.1.2 DBS West in Isolation*~~

~~1580.~~1670.~~At the baseline mortality rate for adult gannet of 0.088 (**Table 9-5**~~) the number of adults from Hermaness, Saxa Vord and Valla Field SPA population expected to die per year is 5,203 (59,124 x 0.088). The predicted annual construction mortality impacts from DBS ~~West~~East alone on the breeding gannet population is 0.~~38~~36 birds per annum (**Table 9-185**). This results in a predicted change in adult mortality rate of <0.01% which is below the 1% threshold for detectability and therefore no further assessment is required.

~~9.25.2.1.3.1.3~~9.26.2.1.3.1.2 *DBS ~~East and~~ West ~~Together~~in Isolation*

1671. At the baseline mortality rate for adult gannet of 0.088 (**Table 9-7**) the number of adults from Hermaness, Saxa Vord and Valla Field SPA population expected to die per year is 5,203 (59,124 x 0.088). The predicted annual construction mortality impacts from DBS West alone on the breeding gannet population is 0.38 birds per annum (**Table 9-185**). This results in a predicted change in adult mortality rate of <0.01% which is below the 1% threshold for detectability and therefore no further assessment is required.

9.26.2.1.3.1.3 DBS East and West Together

~~1581.~~1672.At the baseline mortality rate for adult gannet of 0.088 (**Table 9-7**) the number of adults from Hermaness, Saxa Vord and Valla Field SPA population expected to die per year is 5,203 (59,124 x 0.088). The predicted annual construction mortality impacts from DBS East and DBS West on the breeding gannet population is 0.74 birds per annum (**Table 9-185**). This results in a predicted change in adult mortality rate of 0.01% which is below the 1% threshold for detectability and therefore no further assessment is required.

~~9.25.2.1.3.2~~9.26.2.1.3.2 *Potential Effects During Operation: Disturbance and Displacement*

~~9.25.2.1.3.2.1~~9.26.2.1.3.2.1 *DBS East in Isolation*

~~1582.~~ At the baseline mortality rate for adult gannet of 0.088 (**Table 9-7**~~) the number of individuals from Hermaness, Saxa Vord and Valla Field SPA population expected to die per year is 5,203 (59,124 x 0.088). The predicted annual impacts from DBS East alone on the breeding gannet population is 0.61 birds per annum (**Table 9-147**). This results in a predicted change in adult mortality rate of 0.01% which is below the 1% threshold for detectability and therefore no further assessment is required.~~

~~9.25.2.1.3.2.2 *DBS West in Isolation*~~

~~1583.~~1673.~~At the baseline mortality rate for adult gannet of 0.088 (**Table 9-5**~~) the number of individuals from Hermaness, Saxa Vord and Valla Field SPA population expected to die per year is 5,203 (59,124 x 0.088). The predicted annual impacts from DBS ~~West~~East alone on the breeding gannet population is 0.~~64~~61 birds per annum (**Table 9-185**). This results in a predicted change in adult mortality rate of 0.01% which is below the 1% threshold for detectability and therefore no further assessment is required.

~~9.25.2.1.3.2.3~~9.26.2.1.3.2.2 *DBS ~~East and~~ West ~~Together~~in Isolation*

1674. At the baseline mortality rate for adult gannet of 0.088 (**Table 9-7**) the number of individuals from Hermaness, Saxa Vord and Valla Field SPA population expected to die per year is 5,203 (59,124 x 0.088). The predicted annual impacts from DBS West alone on the breeding gannet population is 0.64 birds per annum (**Table 9-185**). This results in a predicted change in adult mortality rate of 0.01% which is below the 1% threshold for detectability and therefore no further assessment is required.

9.26.2.1.3.2.3 *DBS East and West Together*

~~1584.~~1675. At the baseline mortality rate for adult gannet of 0.088 (**Table 9-7**) the number of individuals from Hermaness, Saxa Vord and Valla Field SPA population expected to die per year is 5,203 (59,124 x 0.088). The predicted annual impacts from DBS West alone on the breeding gannet population is 1.25 birds per annum (**Table 9-185**). This results in a predicted change in adult mortality rate of 0.02% which is below the 1% threshold for detectability and therefore no further assessment is required.

~~9.25.2.1.3.3~~9.26.2.1.3.3 Potential Effects During Operation: Collision Risk

Table 9-186 Summary of gannet total collisions and apportioned to Hermaness, Saxa Vord and Valla Field SPA.

Site	Season	Collision mortality			SPA %	Adult %	Collisions apportioned to SPA		
		Lower 95% c.i.	Mean	Upper 95% c.i.			Lower 95% c.i.	Mean	Upper 95% c.i.
DBS East	Breeding	0.7	3.4	7.8	0	60	0.0	0.0	0.0
	Autumn	0.3	1.6	3.8	8.5	100	0.0	0.1	0.3
	Spring	0.0	0.1	0.6	13.7	100	0.0	0.0	0.1
	Annual	1.1	5.1	12.2	-	-	0.0	0.1	0.4
DBS West	Breeding	0.6	4.9	15.3	0	60	0.0	0.0	0.0
	Autumn	0.3	2.1	6.0	8.5	100	0.0	0.2	0.5
	Spring	0.0	0.1	0.7	13.7	100	0.0	0.0	0.1
	Annual	1.5	7.1	17.7	-	-	0.0	0.2	0.6
DBS East + DBS West	Breeding	0.9	8.4	26.5	0	60	0.0	0.0	0.0
	Autumn	0.5	3.7	10.8	8.5	100	0.0	0.3	0.9
	Spring	0.0	0.3	1.3	13.7	100	0.0	0.0	0.2
	Annual	2.7	12.4	29.8	-	-	0.0	0.4	1.1

~~9.25.2.1.3.3.1~~9.26.2.1.3.3.1 DBS East in Isolation

~~1585.~~1676. At the baseline mortality rate for adult gannet of 0.088 (**Table 9-7**) the number of individuals from Hermaness, Saxa Vord and Valla Field SPA population expected to die per year is 5,203 (59,124 x 0.088) adults per annum. The predicted impacts from DBS East alone on the breeding gannet population is 0.1 (0.0 to 0.4) birds per annum (**Table 9-186**). This results in a predicted change in adult mortality rate of <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.25.2.1.3.3.2~~9.26.2.1.3.3.2 *DBS West in Isolation*

~~1586.~~1677. At the baseline mortality rate for adult gannet of 0.088 (**Table 9-7**) the number of individuals from Hermaness, Saxa Vord and Valla Field SPA population expected to die per year is 5,203 (59,124 x 0.088) adults per annum. The predicted impacts from DBS West alone on the breeding gannet population is 0.2 (0.0 to 0.6) birds per annum (**Table 9-186**). This results in a predicted change in adult mortality rate of <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.25.2.1.3.3.3~~9.26.2.1.3.3.3 *DBS East and West Together*

~~1587.~~1678. At the baseline mortality rate for adult gannet of 0.088 (**Table 9-7**) the number of individuals from Hermaness, Saxa Vord and Valla Field SPA population expected to die per year is 5,203 (59,124 x 0.088) adults per annum. The predicted impacts from DBS East and DBS West on the breeding gannet population is 0.4 (0.0 to 1.1) birds per annum (**Table 9-186**). This results in a predicted change in adult mortality rate of 0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.25.2.1.3.4~~9.26.2.1.3.4 *Potential Effects During Operation: Combined Operational Displacement and Collision Risk*

~~9.25.2.1.3.4.1~~9.26.2.1.3.4.1 *DBS East in Isolation*

~~1588.~~1679. Since the estimated impacts from DBS East on the Hermaness, Saxa Vord and Valla Field SPA population due to operational displacement and collision risk were extremely small, there is no risk of a combined impact from both together.

~~9.25.2.1.3.4.2~~9.26.2.1.3.4.2 *DBS West in Isolation*

~~1589.~~1680. Since the estimated impacts from DBS West on the Hermaness, Saxa Vord and Valla Field SPA population due to operational displacement and collision risk were extremely small, there is no risk of a combined impact from both together.

~~9.25.2.1.3.4.3~~9.26.2.1.3.4.3 *DBS East and West Together*

~~1590.~~1681. Since the estimated impacts from DBS East and DBS West on the Hermaness, Saxa Vord and Valla Field SPA population due to operational displacement and collision risk were extremely small, there is no risk of a combined impact from both together.

~~9.25.2.1.4~~9.26.2.1.4 Summary

~~1591.~~1682. A table summarising the gannet construction and operational disturbance / displacement, as well as operational collision risk and finally the combination of operational disturbance and displacement with collision risk assessment for DBS East and DBS West together is provided below (**Table 9-187**).

~~1592.~~1683. It is concluded that predicted gannet mortality due to construction and operational phase displacement , as well as operational collision risk and finally the combination of operational disturbance and displacement with collision risk impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the Hermaness, Saxa Vord and Valla Field SPA**.

Table 9-187 Summary of predicted gannet construction and operational displacement and operational collision risk mortality from Hermaness, Saxa Vord and Valla Field SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.

Gannet				
Potential Effects During Construction: Disturbance and Displacement				
Displacement mortality (80% + 1%)		Mean	Lower c.i.	Upper c.i.
Breeding season		0	-	-
Autumn		0.63	-	-
Spring		0.1	-	-
Annual		0.73		
Effect	Reference population	59,124	-	-
	Increase in background mortality (%)	0.01	-	-
Potential Effects During Operation: Disturbance and Displacement				
Displacement mortality (80% + 1%)		Mean	Lower c.i.	Upper c.i.
Breeding season		0	-	-
Autumn		1.07	-	-
Spring		0.18	-	-
Annual		1.25		
Effect	Reference population	59,124	-	-
	Increase in background mortality (%)	0.02	-	-
Potential Effects During Operation: Collision Risk				
Collision mortality		Lower c.i.	Mean	Upper c.i.
Breeding season		0	0	0
Autumn		0.0	0.3	0.9
Spring		0.0	0.0	0.2
Annual		0.0	0.4	1.1
Effect	Reference population	59,124		

Gannet				
	Increase in background mortality (%)	<0.01	0.01	0.02
Potential Effects During Operation: Combined Disturbance and Displacement and Collision Risk				
Combined Displacement and Collision mortality		Mean	Lower c.i.	Upper c.i.
Breeding season		0	-	-
Autumn		1.39	-	-
Spring		0.22	-	-
Annual		1.61		
Effect	Reference population	59,124	-	-
	Increase in background mortality (%)	0.03	-	-

~~9.25.2.1.5~~9.26.2.1.5 Assessment of potential effects of the Projects in combination with other plans and projects

~~1593.~~1684. Given that no measurable increase in the Hermaness, Saxa Vord and Valla Field SPA gannet mortality is predicted as a result of DBS East and DBS West combined (e.g. with total displacement and collision mortality of only 1.61 birds per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted gannet mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Hermaness, Saxa Vord and Valla Field SPA**.

~~9.25.2.2~~9.26.2.2 Kittiwake

~~1594.~~1685. Kittiwake has been screened into the assessment to assess the impacts from collision risk in the operation phase.

~~9.25.2.2.1~~9.26.2.2.1 Status

~~1595.~~1686. Kittiwake is listed as a named component of the breeding seabird assemblage of the Hermaness, Saxa Vord and Valla Field SPA.

~~1596.~~1687. The SPA breeding population at classification was cited as 922 pairs or 1,844 breeding adults in 2009 (SNH, 2009). Burnell *et al*. (2023) give an updated count of 177 AON which has been used in this assessment.

~~9.25.2.2.2~~9.26.2.2.2 *Connectivity to the Projects*

~~1597.~~1688. DBS East and DBS West are 705km and 681km respectively from the Hermaness, Saxa Vord and Valla Field SPA. The mean maximum foraging range of kittiwake is 300.6km (156.1km + 144.5km, Woodward *et al.*, 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding kittiwake from the Hermaness, Saxa Vord and Valla Field SPA there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

~~1598.~~1689. Outside the breeding season breeding kittiwakes, including those from the Hermaness, Saxa Vord and Valla Field SPA, are not constrained by requirements to visit nests to incubate eggs or provision chicks. At this time, they are assumed to range more widely and to mix with kittiwakes of all age classes from breeding colonies in the UK and further afield. The background population during these seasons is the UK North Sea BDMPS. This consists of 829,937 individuals during the autumn migration season (August to December), and 627,816 individuals during the spring migration season (January to April) (Furness, 2015).

~~1599.~~1690. It is estimated that 0.1% of birds present in the Project array areas in the autumn and spring migration seasons are considered to be breeding adults from Hermaness, Saxa Vord and Valla Field SPA. Note, these percentages have been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

~~9.25.2.2.3~~9.26.2.2.3 *Assessment of Potential Effects of the Projects alone and Together*

~~9.25.2.2.3.1~~9.26.2.2.3.1 *Potential Effects During Operation: Collision risk*

Table 9-188 Summary of kittiwake total collisions and apportioned to the Hermaness, Saxa Vord and Valla Field SPA.

Site	Season	Collision mortality			SPA %	Adult %	Collisions apportioned to SPA		
		Lower 95% c.i.	Mean	Upper 95% c.i.			Lower 95% c.i.	Mean	Upper 95% c.i.
DBS East	Breeding	42.3	83.3	168.5	0	53	0.0	0.0	0.0
	Autumn	14.6	41.4	82.9	0.1	100	0.0	0.0	0.1
	Spring	6.8	14.6	28.0	0.1	100	0.0	0.0	0.0
	Annual	66.9	139.3	261.3	-	-	0.0	0.1	0.1

Site	Season	Collision mortality			SPA %	Adult %	Collisions apportioned to SPA		
		Lower 95% c.i.	Mean	Upper 95% c.i.			Lower 95% c.i.	Mean	Upper 95% c.i.
DBS West	Breeding	36.9	107.8	280.8	0	53	0.0	0.0	0.0
	Autumn	9.5	37.9	81.9	0.1	100	0.0	0.0	0.1
	Spring	7.1	14.9	26.5	0.1	100	0.0	0.0	0.0
	Annual	55.9	160.6	327.0	-	-	0.0	0.1	0.1
DBS East + DBS West	Breeding	96.2	191.1	378.4	0	53	0.0	0.0	0.0
	Autumn	30.5	79.3	143.1	0.1	100	0.0	0.1	0.1
	Spring	16.9	29.5	47.3	0.1	100	0.0	0.0	0.0
	Annual	150.9	299.9	540.5	-	-	0.0	0.1	0.2

~~9.25.2.2.3.1.1~~9.26.2.2.3.1.1 *DBS East in Isolation*

1691. At the baseline mortality rate for adult kittiwake of 0.146 **(Table 9-7**) the number of individuals from the Hermaness, Saxa Vord and Valla Field SPA population expected to die is 52 (354 x 0.146) adults per annum. The predicted annual impacts from DBS East alone on the breeding kittiwake population is 0.03 birds per annum (**Table 9-188**). This results in a predicted change in adult mortality rate of 0.07% which is below the 1% threshold for detectability and therefore no further assessment was required.

9.26.2.2.3.1.2 DBS West in Isolation

~~1600.~~1692. At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-7**) the number of individuals from the Hermaness, Saxa Vord and Valla Field SPA population expected to die is 52 (354 x 0.146) adults per annum. The predicted annual impacts from DBS ~~East~~West alone on the breeding kittiwake population is 0.03 birds per annum (**Table 9-188**). This results in a predicted change in adult mortality rate of 0.~~07~~06% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.25.2.2.3.1.2~~9.26.2.2.3.1.3 DBS East and West ~~in Isolation~~Together

~~1601.~~ At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-7**) the number of individuals from the Hermaness, Saxa Vord and Valla Field SPA population expected to die is 52 (354 x 0.146) adults per annum. ~~The predicted annual impacts from DBS West alone on the breeding kittiwake population is 0.03 birds per annum (**Table 9-150**). This results in a predicted change in adult mortality rate of 0.06% which is below the 1% threshold for detectability and therefore no further assessment was required.~~

~~9.25.2.2.3.1.3 DBS East and West Together~~

~~1602.~~1693. ~~At the baseline mortality rate for adult kittiwake of 0.146 (**Table 9-5**) the number of individuals from the Hermaness, Saxa Vord and Valla Field SPA population expected to die is 52 (354 x 0.146) adults per annum.~~ The predicted annual impacts from DBS East and DBS West on the breeding kittiwake population is 0.07 birds per annum (**Table 9-188**). This results in a predicted change in adult mortality rate of 0.13% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.25.2.2.4~~9.26.2.2.4 Summary

~~1603.~~1694. A table summarising the kittiwake operational collision risk assessment for DBS East and DBS West together is provided below (**Table 9-189**).

~~1604.~~1695. It is concluded that predicted kittiwake mortality due to operational phase collision risk at DBS East, DBS West, and the Projects together would **not adversely affect the integrity of the Hermaness, Saxa Vord and Valla Field SPA.**

Table 9-189 Summary of predicted Kittiwake collision mortality from Hermaness, Saxa Vord and Valla Field SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations for the Worst Case Wind Turbine Scenario.

Kittiwake		**Collisions**		
Potential Effects During Operation: Collision Risk				
Collision mortality		Lower c.i.	Mean	Upper c.i.
Breeding season		-	-	-
Autumn		0.0	0.1	0.1
Spring		0.0	0.0	0.0
Annual		0.0	0.1	0.2
Effect	Reference population	354		
	Increase in background mortality (%)	<0.01	0.13	0.29

~~9.25.2.2.5~~9.26.2.2.5 *Assessment of potential effects of the Projects in combination with other plans and projects*

~~1605.~~1696. Given that no measurable increase in the Hermaness, Saxa Vord and Valla Field SPA kittiwake mortality is predicted as a result of DBS East and DBS West combined (e.g. with total collision mortality of only 0.07 birds per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted kittiwake mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Hermaness, Saxa Vord and Valla Field SPA**.

~~9.25.2.3~~9.26.2.3 Guillemot

~~1606.~~1697. Guillemot has been screened in to assess the impacts from disturbance / displacement in the construction and operation phases.

~~1607.~~1698. The guillemot assessment is based on a displacement matrix approach presented in the EIA following statutory guidance (Joint SNCB Note, 2017) using displacement rates of 30% to 70% and mortality rates of 1% to 10%. At the upper end these rates represent a highly precautionary worst-case scenario (for further details on displacement rates and the matrix approach, refer to **Volume 7, Chapter 12 Offshore Ornithology (application ref: 7.12)**).

~~9.25.2.3.1~~9.26.2.3.1 *Status*

~~1608.~~1699. Guillemot is listed as a named component of the breeding seabird assemblage of the Hermaness, Saxa Vord and Valla Field SPA.

~~1609.~~1700. The SPA breeding population at classification was 25,000 individuals over two surveys carried out in 1996 and 1999 (SNH, 2009). Burnell *et al.* (2023) give an updated count of 6,109 individuals which has been used in this assessment.

~~9.25.2.3.2~~9.26.2.3.2 *Connectivity to the Projects*

~~1610.~~1701. DBS East and DBS West are 705km and 681km respectively from the Hermaness, Saxa Vord and Valla Field SPA. The mean maximum foraging range of guillemot is 153.7km (73.2km + 80.5km, Woodward *et al.*, 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding guillemot from the Hermaness, Saxa Vord and Valla Field SPA, there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

~~1611.~~1702.Outside the breeding season, breeding guillemots from the SPA are assumed to range widely and to mix with guillemots from breeding colonies in the UK and beyond. The relevant non-breeding season reference population is the UK North Sea and Channel BDMPS, consisting of 1,617,306 individuals (August to February) (Furness, 2015).

~~1612.~~1703.During the non-breeding season, 70% of the Hermaness, Saxa Vord and Valla Field SPA breeding adults are assumed to be present in the BDMPS. It is estimated that 0.4% of birds present at the Projects are considered to be breeding adults from the Hermaness, Saxa Vord and Valla Field SPA, and impacts are apportioned accordingly **(Table 9-190**). Note, this percentage has been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

~~1613.~~1704.It is estimated that 0.4% of birds present at the Projects are considered to be breeding adults from Hermaness, Saxa Vord and Valla Field SPA. Note, this percentage has been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

~~9.25.2.3.3~~9.26.2.3.3 Assessment of Potential Effects of the Projects alone and Together

Table 9-190 Summary of guillemot density and abundance estimates and SPA apportioning rates and used in the operation and construction displacement assessment for Hermaness, Saxa Vord and Valla Field SPA. Note that displacement from the wind farm has been estimated as 15%-35%, half the operational rates.

Site	Season	Peak no.	SPA %	Adult %	No. apportioned to SPA	Wind farm operation displacement mortality to SPA			Wind farm construction displacement mortality to SPA			Peak density (birds/ km^2)	Total vessel displacement mortality (2km around 3 vessels, 1% mortality)	Vessel mortality to SPA	Total construction displacement mortality to SPA		
						30-1	50-1	70-10	15-1	25 - 1	35-10				15-1 & vessel	25 – 1 & vessel	35-10 & vessel
DBS East	Breeding	9030.5	0	55.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.71	6.7	0.00	0.00	0.00	0.00
	Nonbreeding	12551.8	0.4	100	50.2	0.2	0.3	3.5	0.1	0.1	1.8	24.62	9.3	0.04	0.11	0.16	1.79
	Annual				50.2	0.2	0.3	3.5	0.1	0.1	1.8	-	16	0.04	0.11	0.16	1.79
DBS West	Breeding	8783.5	0	55.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.92	6.4	0.00	0.00	0.00	0.00
	Nonbreeding	12498.4	0.4	100	50.0	0.1	0.2	3.5	0.1	0.1	1.7	24.08	9.1	0.04	0.11	0.16	1.79
	Annual				50.0	0.1	0.2	3.5	0.1	0.1	1.7	-	15.5	0.04	0.11	0.16	1.79
DBS East + DBS West	Breeding	~~14927.7~~17815	0	55.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	13.0	0.00	0.00	0.00	0.00
	Nonbreeding	~~20136.0~~25050	0.4	100	~~80.5~~100.2	0.~~2~~3	0.~~4~~5	~~5.6~~7.0	0.~~1~~2	0.~~2~~3	~~2.8~~3.5		18.4	0.07	0.~~19~~2	0.~~27~~3	~~2.89~~3.6
	Annual				~~80.5~~100.2	0.~~2~~3	0.~~4~~5	~~5.6~~7.0	0.~~1~~2	0.~~2~~3	~~2.8~~3.5		31.4	0.07	0.~~19~~2	0.~~27~~3	~~2.89~~3.6

~~9.25.2.3.3.1~~9.26.2.3.3.1 *Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines*

~~9.25.2.3.3.1.1~~9.26.2.3.3.1.1 *DBS East in Isolation*

~~1614.~~1705. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Hermaness, Saxa Vord and Valla Field SPA population expected to die is 373 (6,109 x 0.061) adults per annum. The predicted annual construction impact from DBS East alone on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 1.79 birds per annum (**Table 9-190**). This would result in a predicted change in adult mortality rate of 0.48%. The equivalent mortality assuming 35% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 0.36 which would increase the background mortality rate by 0.09%.

~~1615.~~ There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.~~

~~1616. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Hermaness, Saxa Vord and Valla Field SPA (0.16) would increase the predicted annual mortality by 0.04% which is below the 1% threshold for detectability and therefore no further assessment was required.~~

~~*9.25.2.3.3.1.2 DBS West in Isolation*~~

~~1617. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Hermaness, Saxa Vord and Valla Field SPA population expected to die is 373 (6,109 x 0.061) adults per annum. The predicted annual construction impact from DBS West alone on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 1.79 birds per annum (**Table 9-152**). This would result in a predicted change in adult mortality rate of 0.47%.~~

~~1618.~~1706.Trinder *et al*. 2024~~In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023~~) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1619.~~1707.At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Hermaness, Saxa Vord and Valla Field SPA (0.16) would increase the predicted annual mortality by 0.04% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.25.2.3.3.1.3~~9.26.2.3.3.1.2 DBS ~~East and~~ West ~~Together~~in Isolation

~~1620.~~1708.At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Hermaness, Saxa Vord and Valla Field SPA population expected to die is 373 (6,109 x 0.061) adults per annum. The predicted annual construction impact from DBS ~~East and DBS~~ West alone on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is ~~2.89~~1.79 birds per annum (**Table 9-190)**. This would result in a predicted change in adult mortality rate of 0.~~77%.~~ 47%. The equivalent mortality assuming 35% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 0.36 which would increase the background mortality rate by 0.09%.

~~1621.~~1709.There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1622.~~1710. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Hermaness, Saxa Vord and Valla Field SPA (0.~~07~~16) would increase the predicted annual mortality by 0.~~3~~04% which is below the 1% threshold for detectability and therefore no further assessment was required.

9.26.2.3.3.1.3 DBS East and West Together

1711. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Hermaness, Saxa Vord and Valla Field SPA population expected to die is 373 (6,109 x 0.061) adults per annum. The predicted annual construction impact from DBS East and DBS West on the breeding guillemot population applying highly precautionary rates of 35% displacement and 10% mortality is 3.6 birds per annum (**Table 9-190**). This would result in a predicted change in adult mortality rate of 0.96%. The equivalent mortality assuming 35% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 0.72 which would increase the background mortality rate by 0.19%.

1712. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1713. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Hermaness, Saxa Vord and Valla Field SPA (0.3) would increase the predicted annual mortality by 0.1 which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.25.2.3.3.2~~9.26.2.3.3.2 *Potential Effects During Operation: Disturbance and Displacement*

~~9.25.2.3.3.2.1~~9.26.2.3.3.2.1 *DBS East in Isolation*

~~1623.~~1714. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Hermaness, Saxa Vord and Valla Field SPA population expected to die is 373 (6,109 x 0.061) adults per annum. The predicted annual operation impact from DBS East alone on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 3.5 birds per annum (**Table 9-190**). This would result in a predicted change in adult mortality rate of 0.94%. The equivalent mortality assuming 70% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 0.7 which would increase the background mortality rate by 0.19%.

~~1624.~~1715. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1625.~~1716. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Hermaness, Saxa Vord and Valla Field SPA (0.3) would increase the predicted annual mortality by 0.06 which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.25.2.3.3.2.2~~9.26.2.3.3.2.2 *DBS West in Isolation*

~~1626.~~1717. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Hermaness, Saxa Vord and Valla Field SPA population expected to die is 373 (6,109 x 0.061) adults per annum. The predicted annual operation impact from DBS West alone on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 3.5 birds per annum (**Table 9-190**). This would result in a predicted change in adult mortality rate of 0.93%. The equivalent mortality assuming 70% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 0.7 which would increase the background mortality rate by 0.19%.

~~1627.~~1718. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1628. At a more appropriate (construction) displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Hermaness, Saxa Vord and Valla Field SPA (0.3) would increase the predicted annual mortality by 0.06% which is below the 1% threshold for detectability and therefore no further assessment was required.~~

~~*9.25.2.3.3.2.3 DBS East and West Together*~~

~~1629. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-5**) the number of individuals from the Hermaness, Saxa Vord and Valla Field SPA population expected to die is 373 (6,109 x 0.061) adults per annum. The predicted annual operation impact from DBS East and DBS West on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 5.6 birds per annum (**Table 9-152**). This would result in a predicted change in adult mortality rate of 1.51% but is based on highly precautionary impact rates. A reduction in either the displacement rate (e.g. to 46%) or the mortality rate (e.g. to 6.6%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in both together).~~

~~1630.1.~~ ~~There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (MacArthur Green 2023~~At a more appropriate (construction)~~) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.~~

~~1631.~~1719.~~At a more appropriate~~ displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Hermaness, Saxa Vord and Valla Field SPA (0.~~4~~3) would increase the predicted annual mortality by 0.~~11~~06% which is below the ~~0.~~1% threshold for detectability and therefore no further assessment was required.

9.26.2.3.3.2.3 DBS East and West Together

1720. At the baseline mortality rate for adult guillemot of 0.061 (**Table 9-7**) the number of individuals from the Hermaness, Saxa Vord and Valla Field SPA population expected to die is 373 (6,109 x 0.061) adults per annum. The predicted annual operation impact from DBS East and DBS West on the breeding guillemot population applying highly precautionary rates of 70% displacement and 10% mortality is 7.0 birds per annum (**Table 9-190**). This would result in a predicted change in adult mortality rate of 1.88% but is based on highly precautionary impact rates. The equivalent mortality assuming 70% displacement and 2% mortality (the latter rate as accepted in the assessments for the consented Sheringham and Dudgeon Extensions projects[1]) was 1.4 which would increase the background mortality rate by 0.37%. A reduction in either the displacement rate (e.g. to 37%) or the mortality rate (e.g. to 5%) would reduce the impact below the 1% threshold of detectability (and this also applies for smaller reductions in both together).

1721. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (Trinder *et al*. 2024) no evidence was found that guillemots avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is nearly double the natural adult background mortality rate of 6%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of guillemot populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

1722. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Hermaness, Saxa Vord and Valla Field SPA (0.5) would increase the predicted annual mortality by 0.13% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.25.2.3.4~~9.26.2.3.4 Summary

~~1632.~~1723. A matrix of the annual operational displacement estimates for DBS East and DBS West is provided in **Table 9-191**.

Table 9-191 Displacement matrix for annual project alone (DBS East plus DBS West) guillemot apportioned to Hermaness, Saxa Vord and Valla Field SPA adult population.

Mortality %	**Displacement %**									
	10	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**
1	0	0	0	0	1	1	1	1	1	1
2	0	0	1	1	1	1	1	2	2	2
3	0	1	1	1	2	2	2	2	3	3
4	0	1	1	2	2	2	3	3	4	4
5	1	1	2	2	3	3	4	4	5	5
6	1	1	2	2	3	4	4	5	5	6
7	1	1	2	3	4	4	5	6	6	7
8	1	2	2	3	4	5	6	6	7	8
9	1	2	3	4	5	5	6	7	8	9
10	1	2	3	4	5	6	7	8	9	10
20	2	4	6	8	10	12	14	16	18	20
30	3	6	9	12	15	18	21	24	27	30
50	5	10	15	20	25	30	35	40	45	50
75	8	15	23	30	38	45	53	60	68	75
100	10	20	30	40	50	60	70	80	90	100

~~1633.~~1724. A table summarising the guillemot construction and operational disturbance and displacement assessment for DBS East and DBS West together is provided below (**Table 9-192**).

~~1634.~~1725. It is concluded that predicted guillemot mortality due to construction and operational phase disturbance and displacement impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the Hermaness, Saxa Vord and Valla Field SPA**.

Table 9-192 Summary of predicted guillemot displacement mortality from Hermaness, Saxa Vord and Valla Field SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.

Guillemot		Displacement		
Potential Effects During Construction: Disturbance and Displacement				
Displacement mortality		Mean (@50% x 1%)	Mean (@70% x ~~10~~2%)	Mean (@~~50~~70% x ~~1~~10%)
Breeding season		0	0	0
Nonbreeding season		~~2.98~~0.3	0.~~27~~7	3.6
Annual		~~2.98~~0.3	0.~~27~~7	3.6
Effect	Reference population	6,109		
	Increase in back-ground mortality (%)	0.~~77~~09	0.~~07~~19	0.96
Potential Effects During Operation: Disturbance and Displacement				
Displacement mortality		Mean (@50% x 1%)	Mean (@70% x ~~10~~2%)	Mean (@~~50~~70% x ~~1~~10%)
Breeding season		0	0	0
Nonbreeding season		0.5~~.6~~	~~0~~1.4	7.0
Annual		0.5~~.6~~	~~0~~1.4	7.0
Effect	Reference population	6,109		
	Increase in back-ground mortality (%)	~~1.51~~0.13	0.~~11~~37	1.88

~~9.25.2.3.5~~9.26.2.3.5 Assessment of potential effects of the Projects in combination with other plans and projects

~~1635.~~1726. Given that no measurable increase in the Hermaness, Saxa Vord and Valla Field SPA razorbill mortality is predicted as a result of DBS East and DBS West combined (e.g. with realistic displacement mortality of less than 0.~~4~~5 bird per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted guillemot mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Hermaness, Saxa Vord and Valla Field SPA**.

~~9.25.2.4~~9.26.2.4 Puffin

~~1636.~~1727. Puffin has been screened in to assess the impacts from disturbance / displacement in the construction and operation phases.

~~1637.~~1728. The puffin assessment is based on a displacement matrix approach presented in the EIA following statutory guidance (Joint SNCB Note, 2017) using displacement rates of 30% to 70% and mortality rates of 1% to 10%. At the upper end these rates represent a highly precautionary worst-case scenario (for further details on displacement rates and the matrix approach, refer to **Volume 7, Chapter 12 Offshore Ornithology (application ref: 7.12)**).

~~9.25.2.4.1~~9.26.2.4.1 Status

~~1638.~~1729. Puffin is listed as a designated species of the Hermaness, Saxa Vord and Valla Field SPA.

~~1639.~~1730. The SPA breeding population at classification was 55,000 individuals in 1999 (SNH, 2009). Burnell *et al*. (2023) give an updated count of 14,375 AOB which has been used in this assessment.

~~9.25.2.4.2~~9.26.2.4.2 Connectivity to the Projects

~~1640.~~1731. DBS East and DBS West are 705km and 681km respectively from the Hermaness, Saxa Vord and Valla Field SPA. The mean maximum foraging range of puffin is 265.4km (137.1km +128.3km, Woodward *et al*., 2019). Therefore, as DBS East and DBS West are both outside the potential foraging range for breeding puffin from the Hermaness, Saxa Vord and Valla Field SPA, there is no connectivity between the SPA and the Projects during the breeding season and this species is considered for potential impacts during the non-breeding season only.

~~1641.~~1732. Outside the breeding season, breeding puffins from the SPA are assumed to range widely and to mix with puffins from breeding colonies in the UK and further afield. The relevant non-breeding season reference population is the UK North Sea and Channel BDMPS, consisting of 231,957 individuals (mid-August to March) (Furness, 2015).

~~1642.~~1733. It is estimated that 3.1% of birds present at the Projects are breeding adults from Hermaness, Saxa Vord and Valla Field SPA. Note, this percentage has been calculated using the populations in Furness (2015) in order to ensure consistent colony estimates have been applied.

~~9.25.2.4.3~~9.26.2.4.3 Assessment of Potential Effects of the Projects alone and Together

Table 9-193 Summary of puffin density and abundance estimates and SPA apportioning rates and used in the operation and construction displacement assessment for Hermaness, Saxa Vord and Valla Field SPA. Note that displacement from the wind farm has been estimated as 15%-35%, half the operational rates.

Site	Season	Peak no.	SPA %	Adult %	No. apportioned to SPA	Wind farm operation displacement mortality to SPA			Wind farm construction displacement mortality to SPA			Peak density (birds/ km^2)	Total vessel displacement mortality (2km around 3 vessels, 1% mortality)	Vessel mortality to SPA	Total construction displacement mortality to SPA		
						30-1	50-1	70-10	15-1	25 - 1	35-10				15-1 & vessel	25 – 1 & vessel	35-10 & vessel
DBS East	Breeding	62.60	0	0.543	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.05	0.00	0.00	0.00	0.00
	Nonbreeding	178.70	3.1	1	5.5	0.02	0.03	0.39	0.01	0.01	0.19	0.35	0.13	0.00	0.01	0.02	0.20
	Annual				5.5	0.02	0.03	0.39	0.01	0.01	0.19	-	0.18				
DBS West	Breeding	109.3	0	0.543	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.21	0.08	0.00	0.00	0.00	0.00
	Nonbreeding	198.2	3.1	1	6.1	0.02	0.03	0.43	0.01	0.02	0.22	0.38	0.14	0.00	0.01	0.02	0.22
	Annual				6.1	0.02	0.03	0.43	0.01	0.02	0.22	-	0.22	0.00	0.01	0.02	0.22
DBS East + DBS West	Breeding	~~146.60~~171.9	0	0.543	0.0	0.00	0.00	0.00	0.00	0.00	0.00	-	0.12	0.00	0.00	0.00	0.00
	Nonbreeding	~~372.70~~376.9	3.1	1	11.6	0.03	0.06	0.81	0.02	0.03	0.40		0.28	0.01	0.03	0.04	0.41
	Annual				11.6	0.03	0.06	0.81	0.02	0.03	0.40		0.4	0.01	0.03	0.04	0.41

~~9.25.2.4.3.1~~9.26.2.4.3.1 *Potential Effects During Construction: Disturbance and Displacement – construction vessels and 50% installed turbines*

~~9.25.2.4.3.1.1~~9.26.2.4.3.1.1 *DBS East in Isolation*

~~1643.~~1734. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-7**) the number of individuals from the Hermaness, Saxa Vord and Valla Field SPA population expected to die is 2,702 (28,750 x 0.094) adults per annum. The predicted annual construction impact from DBS East alone on the breeding puffin population applying highly precautionary rates of 35% displacement and 10% mortality is 0.20 birds per annum (**Table 9-193)**. This would result in a predicted change in adult mortality rate of <0.01%.

~~1644.~~1735. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that puffins avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is equivalent to the natural adult background mortality rate of 9.4%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of puffin populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1645.~~1736. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Hermaness, Saxa Vord and Valla Field SPA (0.02) would increase the predicted annual mortality by <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.25.2.4.3.1.2~~9.26.2.4.3.1.2 *DBS West in Isolation*

~~1646.~~1737. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-7**) the number of individuals from the Hermaness, Saxa Vord and Valla Field SPA population expected to die is 2,702 (28,750 x 0.094) adults per annum. The predicted annual construction impact from DBS West alone on the breeding puffin population applying highly precautionary rates of 35% displacement and 10% mortality is 0.22 birds per annum (**Table 9-193**). This would result in a predicted change in adult mortality rate of <0.01%.

~~1647.~~1738.There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that puffins avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is equivalent to the natural adult background mortality rate of 9.4%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of puffin populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1648.~~1739.At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Hermaness, Saxa Vord and Valla Field SPA (0.02) would increase the predicted annual mortality by <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.25.2.4.3.1.3~~9.26.2.4.3.1.3 DBS East and West Together

~~1649.~~1740.At the baseline mortality rate for adult puffin of 0.094 (**Table 9-7**) the number of individuals from the Hermaness, Saxa Vord and Valla Field SPA population expected to die is 2,702 (28,750 x 0.094) adults per annum. The predicted annual construction impact from DBS East and DBS West on the breeding puffin population applying highly precautionary rates of 35% displacement and 10% mortality is 0.41 birds per annum (**Table 9-193**). This would result in a predicted change in adult mortality rate of 0.01%.

~~1650.~~1741.There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that puffins avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is equivalent to the natural adult background mortality rate of 9.4%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of puffin populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1651.~~1742. At a more appropriate (construction) displacement rate of 25% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Hermaness, Saxa Vord and Valla Field SPA (0.04) would increase the predicted annual mortality by <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.25.2.4.3.2~~9.26.2.4.3.2 *Potential Effects During Operation: Disturbance and Displacement*

~~9.25.2.4.3.2.1~~9.26.2.4.3.2.1 *DBS East in Isolation*

~~1652.~~1743. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-7**) the number of individuals from the Hermaness, Saxa Vord and Valla Field SPA population expected to die is 2,702 (28,750 x 0.094) adults per annum. The predicted annual operation impact from DBS East alone on the breeding puffin population applying highly precautionary rates of 70% displacement and 10% mortality is 0.39 birds per annum (**Table 9-193**). This would result in a predicted change in adult mortality rate of 0.01%.

~~1653.~~1744. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that puffins avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is equivalent to the natural adult background mortality rate of 9.4%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of puffin populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1654.~~1745. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Hermaness, Saxa Vord and Valla Field SPA (0.03) would increase the predicted annual mortality by <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.25.2.4.3.2.2~~9.26.2.4.3.2.2 *DBS West in Isolation*

~~1655.~~1746. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-7**) the number of individuals from the Hermaness, Saxa Vord and Valla Field SPA population expected to die is 2,702 (28,750 x 0.094) adults per annum. The predicted annual operation impact from DBS West alone on the breeding puffin population applying highly precautionary rates of 70% displacement and 10% mortality is 0.43 birds per annum (**Table 9-193**). This would result in a predicted change in adult mortality rate of 0.01%.

~~1656.~~1747. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that puffins avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is equivalent to the natural adult background mortality rate of 9.4%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of puffin populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1657.~~1748. At a more appropriate (construction) displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Hermaness, Saxa Vord and Valla Field SPA (0.03) would increase the predicted annual mortality by <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.25.2.4.3.2.3~~9.26.2.4.3.2.3 *DBS East and West Together*

~~1658.~~1749. At the baseline mortality rate for adult puffin of 0.094 (**Table 9-7**) the number of individuals from the Hermaness, Saxa Vord and Valla Field SPA population expected to die is 2,702 (28,750 x 0.094) adults per annum. The predicted annual operation impact from DBS East and DBS West on the breeding puffin population applying highly precautionary rates of 70% displacement and 10% mortality is 0.81 birds per annum (**Table 9-193**). This would result in a predicted change in adult mortality rate of 0.03%.

~~1659.~~1750. There is no evidence in support of either the (operational) 70% displacement rate or the 10% mortality rate. In a study conducted over two breeding seasons conducted at the Beatrice wind farm (~~MacArthur Green 2023~~Trinder *et al*. 2024) no evidence was found that puffins avoided turbines, with densities even within 100m no different from those expected by chance. Similarly, a 10% mortality consequence for displacement is equivalent to the natural adult background mortality rate of 9.4%. If displacement did have such a serious effect on survival it seems certain that this would have been detected in counts of puffin populations over the last 10-15 years that offshore wind farms have been operating. But there is no such indication of mortality effects of this magnitude.

~~1660.~~1751. At a more appropriate displacement rate of 50% combined with 1% mortality, as recommended in MacArthur Green (2019b), the annual displacement mortality apportioned to the Hermaness, Saxa Vord and Valla Field SPA (0.06) would increase the predicted annual mortality by <0.01% which is below the 1% threshold for detectability and therefore no further assessment was required.

~~9.25.2.4.4~~9.26.2.4.4 *Summary*

~~1661.~~1752. A table summarising the puffin construction and operational disturbance and displacement assessment for DBS East and DBS West together is provided below (**Table 9-194**).

~~1662.~~1753. It is concluded that predicted puffin mortality due to construction and operational phase disturbance and displacement impacts at DBS East, DBS West and the Projects together would **not adversely affect the integrity of the Hermaness, Saxa Vord and Valla Field SPA**.

Table 9-194 Summary of predicted puffin displacement mortality from Hermaness, Saxa Vord and Valla Field SPA at DBS East and DBS West together (Projects) and percentage increases in the Background Mortality Rate of Annual Populations.

~~Guillemot~~Puffin		Displacement	
Potential Effects During Construction: Disturbance and Displacement			
Displacement mortality		Mean (@~~35~~25% x ~~10~~1%)	Mean (@~~25~~35% x ~~1~~10%)
Breeding season		0	0
Nonbreeding season		0.~~41~~04	0.~~04~~41
Annual		0.~~41~~04	0.~~04~~41
Effect	Reference population	28,750	
	Increase in background mortality (%)	<0.01	~~<~~0.01

~~Guillemot~~Puffin		Displacement	
Potential Effects During Operation: Disturbance and Displacement			
Displacement mortality		Mean (@~~70~~50% x ~~10~~1%)	Mean (@~~50~~70% x ~~1~~10%)
Breeding season		0	0
Nonbreeding season		0.~~81~~06	0.~~06~~81
Annual		0.~~81~~06	0.~~06~~81
Effect	Reference population	28,750	
	Increase in background mortality (%)	<0.~~03~~01	~~<~~0.~~01~~03

~~9.25.2.4.5~~9.26.2.4.5 *Assessment of potential effects of the Projects in combination with other plans and projects*

~~1663.~~1754.Given that no measurable increase in the Hermaness, Saxa Vord and Valla Field SPA puffin mortality is predicted as a result of DBS East and DBS West combined (e.g. with realistic displacement mortality of 0.06 birds per year during operation), it is concluded that the projects would not contribute to in-combination effects on this species. Therefore, predicted puffin mortality due to operational phase collision impacts at DBS East and DBS West together in-combination with other offshore wind farms would **not adversely affect the integrity of the Hermaness, Saxa Vord and Valla Field SPA**.

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Annex A: SPA PVA Results

Table A-1 Inputs: GX FFC Annual

Baseline parameters	Settings	Impact parameters	Values
Reference name	GX FFC Annual	Number of scenarios of impact	~~5~~6
Type	Simulation	Are impacts applied separately to each subpopulation	FALSE
Case studies	None	Are impacts specified separately for immatures	FALSE
Model to use for environmental stochasticity	Beta/Gamma	Are standard errors of impacts available	FALSE
Choose model for density dependence	No density dependence	Should random seeds be matched for impact scenarios	TRUE
Include demographic stochasticity in model	TRUE	Impacts are specified as	Relative
Number of simulations	5000	Years in which impacts are assumed to begin	2027
Random seed	1971	Years in which impacts are assumed to end	2057
Years for burn in	5	Scenario A name	~~Incomb~~Proj alone disp ~~lwr~~80-1 plus crm
Species	Northern gannet	Scenario A Impact on productivity rate per pair mean	0
Age at first breeding	5	Scenario A Impact on adult survival rate	0.~~0023238~~0008228571
Is there an upper constraint on productivity in the model	~~Yes~~TRUE	Scenario A Impact on immature survival rate mean	-
Maximum brood size per pair chicks will be constrained to be no greater than	1	Scenario B name	Incomb disp ~~upr~~60-1
Number of subpopulations	1	Scenario B Impact on productivity rate per pair mean	0
Units for initial population size	~~Breeding~~ breeding.adults	Scenario B Impact on adult survival rate	0.~~0033143~~002514286
Are baseline demographic rates specified separately for immatures	~~Yes~~TRUE	Scenario B Impact on immature survival rate mean	-
Initial population size	26250	Scenario C name	Incomb ~~crm~~disp 80-1
Year	2024	Scenario C Impact on productivity rate per pair mean	0
Productivity rate per pair mean	0.823	Scenario C Impact on adult survival rate per pair mean	0.~~0029105~~003542857
Productivity rate per pair standard deviation	0.038	Scenario C Impact on immature survival rate mean	-
Adult survival rate Mean	0.919	Scenario D name	~~In-combination disp.crm lwr~~Incomb crm
Adult survival rate standard deviation	0.042	Scenario D Impact on productivity rate per pair mean	0
Immatures survival rates 0 to 1 mean	0.424	Scenario D Impact on adult survival rate	0.~~005219~~003009524

Immatures survival rates 0 to 1 standard deviation	0.045	Scenario D Impact on immature survival rate mean	-
Immatures survival rates 1 to 2 mean	0.829	Scenario E name	~~Incomb~~In-combination disp~~.~~ 60-1 plus crm ~~upr~~
Immatures survival rates 1 to 2 standard deviation	0.026	Scenario E Impact on productivity rate per pair mean	0
Immatures survival rates 2 to 3 mean	0.891	Scenario E Impact on adult survival rate	0.~~006209500~~00552381
Immatures survival rates 2 to 3 standard deviation	0.019	Scenario E Impact on immature survival rate mean	-
Immatures survival rates 3 to 4 mean	0.895	Scenario F name	Incomb disp 80-1 plus crm
Immatures survival rates 3 to 4 standard deviation	0.019	Scenario F Impact on productivity rate per pair mean	0
Immatures survival rates 4 to 5 mean	0.919	Scenario F Impact on adult survival rate	0.006552381
Immatures survival rates 4 to 5 standard deviation	0.042	Scenario F Impact on immature survival rate mean	-
Immatures survival rates 5 to 6 mean		Scenario G name	
Immatures survival rates 5 to 6 standard deviation		Scenario G Impact on productivity rate per pair mean	0
Units for output	breeding.adults	Scenario G Impact on adult survival rate	
		Scenario G Impact on immature survival rate mean	-

Table A-2 Outputs: GX FFC Annual

Scenario	Impact	Increase in mortality rate	Years since impact	C-PGR					C-PS					50% Quantiles	
				Med.	Mean	SD	LCI	UCI	Med.	Mean	SD	LCI	UCI	Q-UNIMP-50%	Q-IMP-50%
~~Incomb~~Proj alone disp ~~lwr~~80-1 plus crm	~~61~~22	0.~~0023238~~0008228571	10	0.~~9982~~9994	0.~~9982~~9994	0.0007	0.~~9968~~9980	~~0.9997~~1.0008	0.~~9809~~9931	0.~~9809~~9931	0.~~0081~~0082	0.~~9653~~9769	~~0.9972~~1.0090	~~43.44~~47.48	~~56.44~~52.42
Incomb disp ~~upr~~60-1	~~87~~66	0.~~0033143~~0025142857	10	0.~~9975~~9981	0.~~9975~~9981	0.0007	0.~~9961~~9966	0.~~9989~~9995	0.~~9730~~9794	0.~~9730~~9793	0.0082	0.~~9570~~9633	0.~~9890~~9954	~~40.72~~42.98	~~59~~57.22
Incomb disp 80-1	93	0.0035428571	10	0.9973	0.9973	0.0007	0.9959	0.9988	0.9711	0.9711	0.0082	0.9552	0.9872	39.90	59.84
Incomb crm	~~76~~79	0.~~0029105~~0030095238	10	0.~~9978~~9977	0.~~9978~~9977	0.0007	0.9964	0.9992	0.~~9762~~9753	0.~~9764~~9753	0.0081	0.~~9608~~9593	0.~~9923~~9916	41.~~90~~66	58.~~18~~60
In-combination disp~~.~~ 60-1 plus crm ~~lwr~~	~~137~~145	0.~~0052190~~0055238095	10	0.~~9961~~9958	0.~~9961~~9958	0.0007	0.~~9947~~9944	0.~~9975~~9973	0.~~9577~~9552	0.~~9578~~9552	0.0080	0.~~9422~~9391	0.~~9736~~9709	~~35~~34.98	~~64.76~~65.74
Incomb disp~~.~~ 80-1 plus crm ~~upr~~	~~163~~172	0.~~0062095~~0065523810	10	0.~~9953~~9951	0.~~9953~~9951	0.0007	0.~~9939~~9936	0.~~9967~~9965	0.~~9499~~9473	0.~~9499~~9472	0.~~0080~~0081	0.~~9341~~9310	0.~~9653~~9629	~~33.26~~32.38	~~67.24~~68.22
Proj alone disp 80-1 plus crm	22	0.0008228571	20	0.9994	0.9994	0.0005	0.9985	1.0004	0.9873	0.9873	0.0103	0.9674	1.0077	46.66	53.24
Incomb disp ~~lwr~~60-1	~~61~~66	0.~~0023238~~0025142857	20	0.~~9983~~9982	0.~~9983~~9982	0.0005	0.~~9973~~9972	0.~~9993~~9991	0.~~9650~~9621	0.~~9650~~9621	0.0102	0.~~9456~~9425	0.~~9857~~9823	~~40.58~~39.74	59.~~26~~58
Incomb disp ~~upr~~80-1	~~87~~93	0.~~0033143~~0035428571	20	0.~~9976~~9974	0.~~9976~~9974	0.0005	0.~~9966~~9965	0.~~9985~~9984	0.~~9505~~9471	0.~~9505~~9471	0.~~0102~~0101	0.~~9303~~9275	0.~~9705~~9669	~~37.32~~35.86	~~62.86~~63.50

Scenario	Impact	Increase in mortality rate	Years since impact	C-PGR					C-PS					50% Quantiles	
				Med.	Mean	SD	LCI	UCI	Med.	Mean	SD	LCI	UCI	Q-UNIMP-50%	Q-IMP-50%
Incomb crm	~~76~~79	0.~~0029105~~0030095238	20	0.~~9979~~9978	0.~~9979~~9978	0.0005	0.~~9969~~9968	0.~~9988~~9987	0.~~9564~~9547	0.~~9564~~9547	0.~~0101~~0100	0.~~9371~~9350	0.~~9759~~9741	38.~~62~~20	61.~~20~~36
In-combination disp~~.~~ 60-1 plus crm ~~lwr~~	~~137~~145	0.~~0052190~~0055238095	20	0.~~9962~~9960	0.~~9962~~9960	0.0005	0.~~9952~~9950	0.~~9972~~9969	0.~~9231~~9185	0.~~9231~~9185	0.~~0099~~0098	0.~~9041~~8989	0.~~9428~~9378	~~30~~29.54	~~69.96~~71.20
Incomb disp~~.~~ 80-1 plus crm ~~upr~~	~~163~~172	0.~~0062095~~0065523810	20	0.~~9955~~9952	0.~~9955~~9952	0.0005	0.~~9945~~9942	0.~~9965~~9962	0.~~9092~~9043	0.~~9092~~9043	0.0098	0.~~8903~~8850	0.~~9286~~9239	~~27.38~~26.00	~~73.44~~74.24
Proj alone disp 80-1 plus crm	22	0.0008228571	30	0.9994	0.9994	0.0004	0.9986	1.0002	0.9818	0.9817	0.0118	0.9584	1.0051	45.80	53.88
Incomb disp ~~lwr~~60-1	~~61~~66	0.~~0023238~~0025142857	30	0.~~9983~~9982	0.~~9983~~9982	0.0004	0.~~9976~~9974	0.~~9991~~9989	0.~~9491~~9453	0.~~9492~~9451	0.~~0116~~0115	0.~~9265~~9223	0.~~9723~~9677	38.~~66~~02	~~61.28~~62.38
Incomb disp ~~upr~~80-1	~~87~~93	0.~~0033143~~0035428571	30	0.~~9976~~9974	0.~~9976~~9974	0.0004	0.~~9968~~9967	0.~~9984~~9982	0.~~9286~~9236	0.~~9285~~9235	0.~~0114~~0112	0.~~9063~~9016	0.~~9509~~9454	~~34.18~~33.36	~~66.08~~67.04
Incomb crm	~~76~~79	0.~~0029105~~0030095238	30	0.~~9979~~9978	0.~~9979~~9978	0.0004	0.9971	0.~~9987~~9986	0.~~9368~~9344	0.~~9369~~9345	0.~~0114~~0113	0.~~9153~~9125	0.~~9597~~9568	~~36.44~~35.58	64.~~16~~52
In-combination disp~~.~~ 60-1 plus crm ~~lwr~~	~~137~~145	0.~~0052190~~0055238095	30	0.~~9962~~9960	0.~~9962~~9960	0.0004	0.~~9955~~9952	0.~~9970~~9968	0.~~8896~~8832	0.~~8897~~8832	0.~~0110~~0109	0.~~8685~~8616	0.~~9113~~9046	~~25.74~~24.60	~~74.22~~75.64
Incomb disp~~.~~ 80-1 plus crm ~~upr~~	~~163~~172	0.~~0062095~~0065523810	30	0.~~9955~~9953	0.~~9955~~9953	0.0004	0.~~9947~~9945	0.~~9963~~9960	0.~~8700~~8634	0.~~8702~~8632	0.0108	0.~~8492~~8424	0.~~8916~~8852	~~22.04~~20.82	~~78.00~~79.14

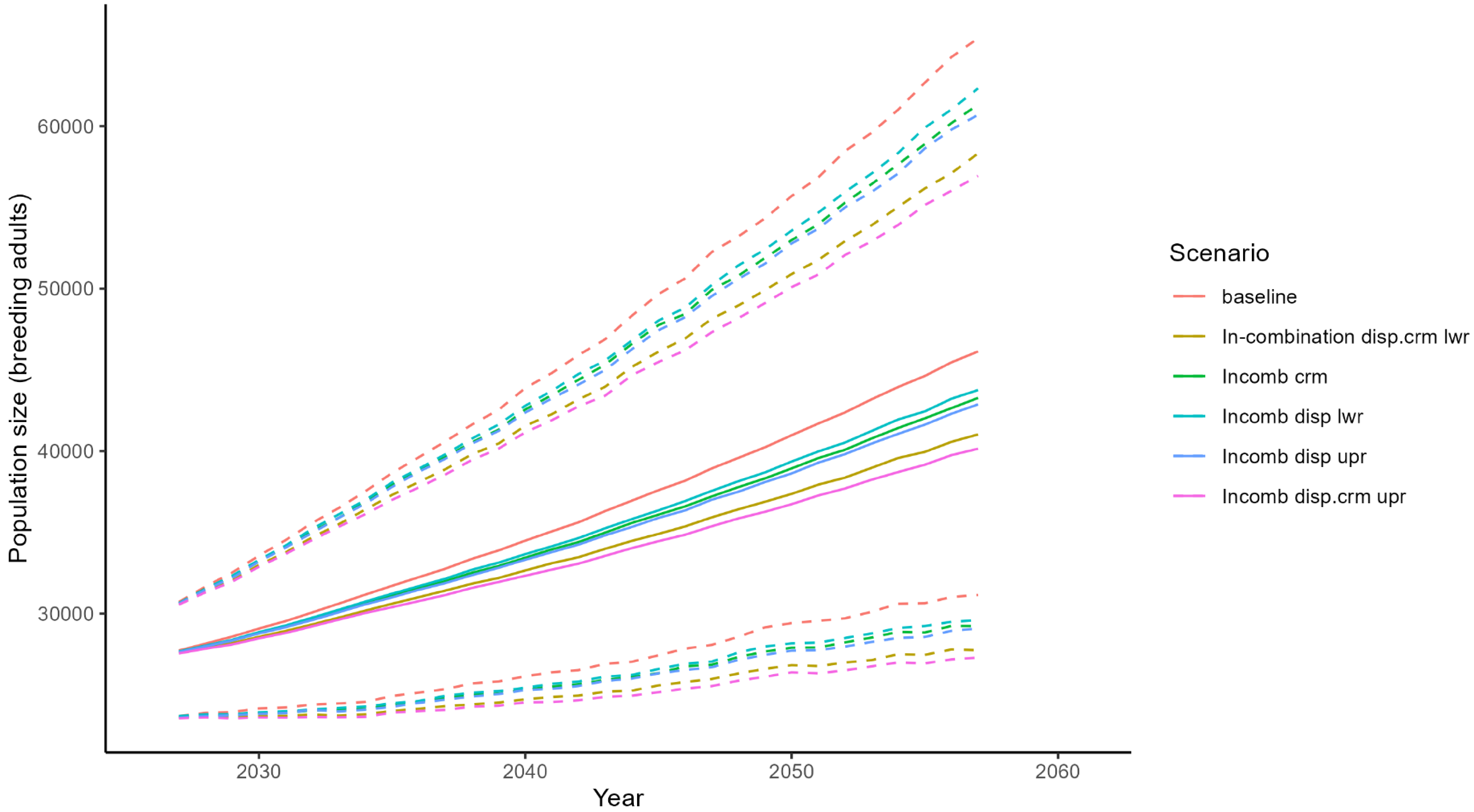

Figure A-1GX FFC Annual

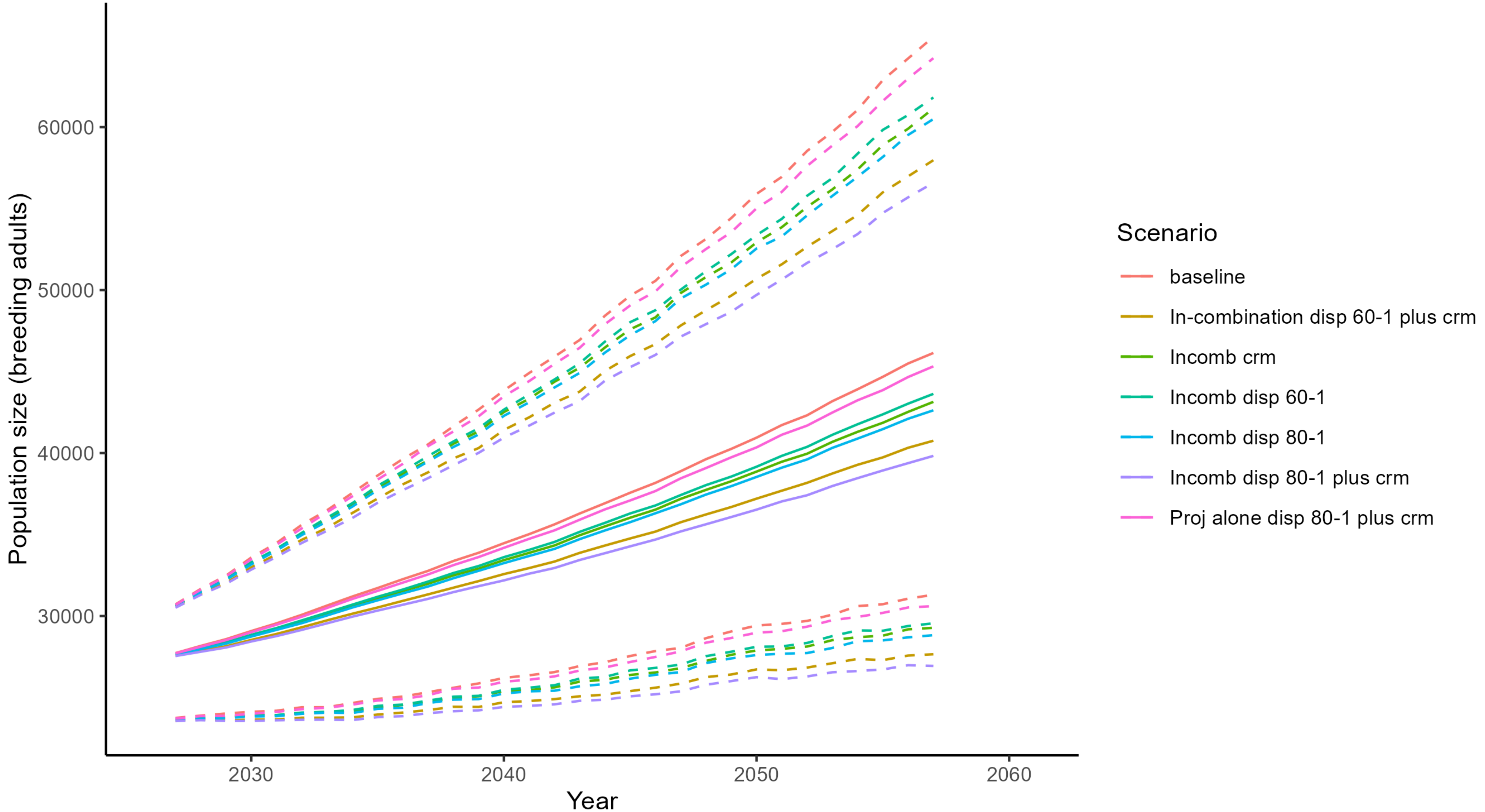
Population size (breeding adults)
60000
50000
40000
30000
2030
2040
2050
2060
Year
Scenario
baseline
In-combination disp 60-1 plus crm
Incomb crm
Incomb disp 60-1
Incomb disp 80-1
Incomb disp 80-1 plus crm
Proj alone disp 80-1 plus crm

Table A-3 Inputs: KI FFC Annual

Baseline parameters	Settings	Impact parameters	Values
Reference name	KI FFC Annual	Number of scenarios of impact	~~2~~5
Type	Simulation	Are impacts applied separately to each subpopulation	FALSE
Case studies	None	Are impacts specified separately for immatures	FALSE
Model to use for environmental stochasticity	Beta/Gamma	Are standard errors of impacts available	FALSE
Choose model for density dependence	No density dependence	Should random seeds be matched for impact scenarios	TRUE
Include demographic stochasticity in model	TRUE	Impacts are specified as	Relative
Number of simulations	5000	Years in which impacts are assumed to begin	2027
Random seed	1971	Years in which impacts are assumed to end	2057
Years for burn in	5	Scenario A name	~~Incomb~~Proj alone crm ~~lwr~~DBS 100pct ads
Species	Black-legged kittiwake	Scenario A Impact on productivity rate per pair mean	0
Age at first breeding	4	Scenario A Impact on adult survival rate	0.~~0038458~~002142505
Is there an upper constraint on productivity in the model	~~Yes~~TRUE	Scenario A Impact on immature survival rate mean	~~0~~
Maximum brood size per pair chicks will be constrained to be no greater than	2	Scenario B name	Incomb crm ~~upr~~DBS 53pct ads exc comp
Number of subpopulations	1	Scenario B Impact on productivity rate per pair mean	0
Units for initial population size	~~Breeding~~ breeding.adults	Scenario B Impact on adult survival rate	0.~~0049007~~004262575
Are baseline demographic rates specified separately for immatures	~~Yes~~TRUE	Scenario B Impact on immature survival rate mean	~~-~~0
Initial population size	~~9100~~889148	Scenario C name	Incomb crm DBS 100pct ads exc comp
Year	2024	Scenario C Impact on productivity rate per pair mean	0
Productivity rate per pair mean	0.737	Scenario C Impact on adult survival rate per pair mean	0.005227263
Productivity rate per pair standard deviation	0.2015	Scenario C Impact on immature survival rate mean	-
Adult survival rate Mean	0.854	Scenario D name	Incomb crm DBS 53pct ads inc comp
Adult survival rate standard deviation	0.077	Scenario D Impact on productivity rate per pair mean	0
Immatures survival rates 0 to 1 mean	0.79	Scenario D Impact on adult survival rate	0.005810562

Immatures survival rates 0 to 1 standard deviation	0.077	Scenario D Impact on immature survival rate mean	0
Immatures survival rates 1 to 2 mean	0.854	Scenario E name	Incomb crm DBS 100pct ads inc comp
Immatures survival rates 1 to 2 standard deviation	0.077	Scenario E Impact on productivity rate per pair mean	0
Immatures survival rates 2 to 3 mean	0.854	Scenario E Impact on adult survival rate	0.006786467
Immatures survival rates 2 to 3 standard deviation	0.077	Scenario E Impact on immature survival rate mean	-
Immatures survival rates 3 to 4 mean	0.854	Scenario F name	
Immatures survival rates 3 to 4 standard deviation	0.077	Scenario F Impact on productivity rate per pair mean	0
Immatures survival rates 4 to 5 mean		Scenario F Impact on adult survival rate	
Immatures survival rates 4 to 5 standard deviation		Scenario F Impact on immature survival rate mean	-
Immatures survival rates 5 to 6 mean		Scenario G name	
Immatures survival rates 5 to 6 standard deviation		Scenario G Impact on productivity rate per pair mean	0
Units for output	breeding.adults	Scenario G Impact on adult survival rate	
		Scenario G Impact on immature survival rate mean	-

Table A-4 Outputs: KI FFC Annual

Scenario	Impact	Increase in mortality rate	Years since impact	C-PGR					C-PS					50% Quantiles	
				Med.	**Mean**	**SD**	**LCI**	**UCI**	**Med.**	**Mean**	**SD**	**LCI**	**UCI**	**Q-UNIMP-50%**	**Q-IMP-50%**
~~Incomb~~Proj alone crm ~~lwr~~DBS 100pct ads	~~350~~191	0.~~0038458~~002142505	10	0.~~9973~~9985	0.~~9973~~9985	0.0005	0.~~9964~~9976	0.~~9983~~9994	0.~~9710~~9838	0.~~9710~~9837	0.~~0054~~0053	0.~~9602~~9732	0.~~9816~~9941	~~45.02~~ 47.14	~~54.82~~ 52.96
Incomb crm ~~upr~~DBS 53pct ads exc comp	~~446~~380	0.~~0049007~~004262575	10	0.~~9966~~9970	0.~~9966~~9970	0.0005	0.~~9956~~9961	0.~~9975~~9980	0.~~9633~~9679	0.~~9632~~9679	0.0054	0.~~9523~~9573	0.~~9737~~9786	~~43.48~~ 44.58	~~56.10~~ 55.54
Incomb crm DBS 100pct ads exc comp	466	0.005227263	10	0.9964	0.9964	0.0005	0.9954	0.9973	0.9606	0.9607	0.0055	0.9498	0.9712	43.12	56.64
Incomb crm DBS 53pct ads inc comp	518	0.005810562	10	0.9960	0.9960	0.0005	0.9950	0.9969	0.9565	0.9564	0.0055	0.9457	0.9670	42.56	57.42
Incomb crm DBS 100pct ads inc comp	605	0.006786467	10	0.9953	0.9953	0.0005	0.9943	0.9963	0.9494	0.9494	0.0055	0.9386	0.9602	41.40	58.64
Proj alone crm DBS 100pct ads	191	0.002142505	20	0.9986	0.9986	0.0003	0.9979	0.9992	0.9700	0.9700	0.0067	0.9569	0.9830	46.50	53.96
Incomb crm ~~lwr~~DBS 53pct ads exc comp	~~350~~380	0.~~0038458~~004262575	20	0.~~9974~~9971	0.~~9974~~9971	0.0003	0.~~9967~~9965	0.~~9980~~9977	0.~~9469~~9413	0.~~9468~~9412	0.0066	0.~~9334~~9282	0.~~9597~~9539	~~43.38~~ 42.70	57.~~14~~68
Incomb crm DBS 100pct ads exc comp	466	0.005227263	20	0.9965	0.9965	0.0003	0.9958	0.9971	0.9286	0.9284	0.0067	0.9148	0.9413	40.58	59.52

Incomb crm ~~upr~~DBS 53pct ads inc comp	~~446~~518	0.~~0049007~~005810562	20	0.~~9967~~9961	0.~~9967~~9961	0.0003	0.~~9960~~9954	0.~~9973~~9967	0.~~9328~~9209	0.~~9327~~9208	0.~~0067~~0068	0.~~9196~~9075	0.~~9457~~9339	~~41.34~~39.20	~~58.78~~60.74
Incomb crm ~~lwr~~DBS 100pct ads inc comp	~~350~~605	0.~~0038458~~006786467	~~30~~20	0.~~9974~~99954	0.~~9974~~9954	0.0003	0.~~9969~~9948	0.~~9979~~9961	0.~~9233~~9081	0.~~9233~~9082	0.~~0075~~0066	0.~~9082~~8951	0.~~9378~~9217	~~41.00~~37.66	~~58.32~~62.26
Proj alone crm DBS 100pct ads	191	0.002142505	30	0.9986	0.9986	0.0002	0.9981	0.9991	0.9565	0.9565	0.0075	0.9418	0.9714	44.80	54.72
Incomb crm ~~upr~~DBS 53pct ads exc comp	~~446~~380	0.~~0049007~~004262575	30	0.~~9967~~99972	0.~~9967~~9972	0.0003	0.~~9962~~9966	0.~~9972~~9976	0.~~9034~~9153	0.~~9033~~9154	0.~~0075~~0073	0.~~8883~~9011	0.~~9180~~9299	~~38.52~~39.70	~~60.34~~58.98
Incomb crm DBS 100pct ads exc comp	466	0.005227263	30	0.9965	0.9965	0.0003	0.9960	0.9970	0.8973	0.8972	0.0074	0.8827	0.9117	37.74	60.98
Incomb crm DBS 53pct ads inc comp	518	0.005810562	30	0.9961	0.9961	0.0003	0.9956	0.9966	0.8865	0.8865	0.0074	0.8718	0.9010	36.52	62.22
Incomb crm DBS 100pct ads inc comp	605	0.006786467	30	0.9955	0.9955	0.0003	0.9949	0.9960	0.8689	0.8688	0.0073	0.8541	0.8830	35.04	64.04

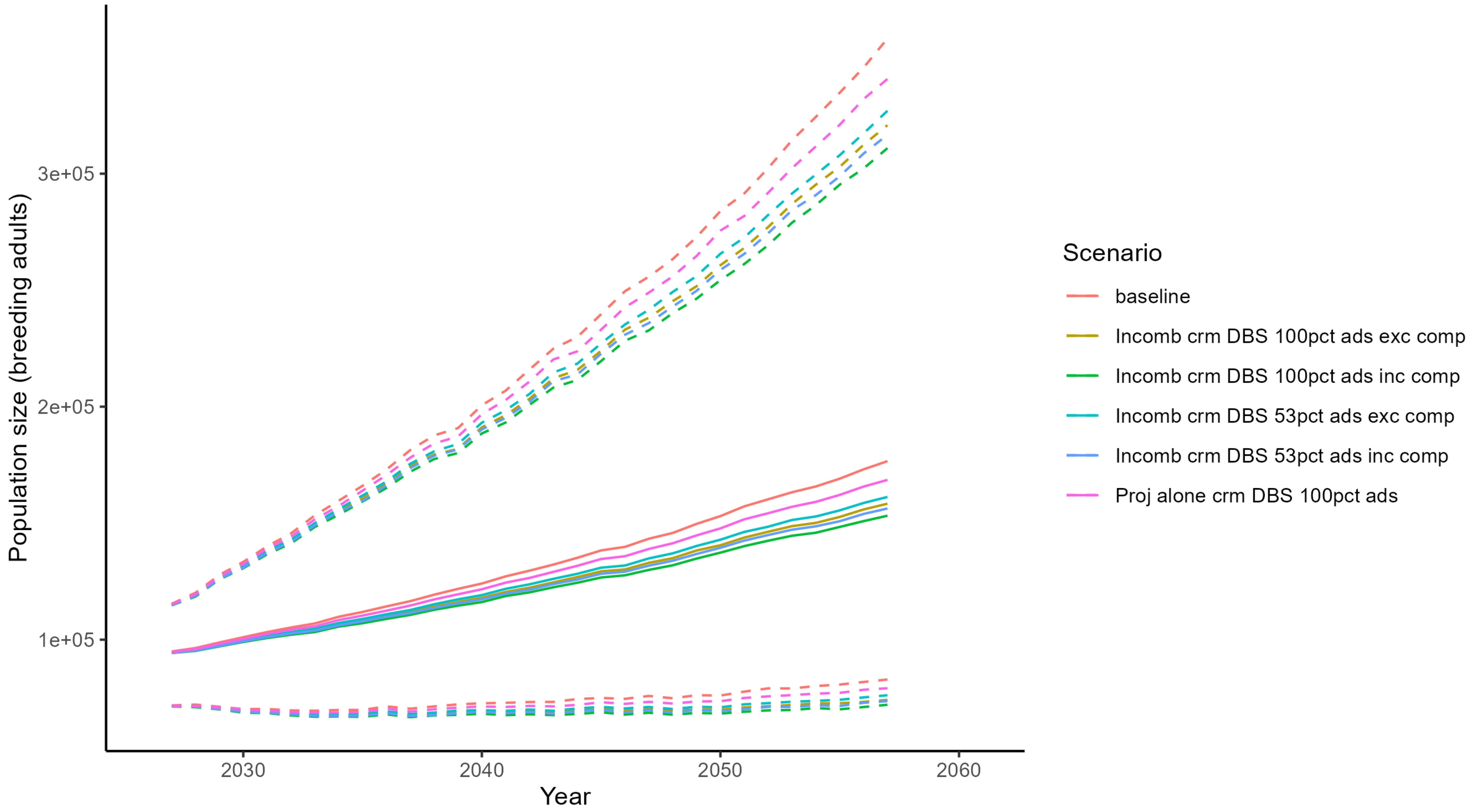

Figure A-2 KI FFC Annual

Table A-5 Inputs: GU FFC Annual

Baseline parameters	Settings	Impact parameters	Values
Reference name	GU FFC Annual	Number of scenarios of impact	~~6~~8
Type	Simulation	Are impacts applied separately to each subpopulation	FALSE
Case studies	None	Are impacts specified separately for immatures	FALSE
Model to use for environmental stochasticity	Beta/Gamma	Are standard errors of impacts available	FALSE
Choose model for density dependence	No density dependence	Should random seeds be matched for impact scenarios	TRUE
Include demographic stochasticity in model	TRUE	Impacts are specified as	Relative
Number of simulations	5000	Years in which impacts are assumed to begin	2027
Random seed	1971	Years in which impacts are assumed to end	2057
Years for burn in	5	Scenario A name	Proj alone disp 50-1 DBS 55pct ads
Species	Common Guillemot	Scenario A Impact on productivity rate per pair mean	0
Age at first breeding	6	Scenario A Impact on adult survival rate	0.0008201203
Is there an upper constraint on productivity in the model	TRUE	Scenario A Impact on immature survival rate mean	
Maximum brood size per pair chicks will be constrained to be no greater than	1	Scenario B name	Proj alone disp 50-1 DBS 100pct ads
Number of subpopulations	1	Scenario B Impact on productivity rate per pair mean	0
Units for initial population size	breeding.adults	Scenario B Impact on adult survival rate	0.001120164
Are baseline demographic rates specified separately for immatures	TRUE	Scenario B Impact on immature survival rate mean	-
Initial population size	149978	Scenario C name	Proj alone disp 70-2 DBS 55pct ads
Year	2024	Scenario C Impact on productivity rate per pair mean	0
Productivity rate per pair mean	0.6879	Scenario C Impact on adult survival rate per pair mean	0.00229367
Productivity rate per pair standard deviation	0.0825	Scenario C Impact on immature survival rate mean	-

Baseline parameters	Settings	Impact parameters	Values
Adult survival rate Mean	0.94	Scenario D name	Proj alone disp 70-2 DBS 100pct ads
Adult survival rate standard deviation	0.025	Scenario D Impact on productivity rate per pair mean	0
Immatures survival rates 0 to 1 mean	0.56	Scenario D Impact on adult survival rate	0.003040446
Immatures survival rates 0 to 1 standard deviation	0.058	Scenario D Impact on immature survival rate mean	-
Immatures survival rates 1 to 2 mean	0.792	Scenario E name	Incomb disp 50-1 DBS 100pct ads exc comp
Immatures survival rates 1 to 2 standard deviation	0.152	Scenario E Impact on productivity rate per pair mean	0
Immatures survival rates 2 to 3 mean	0.917	Scenario E Impact on adult survival rate	0.002567043
Immatures survival rates 2 to 3 standard deviation	0.098	Scenario E Impact on immature survival rate mean	-
Immatures survival rates 3 to 4 mean	0.938	Scenario F name	Incomb disp 50-1 DBS 100pct ads inc comp
Immatures survival rates 3 to 4 standard deviation	0.107	Scenario F Impact on productivity rate per pair mean	0
Immatures survival rates 4 to 5 mean	0.94	Scenario F Impact on adult survival rate	0.003667205
Immatures survival rates 4 to 5 standard deviation	0.025	Scenario F Impact on immature survival rate mean	-
Immatures survival rates 5 to 6 mean	0.94	Scenario G name	Incomb disp 70-2 DBS 100pct ads exc comp
Immatures survival rates 5 to 6 standard deviation	0.025	Scenario G Impact on productivity rate per pair mean	0
Units for output	breeding.adults	Scenario G Impact on adult survival rate	0.007194389
		Scenario G Impact on immature survival rate mean	-

Table 6 Outputs: GU FFC Annual

Scenario	Impact	Increase in mortality rate	Years since impact	C-PGR					C-PS					50% Quantiles	
				Med.	Mean	SD	LCI	UCI	Med.	Mean	SD	LCI	UCI	Q-UNIMP-50%	Q-IMP-50%
Proj alone disp 50-1 DBS 55pct ads	123	0.0008201203	10	0.9994	0.9994	0.0002	0.9989	0.9999	0.9935	0.9935	0.0028	0.9882	0.9989	47.26	53.04
Proj alone disp 50-1 DBS 100pct ads	168	0.0011201643	10	0.9992	0.9992	0.0002	0.9987	0.9997	0.9912	0.9912	0.0027	0.9859	0.9966	45.98	54.20
Proj alone disp 70-2 DBS 55pct ads	344	0.0022936697	10	0.9984	0.9984	0.0002	0.9979	0.9988	0.9821	0.9821	0.0028	0.9765	0.9873	42.66	58.00
Proj alone disp 70-2 DBS 100pct ads	456	0.0030404459	10	0.9978	0.9978	0.0002	0.9973	0.9983	0.9764	0.9763	0.0028	0.9708	0.9817	39.78	60.32
Incomb disp 50-1 DBS 100pct ads exc comp	385	0.0025670432	10	0.9982	0.9982	0.0002	0.9977	0.9986	0.9799	0.9799	0.0028	0.9744	0.9853	41.48	58.88
Incomb disp 50-1 DBS 100pct ads inc comp	550	0.0036672045	10	0.9974	0.9974	0.0003	0.9969	0.9979	0.9715	0.9715	0.0028	0.9658	0.9770	37.78	62.50
Incomb disp 70-2 DBS 100pct ads exc comp	1,079	0.0071943885	10	0.9949	0.9949	0.0003	0.9943	0.9954	0.9449	0.9449	0.0029	0.9389	0.9506	27.40	73.90

Scenario	Impact	Increase in mortality rate	Years since impact	C-PGR					C-PS					50% Quantiles	
				Med.	Mean	SD	LCI	UCI	Med.	Mean	SD	LCI	UCI	Q-UNIMP-50%	Q-IMP-50%
Incomb disp 70-2 DBS 100pct ads inc comp	1,541	0.0102748403	10	0.9927	0.9927	0.0003	0.9920	0.9933	0.9223	0.9223	0.0032	0.9158	0.9287	19.76	81.54
Proj alone disp 50-1 DBS 55pct ads	123	0.0008201203	20	0.9994	0.9994	0.0002	0.9991	0.9997	0.9882	0.9882	0.0034	0.9816	0.9949	46.30	53.70
Proj alone disp 50-1 DBS 100pct ads	168	0.0011201643	20	0.9992	0.9992	0.0002	0.9989	0.9995	0.9839	0.9839	0.0034	0.9772	0.9905	45.20	55.06
Proj alone disp 70-2 DBS 55pct ads	344	0.0022936697	20	0.9984	0.9984	0.0002	0.9981	0.9987	0.9673	0.9673	0.0034	0.9608	0.9738	40.02	60.38
Proj alone disp 70-2 DBS 100pct ads	456	0.0030404459	20	0.9979	0.9979	0.0002	0.9976	0.9982	0.9571	0.9571	0.0034	0.9503	0.9636	37.04	63.84
Incomb disp 50-1 DBS 100pct ads exc comp	385	0.0025670432	20	0.9982	0.9982	0.0002	0.9979	0.9986	0.9635	0.9635	0.0034	0.9569	0.9701	38.88	61.60
Incomb disp 50-1 DBS 100pct ads inc comp	550	0.0036672045	20	0.9975	0.9975	0.0002	0.9971	0.9978	0.9483	0.9484	0.0034	0.9416	0.9550	34.24	66.84
Incomb disp 70-2 DBS 100pct ads exc comp	1,079	0.0071943885	20	0.9951	0.9951	0.0002	0.9947	0.9954	0.9013	0.9013	0.0035	0.8944	0.9081	20.42	80.18

Scenario	Impact	Increase in mortality rate	Years since impact	C-PGR					C-PS					50% Quantiles	
				Med.	Mean	SD	LCI	UCI	Med.	Mean	SD	LCI	UCI	Q-UNIMP-50%	Q-IMP-50%
Incomb disp 70-2 DBS 100pct ads inc comp	1,541	0.0102748403	20	0.9930	0.9930	0.0002	0.9925	0.9934	0.8622	0.8622	0.0038	0.8545	0.8695	12.06	89.48
Proj alone disp 50-1 DBS 55pct ads	123	0.0008201203	30	0.9994	0.9994	0.0001	0.9992	0.9997	0.9828	0.9829	0.0037	0.9754	0.9902	45.80	55.44
Proj alone disp 50-1 DBS 100pct ads	168	0.0011201643	30	0.9992	0.9992	0.0001	0.9990	0.9995	0.9767	0.9767	0.0037	0.9694	0.9841	44.46	57.42
Proj alone disp 70-2 DBS 55pct ads	344	0.0022936697	30	0.9984	0.9984	0.0001	0.9982	0.9987	0.9528	0.9528	0.0037	0.9457	0.9599	37.86	64.14
Proj alone disp 70-2 DBS 100pct ads	456	0.0030404459	30	0.9979	0.9979	0.0001	0.9977	0.9982	0.9382	0.9381	0.0037	0.9306	0.9454	34.52	68.08
Incomb disp 50-1 DBS 100pct ads exc comp	385	0.0025670432	30	0.9983	0.9983	0.0001	0.9980	0.9985	0.9474	0.9474	0.0037	0.9401	0.9545	36.72	65.70
Incomb disp 50-1 DBS 100pct ads inc comp	550	0.0036672045	30	0.9975	0.9975	0.0001	0.9973	0.9978	0.9258	0.9258	0.0038	0.9182	0.9331	31.42	71.30
Incomb disp 70-2 DBS 100pct ads exc comp	1,079	0.0071943885	30	0.9951	0.9951	0.0001	0.9949	0.9954	0.8597	0.8597	0.0037	0.8525	0.8670	16.28	86.16

Scenario	Impact	Increase in mortality rate	Years since impact	C-PGR					C-PS					50% Quantiles	
				Med.	Mean	SD	LCI	UCI	Med.	Mean	SD	LCI	UCI	Q-UNIMP-50%	Q-IMP-50%
Incomb disp 70-2 DBS 100pct ads inc comp	1,541	0.0102748403	30	0.9931	0.9931	0.0002	0.9927	0.9934	0.8060	0.8060	0.0041	0.7980	0.8139	7.72	94.06

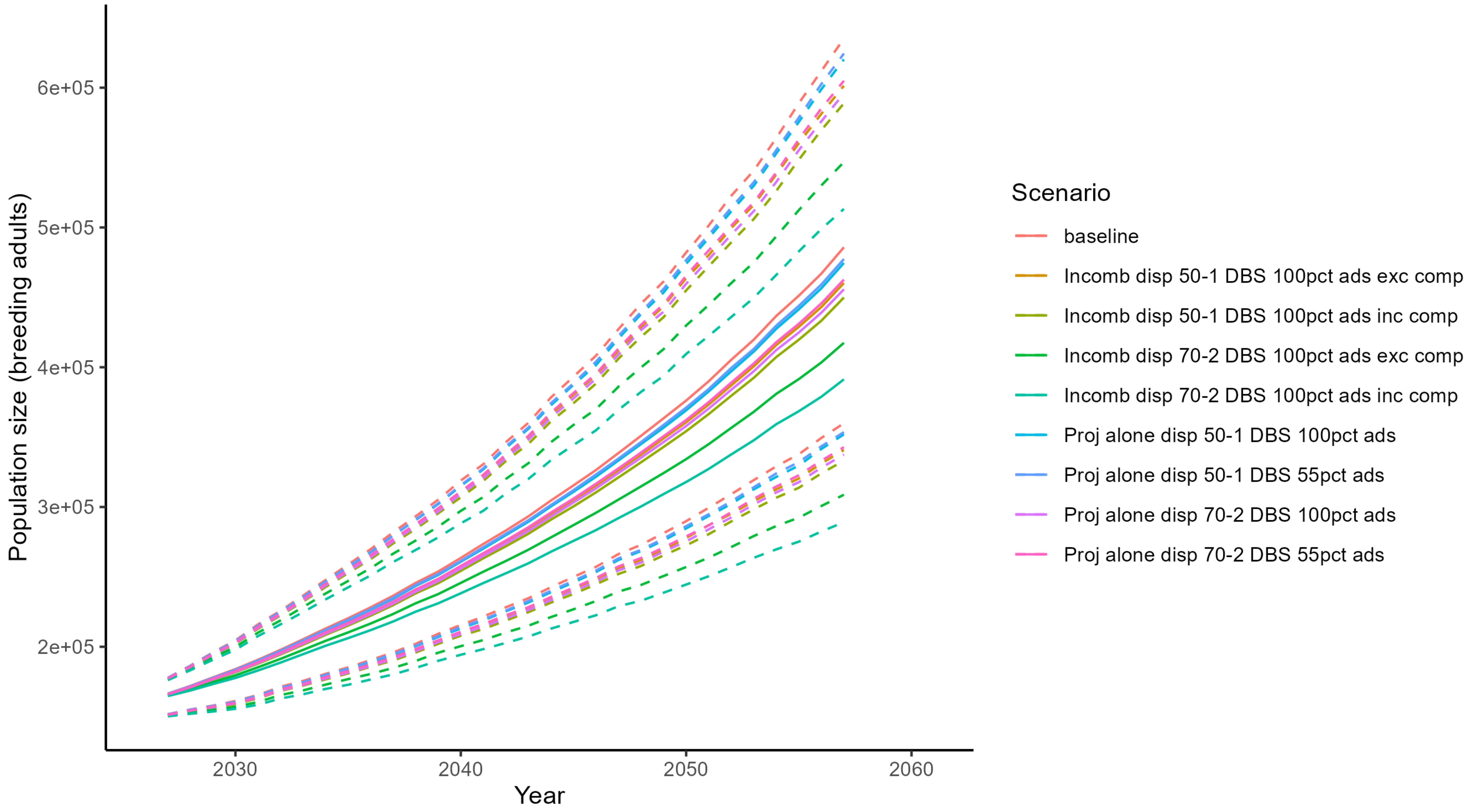

Figure A-3 GU FFC Annual

Table A-7 Inputs: RA FFC Annual

Baseline parameters	**Settings**	**Impact parameters**	**Values**
Reference name	RA FFC Annual	Number of scenarios of impact	8
Type	Simulation	Are impacts applied separately to each subpopulation	FALSE
Case studies	None	Are impacts specified separately for immatures	FALSE
Model to use for environmental stochasticity	Beta/Gamma	Are standard errors of impacts available	FALSE
Choose model for density dependence	No density dependence	Should random seeds be matched for impact scenarios	TRUE
Include demographic stochasticity in model	TRUE	Impacts are specified as	Relative
Number of simulations	5000	Years in which impacts are assumed to begin	2027
Random seed	1971	Years in which impacts are assumed to end	2057
Years for burn in	5	Scenario A name	~~Incomb~~Proj alone disp ~~lwr1~~50-1 DBS 61.3pct ads
Species	~~Common Guillemot~~Razorbill	Scenario A Impact on productivity rate per pair mean	0
Age at first breeding	~~6~~5	Scenario A Impact on adult survival rate	0.~~000773446~~80007286657
Is there an upper constraint on productivity in the model	TRUE	Scenario A Impact on immature survival rate mean	-
Maximum brood size per pair chicks will be constrained to be no greater than	1	Scenario B name	~~Incomb~~Proj alone disp ~~lwr2~~50-1 DBS 100pct ads
Number of subpopulations	1	Scenario B Impact on productivity rate per pair mean	0
Units for initial population size	breeding.adults	Scenario B Impact on adult survival rate	0.~~000933470~~20008183226
Are baseline demographic rates specified separately for immatures	TRUE	Scenario B Impact on immature survival rate mean	-
Initial population size	61345~~149978~~	Scenario C name	~~Incomb~~Proj alone disp ~~mid1~~70-2 DBS 61.3pct ads
Year	~~2024~~2022	Scenario C Impact on productivity rate per pair mean	0
Productivity rate per pair mean	0.~~6879~~618	Scenario C Impact on adult survival rate per pair mean	0.~~00129352~~3002039286
Productivity rate per pair standard deviation	0.~~0825~~085	Scenario C Impact on immature survival rate mean	-
Adult survival rate Mean	0.~~94~~895	Scenario D name	~~Incomb~~Proj alone disp ~~mid2~~70-2 DBS 100pct ads
Adult survival rate standard deviation	0.~~025~~067	Scenario D Impact on productivity rate per pair mean	0
Immatures survival rates 0 to 1 mean	0.~~56~~794	Scenario D Impact on adult survival rate	0.~~00156022~~9002288695

Immatures survival rates 0 to 1 standard deviation	0.~~058~~067	Scenario D Impact on immature survival rate mean	-
Immatures survival rates 1 to 2 mean	0.~~792~~794	Scenario E name	Incomb disp ~~upr1~~50-1 DBS 100pct ads exc comp
Immatures survival rates 1 to 2 standard deviation	0.~~152~~067	Scenario E Impact on productivity rate per pair mean	0
Immatures survival rates 2 to 3 mean	0.~~917~~895	Scenario E Impact on adult survival rate	0.~~01811599~~001711631
Immatures survival rates 2 to 3 standard deviation	0.~~098~~067	Scenario E Impact on immature survival rate mean	-
Immatures survival rates 3 to 4 mean	0.~~938~~895	Scenario F name	Incomb disp ~~upr2~~50-1 DBS 100pct ads inc comp
Immatures survival rates 3 to 4 standard deviation	0.~~107~~067	Scenario F Impact on productivity rate per pair mean	0
Immatures survival rates 4 to 5 mean	0.~~94~~895	Scenario F Impact on adult survival rate	0.~~02183654~~002005053
Immatures survival rates 4 to 5 standard deviation	0.~~025~~067	Scenario F Impact on immature survival rate mean	-
Immatures survival rates 5 to 6 mean	~~0.94~~	Scenario G name	Incomb disp 70-2 DBS 100pct ads exc comp
Immatures survival rates 5 to 6 standard deviation	~~0.025~~	Scenario G Impact on productivity rate per pair mean	0
Units for output	breeding.adults	Scenario G Impact on adult survival rate	0.004776265
		Scenario G Impact on immature survival rate mean	-

Table A-8 Outputs: RA FFC Annual

Scenario	**Impact**	**Increase in mortality rate**	**Years since impact**	**C-PGR**					**C-PS**					**50% Quantiles**	
				Med.	**Mean**	**SD**	**LCI**	**UCI**	**Med.**	**Mean**	**SD**	**LCI**	**UCI**	**Q-UNIMP-50%**	**Q-IMP-50%**
Proj alone disp 50-1 DBS 61.3pct ads	45	0.0007286657	10	0.9995	0.9995	0.0005	0.9985	1.0005	0.9943	0.9943	0.0058	0.9832	1.0058	49.04	50.98
Proj alone disp 50-1 DBS 100pct ads	50	0.0008183226	10	0.9994	0.9994	0.0005	0.9984	1.0003	0.9937	0.9937	0.0059	0.9822	1.0053	48.78	51.16
Proj alone disp 70-2 DBS 61.3pct ads	125	0.0020392860	10	0.9986	0.9986	0.0005	0.9976	0.9995	0.9844	0.9844	0.0059	0.9730	0.9962	47.26	52.92

Scenario	Impact	Increase in mortality rate	Years since impact	C-PGR					C-PS					50% Quantiles	
				Med.	Mean	SD	LCI	UCI	Med.	Mean	SD	LCI	UCI	Q-UNIMP-50%	Q-IMP-50%
Proj alone disp 70-2 DBS 100pct ads	140	0.0022886951	10	0.9984	0.9984	0.0005	0.9974	0.9993	0.9826	0.9825	0.0058	0.9711	0.9940	46.72	53.06
Incomb disp 50-1 DBS 100pct ads exc comp	105	0.0017116309	10	0.9988	0.9988	0.0005	0.9978	0.9997	0.9869	0.9869	0.0059	0.9753	0.9984	47.84	52.46
Incomb disp 50-1 DBS 100pct ads inc comp	123	0.0020050534	10	0.9986	0.9986	0.0005	0.9976	0.9996	0.9845	0.9846	0.0059	0.9731	0.9960	47.28	52.82
Incomb disp 70-2 DBS 100pct ads exc comp	293	0.0047762654	10	0.9967	0.9967	0.0005	0.9957	0.9976	0.9638	0.9638	0.0058	0.9526	0.9750	42.54	56.98
Incomb disp 70-2 DBS 100pct ads inc comp	343	0.0055913277	10	0.9961	0.9961	0.0005	0.9951	0.9971	0.9578	0.9578	0.0057	0.9465	0.9693	41.56	58.52
Proj alone disp 50-1 DBS 61.3pct ads	45	0.0007286657	20	0.9995	0.9995	0.0003	0.9989	1.0001	0.9896	0.9896	0.0072	0.9756	1.0038	48.42	51.72
Proj alone disp 50-1 DBS 100pct ads	50	0.0008183226	20	0.9994	0.9994	0.0003	0.9988	1.0001	0.9884	0.9884	0.0071	0.9748	1.0024	48.04	51.92
Proj alone disp 70-2 DBS 61.3pct ads	125	0.0020392860	20	0.9986	0.9986	0.0003	0.9980	0.9993	0.9714	0.9714	0.0071	0.9578	0.9855	45.76	54.60
Proj alone disp 70-2 DBS 100pct ads	140	0.0022886951	20	0.9985	0.9985	0.0003	0.9978	0.9991	0.9679	0.9680	0.0071	0.9542	0.9819	45.38	55.20

Scenario	Impact	Increase in mortality rate	Years since impact	C-PGR					C-PS					50% Quantiles	
				Med.	Mean	SD	LCI	UCI	Med.	Mean	SD	LCI	UCI	Q-UNIMP-50%	Q-IMP-50%
Incomb disp 50-1 DBS 100pct ads exc comp	105	0.0017116309	20	0.9988	0.9988	0.0003	0.9982	0.9995	0.9759	0.9759	0.0071	0.9621	0.9902	46.60	53.94
Incomb disp 50-1 DBS 100pct ads inc comp	123	0.0020050534	20	0.9986	0.9986	0.0003	0.9980	0.9993	0.9716	0.9718	0.0071	0.9577	0.9857	45.76	54.74
Incomb disp 70-2 DBS 100pct ads exc comp	293	0.0047762654	20	0.9968	0.9968	0.0003	0.9961	0.9974	0.9343	0.9343	0.0069	0.9207	0.9477	39.38	61.06
Incomb disp 70-2 DBS 100pct ads inc comp	343	0.0055913277	20	0.9962	0.9962	0.0003	0.9956	0.9969	0.9236	0.9236	0.0067	0.9108	0.9371	37.38	63.16
Proj alone disp 50-1 DBS 61.3pct ads	45	0.0007286657	30	0.9995	0.9995	0.0003	0.9990	1.0000	0.9848	0.9850	0.0081	0.9693	1.0007	48.06	51.88
Proj alone disp 50-1 DBS 100pct ads	50	0.0008183226	30	0.9994	0.9994	0.0002	0.9989	0.9999	0.9831	0.9831	0.0079	0.9673	0.9990	47.90	52.34
Proj alone disp 70-2 DBS 61.3pct ads	125	0.0020392860	30	0.9986	0.9986	0.0003	0.9981	0.9991	0.9586	0.9585	0.0079	0.9433	0.9740	44.20	55.58
Proj alone disp 70-2 DBS 100pct ads	140	0.0022886951	30	0.9985	0.9985	0.0003	0.9980	0.9990	0.9535	0.9535	0.0078	0.9379	0.9687	43.32	56.08
Incomb disp 50-1 DBS 100pct ads exc comp	105	0.0017116309	30	0.9989	0.9989	0.0003	0.9984	0.9993	0.9650	0.9650	0.0080	0.9495	0.9806	45.16	54.62

Scenario	Impact	Increase in mortality rate	Years since impact	C-PGR					C-PS					50% Quantiles	
				Med.	Mean	SD	LCI	UCI	Med.	Mean	SD	LCI	UCI	Q-UNIMP-50%	Q-IMP-50%
Incomb disp 50-1 DBS 100pct ads inc comp	123	0.0020050534	30	0.9987	0.9987	0.0003	0.9982	0.9992	0.9591	0.9592	0.0079	0.9434	0.9749	44.20	55.48
Incomb disp 70-2 DBS 100pct ads exc comp	293	0.0047762654	30	0.9968	0.9968	0.0003	0.9963	0.9973	0.9057	0.9056	0.0076	0.8905	0.9204	36.32	62.94
Incomb disp 70-2 DBS 100pct ads inc comp	343	0.0055913277	30	0.9963	0.9963	0.0003	0.9958	0.9968	0.8905	0.8906	0.0074	0.8763	0.9050	34.16	65.40

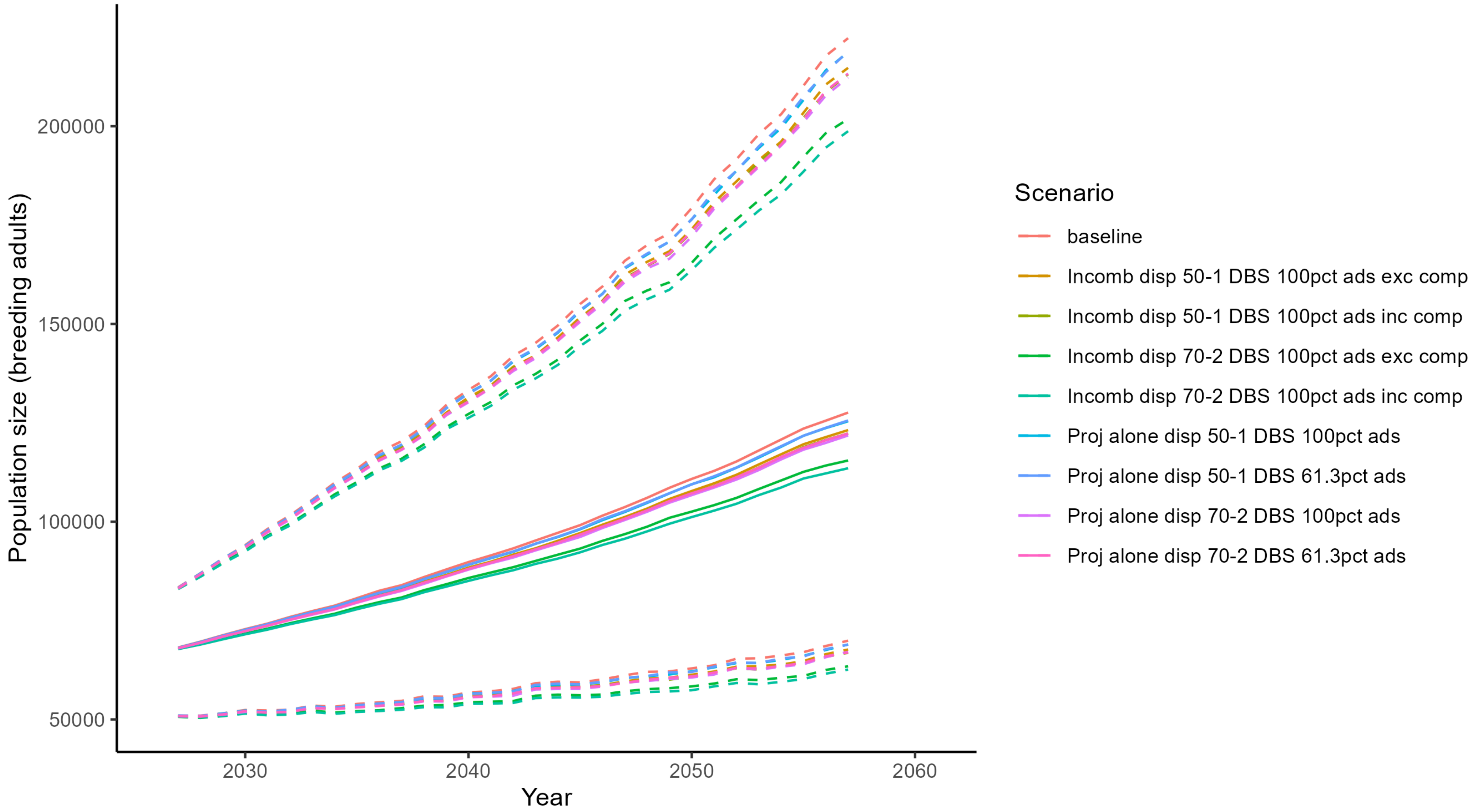
Population size (breeding adults)
200000
150000
100000
50000
2030
2040
2050
2060
Year
Scenario
baseline
Incomb disp 50-1 DBS 100pct ads exc comp
Incomb disp 50-1 DBS 100pct ads inc comp
Incomb disp 70-2 DBS 100pct ads exc comp
Incomb disp 70-2 DBS 100pct ads inc comp
Proj alone disp 50-1 DBS 100pct ads
Proj alone disp 50-1 DBS 61.3pct ads
Proj alone disp 70-2 DBS 100pct ads
Proj alone disp 70-2 DBS 61.3pct ads

Figure A-4 RA FFC Annual

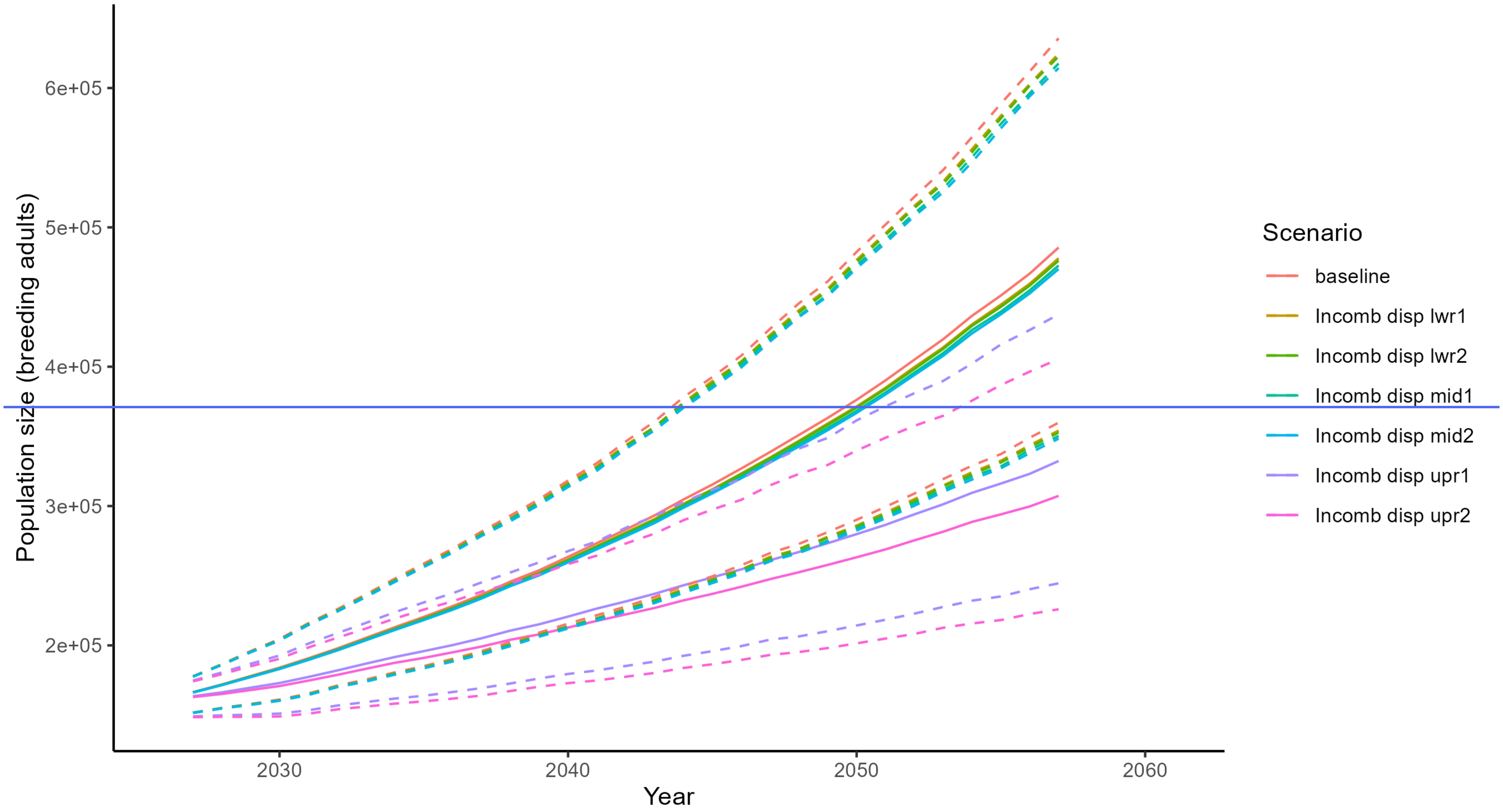

Table 9. Inputs: GU Farne Is. Annual

Baseline parameters	**Settings**	**Impact parameters**	**Values**
Reference name	GU Farne Is. Annual	Number of scenarios of impact	2
Type	Simulation	Are impacts applied separately to each subpopulation	FALSE
Case studies	None	Are impacts specified separately for immatures	FALSE
Model to use for environmental stochasticity	Beta/Gamma	Are standard errors of impacts available	FALSE
Choose model for density dependence	No density dependence	Should random seeds be matched for impact scenarios	TRUE
Include demographic stochasticity in model	TRUE	Impacts are specified as	Relative
Number of simulations	5000	Years in which impacts are assumed to begin	2027
Random seed	1971	Years in which impacts are assumed to end	2057
Years for burn in	5	Scenario A name	Incomb disp ~~Iwr1~~50-1
Species	~~Razorbill~~Common Guillemot	Scenario A Impact on productivity rate per pair mean	0
Age at first breeding	~~5~~6	Scenario A Impact on adult survival rate	0.~~00097806~~001014959
Is there an upper constraint on productivity in the model	~~Yes~~TRUE	Scenario A Impact on immature survival rate mean	~~0~~-
Maximum brood size per pair chicks will be constrained to be no greater than	1	Scenario B name	Incomb disp ~~Iwr2~~70-2
Number of subpopulations	1	Scenario B Impact on productivity rate per pair mean	0
Units for initial population size	~~Breeding~~ breeding.adults	Scenario B Impact on adult survival rate	0.~~00107590~~028575
Are baseline demographic rates specified separately for immatures	~~Yes~~TRUE	Scenario B Impact on immature survival rate mean	-
Initial population size	~~30673~~64042	Scenario C name	~~Incomb disp med1~~
Year	~~2022~~2024	Scenario C Impact on productivity rate per pair mean	~~0~~
Productivity rate per pair mean	0.~~618~~6879	Scenario C Impact on adult survival rate per pair mean	~~0.0016301~~
Productivity rate per pair standard deviation	0.~~085~~0825	Scenario C Impact on immature survival rate mean	~~-~~
Adult survival rate Mean	0.~~895~~94	Scenario D name	~~Incomb disp med2~~
Adult survival rate standard deviation	0.~~067~~025	Scenario D Impact on productivity rate per pair mean	~~0~~
Immatures survival rates 0 to 1 mean	0.~~63~~56	Scenario D Impact on adult survival rate	~~0.0017931~~

Baseline parameters	Settings	Impact parameters	Values
Immatures survival rates 0 to 1 standard deviation	0.~~067~~058	Scenario D Impact on immature survival rate mean	–
Immatures survival rates 1 to 2 mean	0.~~63~~792	Scenario E name	~~Incomb disp upr1~~
Immatures survival rates 1 to 2 standard deviation	0.~~067~~152	Scenario E Impact on productivity rate per pair mean	~~0~~
Immatures survival rates 2 to 3 mean	0.~~895~~917	Scenario E Impact on adult survival rate	~~0.022658~~
Immatures survival rates 2 to 3 standard deviation	0.~~067~~098	Scenario E Impact on immature survival rate mean	–
Immatures survival rates 3 to 4 mean	0.~~895~~938	Scenario F name	~~Incomb disp upr2~~
Immatures survival rates 3 to 4 standard deviation	0.~~067~~107	Scenario F Impact on productivity rate per pair mean	~~0~~
Immatures survival rates 4 to 5 mean	0.~~895~~94	Scenario F Impact on adult survival rate	~~0.025136~~
Immatures survival rates 4 to 5 standard deviation	0.~~067~~025	Scenario F Impact on immature survival rate mean	–
Immatures survival rates 5 to 6 mean	0.94	Scenario G name	
Immatures survival rates 5 to 6 standard deviation	0.025	Scenario G Impact on productivity rate per pair mean	
Units for output	breeding.adults	Scenario G Impact on adult survival rate	
		Scenario G Impact on immature survival rate mean	

Table 10. Outputs: GU Farne Is. Annual

Scenario	Impact	Increase in mortality rate	Years since impact	C-PGR					C-PS					50% Quantiles	
				Med.	Mean	SD	LCI	UCI	Med.	Mean	SD	LCI	UCI	Q-UNIMP-50%	Q-IMP-50%
Incomb disp 50-1	65	0.001014959	10	0.9993	0.9993	0.0004	0.9986	1.0000	0.9920	0.9919	0.0041	0.9837	1.0000	46.36	53.84
Incomb disp 70-2	183	0.002857500	10	0.9980	0.9979	0.0004	0.9972	0.9987	0.9776	0.9776	0.0041	0.9697	0.9856	40.26	59.76
Incomb disp 50-1	65	0.001014959	20	0.9993	0.9993	0.0002	0.9988	0.9998	0.9854	0.9853	0.0050	0.9755	0.9951	45.60	54.56
Incomb disp 70-2	183	0.002857500	20	0.9980	0.9980	0.0002	0.9976	0.9985	0.9595	0.9595	0.0050	0.9497	0.9693	37.80	63.30
Incomb disp 50-1	65	0.001014959	30	0.9993	0.9993	0.0002	0.9990	0.9997	0.9787	0.9786	0.0055	0.9676	0.9893	44.82	56.72
Incomb disp 70-2	183	0.002857500	30	0.9981	0.9981	0.0002	0.9977	0.9984	0.9417	0.9416	0.0055	0.9310	0.9521	35.18	67.16

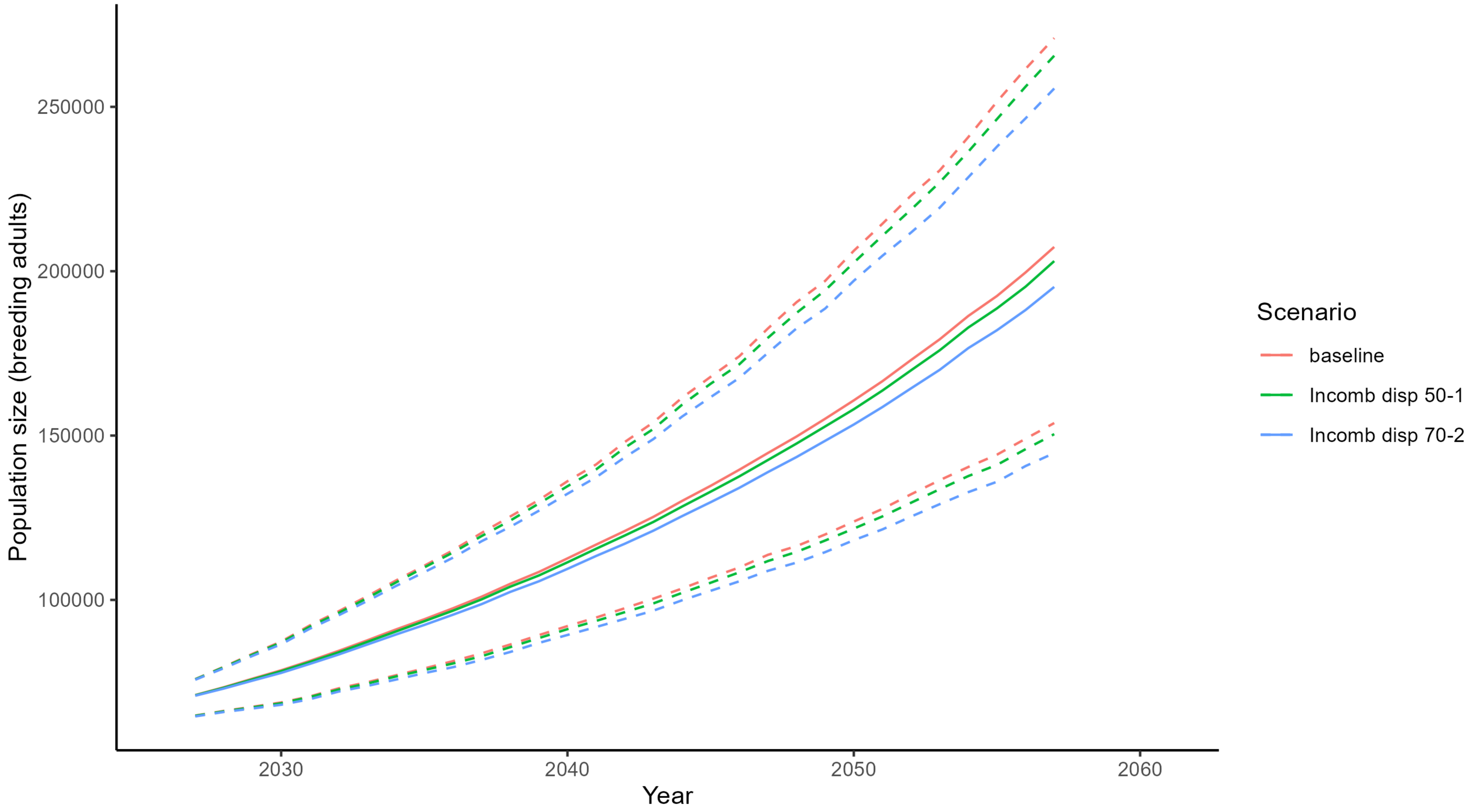

Figure 5.GU Farne Is. Annual

Table 11. Inputs: PU Farne Is. Annual

Baseline parameters	Settings	Impact parameters	Values
Reference name	PU Farne Is. Annual	Number of scenarios of impact	2
Type	Simulation	Are impacts applied separately to each subpopulation	FALSE
Case studies	None	Are impacts specified separately for immatures	FALSE
Model to use for environmental stochasticity	Beta/Gamma	Are standard errors of impacts available	FALSE
Choose model for density dependence	No density dependence	Should random seeds be matched for impact scenarios	TRUE
Include demographic stochasticity in model	TRUE	Impacts are specified as	Relative
Number of simulations	5000	Years in which impacts are assumed to begin	2027
Random seed	1971	Years in which impacts are assumed to end	2057
Years for burn in	5	Scenario A name	Incomb disp 50-1
Species	Atlantic Puffin	Scenario A Impact on productivity rate per pair mean	0
Age at first breeding	5	Scenario A Impact on adult survival rate	0.0004799781
Is there an upper constraint on productivity in the model	TRUE	Scenario A Impact on immature survival rate mean	-
Maximum brood size per pair chicks will be constrained to be no greater than	1	Scenario B name	Incomb disp 70-2
Number of subpopulations	1	Scenario B Impact on productivity rate per pair mean	0
Units for initial population size	breeding.adults	Scenario B Impact on adult survival rate	0.00134851
Are baseline demographic rates specified separately for immatures	TRUE	Scenario B Impact on immature survival rate mean	-
Initial population size	87504	Scenario C name	
Year	2024	Scenario C Impact on productivity rate per pair mean	
Productivity rate per pair mean	0.7522	Scenario C Impact on adult survival rate per pair mean	
Productivity rate per pair standard deviation	0.1289	Scenario C Impact on immature survival rate mean	
Adult survival rate Mean	0.907	Scenario D name	
Adult survival rate standard deviation	0.083	Scenario D Impact on productivity rate per pair mean	
Immatures survival rates 0 to 1 mean	0.892	Scenario D Impact on adult survival rate	
Immatures survival rates 0 to 1 standard deviation	0.108	Scenario D Impact on immature survival rate mean	
Immatures survival rates 1 to 2 mean	0.892	Scenario E name	
Immatures survival rates 1 to 2 standard deviation	0.108	Scenario E Impact on productivity rate per pair mean	
Immatures survival rates 2 to 3 mean	0.892	Scenario E Impact on adult survival rate	

Baseline parameters	Settings	Impact parameters	Values
Immatures survival rates 2 to 3 standard deviation	0.108	Scenario E Impact on immature survival rate mean	
Immatures survival rates 3 to 4 mean	0.76	Scenario F name	
Immatures survival rates 3 to 4 standard deviation	0.093	Scenario F Impact on productivity rate per pair mean	
Immatures survival rates 4 to 5 mean	0.805	Scenario F Impact on adult survival rate	
Immatures survival rates 4 to 5 standard deviation	0.083	Scenario F Impact on immature survival rate mean	
Immatures survival rates 5 to 6 mean		Scenario G name	
Immatures survival rates 5 to 6 standard deviation		Scenario G Impact on productivity rate per pair mean	
Units for output	breeding.adults	Scenario G Impact on adult survival rate	
		Scenario G Impact on immature survival rate mean	

Table 12. Outputs: PU Farne Is. Annual

Scenario	Impact	Increase in mortality rate	Years since impact	C-PGR					C-PS					50% Quantiles	
				Med.	Mean	SD	LCI	UCI	Med.	Mean	SD	LCI	UCI	Q-UNIMP-50%	Q-IMP-50%
Incomb disp 50-1	42	0.0004799781	10	0.9997	0.9997	0.0004	0.9989	1.0004	0.9964	0.9964	0.0041	0.9880	1.0044	49.32	50.66
Incomb disp 70-2	118	0.0013485098	10	0.9991	0.9991	0.0004	0.9984	0.9998	0.9900	0.9900	0.0042	0.9816	0.9983	48.06	51.68
Incomb disp 50-1	42	0.0004799781	20	0.9997	0.9997	0.0002	0.9992	1.0001	0.9934	0.9934	0.0049	0.9839	1.0031	49.06	51.02
Incomb disp 70-2	118	0.0013485098	20	0.9991	0.9991	0.0002	0.9987	0.9996	0.9815	0.9816	0.0050	0.9718	0.9916	47.30	52.82
Incomb disp 50-1	42	0.0004799781	30	0.9997	0.9997	0.0002	0.9994	1.0000	0.9904	0.9904	0.0053	0.9798	1.0010	48.80	51.04
Incomb disp 70-2	118	0.0013485098	30	0.9991	0.9991	0.0002	0.9988	0.9995	0.9733	0.9733	0.0054	0.9628	0.9838	46.98	53.02

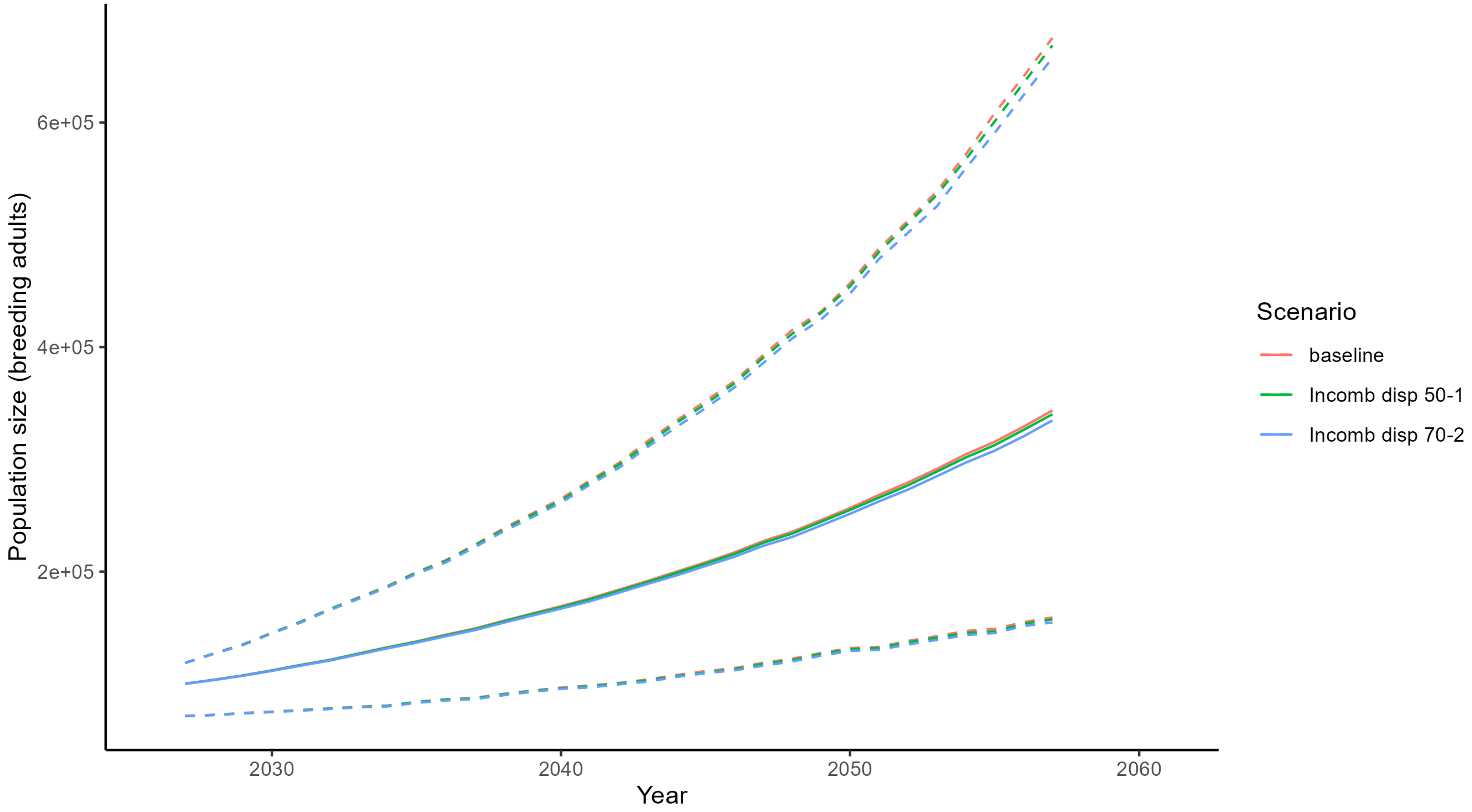

Figure 6.PU Farne Is. Annual

RWE Renewables UK Dogger Bank South (West) Limited

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