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MORGAN OFFSHORE WIND PROJECT: GENERATION ASSETS

Additional PVA Modelling for Great Black-Backed Gull Cumulative Assessment

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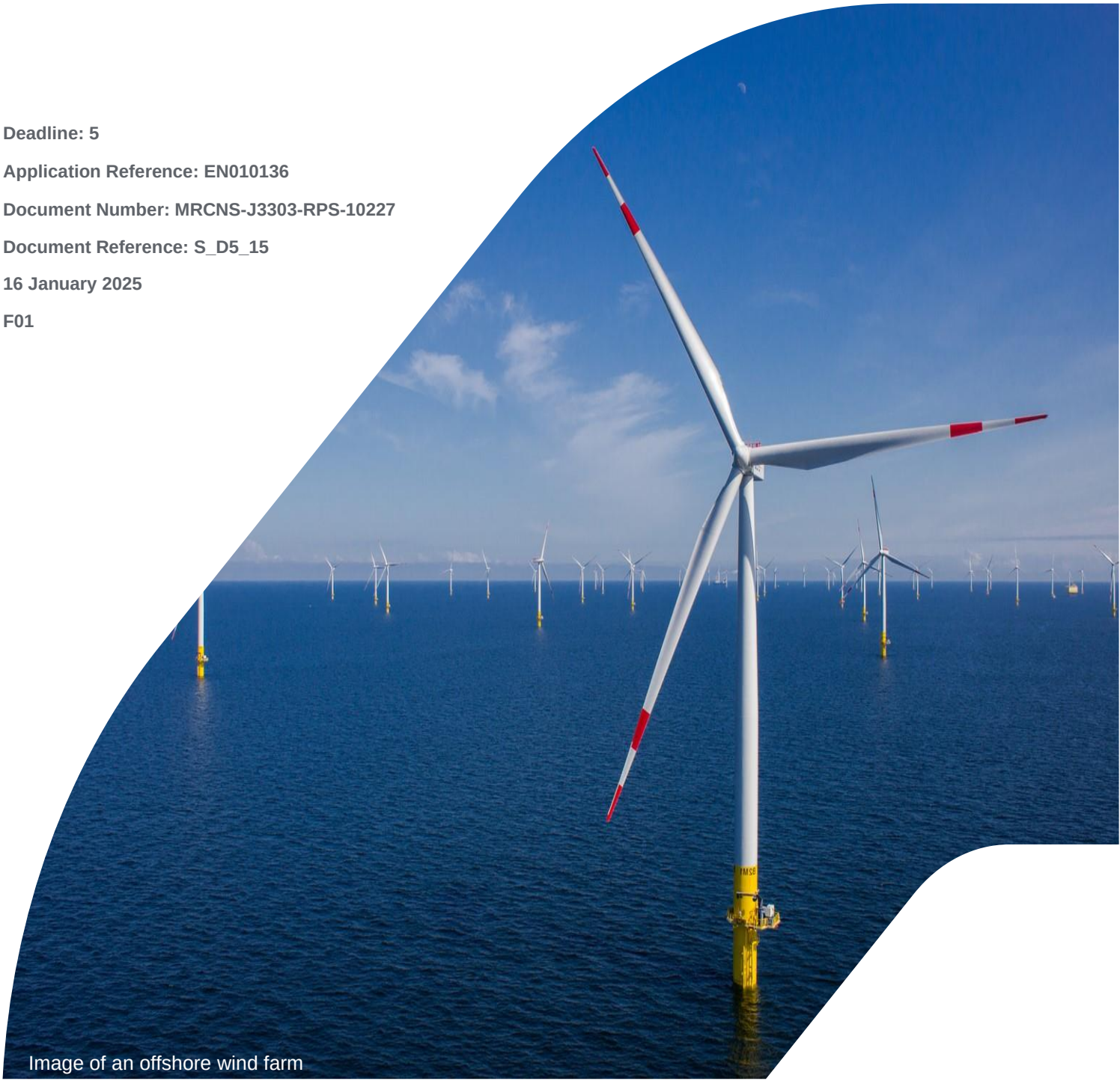

Image of an offshore wind farm

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Glossary

Term	Meaning
Applicant	Morgan Offshore Wind Limited.
Development Consent Order (DCO)	An order made under the Planning Act 2008 granting development consent for a Nationally Significant Infrastructure Project (NSIP).
Morgan Array Area	The area within which the wind turbines, foundations, inter-array cables, interconnector cables, scour protection, cable protection and offshore substation platforms (OSPs) forming part of the Morgan Offshore Wind Project: Generation Assets will be located.
Morgan Offshore Wind Project: Generation Assets	This is the name given to the Morgan Generation Assets project as a whole (includes all infrastructure and activities associated with the project construction, operations and maintenance, and decommissioning).
The Planning Inspectorate	The agency responsible for operating the planning process for applications for development consent under the Planning Act 2008.

Acronyms

Acronym	Description
CGR	Counterfactual of Growth Rate
CPS	Counterfactual of Population Size
EWG	Expert Working Group
PVA	Population Viability Analysis
SNCB	Statutory Nature Conservation Body

Units

Unit	Description
%	Percentage

1 ADDITIONAL PVA MODELLING FOR GREAT BLACK-BACKED GULL CUMULATIVE ASSESSMENT

1.1 Introduction

1.1.1.1 Following discussions with Natural England on 16 December 2024, and to inform the information to be submitted at Deadline 5 to support Natural England's assessments, the Applicant has committed to providing additional Population Viability Analysis (PVA) modelling for the regional population of great black-backed gull (*Larus marinus*). This report therefore provides the PVA inputs and outputs for great black-backed gull on a cumulative basis, with these inputs and outputs also incorporated into other aspects of the Applicant's Deadline 5 submission. Assessments are presented incorporating all outputs.

1.2 Methodology

1.2.1.1 This report provides the following information:

- Calculation of cumulative totals for the following scenarios:
  - Using the Applicant's parameter assumptions
    1. The cumulative impact for great black-backed gull incorporating all projects using assessed turbine scenarios
    2. The cumulative impact for great black-backed gull excluding the Morgan Generation Assets using assessed turbine scenarios
    3. The as-built cumulative impact for great black-backed gull incorporating all projects
    4. The as-built cumulative impact for great black-backed gull excluding the Morgan Generation Assets
  - Using Natural England's parameter assumptions
    5. The cumulative impact for great black-backed gull incorporating all projects using assessed turbine scenarios
    6. The cumulative impact for great black-backed gull excluding the Morgan Generation Assets using assessed turbine scenarios
    7. The as-built cumulative impact for great black-backed gull incorporating all projects
    8. The as-built cumulative impact for great black-backed gull excluding the Morgan Generation Assets

1.2.1.2 The calculation of these scenarios incorporates collision risk estimates for all projects, incorporating those for which impacts are available from project-specific information and those for which impacts were calculated as part of Annex 4.5 to Response to Hearing Action Point 15: Offshore Ornithology CEA and In-combination Gap-filling of Historical Projects Note (REP1-010).

1.2.1.3 For each scenario a table is presented, providing the seasonal impacts for each project. Scenarios 1 to 4 provide impacts calculated applying the Applicant's parameter assumptions. For the Morgan Generation Assets this therefore incorporates flight speed data from Skov *et al.* (2018) and species-specific avoidance rates from Ozsanlav-Harris *et al.* (2023). For projects considered cumulatively, collision risk

estimates are corrected to an avoidance rate of 99.91% representing the species-specific avoidance rates from Ozsanlav-Harris *et al.* (2023). Scenarios 5 to 8 provide impacts calculated applying the Statutory Nature Conservation Bodies (SNCBs) parameter assumptions. For the Morgan Generation Assets this therefore incorporates flight speed data from Alerstam *et al.* (2007) and grouped avoidance rates from Ozsanlav-Harris *et al.* (2023). For projects considered cumulatively, collision risk estimates are corrected to an avoidance rate of 99.39% representing the grouped avoidance rates from Ozsanlav-Harris *et al.* (2023).

1.2.2 As-built scenarios

1.2.2.1 As discussed in Table 5.157 of Volume 2, Chapter 5: Offshore ornithology (APP-023), there are a number of projects included in the cumulative assessment for the Morgan Generation Assets for which it is known that the collision risk estimates represent an over-estimate of the likely impact associated with the project. This is due to the differences in impact magnitude that occur between turbine scenarios that are assessed as part of project applications and those that are eventually built (as-built scenarios). Based on the information presented in The Crown Estate (2019), this is applicable to the following projects listed in Table 1.1 of those incorporated into the cumulative assessments for great black-backed gull.

Table 1.1: Assessed and as-built turbine scenario for operational projects considered in the cumulative assessment for great black-backed gull.

[1] Assessed turbine capacity from project-specific documentation.

Project	Assessed turbine scenario	As-built turbine scenario	Contribution to cumulative total (%) using the assessed turbine scenario
Burbo Bank	30 x 3 MW	25 x 3.6 MW	1.4
Burbo Bank Extension	69 x 3.6 MW	32 x 8 MW	4.2
Gwynt y Môr	250 x 3 MW	160 x 3.6 MW	6.4
Ormonde	30 x 3.6 MW	30 x 5 MW	0.2
Rampion	175 x 4 MW	116 x 3.45 MW	19.4
Robin Rigg	60 x 2 to 3.6 MW	60 x 3 MW	2.6
Walney 1 & 2	152 x 3 and 4.5 MW	102 x 3.6 MW	5.2
Walney 3 & 4	207 x 3.6 MW[1]	87 x 7 and 8 MW	21.1
West of Duddon Sands	139 x 3.6 MW[1]	108 x 3.6 MW	0.6

1.2.2.2 The contribution of the majority of these operational projects to the cumulative total for great black- backed gull is limited, with any change to the parameters incorporated into collision risk modelling as a result of the difference between the assessed and as-built turbine scenarios unlikely to significantly affect the resulting collision risk estimate for the project. However, the Rampion offshore wind farm and Walney 3 & 4 (Walney Extension) offshore wind farm contribute a significant proportion (both approximately 20%) of the cumulative total and therefore consideration has been given to the

potential difference in collision risk estimates associated with the assessed and as-built turbine scenarios for these projects.

1.2.2.3 As discussed in Table 5.157 of Volume 2, Chapter 5: Offshore ornithology (APP-023), updated collision risk estimates for the Walney Extension offshore wind farm are available in Wheeldon *et al.* (2023). Wheeldon *et al.* (2023) considers the changes to collision risk estimates between the consented turbine scenario, the as-built turbine scenario and an additional turbine scenario where aerodynamic tip boosters will be installed on each turbine blade. The difference between the collision risk estimates calculated for the consented design and those for the as-built turbine scenario is 54.67% whereas for the consented to the as-built scenario plus the tip boosters is 53.02%. This is therefore considered in scenarios 3, 4, 7 and 8 in the following sections.

1.2.2.4 An equivalent analysis is not available for the Rampion offshore wind farm and therefore the potential change in collision risk estimates that may result due to differences between the assessed and as-built turbine scenario has not been accounted for in this report.

1.3 Cumulative totals

1.3.1 Applicant's scenarios

1.3.1.1 The cumulative totals for each of the four scenarios incorporating the Applicant's position are provided in Table 1.2 (Scenarios 1 and 2) and Table 1.3 (Scenario 3 and 4).

1.3.2 Natural England's scenarios

1.3.2.1 The cumulative totals for each of the four scenarios incorporating the SNCBs position are provided in Table 1.4 (Scenarios 5 and 6) and Table 1.5 (Scenario 7 and 8).

Table 1.2: Cumulative collision risk total for great black-backed gull for Scenarios 1 and 2.

Project	Source of estimates	Breeding	Non-breeding	Total
Awel y Môr	Project-specific documentation	0.8	0.1	0.9
Barrow	Gap-fill exercise	0.1	0.2	0.3
Burbo Bank	Gap-fill exercise (REP1-010)	0.2	0.1	0.3
Burbo Bank Extension	Gap-fill exercise (REP1-010)	0.6	0.4	1.0
Erebus	Project-specific documentation	0.0	0.1	0.1
Gwynt y Môr	Gap-fill exercise (REP1-010)	0.9	0.7	1.5
Llŷr 1	Project-specific documentation	0.1	0.1	0.2
Mona Offshore Wind Project	Project-specific documentation	0.3	0.5	0.7
Morecambe Offshore Wind Farm: Generation Assets	Project-specific documentation	0.1	0.2	0.3
Morgan Generation Assets	Project-specific documentation	0.1	0.6	0.7
North Hoyle	Gap-fill exercise	0.1	0.1	0.2
Ormonde	Project-specific documentation	0.0	0.0	0.0
Rampion	Project-specific documentation	0.7	3.9	4.7
Rampion 2	Project-specific documentation	0.9	2.0	3.0
Rhyl Flats	Gap-fill exercise	0.1	0.1	0.3
Robin Rigg	Gap-fill exercise (REP1-010)	0.3	0.3	0.6
Twinhub	Project-specific documentation	1.0	1.4	2.3
Walney 1 & 2	Gap-fill exercise (REP1-010)	0.7	0.6	1.3
Walney 3 & 4	Project-specific documentation	0.7	4.4	5.1
West of Duddon Sands	Gap-fill exercise (REP1-010)	0.8	0.4	1.2
White Cross	Project-specific documentation	0.1	0.0	0.1
Scenario Totals				

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Project	Source of estimates	Breeding	Non-breeding	Total
Scenario 1 (full impact, including all projects)				25.0
Scenario 2 (full impact, excluding the Morgan Generation Assets)				24.3

Table 1.3: Cumulative collision risk total for great black-backed gull for Scenarios 3 and 4.

Project	Source of estimates	Breeding	Non-breeding	Total
Awel y Môr	Project-specific documentation	0.8	0.1	0.9
Barrow	Gap-fill exercise	0.1	0.2	0.3
Burbo Bank	Gap-fill exercise (REP1-010)	0.2	0.1	0.3
Burbo Bank Extension	Gap-fill exercise (REP1-010)	0.6	0.4	1.0
Erebus	Project-specific documentation	0.0	0.1	0.1
Gwynt y Môr	Gap-fill exercise (REP1-010)	0.9	0.7	1.5
Llŷr 1	Project-specific documentation	0.1	0.1	0.2
Mona Offshore Wind Project	Project-specific documentation	0.3	0.5	0.7
Morecambe Offshore Wind Farm: Generation Assets	Project-specific documentation	0.1	0.2	0.3
Morgan Generation Assets	Project-specific documentation	0.1	0.6	0.7
North Hoyle	Gap-fill exercise	0.1	0.1	0.2
Ormonde	Project-specific documentation	0.0	0.0	0.0
Rampion	Project-specific documentation	0.7	3.9	4.7
Rampion 2	Project-specific documentation	0.9	2.0	3.0
Rhyl Flats	Gap-fill exercise	0.1	0.1	0.3
Robin Rigg	Gap-fill exercise (REP1-010)	0.3	0.3	0.6
Twinhub	Project-specific documentation	1.0	1.4	2.3
Walney 1 & 2	Gap-fill exercise (REP1-010)	0.7	0.6	1.3
Walney 3 & 4	Project-specific documentation	0.4	1.4	1.8
West of Duddon Sands	Gap-fill exercise (REP1-010)	0.8	0.4	1.2
White Cross	Project-specific documentation	0.1	0.0	0.1
Scenario Totals				

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Project	Source of estimates	Breeding	Non-breeding	Total
Scenario 3 (as-built impact, including all projects)				21.8
Scenario 4 (as-built impact, excluding the Morgan Generation Assets)				21.1

Table 1.4: Cumulative collision risk total for great black-backed gull for Scenarios 5 and 6.

Project	Source of estimates	Breeding	Non-breeding	Total
Awel y Môr	Project-specific documentation	5.3	0.6	6.0
Barrow	Gap-fill exercise	0.8	1.4	2.2
Burbo Bank	Gap-fill exercise (REP1-010)	1.3	1.0	2.3
Burbo Bank Extension	Gap-fill exercise (REP1-010)	4.0	2.8	6.8
Erebus	Project-specific documentation	0.0	0.8	0.8
Gwynt y Môr	Gap-fill exercise (REP1-010)	5.8	4.6	10.4
Llŷr 1	Project-specific documentation	0.7	1.0	1.6
Mona Offshore Wind Project	Project-specific documentation	1.7	3.2	4.9
Morecambe Offshore Wind Farm: Generation Assets	Project-specific documentation	0.7	1.1	1.8
Morgan Generation Assets	Project-specific documentation	1.1	4.6	5.7
North Hoyle	Gap-fill exercise	1.0	0.7	1.7
Ormonde	Project-specific documentation	0.1	0.2	0.3
Rampion	Project-specific documentation	5.0	26.7	31.7
Rampion 2	Project-specific documentation	6.4	13.8	20.2
Rhyl Flats	Gap-fill exercise	0.9	1.0	1.9
Robin Rigg	Gap-fill exercise (REP1-010)	2.0	2.2	4.2
Twinhub	Project-specific documentation	6.6	9.2	15.7
Walney 1 & 2	Gap-fill exercise (REP1-010)	4.7	3.8	8.5
Walney 3 & 4	Project-specific documentation	4.7	29.8	34.5
West of Duddon Sands	Gap-fill exercise (REP1-010)	5.8	2.7	8.5
White Cross	Project-specific documentation	0.9	0.0	0.9
Scenario Totals				

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Project	Source of estimates	Breeding	Non-breeding	Total
Scenario 5 (full impact, including all projects)				170.6
Scenario 6 (full impact, excluding the Morgan Generation Assets)				164.9

Table 1.5: Cumulative collision risk total for great black-backed gull for Scenarios 7 and 8.

Project	Source of estimates	Breeding	Non-breeding	Total
Awel y Môr	Project-specific documentation	5.3	0.6	6.0
Barrow	Gap-fill exercise	0.8	1.4	2.2
Burbo Bank	Gap-fill exercise (REP1-010)	1.3	1.0	2.3
Burbo Bank Extension	Gap-fill exercise (REP1-010)	4.0	2.8	6.8
Erebus	Project-specific documentation	0.0	0.8	0.8
Gwynt y Môr	Gap-fill exercise (REP1-010)	5.8	4.6	10.4
Llŷr 1	Project-specific documentation	0.7	1.0	1.6
Mona Offshore Wind Project	Project-specific documentation	1.7	3.2	4.9
Morecambe Offshore Wind Farm: Generation Assets	Project-specific documentation	0.7	1.1	1.8
Morgan Generation Assets	Project-specific documentation	1.1	4.6	5.7
North Hoyle	Gap-fill exercise	1.0	0.7	1.7
Ormonde	Project-specific documentation	0.1	0.2	0.3
Rampion	Project-specific documentation	5.0	26.7	31.7
Rampion 2	Project-specific documentation	6.4	13.8	20.2
Rhyl Flats	Gap-fill exercise	0.9	1.0	1.9
Robin Rigg	Gap-fill exercise (REP1-010)	2.0	2.2	4.2
Twinhub	Project-specific documentation	6.6	9.2	15.7
Walney 1 & 2	Gap-fill exercise (REP1-010)	4.7	3.8	8.5
Walney 3 & 4	Project-specific documentation	0.7	2.4	3.1
West of Duddon Sands	Gap-fill exercise (REP1-010)	5.8	2.7	8.5
White Cross	Project-specific documentation	0.9	0.0	0.9
Scenario Totals				

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Project	Source of estimates	Breeding	Non-breeding	Total
Scenario 7 (as-built impact, including all projects)				148.6
Scenario 8 (as-built impact, excluding the Morgan Generation Assets)				142.9

1.4 Assessment

1.4.1.1 The impact on the baseline mortality (0.095 as calculated in Volume 2, Chapter 5: Offshore ornithology (APP-023)) of the regional population of great black-backed gull (17,742 individuals) is calculated in Table 1.6.

Table 1.6: Increase in baseline mortality as a result of cumulative collision risk impacts on the regional population of great black-backed gull.

Scenario	Impact	Increase in baseline mortality (%)
1	25.0	1.49
2	24.3	1.45
3	21.8	1.29
4	21.1	1.25
5	170.6	9.92
6	164.9	9.59
7	148.6	8.64
8	142.9	8.31

1.4.1.2 The increase in baseline mortality associated with all cumulative totals is greater than 1%. As a result PVA modelling has been conducted incorporating all scenarios as presented in Table 1.7.

Table 1.7: PVA input values for scenarios for which an increase in baseline mortality of greater than 1% has been calculated.

Scenario	Decrease in survival rate
1	0.001410992
2	0.001371282
3	0.001227867
4	0.001188157
5	0.009615541
6	0.009294246
7	0.008374362
8	0.008053067

1.4.1.3 For scenarios 1, 2, 3 and 4, PVA modelling has been undertaken utilising those parameters described in Volume 4, Annex 5.6: Offshore ornithology PVA technical report (APP-058), specifically the survival rates calculated in BTO (2024) and the productivity data provided by JNCC as part of the Expert Working Group (EWG) and recommended for use in the PVA modelling for the Morgan Generation Assets. For scenarios 5, 6, 7 and 8, PVA modelling has been conducted using the parameters recommended by Natural England in REP4-043. Input logs for the modelling are provided in Appendix A:.

Table 1.8: PVA outputs for great black-backed gull for the regional population (Scenarios 1, 2, 3, and 4).

Notes:

CGR = Counterfactual of Growth Rate

CPS = Counterfactual of Population Size

Year	Impact scenario	Simulated population size	Median population change (%)	Median growth rate	Lower confidence limit of simulated growth rate	Upper confidence limit of simulated growth rate	Median CGR	Median CPS
2030	Baseline (unimpacted)	34,082	5.4	1.054	0.881	1.175	-	-
2030	Full_impact_Morgan (Scenario 1)	34,084	5.1	1.051	0.879	1.175	0.998	0.999
2030	Full_impact_noMorgan (Scenario 2)	34,024	5.2	1.052	0.880	1.174	0.998	0.999
2030	Asbuilt_impact_Morgan (Scenario 3)	34,020	5.2	1.052	0.880	1.175	0.999	0.998
2030	Asbuilt_impact_noMorgan (Scenario 4)	34,101	5.2	1.052	0.878	1.175	0.999	0.999
2065	Baseline (unimpacted)	149,986	361.1	1.043	1.019	1.067	-	-
2065	Full_impact_Morgan (Scenario 1)	140,917	333.7	1.042	1.017	1.065	0.998	0.942
2065	Full_impact_noMorgan (Scenario 2)	141,468	334.4	1.042	1.017	1.065	0.998	0.944
2065	Asbuilt_impact_Morgan (Scenario 3)	142,042	337.1	1.042	1.017	1.066	0.999	0.949
2065	Asbuilt_impact_noMorgan (Scenario 4)	142,806	338.6	1.042	1.017	1.066	0.999	0.951

Table 1.9: PVA outputs for great black-backed gull for the regional population (Scenarios 5, 6, 7, and 8).

Year	Impact scenario	Simulated population size	Median population change (%)	Median growth rate	Lower confidence limit of simulated growth rate	Upper confidence limit of simulated growth rate	Median CGR	Median CPS
2030	Baseline (unimpacted)	106,204	12.7	1.127	1.058	1.195	-	-
2030	Full_impact_Morgan (Scenario 5)	105,179	11.6	1.116	1.047	1.182	0.989	0.990
2030	Full_impact_noMorgan (Scenario 6)	105,040	11.6	1.116	1.046	1.183	0.990	0.990
2030	Asbuilt_impact_Morgan (Scenario 7)	105,187	11.7	1.117	1.048	1.184	0.991	0.991
2030	Asbuilt_impact_noMorgan (Scenario 8)	105,284	11.7	1.117	1.048	1.184	0.991	0.991
2065	Baseline (unimpacted)	6,823,314	7,145.1	1.126	1.120	1.133	-	-
2065	Full_impact_Morgan (Scenario 5)	4,661,116	4,848.9	1.114	1.108	1.121	0.989	0.683
2065	Full_impact_noMorgan (Scenario 6)	4,714,584	4,913.0	1.115	1.108	1.121	0.990	0.692
2065	Asbuilt_impact_Morgan (Scenario 7)	4,896,842	5,100.0	1.116	1.109	1.123	0.991	0.718
2065	Asbuilt_impact_noMorgan (Scenario 8)	4,955,306	5,166.7	1.116	1.110	1.123	0.991	0.727

1.4.1.4 Two sources have been used to parameterise the survival rates of great black-backed gull within the models conducted. The first represents survival data reported as part of the BTO's Retrap Adult Survival project which has been collected subsequent to the publication of Horswill and Robinson (2015) (BTO, 2024). The second set of rates are those recommended by Natural England in REP4-043. These rates represent the immature survival rates for herring gull and the adult survival rate for great black-backed gull. These rates are all presented in Horswill and Robinson (2015). Due to the limited amount of data, Horswill and Robinson (2015) recommended using the survival rates of other large gull species when conducting population modelling for great black-backed gull. The Applicant followed this recommendation in Volume 4, Annex 5.6: Offshore ornithology PVA technical report (APP-058) but has updated the adult survival rate to the adult survival rate for great black-backed gull as provided in Horswill and Robinson (2015), at Natural England's recommendation (REP4-043), despite this being against the recommendations in Horswill and Robinson (2015).

1.4.1.5 When considering scenario 5 (which has the highest associated impact of 170.6 collisions/annum) the model predicts a median counterfactual of growth rate of 0.989 after 35 years (for both models) identical to that predicted at the onset of impacts as incorporated into the modelling approach. Under this impact scenario, the predicted counterfactual median impacted population size would be approximately 31.7% smaller compared to that which the model predicts would occur in the absence of any additional impact after 35 years. This is a relative reduction in population size (compared to that which might otherwise have arisen) and as the predicted growth rate is positive the predicted simulated population size is greater than at the start of the modelling period. This indicates that a slowing of the population growth rate, rather than a population decline, is likely as a result of cumulative collision mortality. This occurs for all scenarios including that representing the largest impact (Scenario 5).

1.4.1.6 Comparing the PVA outputs for scenario 5 and scenario 6 indicates that the inclusion of the Morgan Generation Assets in the cumulative total makes a very small difference to the PVA outputs, with the counterfactual of growth rate similar for both scenarios (0.989 and 0.990) after 35 years. Similarly, there is little difference between the predicted growth rates (1.114 and 1.115).

1.4.1.7 The conclusions reached in paragraph 1.4.1.5 remain true when considering the as-built scenarios (Scenarios 7 and 8), which show that consideration of impacts representing the as-built turbine scenarios at the Walney Extension offshore wind farm make more of a difference, albeit still minor, to the PVA outputs when compared to PVA outputs with and without the Morgan Generation Assets. For example, the median growth rate increases by 0.002, the CGR by 0.002 and CPS by 0.035 when considering the outputs of scenario 5 against scenario 7 (Table 1.9).

1.4.1.8 The trends and conclusions associated with the PVA outputs for scenarios 5, 6, 7 and 8 are also applicable to the PVA outputs associated with scenarios 1, 2, 3 and 4 albeit less extreme. The use of more recent survival data results in more realistic and representative outputs (survival data from the UK and not Germany as for the data in Horswill and Robinson (2015)), for example the final population of approximately 140,000 to 150,000 individuals. The counterfactual of median population growth is higher at 0.998 to 0.999, depending on the scenario considered with the inclusion of the Morgan Generation Assets making no noticeable difference to that metric. The models again predict a positive population growth rate meaning that although the population after 35 years will be lower than under a no impact scenario, the population is higher than that at the onset of impacts.

1.4.1.9 It should be noted that there are a number of uncertainties associated with the PVA modelling, these include:

- Over-estimation of cumulative impacts. The PVA modelling does not account for changes in the predicted cumulative impacts due to the decommissioning of projects considered cumulatively over the lifetime of the Morgan Generation Assets. The PVA metrics are therefore precautionary. Whilst there is potential for future projects to contribute to the cumulative impact predicted in Table 1.3, as many are yet to enter the planning system there is some uncertainty that remains in relation to whether these projects will come forward.
- No consideration has been made for density dependent compensation of demographic parameters within the modelled population, nor immigration, both of which could reduce the magnitude of any population change.

1.4.1.10 Whilst the conservation status and population trends of great black-backed gull in a UK context are not favourable, the results of the PVA, as presented in Table 1.9, indicate that these are unlikely to be exacerbated by the predicted cumulative impact under all scenarios. Further to this, the contribution of the Morgan Generation Assets makes a very small difference to the PVA outputs under all scenarios. This is driven by the Applicant's commitment to an increased air gap which has served to significantly reduce the contribution of the Morgan Generation Assets to the cumulative totals estimated in section 1.3.

1.4.1.11 The Applicant considers that impact scenarios 1 to 4 provide a more accurate representation of the cumulative impact on the regional population of great black-backed gull for the following reasons:

- It is considered that an avoidance rate of 99.91% is more representative of the avoidance behaviour of great black-backed gull when compared to the grouped avoidance rate based on the information presented in Ozsanlav-Harris *et al.* (2023) (see Volume 4, Annex 5.3: Offshore Ornithology Collision Risk Modelling Technical Report (APP-055)).
- It is considered that the flight speed information provided by Skov *et al.* (2018) provides a far more robust appraisal of great black-backed gull flight behaviour than any other source of flight height data (see Volume 4, Annex 5.3: Offshore Ornithology Collision Risk Modelling Technical Report (APP-055)).

1.4.1.12 In addition, all of the scenarios presented are over-estimates to varying extents due to the use of assessed turbine scenarios for nearly all projects. As-built turbine scenarios are associated with lower collision risk estimates due to the use of either larger turbines and/or fewer turbines.

1.4.1.13 The impacts predicted under scenarios 5 to 8 indicate that the predicted impacts will not exacerbate the underlying reasons for the observed trends in the population of great black-backed gull and as a result the conservation status conferred upon the species. The PVA outputs show that the contribution of the Morgan Generation Assets makes no measurable difference to the assessment outcome.

1.4.1.14 Overall, the magnitude of the cumulative impact is deemed to be low and the sensitivity of the receptor is considered to be medium. The cumulative effect will, therefore, be of minor adverse significance for all scenarios considered in this report. A conclusion that the impact is not significant is consistent with the conclusion reached in Volume 2, Chapter 5: Offshore Ornithology (APP-023).

1.5 References

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Appendix A: PVA input logs

A.1 Impact scenarios 1 to 4

A.1.1 Set up

The log file was created on: 2025-01-15 09:50:00 using Tool version 2, with R version 3.5.1, PVA package version: 4.18 (with UI version 1.7)

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

A.1.2 Basic information

This run had reference name “GBBG_Regional_Cumulative_App”.
PVA model run type: simplescenarios.
Model to use for environmental stochasticity: betagamma.
Model for density dependence: nodd.
Include demographic stochasticity in model?: Yes.
Number of simulations: 5000.
Random seed: 15.
Years for burn-in: 5.
Case study selected: None.

A.1.3 Baseline demographic rates

Species chosen to set initial values: Great Black-Backed Gull.
Region type to use for breeding success data: .
Available colony-specific survival rate: . Sector to use within breeding success region: .
Age at first breeding: 5.
Is there an upper constraint on productivity in the model?: Yes, constrained to 3 per pair.
Number of subpopulations: 1.
Are demographic rates applied separately to each subpopulation?: No.
Units for initial population size: all.individuals
Are baseline demographic rates specified separately for immatures?: Yes.

A.1.3.1 Population 1

Initial population values: Initial population 17742 in 2015

Productivity rate per pair: mean: 1.06052 , sd: 0.1319869

Adult survival rate: mean: 0.85 , sd: 0.111

Immatures survival rates:

Age class 0 to 1 - mean: 0.85 , sd: 0.111 , DD: NA

Age class 1 to 2 - mean: 0.85 , sd: 0.111 , DD: NA

Age class 2 to 3 - mean: 0.85 , sd: 0.111 , DD: NA

Age class 3 to 4 - mean: 0.85 , sd: 0.111 , DD: NA

Age class 4 to 5 - mean: 0.85 , sd: 0.113 , DD: NA

A.1.4 Impacts

Number of impact scenarios: 4.

Are impacts applied separately to each subpopulation?: No

Are impacts of scenarios specified separately for immatures?: No

Are standard errors of impacts available?: No

Should random seeds be matched for impact scenarios?: No

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

Years in which impacts are assumed to begin and end: 2030 to 2065

A.1.4.1 Impact on Demographic Rates

Scenario A - Name: Full_impact_Morgan

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.001410992 , se: NA

Scenario B - Name: Full_impact_noMorgan

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.001371282 , se: NA

Scenario C - Name: Asbuilt_impact_Morgan

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.001227867 , se: NA

Scenario D - Name: Asbuilt_impact_noMorgan

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.001188157 , se: NA

A.1.5 Output:

First year to include in outputs: 2030
Final year to include in outputs: 2065
How should outputs be produced, in terms of ages?: whole.population
Target population size to use in calculating impact metrics: NA
Quasi-extinction threshold to use in calculating impact metrics: NA

A.2 Impact scenarios 5 to 8

A.2.1 Set up

The log file was created on: 2025-01-10 13:20:53 using Tool version 2, with R version 3.5.1, PVA package version: 4.18 (with UI version 1.7)

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

A.2.2 Basic information

This run had reference name “GBBG_Regional_Cumulative_NE”.
PVA model run type: simplescenarios.
Model to use for environmental stochasticity: betagamma.
Model for density dependence: nodd.
Include demographic stochasticity in model?: Yes.
Number of simulations: 5000.
Random seed: 15.
Years for burn-in: 5.
Case study selected: None.

A.2.3 Baseline demographic rates

Species chosen to set initial values: Great Black-Backed Gull.
Region type to use for breeding success data: .
Available colony-specific survival rate: National. Sector to use within breeding success region: .
Age at first breeding: 5.
Is there an upper constraint on productivity in the model?: Yes, constrained to 3 per pair.
Number of subpopulations: 1.
Are demographic rates applied separately to each subpopulation?: No.
Units for initial population size: all.individuals
Are baseline demographic rates specified separately for immatures?: Yes.

A.2.3.1 Population 1

Initial population values: Initial population 17742 in 2015

Productivity rate per pair: mean: 1.06052 , sd: 0.1319869

Adult survival rate: mean: 0.93 , sd: 1e-06

Immatures survival rates:

Age class 0 to 1 - mean: 0.798 , sd: 0.092 , DD: NA

Age class 1 to 2 - mean: 0.93 , sd: 1e-06 , DD: NA

Age class 2 to 3 - mean: 0.93 , sd: 1e-06 , DD: NA

Age class 3 to 4 - mean: 0.93 , sd: 1e-06 , DD: NA

Age class 4 to 5 - mean: 0.93 , sd: 1e-06 , DD: NA

A.2.4 Impacts

Number of impact scenarios: 4.

Are impacts applied separately to each subpopulation?: No

Are impacts of scenarios specified separately for immatures?: No

Are standard errors of impacts available?: No

Should random seeds be matched for impact scenarios?: No

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

Years in which impacts are assumed to begin and end: 2030 to 2065

A.2.4.1 Impact on Demographic Rates

Scenario A - Name: Full_impact_Morgan

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.009615541 , se: NA

Scenario B - Name: Full_impact_noMorgan

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.009294246 , se: NA

Scenario C - Name: Asbuilt_impact_Morgan

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.008374362 , se: NA

Scenario D - Name: Asbuilt_impact_noMorgan

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.008053067 , se: NA

A.2.5 Output:

First year to include in outputs: 2030
Final year to include in outputs: 2065

How should outputs be produced, in terms of ages?: whole.population
Target population size to use in calculating impact metrics: NA
Quasi-extinction threshold to use in calculating impact metrics: NA