WHITE CROSS

White Cross Offshore Wind Farm ES Addendum

Appendix Q: Ornithology Assessment

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1. Appendix Q: Ornithology Assessment

1.1 Structure of this document

1. This document contains the following ornithological reports provided in order to address consultee comments on the White Cross Offshore Windfarm Project:

- **Appendix Q Annex 1: Population Viability Analysis** (WHX001-FLO-CON-ENV-ASS-0004)
- **Appendix Q Annex 2: Updates to Habitats Regulations Assessments for Gannet excluding apportionment accounting for sabbatical rates** (WHX001-FLO-CON-CAG-ASS-0001)
- **Appendix Q Annex 3: Cumulative and In-combination Gap Analysis** (WHX001-FLO-CON-ENV-ASS-0003).

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White Cross Offshore Wind Farm ES Addendum

Appendix Q Annex 1: Population Viability Analysis (WHX001-FLO-CON-ENV-ASS-0004)

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Glossary of Acronyms

Acronym	Definition
AEoI	Adverse Effect on Integrity
EIA	Environmental Impact Assessment
ES	Environmental Statement
FLOW	Floating Offshore Windfarm
JNCC	Joint Nature Conservancy Council
OWF	Offshore Windfarm
PVA	Population Viability Analysis
WCOWL	Offshore Wind Ltd
WTG	Wind Turbine Generator

Glossary of Terminology

Defined Term	Description
Applicant	White Cross Offshore Wind Limited
Cumulative effects	The effect of the Project taken together with similar effects from a number of different projects, on the same single receptor/resource. Cumulative Effects are those that result from changes caused by other past, present or reasonably foreseeable actions together with the Project.
Environmental Impact Assessment (EIA)	Assessment of the potential impact of the proposed Project on the physical, biological and human environment during construction, operation and decommissioning.
Offshore Development Area	The Windfarm Site (including wind turbine generators, substructures, mooring lines, seabed anchors, inter-array cables and Offshore Substation Platform (as applicable)) and Offshore Export Cable Corridor to MHWS at the Landfall. This encompasses the part of the project that is the focus of this application and Environmental Statement and the parts of the project consented under Section 36 of the Electricity Act and the Marine and Coastal Access Act 2009
the Offshore Project	The Offshore Project for the offshore Section 36 and Marine Licence application includes all elements offshore of MHWS. This includes the infrastructure within the windfarm site (e.g. wind turbine generators, substructures, mooring lines, seabed anchors, inter-array cables and Offshore Substation Platform (as applicable)) and all infrastructure associated with the export cable route and landfall (up to MHWS) including the cables and associated cable protection (if required).
Offshore Wind Limited	Offshore Wind Ltd (OWL) is a joint venture between Cobra Instalaciones Servicios, S.A., and Flotation Energy Ltd
the Project	the Project is a proposed floating offshore windfarm called White Cross located in the Celtic Sea with a capacity of up to 100MW. It encompasses the project as a whole, i.e. all onshore and offshore infrastructure and activities associated with the Project.

Defined Term	Description
White Cross Offshore Windfarm	100MW capacity offshore windfarm including associated onshore and offshore infrastructure
Wind Turbine Generators (WTG)	The wind turbine generators convert wind energy into electrical power. Key components include the rotor blades, nacelle (housing for electrical generator and other electrical and control equipment) and tower. The final selection of project wind turbine model will be made post-consent application
Windfarm Site	The area within which the wind turbines, Offshore Substation Platform and inter-array cables will be present

1. Introduction

1.1 Purpose of this report

1. White Cross Offshore Wind Limited (WCOWL) ('the Applicant') requested APEM Ltd (APEM) to conduct Population Viability Analysis (PVA) following the updated cumulative assessments for the White Cross Offshore Windfarm Project (hereafter referred to as 'the Project'). This report has been produced for the purpose of describing the methods and presenting the results of PVA run for selected species requiring further assessment.

1.2 Background

2. The Windfarm Site is located in the Celtic Sea, approximately 52km off the North Cornwall and North Devon coast (west-north-west of Hartland Point). The Windfarm Site covers approximately 50km^2. Details of the location of the Project and the offshore elements (including the Wind Turbine Generator (WTG) layout, overall Offshore Project operational footprint, Windfarm Site layout, inter-array cables and associated protection, and the spatial footprints of the construction or decommissioning works) are set out within **Chapter 5: Project Description** of the **Offshore Project Environmental Statement (ES)**.

3. Following the submission of **Chapter 13: Offshore Ornithology the Offshore ES**, Natural England provided advice and recommendations for the application following a review (Natural England, 2023a). A key concern highlighted by Natural England was as follows:

4. *"cumulative and in-combination assessments do not factor in impacts from a number of other projects due to lack of data. Impacts specified as 'unknown' have been treated as zero which will inevitably underestimate impacts, potentially significantly."*

5. Following this request, a gap analysis was conducted in order to provide an estimate of the potential impacts posed by these historic projects (**Appendix Q Annex 3: Cumulative and In-combination Gap Analysis Report** of the **ES Addendum** (WHX001-FLO-CON-ENV-ASS-0003)). Updated cumulative effects assessments of displacement were calculated for:

- Guillemot (*Uria aalge*)
- Razorbill (*Alca torda*)
- Puffin (*Fratercula arctica*)
- Manx shearwater (*Puffinus puffinus*)
- Gannet (*Morus bassanus*).

6. Updated cumulative effects assessments of collision risk were calculated for:

- Kittiwake (*Rissa tridactyla*)
- Great black-backed gull (*Larus marinus*)
- Herring gull (*Larus argentatus*)
- Lesser black-backed gull (*Larus fuscus*)
- Gannet (*Morus bassanus*).

7. Updates to the cumulative assessments, as requested by Natural England, resulted in a change in the cumulative impact totals from those submitted in the **Chapter 13: Offshore Ornithology** of the **Offshore ES**. The species for which the cumulative assessment exceeded the 1% threshold, and so triggered the need for PVA, include:

- Guillemot
- Razorbill
- Great black-backed gull.

8. These three species were selected for further assessment due to the predicted impacts at a cumulative scale exceeding a 1% increase relative to the baseline mortality rate at the BDMPS scale, with a 1% increase being the level which has been regarded as the threshold for undertaking further assessments such as PVA.

1.3 Population Viability Analysis

9. Renewable energy projects in the marine environment, such as Offshore Windfarms (OWFs), have the potential to impact on seabirds through a number of processes such as collision with turbine blades resulting in mortality, or displacement from an area due to the presence of wind turbine generators (WTGs). These processes affect individuals and have the potential to elevate the baseline mortality of a population or its productivity. The Environmental Impact Assessment (EIA) process provides the assessment of such potential effects as a consequence of OWFs at varying population scales.

10. The population-level consequences from estimated mortalities (such as those from collision risk and displacement) need to be considered for seabirds. One method to estimate the effect that development-alone or cumulatively (when the project alone effects are considered alongside any effects from nearby projects on the same receptor) may have on a population is through PVA. PVA provides a robust framework using impacts on demographic parameters to predict changes in the population, using statistical population models to forecast future changes over a set period. Comparisons are made between 'baseline',

unimpacted populations and under 'scenario' conditions where an impact is applied to a population by the alteration of demographic parameters.

11. PVA was undertaken using the Seabird PVA Tool developed by Natural England (Searle et al., 2019). The Seabird PVA Tool was accessed via the 'Shiny App' interface, which is a user-friendly graphical user interface accessible via a standard web-browser that uses the nepva R package to perform the modelling and analysis. The advantages of using an online platform for modelling and analysis purposes are that users are not required to use any R code, users are not required to install or maintain R, and updates to the model are made directly to the server. The tool is capable of assessing any type of impact in terms of change to demographic parameters, or as a cull or harvest of a fixed size per year (Searle et al., 2019).

1.4 Methodology

1.5 Modelling approach

12. All PVA models were undertaken using the 'Simulation' run type, which is used to simulate population trajectories based on the specified demographic parameters, initial population sizes and scenarios the user inputs into the model.

13. The Seabird PVA Tool uses a Leslie matrix to construct a PVA model (Caswell, 2000) based on the parameters provided by the user. Users can specify whether they wish the model to include demographic stochasticity, environmental stochasticity, density dependence, density independence or whether they want the model to run an entirely deterministic model.

14. A deterministic model translates the demographic parameters provided into point estimates with no confidence values due to no variability (i.e., standard deviation/error) in parameter values. Due to the lack of variability (stochasticity), a deterministic model will produce the same result every time the simulation is run. In situations where little is known about how the population size has varied, or how the scale of impact may vary, running a deterministic model might provide a more candid assessment of the population and how it may be impacted.

15. A stochastic model produces probabilistic outputs to account for the impact of environmental and demographic stochasticity. Environmental stochasticity describes the effects random variation in factors such as weather can have on a population and is modelled by the incorporation of randomly generated values for the probability of survival from one-time step to the next. Demographic stochasticity refers to the effect of random variation in population structure on demographic rates and is modelled by generating random numbers of surviving individuals for any given survival probability. Demographic stochasticity can

usually be ignored for populations greater than 100 individuals, however including demographic stochasticity will not cause any penalty when simulating larger populations (WWT Consulting, 2012).

16. All PVA modelling in this report was undertaken with environmental and demographic stochasticity. To ensure robust results, all simulations were set to run 5,000 times. All models were run for a 35-year time span (2027 to 2062), representing the likely lifespan of the Project.

17. The Seabird PVA tool is able to utilise a "burn-in" parameter. The use of "burn-in" allows the model to run for a set number of years which are removed from the outputs. These dropped modelled years are likely more variable in their estimates of population numbers due to potential initial population structure instability (i.e., an imbalance of immature-matures). After several years, the modelled structure will become stable and it’s at this point where it is appropriate to take outputs from, informed by the internal model parameterisation developed during the burn-in period. The burn-in parameter value used for each species followed the guidance of 10 years.

18. Demographic processes such as growth, survival, productivity and recruitment are density-dependent, as their rates change in relation to the number of individuals in a population. Density dependence can be described as being either compensatory or depensatory (Begon et al., 2005). Compensation is characterised by demographic changes that cause a stabilising effect on a populations long-term average. Depensation acts to further decrease the rate of population growth in declining populations and can delay the rate of recovery. This is typically exhibited in populations that have been significantly depleted in size and is caused by a reduction in the benefits associated with conspecific presence.

19. Density dependence is self-evident in the natural environment, as without density dependence, populations would grow exponentially. For seabird populations, the mechanisms as to how this operates are largely uncertain and highly variable between species and regions. If density dependence is mis-specified in an assessment, the modelled predictions may be unreliable. Therefore, it is more typical to use density independent models for seabird assessments, despite the lack of biologically realistic density dependence. As such, density independent models lack any means by which a population can recover once it has been reduced beyond a certain point, they are therefore appropriate for impact assessment purposes on the grounds of precaution (i.e., another source of precaution in the assessment process) (Ridge et al. 2019).

1.6 Demographic rates

20. The Shiny App offers the users the choice of using pre-set demographic parameters or the ability to enter custom values. The pre-set demographic values are available for a total of 15 different species. The values are derived from previously reported national or colony specific demographic parameters sourced from the Joint Nature Conservation Committee (JNCC) Seabird Monitoring Programme (SMP, 2024), divided into eight regional classifications (further information on the eight regional classifications can be found in Mobbs et al., (2020) for breeding success data or Horswill and Robinson, (2015) for survival rate. **Table 1** summarises the species-specific values selected for the two species that are the focus of this report.

21. After reviewing the pre-formulated productivity rates within the tool for the eight regional classifications, due to the age of the data (productivity data spanning over 50 years in some instances) feeding into the productivity rates, none of the pre-formulated values for productivity were representative of the populations assessed within this report. The national productivity values presented within Horswill and Robinson (2015) were instead used for assessment, due to providing a more representative productivity rate of the populations assessed.

22. Natural England and Natural Resource Wales have provided updated interim advice on the reference populations and demographic rates that should be used at EIA level assessments (SNCBs, 2024). For all three species undergoing PVA, the initial population size inputted into all PVAs for the UK Western Waters BDMPS were taken from the updated guidance that provides values based on Furness (2015).

23. The survival rate for guillemot was kept as the national value presented within the tool, which matches the mean estimate presented in Horswill and Robinson (2015). The survival rate for razorbill was based on updated guidance (SNCBs, 2024).

24. The survival rates for great black-backed gull presented in Horswill and Robinson (2015) are limited and are based on a relatively old study by Glutz von Blotzheim & Bauer (1982). Due to the limited amount of data available for great black-backed gull, Horswill and Robinson (2015) recommended using the survival rates of other large gull species when conducting population modelling for great black-backed gull. Therefore, the survival rates for great black-backed gull used for the PVA are based on adult and juvenile rates for herring gull as presented in Horswill & Robinson (2015).

25. For age at first breeding and maximum brood size per pair parameters, the pre-formulated values within the tool were used.

Table 1 BDMPS population demographic parameters selected for guillemot, razorbill and great black-backed gull

Species	Productivity rate + SD**	BDMPS population size (all individuals)*	Mean adult survival rate + SD**	Mean immature age class 0 – 1 survival rate + SD	Mean immature age class 1 – 2 survival rate + SD	Mean immature age class 2 – 3 survival rate + SD	Mean immature age class 3 – 4 survival rate + SD	Mean immature age class 4 – 5 survival rate + SD	Mean immature age class 5 – 6 survival rate + SD
Guillemot	0.672 ± 0.147	1,145,528	0.939 ± 0.015	0.56 ± 0.0001	0.792 ± 0.0001	0.917 ± 0.0001	0.917 ± 0.0001	0.939 ± 0.015	0.939 ± 0.015
Razorbill	0.570 ± 0.247	606,915	0.895 ± 0.067	0.794 ± 0.0001*	0.794 ± 0.0001*	0.895 ± 0.067	0.895 ± 0.067	0.895 ± 0.067	0.895 ± 0.067
Great black-backed gull	1.139 ± 0.533	17,742	0.834 ± 0.034	0.798 ± 0.092	0.834 ± 0.034	0.834 ± 0.034	0.834 ± 0.034	0.834 ± 0.034	0.834 ± 0.034

Table note: *Values taken from SNCB (2024); **Values taken from Horswill & Robinson (2015). All immature survival rates apart from those marked with a * are taken from Horswill & Robinson (2015).

1.7 Impact values assessed

26. PVA was undertaken following cumulative assessments considering all consented and planned projects within the Western Waters BDMPS. PVA analysis for all three species was run using the following totals:

- Total consented excluding White Cross
- Total consented including White Cross
- All projects (consented and planned) excluding White Cross
- All projects (consented and planned) including White Cross

27. For guillemot and razorbill five different approaches were taken for the PVA as follows:

- Natural England's lower level of predicted impact using 30% Displacement and 1% Mortality
- Applicant's upper level of predicted impact using 50% Displacement and 1% Mortality
- Secretary of State's upper level of predicted impact using 70% Displacement and 2% Mortality
- Natural England's upper level of predicted impact using 70% Displacement and 5% Mortality
- Natural England's maximum level of predicted impact using 70% Displacement and 10% Mortality.

28. All cumulative impact values, including the aforementioned scenarios, are found in **Appendix Q Annex 3: Cumulative and In-combination Gap Analysis Report** of the **ES Addendum** (WHX001-FLO-CON-ENV-ASS-0003).

2. Results

29. The outputs of the Seabird PVA Tool are set out in **Table 2** - **Table 4** below for the three species requiring PVA. The metrics used to summarise the PVA results are based on the median of the ratio of impacted to unimpacted counterfactual of population growth rate and the median counterfactual of population size.

30. Although both the counterfactual of population size and population growth rate are presented within this report, the Project considers that only the counterfactual of population growth rate should be used for interpreting the predicted impacts. This is because the counterfactual of population growth rate can be compared against known population trends and is relatively insensitive to the baseline rate of growth and direction. Whereas, the counterfactual of population size will predict very large differences in comparison to the baseline population size, especially when density dependent factors allowing for population recovery of preventing exponential growth are not considered within the PVA, as is the case with these assessments.

Table 2 PVA results using Seabird PVA Tool for cumulative displacement impacts on guillemots in the UK Western Waters BDMPS

Projects	Scenario	Increase in mortality	Density independent counterfactual metric (after 35 years)		Predicted reduction in growth rate per annum	Predicted reduction in population size after 35 years
			Growth rate	Population size		
Consented including White Cross	30% disp, 1% mort	233.5	1.000 (<0.001)	0.992 (0.002)	0.0%	0.8%
	50% disp, 1% mort	358.5	1.000 (<0.001)	0.987 (0.002)	0.0%	1.3%
	70% disp, 2% mort	920.8	0.999 (<0.001)	0.968 (0.002)	0.1%	3.2%
	70% disp, 5% mort	2,232.9	0.998 (<0.001)	0.924 (0.002)	0.2%	7.6%
	70% disp, 10% mort	4,419.6	0.996 (<0.001)	0.855 (0.002)	0.4%	14.5%
Consented excluding White Cross	30% disp, 1% mort	220.4	1.000 (<0.001)	0.992 (0.002)	0.0%	0.8%
	50% disp, 1% mort	336.7	1.000 (<0.001)	0.988 (0.002)	0.0%	1.2%
	70% disp, 2% mort	859.7	0.999 (<0.001)	0.970 (0.002)	0.1%	3.0%
	70% disp, 5% mort	2,080.2	0.998 (<0.001)	0.929 (0.002)	0.2%	7.1%
	70% disp, 10% mort	4,114.2	0.996 (<0.001)	0.864 (0.002)	0.4%	13.6%
All Projects including White Cross	30% disp, 1% mort	346.9	1.000 (<0.001)	0.988 (0.002)	0.0%	1.2%
	50% disp, 1% mort	547.5	0.999 (<0.001)	0.981 (0.002)	0.1%	1.9%
	70% disp, 2% mort	1,450.1	0.999 (<0.001)	0.950 (0.002)	0.1%	5.0%

Projects	Scenario	Increase in mortality	Density independent counterfactual metric (after 35 years)		Predicted reduction in growth rate per annum	Predicted reduction in population size after 35 years
			Growth rate	Population size		
	70% disp, 5% mort	3,556	0.997 (<0.001)	0.882 (0.002)	0.3%	11.8%
	70% disp, 10% mort	7,065.8	0.993 (<0.001)	0.778 (0.002)	0.7%	22.2%
All Projects Excluding White Cross	30% disp, 1% mort	233.9	1.000 (<0.001)	0.992 (0.002)	0.0%	0.8%
	50% disp, 1% mort	525.7	0.999 (<0.001)	0.982 (0.002)	0.1%	1.8%
	70% disp, 2% mort	1,389	0.999 (<0.001)	0.952 (0.002)	0.1%	4.8%
	70% disp, 5% mort	3,403.3	0.997 (<0.001)	0.886 (0.002)	0.3%	11.4%
	70% disp, 10% mort	6,760.4	0.993 (<0.001)	0.787 (0.002)	0.7%	21.3%

Table 3 PVA results using Seabird PVA Tool for cumulative displacement impacts on razorbills in the UK Western Waters BDMPS

Projects	Scenario	Increase in mortality	Density independent counterfactual metric (after 35 years)		Predicted reduction in growth rate per annum	Predicted reduction in population size after 35 years
			Growth rate	Population size		
Consented including White Cross	30% disp, 1% mort	108.1	1.000 (<0.001)	0.993 (0.004)	0.0%	0.7%
	50% disp, 1% mort	164.6	1.000 (<0.001)	0.989 (0.004)	0.0%	1.1%
	70% disp, 2% mort	418.7	0.999 (<0.001)	0.972 (0.004)	0.1%	2.8%

Projects	Scenario	Increase in mortality	Density independent counterfactual metric (after 35 years)		Predicted reduction in growth rate per annum	Predicted reduction in population size after 35 years
			Growth rate	Population size		
	70% disp, 5% mort	1,011.8	0.998 (<0.001)	0.933 (0.004)	0.2%	6.7%
	70% disp, 10% mort	2,000.1	0.996 (<0.001)	0.873 (0.004)	0.4%	12.7%
Consented excluding White Cross	30% disp, 1% mort	105.8	1.000 (<0.001)	0.993 (0.004)	0.0%	0.7%
	50% disp, 1% mort	160.7	1.000 (<0.001)	0.989 (0.004)	0.0%	1.1%
	70% disp, 2% mort	407.7	0.999 (<0.001)	0.973 (0.004)	0.1%	2.7%
	70% disp, 5% mort	984.3	0.998 (<0.001)	0.935 (0.004)	0.2%	6.5%
	70% disp, 10% mort	1,945.1	0.996 (<0.001)	0.876 (0.004)	0.4%	12.4%
All Projects including White Cross	30% disp, 1% mort	123.8	1.000 (<0.001)	0.992 (0.004)	0.0%	0.8%
	50% disp, 1% mort	190.8	1.000 (<0.001)	0.987 (0.004)	0.0%	1.3%
	70% disp, 2% mort	492.1	0.999 (<0.001)	0.967 (0.004)	0.1%	3.3%
	70% disp, 5% mort	1,195	0.998 (<0.001)	0.922 (0.004)	0.2%	7.8%
	70% disp, 10% mort	2,366.7	0.996 (<0.001)	0.851 (0.004)	0.4%	14.9%
All Projects Excluding	30% disp, 1% mort	121.5	1.000 (<0.001)	0.992 (0.004)	0.0%	0.8%
	50% disp, 1% mort	186.8	1.000 (<0.001)	0.987 (0.004)	0.0%	1.3%

Projects	Scenario	Increase in mortality	Density independent counterfactual metric (after 35 years)		Predicted reduction in growth rate per annum	Predicted reduction in population size after 35 years
			Growth rate	Population size		
White Cross	70% disp, 2% mort	481.1	0.999 (<0.001)	0.968 (0.004)	0.1%	3.2%
	70% disp, 5% mort	1,167.5	0.998 (<0.001)	0.924 (0.004)	0.2%	7.6%
	70% disp, 10% mort	2,311.6	0.996 (<0.001)	0.855 (0.004)	0.4%	14.5%

Table 4 PVA results using Seabird PVA Tool for cumulative displacement impacts on great black-backed gulls in the UK Southwest channel BDMPS

Projects	Increase in mortality	Density independent counterfactual metric (after 35 years)	Reduction in growth rate	Predicted reduction in growth rate per annum	Predicted reduction in population size after 35 years
		Growth rate	Population size		
Consented including White Cross	155.1	0.990 (0.001)	0.684 (0.020)	1.0%	31.6%
Consented excluding White Cross	153.8	0.989 (0.001)	0.684 (0.020)	1.1%	31.6%
All Projects including White Cross	183.6	0.988 (0.001)	0.638 (0.019)	1.2%	36.2%
All Projects excluding White Cross	182.3	0.988 (0.001)	0.638 (0.018)	1.2%	36.2%

3. Assessment conclusions

3.1 Guillemot

31. The maximum predicted impact is seen when the cumulative assessment considers all projects following the 70% Displacement and 10% Mortality of Natural England's preferred approach. This cumulative PVA predicts a potential 22.2% reduction in population size after 35 years, with a decrease in growth rate of 0.7% per annum in contrast to the unimpacted baseline scenario. However, as evidenced from the actual behavioural responses recorded for a significant number of post-construction monitoring studies of operational OWFs, such a level of potential effect can be concluded as overly precautionary (MacArthur Green, 2024 & APEM, 2022).

32. The Applicant considers the more realistic scenario following the Applicant's Approach upper-level estimate (50% displacement, 1% mortality), which predicts a maximum potential for all modelled scenarios of 1.9% reduction in population size after 35 years in contrast to the unimpacted baseline scenario, with a reduction in growth rate of 0.1% per annum to be most appropriate for concluding assessments. When considering the high degree of natural variability in the UK guillemot population presented in **Table 5**, such a level of cumulative effect would almost certainly be indistinguishable from natural fluctuations in the population, therefore the level of impact predicted can confidently concluded as not significant in EIA terms.

33. Regardless of which assessment approach is taken, **Table 2** clearly shows that the Project provides a non-tangible contribution to the level of cumulative displacement impact predicted for guillemots in the Western Waters BDMPS annually. Combining the variability in the historic UK population counts for guillemots and the Project's non-tangible contribution, it is not expected that the inclusion of the Project would lead to a material change in cumulative assessment predictions, nor lead to any scenario which would significantly affect the predicted population trend.

Table 5 Historic census counts for breeding guillemots in the UK (Burnell et al, 2023)

	Operation Seafarer (1969-1970)	Seabird Colony Register (1985-1988)	Seabird 2000 (1998-2002)	Seabirds Count (2015-2021)
Guillemot breeding numbers (individuals)	599,843	1,081,341	1,426,282	1,265,888
% change since previous census	N/A	+80%	+32%	-11%

3.2 Razorbill

34. The maximum predicted impact is seen when the cumulative assessment considers all projects following the 70% Displacement and 10% Mortality of Natural England's preferred approach. This cumulative PVA predicts a potential 14.9% reduction in population size after 35 years, with a decrease in growth rate of 0.4% per annum in contrast to the unimpacted baseline scenario. However, as evidenced from the actual behavioural responses recorded for a significant number of post-construction monitoring studies of operational OWFs, such a level of potential effect can be concluded as overly precautionary (MacArthur Green. 2024 & APEM, 2022).

35. The Applicant considers the more realistic scenario following the Applicant's Approach upper level estimate (50% displacement, 1% mortality), which predicts a maximum potential for all modelled scenarios of 1.3% reduction in population size after 35 years in contrast to the unimpacted baseline scenario, with a reduction in growth rate of 0.0% per annum to be most appropriate for concluding assessments. When considering the strong positive growth rate of UK razorbills presented within **Table 6**, such a level of cumulative effect would almost certainly be indistinguishable from natural fluctuations in the population, therefore the level of impact predicted can confidently concluded as not significant in EIA terms.

36. Regardless of which assessment approach is taken, **Table 3** clearly shows that the Project provides a non-tangible contribution to the level of cumulative displacement impact predicted for guillemots in the Western Waters BDMPS annually. Combining the variability in the historic UK population counts for guillemots and the Project's non-tangible contribution, it is not expected that the inclusion of the Project would lead to a material change in cumulative assessment predictions, nor lead to any scenario which would significantly affect the predicted population trend.

Table 6 Historic census counts for breeding razorbills in the UK (Burnell et al, 2023)

	Operation Seafarer (1969-1970)	Seabird Colony Register (1985-1988)	Seabird 2000 (1998-2002)	Seabirds Count (2015-2021)
Razorbill breeding numbers (individuals)	130,972	154,219	190,397	225,015
% change since previous census	N/A	+18%	+23	+18%

3.3 Great black-backed gull

37. The maximum predicted impact is seen when the cumulative assessment considers all projects. This cumulative PVA predicts a potential 36.2% reduction in population size after 35 years, with a decrease in growth rate of 1.2% in contrast to the unimpacted baseline scenario. At the UK South-west and Channel BDMPS population scale, this level of potential impact is considered to be of minor magnitude on an annual cumulative basis, as it represents a reduction in growth rate of only 1.2% per annum.

38. Great black-backed gulls in the UK have seen a decline in recent years (Burnell et al, 2023) (**Table 7**), though this is predominately skewed by the significant decline noted within the Scottish population (63% in the last 15- 20 years; Burnell etal., 2023) which makes up the majority of the UK population. Historic counts indicated high populations of the species, with birds taking advantage of waste treatment sites and fish discards to forage food, which is suggested as being a possible cause of the great black-backed gull population seeing significant expansion in the early 20th century (Burnell et al, 2023). With the change in industry standards for these two practices, the availability of easy food sources has reduced, and thus leading to the declines observed in the great black-backed gull populations within the UK (Burnell et al, 2023). However, it has been suggested that rather than the great black-backed gull population being in decline, it is likely stabilising to 'normal' levels with the absence of the human mediated food source (Burnell et al, 2023). Although not at the same rate as other large gull species such as herring gull (Larus argentatus) and lesser black-backed gull (Larus fuscus), great black-backed gulls do appear to be shifting to nesting in urban environments which may aid in explanation of some declines seen in natural populations (Calladine et al, 2006; Burnell et al, 2023).

39. In contrast to the UK population trend, the Southwest and Channel BDMPs region is expected to be stable to favourable condition given the recent positive regional growth trends for Wales (49% increase in the last 15- 20 years), Northern Ireland (507% increase in the last 15- 20 years) and republic of Ireland (28% increase in the last 15- 20 years) combined with the overall stable population trend for England (3& decrease in the last 15- 20 years) (Burnell et al., 2023). It is expected that a worst-case annual growth rate reduction of 1.2% would be would almost certainly be indistinguishable from natural fluctuations in the population, therefore the level of impact predicted can confidently concluded as not significant in EIA terms.

40. Furthermore, as clearly presented within **Table 4**, the Project provides a non-tangible contribution to the predicted annual cumulative collision impacts for great black-backed gulls in the UK Southwest and Channel BDMPS. Combining the favourable growth trend for the UK Southwest and Channel BDMPS and the Project's non-tangible contribution, it is not expected that the inclusion of the

Project would lead to a material change in cumulative assessment predictions, nor lead to any scenario which would significantly affect the predicted population trend.

Table 7 Historic census counts for breeding great black-backed gulls in the UK (Burnell et al, 2023)

	Operation Seafarer (1969-1970)	Seabird Colony Register (1985-1988)	Seabird 2000 (1998-2002)	Seabirds Count (2015-2021)
Great black-backed gull breeding numbers (Apparently Occupied Nests)	18,771	17,415	16,814	8,021
% change since previous census	N/A	-7%	-3%	-52%

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Appendix 1: Seabird PVA Tool input log

Guillemot (White Cross plus Consented) parameter log

Set up

The log file was created on: 2024-04-30 11:52:45 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"
```

Basic information

This run had reference name "GU White Cross plus Consented".

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: 1234.

Years for burn-in: 10.

Case study selected: None.

Baseline demographic rates

Species chosen to set initial values: Common Guillemot.

Region type to use for breeding success data: Global.

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

Age at first breeding: 6.

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

Number of subpopulations: 1.

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

Units for initial population size: all.individuals

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

Population 1

Initial population values: Initial population 1145528 in 2015

Productivity rate per pair: mean: 0.672 , sd: 0.147

Adult survival rate: mean: 0.939 , sd: 0.015

Immatures survival rates:

Age class 0 to 1 - mean: 0.56 , sd: 1e-04 , DD: NA

Age class 1 to 2 - mean: 0.792 , sd: 1e-04 , DD: NA

Age class 2 to 3 - mean: 0.917 , sd: 1e-04 , DD: NA

Age class 3 to 4 - mean: 0.917 , sd: 1e-04 , DD: NA

Age class 4 to 5 - mean: 0.939 , sd: 0.015 , DD: NA

Age class 5 to 6 - mean: 0.939 , sd: 0.015 , DD: NA

Impacts

Number of impact scenarios: 5.

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: 2027 to 2062

Impact on Demographic Rates

Scenario A - Name: 30% disp, 1% mort

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 2e-04 , se: NA

Scenario B - Name: 50% disp, 1% mort

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.00031 , se: NA

Scenario C - Name: 70% disp, 2% mort

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 8e-04 , se: NA

Scenario D - Name: 70% disp, 5% mort

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.00195 , se: NA

Scenario E - Name: 70% disp, 10% mort

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.00386 , se: NA

Output:

First year to include in outputs: 2027

Final year to include in outputs: 2062

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

Guillemot (Consented plus White Cross) parameter log

Set up

The log file was created on: 2024-04-30 13:01:05 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"
```

Basic information

This run had reference name “GU Consented without White Cross”.

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: 1234.

Years for burn-in: 10.

Case study selected: None.

Baseline demographic rates

Species chosen to set initial values: Common Guillemot.

Region type to use for breeding success data: Global.

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

Age at first breeding: 6.

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

Number of subpopulations: 1.

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

Units for initial population size: all.individuals

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

Population 1

Initial population values: Initial population 1145528 in 2015

Productivity rate per pair: mean: 0.672 , sd: 0.147

Adult survival rate: mean: 0.939 , sd: 0.015

Immatures survival rates:

Age class 0 to 1 - mean: 0.56 , sd: 1e-04 , DD: NA

Age class 1 to 2 - mean: 0.792 , sd: 1e-04 , DD: NA

Age class 2 to 3 - mean: 0.917 , sd: 1e-04 , DD: NA

Age class 3 to 4 - mean: 0.917 , sd: 1e-04 , DD: NA

Age class 4 to 5 - mean: 0.939 , sd: 0.015 , DD: NA

Age class 5 to 6 - mean: 0.939 , sd: 0.015 , DD: NA

Impacts

Number of impact scenarios: 5.

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: 2027 to 2062

Impact on Demographic Rates

Scenario A - Name: 30% disp, 1% mort

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.00019 , se: NA

Scenario B - Name: 50% disp, 1% mort

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.00029 , se: NA

Scenario C - Name: 70% disp, 2% mort

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.00075 , se: NA

Scenario D - Name: 70% disp, 5% mort

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.00182 , se: NA

Scenario E - Name: 70% disp, 10% mort

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.00359 , se: NA

Output:

First year to include in outputs: 2027

Final year to include in outputs: 2062

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

Guillemot (All Projects) parameter log

Set up

The log file was created on: 2024-04-30 13:08:16 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"

Basic information

This run had reference name “GU All Projects”.

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: 1234.

Years for burn-in: 10.

Case study selected: None.

Baseline demographic rates

Species chosen to set initial values: Common Guillemot.

Region type to use for breeding success data: Global.

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

Age at first breeding: 6.

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

Number of subpopulations: 1.

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

Units for initial population size: all.individuals

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

Population 1

Initial population values: Initial population 1145528 in 2015

Productivity rate per pair: mean: 0.672 , sd: 0.147

Adult survival rate: mean: 0.939 , sd: 0.015

Immatures survival rates:

Age class 0 to 1 - mean: 0.56 , sd: 1e-04 , DD: NA

Age class 1 to 2 - mean: 0.792 , sd: 1e-04 , DD: NA

Age class 2 to 3 - mean: 0.917 , sd: 1e-04 , DD: NA

Age class 3 to 4 - mean: 0.917 , sd: 1e-04 , DD: NA

Age class 4 to 5 - mean: 0.939 , sd: 0.015 , DD: NA

Age class 5 to 6 - mean: 0.939 , sd: 0.015 , DD: NA

Impacts

Number of impact scenarios: 5.

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: 2027 to 2062

Impact on Demographic Rates

Scenario A - Name: 30% disp, 1% mort

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 3e-04 , se: NA

Scenario B - Name: 50% disp, 1% mort

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.00048 , se: NA

Scenario C - Name: 70% disp, 2% mort

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.00127 , se: NA

Scenario D - Name: 70% disp, 5% mort

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.0031 , se: NA

Scenario E - Name: 70% disp, 10% mort

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.00617 , se: NA

Output:

First year to include in outputs: 2027

Final year to include in outputs: 2062

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

Guillemot (All Projects without White Cross) parameter log

Set up

The log file was created on: 2024-04-30 13:44:39 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"

Basic information

This run had reference name "GU All Projects without White Cross".

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: 1234.

Years for burn-in: 10.

Case study selected: None.

Baseline demographic rates

Species chosen to set initial values: Common Guillemot.

Region type to use for breeding success data: Global.

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

Age at first breeding: 6.

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

Number of subpopulations: 1.

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

Units for initial population size: all.individuals

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

Population 1

Initial population values: Initial population 1145528 in 2015

Productivity rate per pair: mean: 0.672 , sd: 0.147

Adult survival rate: mean: 0.939 , sd: 0.015

Immatures survival rates:

Age class 0 to 1 - mean: 0.56 , sd: 1e-04 , DD: NA

Age class 1 to 2 - mean: 0.792 , sd: 1e-04 , DD: NA

Age class 2 to 3 - mean: 0.917 , sd: 1e-04 , DD: NA

Age class 3 to 4 - mean: 0.917 , sd: 1e-04 , DD: NA

Age class 4 to 5 - mean: 0.939 , sd: 0.015 , DD: NA

Age class 5 to 6 - mean: 0.939 , sd: 0.015 , DD: NA

Impacts

Number of impact scenarios: 5.

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: 2027 to 2062

Impact on Demographic Rates

Scenario A - Name: 30% disp, 1% mort

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 2e-04 , se: NA

Scenario B - Name: 50% disp, 1% mort

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.00046 , se: NA

Scenario C - Name: 70% disp, 2% mort

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.00121 , se: NA

Scenario D - Name: 70% disp, 5% mort

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.00297 , se: NA

Scenario E - Name: 70% disp, 10% mort

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.0059 , se: NA

Output:

First year to include in outputs: 2027

Final year to include in outputs: 2062

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

Razorbill (White Cross plus Consented) parameter log

Set up

The log file was created on: 2024-04-30 14:11:18 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"
```

Basic information

This run had reference name "RA White Cross plus Consented".

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: 1234.

Years for burn-in: 10.

Case study selected: None.

Baseline demographic rates

Species chosen to set initial values: Razorbill.

Region type to use for breeding success data: Global.

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

Age at first breeding: 5.

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

Number of subpopulations: 1.

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

Units for initial population size: all.individuals

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

Population 1

Initial population values: Initial population 606915 in 2015

Productivity rate per pair: mean: 0.57 , sd: 0.247

Adult survival rate: mean: 0.895 , sd: 0.067

Immatures survival rates:

Age class 0 to 1 - mean: 0.794 , sd: 1e-04 , DD: NA

Age class 1 to 2 - mean: 0.794 , sd: 1e-04 , DD: NA

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

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

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

Impacts

Number of impact scenarios: 5.

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: 2027 to 2062

Impact on Demographic Rates

Scenario A - Name: 30% disp, 1% mort

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.00018 , se: NA

Scenario B - Name: 50% disp, 1% mort

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.00027 , se: NA

Scenario C - Name: 70% disp, 2% mort

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.00069 , se: NA

Scenario D - Name: 70% disp, 5% mort

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.00167 , se: NA

Scenario E - Name: 70% disp, 10% mort

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.0033 , se: NA

Output:

First year to include in outputs: 2027

Final year to include in outputs: 2062

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

Razorbill (Consented without White Cross) parameter log

Set up

The log file was created on: 2024-04-30 14:35:12 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"
```

Basic information

This run had reference name "RA Consented without White Cross".

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: 1234.

Years for burn-in: 10.

Case study selected: None.

Baseline demographic rates

Species chosen to set initial values: Razorbill.

Region type to use for breeding success data: Global.

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

Age at first breeding: 5.

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

Number of subpopulations: 1.

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

Units for initial population size: all.individuals

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

Population 1

Initial population values: Initial population 606915 in 2015

Productivity rate per pair: mean: 0.57 , sd: 0.247

Adult survival rate: mean: 0.895 , sd: 0.067

Immatures survival rates:

Age class 0 to 1 - mean: 0.794 , sd: 1e-04 , DD: NA

Age class 1 to 2 - mean: 0.794 , sd: 1e-04 , DD: NA

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

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

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

Impacts

Number of impact scenarios: 5.

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: 2027 to 2062

Impact on Demographic Rates

Scenario A - Name: 30% disp, 1% mort

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.00017 , se: NA

Scenario B - Name: 50% disp, 1% mort

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.00026 , se: NA

Scenario C - Name: 70% disp, 2% mort

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.00067 , se: NA

Scenario D - Name: 70% disp, 5% mort

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.00162 , se: NA

Scenario E - Name: 70% disp, 10% mort

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.0032 , se: NA

Output:

First year to include in outputs: 2027

Final year to include in outputs: 2062

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

Razorbill (All Projects) parameter log

Set up

The log file was created on: 2024-04-30 14:52:49 using Tool version 2, with R version 3.5.1, PVA package version: 4.18 (with UI version 1.7)

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

Basic information

This run had reference name "RA All Projects".

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: 1234.

Years for burn-in: 10.

Case study selected: None.

Baseline demographic rates

Species chosen to set initial values: Razorbill.

Region type to use for breeding success data: Global.

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

Age at first breeding: 5.

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

Number of subpopulations: 1.

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

Units for initial population size: all.individuals

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

Population 1

Initial population values: Initial population 606915 in 2015

Productivity rate per pair: mean: 0.57 , sd: 0.247

Adult survival rate: mean: 0.895 , sd: 0.067

Immatures survival rates:

Age class 0 to 1 - mean: 0.794 , sd: 1e-04 , DD: NA

Age class 1 to 2 - mean: 0.794 , sd: 1e-04 , DD: NA

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

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

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

Impacts

Number of impact scenarios: 5.

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: 2027 to 2062

Impact on Demographic Rates

Scenario A - Name: 30% disp, 1% mort

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 2e-04 , se: NA

Scenario B - Name: 50% disp, 1% mort

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.00031 , se: NA

Scenario C - Name: 70% disp, 2% mort

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.00081 , se: NA

Scenario D - Name: 70% disp, 5% mort

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.00197 , se: NA

Scenario E - Name: 70% disp, 10% mort

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.0039 , se: NA

Output:

First year to include in outputs: 2027

Final year to include in outputs: 2062

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

Razorbill (All Projects without White Cross) parameter log

Set up

The log file was created on: 2024-04-30 15:07:40 using Tool version 2, with R version 3.5.1, PVA package version: 4.18 (with UI version 1.7)

Package Version

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

Basic information

This run had reference name "RA All Projects without White Cross".

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: 1234.

Years for burn-in: 10.

Case study selected: None.

Baseline demographic rates

Species chosen to set initial values: Razorbill.

Region type to use for breeding success data: Global.

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

Age at first breeding: 5.

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

Number of subpopulations: 1.

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

Units for initial population size: all.individuals

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

Population 1

Initial population values: Initial population 606915 in 2015

Productivity rate per pair: mean: 0.57 , sd: 0.247

Adult survival rate: mean: 0.895 , sd: 0.067

Immatures survival rates:

Age class 0 to 1 - mean: 0.794 , sd: 1e-04 , DD: NA

Age class 1 to 2 - mean: 0.794 , sd: 1e-04 , DD: NA

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

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

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

Impacts

Number of impact scenarios: 5.

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: 2027 to 2062

Impact on Demographic Rates

Scenario A - Name: 30% disp, 1% mort

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 2e-04 , se: NA

Scenario B - Name: 50% disp, 1% mort

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.00031 , se: NA

Scenario C - Name: 70% disp, 2% mort

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.00079 , se: NA

Scenario D - Name: 70% disp, 5% mort

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.00192 , se: NA

Scenario E - Name: 70% disp, 10% mort

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.00381 , se: NA

Output:

First year to include in outputs: 2027

Final year to include in outputs: 2062

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

Great Black-backed gull (All Scenarios) parameter log

Set up

The log file was created on: 2024-04-30 15:24:46 using Tool version 2, with R version 3.5.1, PVA package version: 4.18 (with UI version 1.7)

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## shiny          "shiny"         "1.1.0"
## shinyjs        "shinyjs"       "1.0"
## shinydashboard "shinydashboard" "0.7.1"
## shinyWidgets   "shinyWidgets"   "0.4.5"
```

```
## DT            "DT"            "0.5"
## plotly        "plotly"        "4.8.0"
## rmarkdown     "rmarkdown"     "1.10"
## dplyr         "dplyr"         "0.7.6"
## tidyr         "tidyr"         "0.8.1"
```

Basic information

This run had reference name "GB All Scenarios".

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: 1234.

Years for burn-in: 10.

Case study selected: None.

Baseline demographic rates

Species chosen to set initial values: Great Black-Backed Gull.

Region type to use for breeding success data: Global.

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

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.

Population 1

Initial population values: Initial population 17742 in 2015

Productivity rate per pair: mean: 1.139 , sd: 0.533

Adult survival rate: mean: 0.834 , sd: 0.034

Immatures survival rates:

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

Age class 1 to 2 - mean: 0.834 , sd: 0.034 , DD: NA

Age class 2 to 3 - mean: 0.834 , sd: 0.034 , DD: NA

Age class 3 to 4 - mean: 0.834 , sd: 0.034 , DD: NA

Age class 4 to 5 - mean: 0.834 , sd: 0.034 , DD: NA

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: 2027 to 2062

Impact on Demographic Rates

Scenario A - Name: White Cross plus Consented

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.0087 , se: NA

Scenario B - Name: Consented without White Cross

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.0087 , se: NA

Scenario C - Name: All Projects

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.0103 , se: NA

Scenario D - Name: All Projects without White Cross

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.0103 , se: NA

Output:

First year to include in outputs: 2027

Final year to include in outputs: 2062

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

WHITE CROSS

White Cross Offshore Wind Farm ES Addendum

Appendix Q: Annex 2: Updates to Habitats Regulations Assessments for Gannet excluding apportionment accounting for sabbatical rates (WHX001-FLO-CON-CAG-ASS-0001)

Document Code:	WHX001-FLO-CON-CAG-ASS-0001	
Contractor Document Number:		
Version Number:	00	
Date:	*24/06/2024*	
Prepared by:	APEM Ltd	*Electronic Signature*
Checked by:	APEM Ltd	*Electronic Signature*
Owned by:	CB	*Electronic Signature*
Approved by Client:	MJ	*Electronic Signature*

Version Number	**Reason for Issue / Major Changes**	**Date of Change**
00	For Issue	24/06/2024

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Glossary of Acronyms

Acronym	Definition
AfL	Agreement for Lease
BEIS	Department for Business, Energy and Industrial Strategy
CEA	Cumulative Effect Assessment
DECC	Department for Energy and Climate Change
Defra	Department for Environment, Food and Rural Affairs
EIA	Environmental Impact Assessment
ES	Environmental Statement
IPC	Infrastructure Planning Commission
IPCC	Intergovernmental Panel on Climate Change
JNCC	Joint Nature Conservancy Council
MMO	Marine Management Organisation
MW	Megawatts
NE	Natural England
NF	Nocturnal Activity Factor
NPS	National Policy Statement
OWL	Offshore Wind Ltd
RIAA	Report to Inform an Appropriate Assessment
RSPB	Royal Society for the Protection of Birds
SNCB	Statutory Nature Conservation Body
SPA	Special Protection Area
SSSI	Site of Special Scientific Interest
TCE	The Crown Estate
WTG	Wind Turbine Generator

Glossary of Terminology

Defined Term	Description
Agreement for Lease	An Agreement for Lease (AfL) is a non-binding agreement between a landlord and prospective tenant to grant and/or to accept a lease in the future. The AfL only gives the option to investigate a site for potential development. There is no obligation on the developer to execute a lease if they do not wish to.
Applicant	Offshore Wind Limited
Cumulative effects	The effect of the Project taken together with similar effects from a number of different projects, on the same single receptor/resource. Cumulative Effects are those that result from changes caused by other past, present or reasonably foreseeable actions together with the Project.
Environmental Impact Assessment (EIA)	Assessment of the potential impact of the proposed Project on the physical, biological and human environment during construction, operation and decommissioning.
In-combination effects	In-combination effects are those effects that may arise from the development proposed in combination with other plans and projects proposed/consented but not yet built and operational.
Offshore Development Area	The Windfarm Site (including wind turbine generators, substructures, mooring lines, seabed anchors, inter-array cables and Offshore Substation Platform (as applicable)) and Offshore Export Cable Corridor to MHWS at the Landfall. This encompasses the part of the project that is the focus of this application and Environmental Statement and the parts of the project consented under Section 36 of the Electricity Act and the Marine and Coastal Access Act 2009
Offshore Infrastructure	All of the offshore infrastructure including wind turbine generators, substructures, mooring lines, seabed anchors, Offshore Substation Platform and all cable types (export and inter-array). This encompasses the infrastructure that is the focus of this application and Environmental Statement and the parts of the project consented under Section 36 of the Electricity Act and the Marine and Coastal Access Act 2009
the Offshore Project	The Offshore Project for the offshore Section 36 and Marine Licence application includes all elements offshore of MHWS. This includes the infrastructure within the windfarm site (e.g. wind turbine generators, substructures, mooring lines, seabed anchors, inter-array cables and Offshore Substation Platform (as applicable)) and all infrastructure associated with the export cable route and landfall (up to MHWS) including the cables and associated cable protection (if required).
Offshore Wind Limited	Offshore Wind Ltd (OWL) is a joint venture between Cobra Instalaciones Servicios, S.A., and Flotation Energy Ltd
the Project	the Project is a proposed floating offshore windfarm called White Cross located in the Celtic Sea with a capacity of up to 100MW. It encompasses the project as a whole, i.e. all onshore and offshore infrastructure and activities associated with the Project.

Defined Term	Description
Project Design Envelope	A description of the range of possible elements that make up the Project design options under consideration. The Project Design Envelope, or 'Rochdale Envelope' is used to define the Project for Environmental Impact Assessment (EIA) purposes when the exact parameters are not yet known but a bounded range of parameters are known for each key project aspect.
White Cross Offshore Windfarm	100MW capacity offshore windfarm including associated onshore and offshore infrastructure
Wind Turbine Generators (WTG)	The wind turbine generators convert wind energy into electrical power. Key components include the rotor blades, nacelle (housing for electrical generator and other electrical and control equipment) and tower. The final selection of project wind turbine model will be made post-consent application
Windfarm Site	The area within which the wind turbines, Offshore Substation Platform and inter-array cables will be present

1. Introduction

1.1 Project Background

1. White Cross Offshore Windfarm is a proposed floating offshore windfarm located in the Celtic Sea with a capacity of up to 100MW (hereafter referred to as 'the Offshore Project'). The Offshore Project requires Section 36 consent and Marine Licences for all components seaward of Mean High Water Springs (MHWS). This includes the infrastructure within the Windfarm Site (e.g., wind turbine generators (WTG), substructures, mooring lines, seabed anchors, inter-array cables and Offshore Substation Platform (as applicable)) and all infrastructure associated with the offshore export cable, Landfall (up to MHWS) and the crossing underneath the Taw Estuary (from MHWS to MHWS).

2. The Offshore Project is being developed by White Cross Offshore Wind Ltd (WCOWL) (hereafter referred to as 'the Applicant') in a joint venture between Cobra Instalaciones Servicios, S.A., and Flotation Energy Ltd.

3. The Windfarm Site is located over 52km off the North Cornwall and North Devon coast (west-northwest of Hartland Point). The Offshore Export Cable will connect the Offshore Substation Platform (OSP) to shore. The Offshore Export Cable will come ashore at a Landfall (up to MHWS) at Saunton Sands on the North Devon Coast.

4. A full project description of the Offshore Project is given in **Chapter 5: Project Description** of the **Offshore Project Environmental Statement (ES)**.

1.2 Purpose of this Document

5. Following the submission of the **Offshore Project ES** and **Report to Inform Appropriate Assessment (RIAA)**, Natural England provided a consultation response note (Natural England, 2023) setting out a key area of disagreement in relation to the use of sabbatical rates.

6. Natural England requested the exclusion of a sabbatical rate within the Habitat Regulations Assessment (HRA) apportionment process undertaken by the Applicant for breeding season impacts apportioned to designated sites. For clarity, inclusion of a sabbatical rate was only applied to the gannet *Morus bassanus* qualifying feature of designated sites assessed. In order to provide Natural England with confidence that the exclusion of a sabbatical rate does not materially change the impact conclusions presented within the **RIAA**, the Applicant requested that APEM Ltd (APEM) undertake apportionment of operational and maintenance phase displacement and collision risk impacts to individual colonies excluding apportionment accounting for sabbatical rates.

7. The results of updated RIAA assessments for displacement and collision risk combined for gannet during operational and maintenance phases are presented in **Section 3**. Updated assessments for collision risk and displacement are presented separately within **Appendix 1** and **Appendix 2** respectively.

2. Methodology

2.1 Apportionment to Individual Colonies

8. To determine if potential impacts from the Offshore Project have the potential to lead to an adverse effect on site integrity (AEoI) for seabird qualifying features of designated sites, predicted impacts are apportioned to individual colonies.

9. During the breeding season, only species with connectivity to designated sites within mean max plus one Standard Deviation foraging range (Woodward et al., 2019) were considered for breeding season apportionment within the original RIAA assessment, in accordance with Natural England's best practice guidance (Parker et al., 2022). These species were Manx shearwater and gannet. However, the updated assessments presented within this report were only required for gannet as the apportionment of displacement and collision risk impacts for Manx shearwater were previously undertaken excluding sabbatical rates, due to lack of evidence to support the inclusion of an appropriate sabbatical rate.

10. Further details of the apportionment process undertaken for the Offshore Project for seabirds is presented within **Chapter 13 Appendix 13.A: Offshore Ornithology Technical Report Annex 4 – SNH (2018) Apportionment Results**. These methods were followed to undertake updated assessments presented within this report, with the exception of the 10% sabbatical apportionment for gannet. The seasonal apportioning rates of predicted impacts used within updated assessments (excluding sabbatical rates) are presented in **Table 1**, compared to those used within the original RIAA assessment.

11. For this assessment of operational and maintenance phase displacement and collision risk impacts for gannet, the Applicant applied a displacement rate of 60 to 80% and a mortality rate of 1% based on best available evidence. This is in line with original assessments agreed and presented within the **Offshore Project ES** and **RIAA** (as detailed within **Section 13.9.1** of the **Offshore Project ES**). Additional consideration is provided in reference to the SNCB's preferred method of assessing potential impacts from displacement using a range of between 60% to 80% and between 1% and 10% mortality rates (SNCBs, 2022).

12. Within updated assessments presented in **Section 3** for displacement and collision risk combined for gannet (during operational and maintenance phases),

NF relates to the Nocturnal Activity Factor rate used within CRM and macro avoidance was considered in line with the **RIAA** and Natural England's best practice guidance. The inclusion of consideration of macro avoidance behaviour exhibited by gannets within modelling was included by reducing the monthly seabird density input value of gannets in flight within the model by selecting a single rate of 70% within the collision risk modelling, as advised within Natural England's best practice guidance (Natural England, 2023).

13. It is important to note that a rounding error was observed within the original assessment in relation to the seasonal apportionment rates of predicted collision risk impacts for gannet to the Saltee Islands Special Protection Area (SPA) and Ailsa Craig SPA during the post-breeding and return migration seasons. Therefore, revised numbers presented in **Table 1** were used to undertake apportionment of both operational and maintenance phase collision risk impacts and displacement and collision risk impacts to these colonies to update original assessments (including sabbatical rates; presented in **Section 3** and **Appendix 1**).

14. It should be noted that no amendments were required for the non-breeding season apportionment rates. As such, predicted impacts for the non-breeding season remain the same as those used to inform conclusions presented within the **RIAA**.

Table 1 Seasonal apportioning rates of predicted impacts for gannet from the Offshore Project to SPAs used within the original RIAA assessment and updated assessments excluding apportionment accounting for sabbatical rates

Site	Original RIAA assessment (inclusion of sabbatical rates)			Updated RIAA assessment (exclusion of sabbatical rates)		
	Full breeding season	Post-breeding migration season	Return migration season	Full breeding season	Post-breeding migration season	Return migration season
Grassholm SPA	52.08%	14.39%	11.87%	57.86%	14.39%	11.87%
Saltee Islands SPA	1.41%	0.35%	0.43%	1.57%	0.35%	0.43%
Ailsa Craig SPA	1.12%	9.94%	8.20%	1.25%	9.94%	8.20%

3. Results

15. This section provides a summary of the updated qualifying feature assessments for displacement and collision risk combined for gannet during operational and maintenance phases for designated sites with potential connecitivty during the breeding season. These sites were the Grassholm SPA (**Section 3.1.1**), the Saltee Islands SPA (**Section 3.1.2**) and the Ailsa Craig SPA (**Section 3.1.3**).

16. Within this section a comparison is made between the level of impact predicted within the RIAA (based upon the inclusion of sabbatical rates) with updated RIAA assessments for displacement and collision risk excluding apportionment accounting for sabbatical rates.

17. In line with Natural England's request to present a range of WTG scenarios, a summary of updated gannet assessments for displacement and collision combined are presented for the 15MW WTG in addition to the 18MW WTG (original assessments were presented for the 18MW worst case scenario only).

18. A summary of updated assessments for collision risk and displacement are presented separately within **Appendix 1** (**Table A1 – Table A12**) and **Appendix 2** (**Table B1 – Table B6**) respectively.

19. As updated apportionment has been undertaken for gannet, a screening exercise has been undertaken in **Section 4** to identify whether the exclusion of sabbatical rates would materially affect the outcomes made within the original RIAA.

3.1 Collision and displacement impacts

3.1.1 Grassholm SPA

Table 2 Summary of gannet operation and maintenance phase collision and displacement (60 – 80% displacement, 1% mortality) impacts apportioned to Grassholm SPA for the 15MW turbine scenario (NF 10) including macro avoidance.

Population Size (Breeding adults)	Season	Applicant's / SNCB's assumed minimum approach collision and displacement impact including sabbatical rates		Applicant's / SNCB's assumed minimum approach collision and displacement impact excluding sabbatical rates		Change in operation and maintenance phase collision and displacement impacts	
		60-80% Disp; 1% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	60-80% Disp; 1% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	Percentage change (%)	Increase in breeding adult mortalities per annum
Citation (66,000)	Full breeding (Mar – Sep)	1.25 – 1.50	0.023 – 0.028	1.39 – 1.67	0.026 – 0.031	11.1	0.1 - 0.2
	Post-breeding migration (Oct – Nov)	0.17 – 0.22	0.003 – 0.004	0.17 – 0.22	0.003 – 0.004	0.0	0.0
	Return migration (Dec – Feb)	0.05 – 0.07	0.001	0.05 – 0.07	0.001	0.0	0.0
	Annual	1.48 – 1.79	0.028 – 0.033	1.62 – 1.96	0.030 – 0.037	9.3-9.4	0.1 - 0.2
Latest Count (72,022)	Full breeding (Mar – Sep)	1.25 – 1.50	0.021 – 0.026	1.39 – 1.67	0.024 – 0.029	11.1	0.1 - 0.2
	Post-breeding migration (Oct – Nov)	0.17 – 0.22	0.003 – 0.004	0.17 – 0.22	0.003 – 0.004	0.0	0.0

Population Size (Breeding adults)	Season	Applicant's / SNCB's assumed minimum approach collision and displacement impact including sabbatical rates		Applicant's / SNCB's assumed minimum approach collision and displacement impact excluding sabbatical rates		Change in operation and maintenance phase collision and displacement impacts	
		60-80% Disp; 1% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	60-80% Disp; 1% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	Percentage change (%)	Increase in breeding adult mortalities per annum
	Return migration (Dec – Feb)	0.05 – 0.07	0.001	0.05 – 0.07	0.001	0.0	0.0
	Annual	1.48 – 1.79	0.025 – 0.031	1.62 – 1.96	0.028 – 0.034	9.3-9.4	0.1 - 0.2

Table 3 Summary of gannet operation and maintenance phase collision and displacement (60 – 80% displacement, 1% mortality) impacts apportioned to Grassholm SPA for the 15MW turbine scenario (NF 20) including macro avoidance.

Population Size (Breeding adults)	Season	Applicant's / SNCB's assumed minimum approach collision and displacement impact including sabbatical rates		Applicant's / SNCB's assumed minimum approach collision and displacement impact excluding sabbatical rates		Change in operation and maintenance phase collision and displacement impacts	
		60-80% Disp; 1% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	60-80% Disp; 1% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	Percentage change (%)	Increase in breeding adult mortalities per annum
Citation (66,000)	Full breeding (Mar – Sep)	1.28 – 1.53	0.024 – 0.029	1.42 – 1.70	0.027 – 0.032	11.1	0.1 – 0.2
	Post-breeding migration (Oct – Nov)	0.18 – 0.22	0.003 – 0.004	0.18 – 0.22	0.003 – 0.004	0.0	0.0
	Return migration (Dec – Feb)	0.05 – 0.07	0.001	0.05 – 0.07	0.001	0.0	0.0
	Annual	1.51 – 1.82	0.028 – 0.034	1.65 – 1.99	0.031 – 0.037	9.3-9.4	0.1 – 0.2
Latest Count (72,022)	Full breeding (Mar – Sep)	1.28 – 1.53	0.022 – 0.026	1.42 – 1.70	0.024 – 0.029	11.1	0.1 – 0.2

Population Size (Breeding adults)	Season	Applicant's / SNCB's assumed minimum approach collision and displacement impact including sabbatical rates		Applicant's / SNCB's assumed minimum approach collision and displacement impact excluding sabbatical rates		Change in operation and maintenance phase collision and displacement impacts	
		60-80% Disp; 1% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	60-80% Disp; 1% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	Percentage change (%)	Increase in breeding adult mortalities per annum
	Post-breeding migration (Oct – Nov)	0.18 – 0.22	0.003 – 0.004	0.18 – 0.22	0.003 – 0.004	0.0	0.0
	Return migration (Dec – Feb)	0.05 – 0.07	0.001	0.05 – 0.07	0.001	0.0	0.0
	Annual	1.51 – 1.82	0.026 – 0.031	1.65 – 1.99	0.028 – 0.034	9.3-9.4	0.1 – 0.2

Table 4 Summary of gannet operation and maintenance phase collision and displacement (60 – 80% displacement, 10% mortality) impacts apportioned to Grassholm SPA for the 15MW turbine scenario (NF 10) including macro avoidance.

Population Size (Breeding adults)	Season	SNCBs assumed maximum approach collision and displacement impact including sabbatical rates		SNCBs assumed maximum approach collision and displacement impact excluding sabbatical rates		Change in operation and maintenance phase collision and displacement impacts	
		60-80% Disp; 10% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	60-80% Disp; 10% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	Percentage change (%)	Increase in breeding adult mortalities per annum
Citation (66,000)	Full breeding (Mar – Sep)	7.98 – 10.47	0.149 – 0.196	8.86 – 11.62	0.166 – 0.217	11.1	0.9 – 1.2
	Post-breeding migration (Oct – Nov)	1.27 – 1.68	0.024 – 0.031	1.27 – 1.68	0.024 – 0.031	0.0	0.0
	Return migration (Dec – Feb)	0.54 – 0.72	0.010 – 0.014	0.54 – 0.72	0.010 – 0.014	0.0	0.0
	Annual	9.79 – 12.86	0.183 – 0.241	10.67 – 14.02	0.200 – 0.262	9.0	0.9 – 1.2
Latest Count (72,022)	Full breeding (Mar – Sep)	7.98 – 10.47	0.137 – 0.179	8.86 – 11.62	0.152 – 0.199	11.1	0.9 – 1.2
	Post-breeding migration	1.27 – 1.68	0.022 – 0.029	1.27 – 1.68	0.022 – 0.029	0.0	0.0

Population Size (Breeding adults)	Season	SNCBs assumed maximum approach collision and displacement impact including sabbatical rates		SNCBs assumed maximum approach collision and displacement impact excluding sabbatical rates		Change in operation and maintenance phase collision and displacement impacts	
		60-80% Disp; 10% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	60-80% Disp; 10% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	Percentage change (%)	Increase in breeding adult mortalities per annum
	(Oct – Nov)						
	Return migration (Dec – Feb)	0.54 – 0.72	0.009 – 0.012	0.54 – 0.72	0.009 – 0.012	0.0	0.0
	Annual	9.79 – 12.86	0.168 – 0.220	10.67 – 14.02	0.183 – 0.240	9.0	0.9 – 1.2

Table 5 Summary of gannet operation and maintenance phase collision and displacement (60 – 80% displacement, 10% mortality) impacts apportioned to Grassholm SPA for the 15MW turbine scenario (NF 20) including macro avoidance.

Population Size (Breeding adults)	Season	SNCBs assumed maximum approach collision and displacement impact including sabbatical rates		SNCBs assumed maximum approach collision and displacement impact excluding sabbatical rates		Change in operation and maintenance phase collision and displacement impacts	
		60-80% Disp; 10% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	60-80% Disp; 10% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	Percentage change (%)	Increase in breeding adult mortalities per annum
Citation (66,000)	Full breeding (Mar – Sep)	8.00 – 10.49	0.150 – 0.196	8.89 – 11.65	0.166 – 0.218	11.1	0.9 – 1.2
	Post-breeding migration (Oct – Nov)	1.28 – 1.68	0.024 – 0.031	1.28 – 1.68	0.024 – 0.031	0.0	0.0
	Return migration (Dec – Feb)	0.54 – 0.72	0.010 – 0.014	0.54 – 0.72	0.010 – 0.014	0.0	0.0
	Annual	9.82 – 12.89	0.184 – 0.241	10.71 – 14.06	0.200 – 0.263	9.0	0.9 – 1.2
Latest Count (72,022)	Full breeding (Mar – Sep)	8.00 – 10.49	0.137 – 0.180	8.89 – 11.65	0.152 – 0.200	11.1	0.9 – 1.2
	Post-breeding migration	1.28 – 1.68	0.022 – 0.029	1.28 – 1.68	0.022 – 0.029	0.0	0.0

Population Size (Breeding adults)	Season	SNCBs assumed maximum approach collision and displacement impact including sabbatical rates		SNCBs assumed maximum approach collision and displacement impact excluding sabbatical rates		Change in operation and maintenance phase collision and displacement impacts	
		60-80% Disp; 10% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	60-80% Disp; 10% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	Percentage change (%)	Increase in breeding adult mortalities per annum
	(Oct – Nov)						
	Return migration (Dec – Feb)	0.54 – 0.72	0.009 – 0.012	0.54 – 0.72	0.009 – 0.012	0.0	0.0
	Annual	9.82 – 12.89	0.168 – 0.221	10.71 – 14.06	0.184 – 0.241	9.0	0.9 – 1.2

Table 6 Summary of gannet operation and maintenance phase collision and displacement (60 – 80% displacement, 1% mortality) impacts apportioned to Grassholm SPA for the 18MW turbine scenario (NF 10) including macro avoidance.

Population Size (Breeding adults)	Season	Applicant's / SNCB's assumed minimum approach collision and displacement impact including sabbatical rates		Applicant's / SNCB's assumed minimum approach collision and displacement impact excluding sabbatical rates		Change in operation and maintenance phase collision and displacement impacts	
		60-80% Disp; 1% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	60-80% Disp; 1% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	Percentage change (%)	Increase in breeding adult mortalities per annum
Citation (66,000)	Full breeding (Mar – Sep)	1.44 – 1.69	0.027 – 0.032	1.60 -1.87	0.030 – 0.035	11.1	0.2
	Post-breeding migration (Oct – Nov)	0.19 – 0.24	0.004	0.19 – 0.24	0.004	0.0	0.0
	Return migration (Dec – Feb)	0.05 – 0.07	0.001	0.05 – 0.07	0.001	0.0	0.0
	Annual	1.69 – 1.99	0.032 – 0.037	1.85 – 2.18	0.035 – 0.041	9.4-9.5	0.2
Latest Count (72,022)	Full breeding (Mar – Sep)	1.44 – 1.69	0.025 – 0.029	1.60 -1.87	0.027 – 0.032	11.1	0.2

Population Size (Breeding adults)	Season	Applicant's / SNCB's assumed minimum approach collision and displacement impact including sabbatical rates		Applicant's / SNCB's assumed minimum approach collision and displacement impact excluding sabbatical rates		Change in operation and maintenance phase collision and displacement impacts	
		60-80% Disp; 1% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	60-80% Disp; 1% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	Percentage change (%)	Increase in breeding adult mortalities per annum
	Post-breeding migration (Oct – Nov)	0.19 – 0.24	0.003 – 0.004	0.19 – 0.24	0.003 – 0.004	0.0	0.0
	Return migration (Dec – Feb)	0.05 – 0.07	0.001	0.05 – 0.07	0.001	0.0	0.0
	Annual	1.69 – 1.99	0.029 – 0.034	1.85 – 2.18	0.032 – 0.037	9.4-9.5	0.2

Table 7 Summary of gannet operation and maintenance phase collision and displacement (60 – 80% displacement, 1% mortality) impacts apportioned to Grassholm SPA for the 18MW turbine scenario (NF 20) including macro avoidance.

Population Size (Breeding adults)	Season	Applicant's / SNCB's minimum assumed approach collision and displacement impact including sabbatical rates		Applicant's / SNCB's minimum assumed approach collision and displacement impact excluding sabbatical rates		Change in operation and maintenance phase collision and displacement impacts	
		60-80% Disp; 1% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	60-80% Disp; 1% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	Percentage change (%)	Increase in breeding adult mortalities per annum
Citation (66,000)	Full breeding (Mar – Sep)	1.48 – 1.73	0.028 – 0.032	1.65 – 1.93	0.031 – 0.036	11.1	0.2
	Post-breeding migration (Oct – Nov)	0.20 – 0.24	0.004 – 0.005	0.20 – 0.24	0.004 – 0.005	0.0	0.0
	Return migration (Dec – Feb)	0.05 – 0.07	0.001	0.05 – 0.07	0.001	0.0	0.0
	Annual	1.74 – 2.05	0.033 – 0.038	1.90 – 2.24	0.036 – 0.042	9.4– 9.5	0.2
Latest Count (72,022)	Full breeding (Mar – Sep)	1.48 – 1.73	0.025 – 0.030	1.65 – 1.93	0.028 – 0.033	11.1	0.2

Population Size (Breeding adults)	Season	Applicant's / SNCB's assumed minimum approach collision and displacement impact including sabbatical rates		Applicant's / SNCB's assumed minimum approach collision and displacement impact excluding sabbatical rates		Change in operation and maintenance phase collision and displacement impacts	
		60-80% Disp; 1% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	60-80% Disp; 1% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	Percentage change (%)	Increase in breeding adult mortalities per annum
	Post-breeding migration (Oct – Nov)	0.20 – 0.24	0.003 – 0.004	0.20 – 0.24	0.003 – 0.004	0.0	0.0
	Return migration (Dec – Feb)	0.05 – 0.07	0.001	0.05 – 0.07	0.001	0.0	0.0
	Annual	1.74 – 2.05	0.030 – 0.035	1.90 – 2.24	0.033 – 0.038	9.4– 9.5	0.2

Table 8 Summary of gannet operation and maintenance phase collision and displacement (60 – 80% displacement, 10% mortality) impacts apportioned to Grassholm SPA for the 18MW turbine scenario (NF 10) including macro avoidance.

Population Size (Breeding adults)	Season	SNCBs assumed maximum approach collision and displacement impact including sabbatical rates		SNCBs assumed maximum approach collision and displacement impact excluding sabbatical rates		Change in operation and maintenance phase collision and displacement impacts	
		60-80% Disp; 10% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	60-80% Disp; 10% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	Percentage change (%)	Increase in breeding adult mortalities per annum
Citation (66,000)	Full breeding (Mar – Sep)	8.16 – 10.65	0.153 – 0.199	9.07 – 11.83	0.170 – 0.221	11.1	0.9 – 1.2
	Post-breeding migration (Oct – Nov)	1.29 – 1.70	0.024 – 0.032	1.29 – 1.70	0.024 – 0.032	0.0	0.0
	Return migration (Dec – Feb)	0.54 – 0.72	0.010 – 0.014	0.54 – 0.72	0.010 – 0.014	0.0	0.0
	Annual	9.99 – 13.07	0.187 – 0.244	10.90 – 14.25	0.204 – 0.267	9.0 – 9.1	0.9 – 1.2
Latest Count (72,022)	Full breeding (Mar – Sep)	8.16 – 10.65	0.140 – 0.183	9.07 – 11.83	0.155 – 0.203	11.1	0.9 – 1.2
	Post-breeding migration	1.29 – 1.70	0.022 – 0.029	1.29 – 1.70	0.022 – 0.029	0.0	0.0

Population Size (Breeding adults)	Season	SNCBs assumed maximum approach collision and displacement impact including sabbatical rates		SNCBs assumed maximum approach collision and displacement impact excluding sabbatical rates		Change in operation and maintenance phase collision and displacement impacts	
		60-80% Disp; 10% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	60-80% Disp; 10% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	Percentage change (%)	Increase in breeding adult mortalities per annum
	(Oct – Nov)						
	Return migration (Dec – Feb)	0.54 – 0.72	0.009 – 0.012	0.54 – 0.72	0.009 – 0.012	0.0	0.0
	Annual	9.99 – 13.07	0.171 – 0.224	10.90 – 14.25	0.187 – 0.244	9.0 – 9.1	0.9 – 1.2

Table 9 Summary of gannet operation and maintenance phase collision and displacement (60 – 80% displacement, 10% mortality) impacts apportioned to Grassholm SPA for the 18MW turbine scenario (NF 20) including macro avoidance.

Population Size (Breeding adults)	Season	SNCBs assumed maximum approach collision and displacement impact including sabbatical rates		SNCBs assumed maximum approach collision and displacement impact excluding sabbatical rates		Change in operation and maintenance phase collision and displacement impacts	
		60-80% Disp; 10% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	60-80% Disp; 10% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	Percentage change (%)	Increase in breeding adult mortalities per annum
Citation (66,000)	Full breeding (Mar – Sep)	8.21 – 10.70	0.154 – 0.200	9.12 – 11.88	0.171 – 0.222	11.1	0.9 – 1.2
	Post-breeding migration (Oct – Nov)	1.30 – 1.70	0.024 – 0.032	1.30 – 1.70	0.024 – 0.032	0.0	0.0
	Return migration (Dec – Feb)	0.54 – 0.72	0.010 – 0.014	0.54 – 0.72	0.010 – 0.014	0.0	0.0
	Annual	10.04 – 13.12	0.188- 0.245	10.95 – 14.31	0.205 – 0.268	9.0 - 9.1	0.9 – 1.2
Latest Count (72,022)	Full breeding (Mar – Sep)	8.21 – 10.70	0.141 – 0.183	9.12 – 11.88	0.156 – 0.204	11.1	0.9 – 1.2
	Post-breeding	1.30 – 1.70	0.022 – 0.029	1.30 – 1.70	0.022 – 0.029	0.0	0.0

Population Size (Breeding adults)	Season	SNCBs assumed maximum approach collision and displacement impact including sabbatical rates		SNCBs assumed maximum approach collision and displacement impact excluding sabbatical rates		Change in operation and maintenance phase collision and displacement impacts	
		60-80% Disp; 10% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	60-80% Disp; 10% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	Percentage change (%)	Increase in breeding adult mortalities per annum
	migration (Oct – Nov)						
	Return migration (Dec – Feb)	0.54 – 0.72	0.09 – 0.012	0.54 – 0.72	0.09 – 0.012	0.0	0.0
	Annual	10.04 – 13.12	0.172 – 0.225	10.95 – 14.31	0.188 – 0.245	9.0 - 9.1	0.9 – 1.2

3.1.2 Saltee Islands SPA

Table 10 Summary of gannet operation and maintenance phase collision and displacement (60 – 80% displacement, 1% mortality) impacts apportioned to Saltee Islands SPA for the 15MW turbine scenario (NF 10) including macro avoidance.

Population Size (Breeding adults)	Season	Applicant's / SNCB's assumed minimum approach collision and displacement impact including sabbatical rates		Applicant's / SNCB's assumed minimum approach collision and displacement impact excluding sabbatical rates		Change in operation and maintenance phase collision and displacement impacts	
		60-80% Disp; 1% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	60-80% Disp; 1% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	Percentage change (%)	Increase in breeding adult mortalities per annum
Citation (4,896)	Full breeding (Mar – Sep)	0.03 – 0.04	0.009 – 0.010	0.04 – 0.05	0.010 – 0.011	10.5 – 10.6	<0.1
	Post-breeding migration (Oct – Nov)	<0.01 – 0.01	0.001	<0.01 – 0.01	0.001	0.0	0.0
	Return migration (Dec – Feb)	<0.01	0.000 – 0.001	<0.01	0.000 – 0.001	0.0	0.0
	Annual	0.04 – 0.05	0.010 – 0.012	0.04 – 0.05	0.011 – 0.013	4.0 – 4.4	<0.1
Latest Count (9,444)	Full breeding	0.03 – 0.04	0.004 – 0.005	0.04 – 0.05	0.005 – 0.006	10.5 – 10.6	<0.1

Population Size (Breeding adults)	Season	Applicant's / SNCB's assumed minimum approach collision and displacement impact including sabbatical rates		Applicant's / SNCB's assumed minimum approach collision and displacement impact excluding sabbatical rates		Change in operation and maintenance phase collision and displacement impacts	
		60-80% Disp; 1% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	60-80% Disp; 1% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	Percentage change (%)	Increase in breeding adult mortalities per annum
	(Mar – Sep)						
	Post-breeding migration (Oct – Nov)	<0.01 – 0.01	0.001	<0.01 – 0.01	0.001	0	0.0
	Return migration (Dec – Feb)	<0.01	<0.001	<0.01	<0.001	0	0.0
	Annual	0.04 – 0.05	0.005 – 0.006	0.04 – 0.05	0.006 – 0.007	4.0 – 4.4	<0.1

Table 11 Summary of gannet operation and maintenance phase collision and displacement (60 – 80% displacement, 1% mortality) impacts apportioned to Saltee Islands SPA for the 15MW turbine scenario (NF 20) including macro avoidance.

Population Size (Breeding adults)	Season	Applicant's / SNCB's assumed minimum approach collision and displacement impact including sabbatical rates		Applicant's / SNCB's assumed minimum approach collision and displacement impact excluding sabbatical rates		Change in operation and maintenance phase collision and displacement impacts	
		60-80% Disp; 1% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	60-80% Disp; 1% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	Percentage change (%)	Increase in breeding adult mortalities per annum
Citation (4,896)	Full breeding (Mar – Sep)	0.03 – 0.04	0.009 – 0.010	0.04 – 0.05	0.010 – 0.012	10.5 – 10.6	<0.1
	Post-breeding migration (Oct – Nov)	<0.01 – 0.01	0.001	<0.01 - 0.01	0.001	0.0	0.0
	Return migration (Dec – Feb)	<0.01	0.000 – 0.001	<0.01	0.000 – 0.001	0.0	0.0
	Annual	0.04 – 0.05	0.010 – 0.012	0.04 – 0.05	0.011 – 0.014	3.8 – 4.2	<0.1
Latest Count (9,444)	Full breeding (Mar – Sep)	0.03 – 0.04	0.005	0.04 – 0.05	0.005 – 0.006	10.5 – 10.6	<0.1

Population Size (Breeding adults)	Season	Applicant's / SNCB's assumed minimum approach collision and displacement impact including sabbatical rates		Applicant's / SNCB's assumed minimum approach collision and displacement impact excluding sabbatical rates		Change in operation and maintenance phase collision and displacement impacts	
		60-80% Disp; 1% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	60-80% Disp; 1% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	Percentage change (%)	Increase in breeding adult mortalities per annum
	Post-breeding migration (Oct – Nov)	<0.01 – 0.01	0.001	<0.01 – 0.01	0.001	0.0	0.0
	Return migration (Dec – Feb)	<0.01	<0.001	<0.01	<0.001	0.0	0.0
	Annual	0.04 – 0.05	0.005 – 0.006	0.04 – 0.05	0.006 – 0.007	3.8 – 4.2	<0.1

Table 12 Summary of gannet operation and maintenance phase collision and displacement (60 – 80% displacement, 10% mortality) impacts apportioned to Saltee Island SPA for the 15MW turbine scenario (NF 10) including macro avoidance.

Population Size (Breeding adults)	Season	SNCBs assumed maximum approach collision and displacement impact including sabbatical rates		SNCBs assumed maximum approach collision and displacement impact excluding sabbatical rates		Change in operation and maintenance phase collision and displacement impacts	
		60-80% Disp; 10% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	60-80% Disp; 10% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	Percentage change (%)	Increase in breeding adult mortalities per annum
Citation (4,896)	Full breeding (Mar – Sep)	0.22 – 0.29	0.055 – 0.072	0.24 – 0.32	0.061 – 0.080	10.3	<0.1
	Post-breeding migration (Oct – Nov)	0.03 – 0.04	0.008 – 0.010	0.03 – 0.04	0.008 – 0.010	0.0	0.0
	Return migration (Dec – Feb)	0.02 – 0.03	0.005 – 0.007	0.02 – 0.03	0.005 – 0.007	0.0	0.0
	Annual	0.27 – 0.35	0.067 – 0.089	0.29 – 0.38	0.073 – 0.096	7.3 – 7.6	<0.1
Latest Count (9,444)	Full breeding (Mar – Sep)	0.22 – 0.29	0.028 – 0.037	0.24 – 0.32	0.031 – 0.041	10.3	<0.1
	Post-breeding migration	0.03 – 0.04	0.004 – 0.005	0.03 – 0.04	0.004 – 0.005	0.0	0.0

Population Size (Breeding adults)	Season	SNCBs assumed maximum approach collision and displacement impact including sabbatical rates		SNCBs assumed maximum approach collision and displacement impact excluding sabbatical rates		Change in operation and maintenance phase collision and displacement impacts	
		60-80% Disp; 10% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	60-80% Disp; 10% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	Percentage change (%)	Increase in breeding adult mortalities per annum
	(Oct – Nov)						
	Return migration (Dec – Feb)	0.02 – 0.03	0.003	0.02 – 0.03	0.003	0.0	0.0
	Annual	0.27 – 0.35	0.035 – 0.046	0.29 – 0.38	0.038 – 0.050	7.3 – 7.6	<0.1

Table 13 Summary of gannet operation and maintenance phase collision and displacement (60 – 80% displacement, 10% mortality) impacts apportioned to Saltee Island SPA for the 15MW turbine scenario (NF 20) including macro avoidance.

Population Size (Breeding adults)	Season	SNCBs assumed maximum approach collision and displacement impact including sabbatical rates		SNCBs assumed maximum approach collision and displacement impact excluding sabbatical rates		Change in operation and maintenance phase collision and displacement impacts	
		60-80% Disp; 10% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	60-80% Disp; 10% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	Percentage change (%)	Increase in breeding adult mortalities per annum
Citation (4,896)	Full breeding (Mar – Sep)	0.22 – 0.29	0.055 – 0.072	0.24 – 0.32	0.061 – 0.080	10.3	<0.1
	Post-breeding migration (Oct – Nov)	0.03 – 0.04	0.008 – 0.010	0.03 – 0.04	0.008 – 0.010	0.0	0.0
	Return migration (Dec – Feb)	0.02 – 0.03	0.005 – 0.007	0.02 – 0.03	0.005 – 0.007	0.0	0.0
	Annual	0.27 – 0.35	0.068 – 0.089	0.29 – 0.38	0.073 – 0.096	7.2 – 7.5	<0.1
Latest Count (9,444)	Full breeding (Mar – Sep)	0.22 – 0.29	0.029 – 0.037	0.24 – 0.32	0.031 – 0.041	10.3	<0.1
	Post-breeding migration	0.03 – 0.04	0.004 – 0.005	0.03 – 0.04	0.004 – 0.005	0.0	0.0

Population Size (Breeding adults)	Season	SNCBs assumed maximum approach collision and displacement impact including sabbatical rates		SNCBs assumed maximum approach collision and displacement impact excluding sabbatical rates		Change in operation and maintenance phase collision and displacement impacts	
		60-80% Disp; 10% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	60-80% Disp; 10% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	Percentage change (%)	Increase in breeding adult mortalities per annum
	(Oct – Nov)						
	Return migration (Dec – Feb)	0.02 – 0.03	0.003	0.02 – 0.03	0.003	0.0	0.0
	Annual	0.27 – 0.35	0.035 – 0.046	0.29 – 0.38	0.038 – 0.050	7.2 – 7.5	<0.1

Table 14 Summary of gannet operation and maintenance phase collision and displacement (60 – 80% displacement, 1% mortality) impacts apportioned to Saltee Islands SPA for the 18MW turbine scenario (NF 10) including macro avoidance.

Population Size (Breeding adults)	Season	Applicant's / SNCB's assumed minimum approach collision and displacement impact including sabbatical rates		Applicant's / SNCB's assumed minimum approach collision and displacement impact excluding sabbatical rates		Change in operation and maintenance phase collision and displacement impacts	
		60-80% Disp; 1% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	60-80% Disp; 1% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	Percentage change (%)	Increase in breeding adult mortalities per annum
Citation (4,896)	Full breeding (Mar – Sep)	0.04 – 0.05	0.010 – 0.012	0.04 – 0.05	0.011 – 0.013	10.6 – 10.7	<0.1
	Post-breeding migration (Oct – Nov)	<0.01 - 0.01	0.001	<0.01 – 0.01	0.001	0.0	0.0
	Return migration (Dec – Feb)	<0.01	0.000 – 0.001	<0.01	0.000 – 0.001	0.0	0.0
	Annual	0.05	0.012 – 0.014	0.05 – 0.06	0.013 – 0.015	3.6 – 4.0	<0.1
Latest Count (9,444)	Full breeding (Mar – Sep)	0.04 – 0.05	0.005 – 0.006	0.04 – 0.05	0.006 – 0.007	10.6 – 10.7	<0.1

Population Size (Breeding adults)	Season	Applicant's / SNCB's assumed minimum approach collision and displacement impact including sabbatical rates		Applicant's / SNCB's assumed minimum approach collision and displacement impact excluding sabbatical rates		Change in operation and maintenance phase collision and displacement impacts	
		60-80% Disp; 1% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	60-80% Disp; 1% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	Percentage change (%)	Increase in breeding adult mortalities per annum
	Post-breeding migration (Oct – Nov)	<0.01 - 0.01	0.001	<0.01 – 0.01	0.001	0.0	0.0
	Return migration (Dec – Feb)	<0.01	<0.001	<0.01	<0.001	0.0	0.0
	Annual	0.05	0.006 – 0.007	0.05 – 0.06	0.007 – 0.008	3.6 – 4.0	<0.1

Table 15 Summary of gannet operation and maintenance phase collision and displacement (60 – 80% displacement, 1% mortality) impacts apportioned to Saltee Islands SPA for the 18MW turbine scenario (NF 20) including macro avoidance.

Population Size (Breeding adults)	Season	Applicant's / SNCB's assumed minimum approach collision and displacement impact including sabbatical rates		Applicant's / SNCB's assumed minimum approach collision and displacement impact excluding sabbatical rates		Change in operation and maintenance phase collision and displacement impacts	
		60-80% Disp; 1% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	60-80% Disp; 1% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	Percentage change (%)	Increase in breeding adult mortalities per annum
Citation (4,896)	Full breeding (Mar – Sep)	0.04 – 0.05	0.010 – 0.012	0.04 – 0.05	0.011 – 0.013	10.6 - 10.7	<0.1
	Post-breeding migration (Oct – Nov)	<0.01 - 0.01	0.001	<0.01 – 0.01	0.001	0.0	0.0
	Return migration (Dec – Feb)	<0.01	0.000 – 0.001	<0.01	0.000 – 0.001	0.0	0.0
	Annual	0.05 – 0.06	0.012 – 0.014	0.05 – 0.06	0.013 – 0.015	3.5 – 3.9	<0.1
Latest Count (9,444)	Full breeding (Mar – Sep)	0.04 – 0.05	0.005 – 0.006	0.04 – 0.05	0.006 – 0.007	10.6 - 10.7	<0.1

Population Size (Breeding adults)	Season	Applicant's / SNCB's assumed minimum approach collision and displacement impact including sabbatical rates		Applicant's / SNCB's assumed minimum approach collision and displacement impact excluding sabbatical rates		Change in operation and maintenance phase collision and displacement impacts	
		60-80% Disp; 1% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	60-80% Disp; 1% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	Percentage change (%)	Increase in breeding adult mortalities per annum
	Post-breeding migration (Oct – Nov)	<0.01 - 0.01	0.001	<0.01 – 0.01	0.001	0.0	0.0
	Return migration (Dec – Feb)	<0.01	<0.001	<0.01	<0.001	0.0	0.0
	Annual	0.05 – 0.06	0.006 – 0.007	0.05 – 0.06	0.007 – 0.008	3.5 – 3.9	<0.1

Table 16 Summary of gannet operation and maintenance phase collision and displacement (60 – 80% displacement, 10% mortality) impacts apportioned to Saltee Islands SPA for the 18MW turbine scenario (NF 10) including macro avoidance.

Population Size (Breeding adults)	Season	SNCBs assumed maximum approach collision and displacement impact including sabbatical rates		SNCBs assumed maximum approach collision and displacement impact excluding sabbatical rates		Change in operation and maintenance phase collision and displacement impacts	
		60-80% Disp; 10% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	60-80% Disp; 10% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	Percentage change (%)	Increase in breeding adult mortalities per annum
Citation (4,896)	Full breeding (Mar – Sep)	0.22 – 0.29	0.056 – 0.073	0.25 – 0.32	0.062 – 0.081	10.3	<0.1
	Post-breeding migration (Oct – Nov)	0.03 – 0.04	0.08 – 0.010	0.03 – 0.04	0.08 – 0.010	0.0	0.0
	Return migration (Dec – Feb)	0.02 – 0.03	0.005 – 0.007	0.02 – 0.03	0.005 – 0.007	0.0	0.0
	Annual	0.27 – 0.36	0.069 – 0.090	0.30 – 0.39	0.075 – 0.098	6.9 – 7.2	<0.1
Latest Count (9,444)	Full breeding (Mar – Sep)	0.22 – 0.29	0.029 – 0.038	0.25 – 0.32	0.032 – 0.042	10.3	<0.1
	Post-breeding migration	0.03 – 0.04	0.004 – 0.005	0.03 – 0.04	0.004 – 0.005	0.0	0.0

Population Size (Breeding adults)	Season	SNCBs assumed maximum approach collision and displacement impact including sabbatical rates		SNCBs assumed maximum approach collision and displacement impact excluding sabbatical rates		Change in operation and maintenance phase collision and displacement impacts	
		60-80% Disp; 10% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	60-80% Disp; 10% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	Percentage change (%)	Increase in breeding adult mortalities per annum
	(Oct – Nov)						
	Return migration (Dec – Feb)	0.02 – 0.03	0.003	0.02 – 0.03	0.003	0.0	0.0
	Annual	0.27 – 0.36	0.036 – 0.047	0.30 – 0.39	0.039 – 0.051	6.9 – 7.2	<0.1

Table 17 Summary of gannet operation and maintenance phase collision and displacement (60 – 80% displacement, 10% mortality) impacts apportioned to Saltee Islands SPA for the 18MW turbine scenario (NF 20) including macro avoidance.

Population Size (Breeding adults)	Season	SNCBs assumed maximum approach collision and displacement impact including sabbatical rates		SNCBs assumed maximum approach collision and displacement impact excluding sabbatical rates		Change in operation and maintenance phase collision and displacement impacts	
		60-80% Disp; 10% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	60-80% Disp; 10% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	Percentage change (%)	Increase in breeding adult mortalities per annum
Citation (4,896)	Full breeding (Mar – Sep)	0.22 – 0.29	0.057 – 0.074	0.25 – 0.32	0.062 – 0.081	10.3	<0.1
	Post-breeding migration (Oct – Nov)	0.03 – 0.04	0.008 – 0.010	0.03 – 0.04	0.008 – 0.010	0.0	0.0
	Return migration (Dec – Feb)	0.02 – 0.03	0.005 – 0.007	0.02 – 0.03	0.005 – 0.007	0.0	0.0
	Annual	0.27 – 0.36	0.069 – 0.090	0.30 – 0.39	0.075 – 0.098	6.8 – 7.2	<0.1
Latest Count (9,444)	Full breeding (Mar – Sep)	0.22 – 0.29	0.029 – 0.038	0.25 – 0.32	0.032 – 0.042	10.3	<0.1
	Post-breeding	0.03 – 0.04	0.004 – 0.005	0.03 – 0.04	0.004 – 0.005	0.0	0.0

Population Size (Breeding adults)	Season	SNCBs assumed maximum approach collision and displacement impact including sabbatical rates		SNCBs assumed maximum approach collision and displacement impact excluding sabbatical rates		Change in operation and maintenance phase collision and displacement impacts	
		60-80% Disp; 10% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	60-80% Disp; 10% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	Percentage change (%)	Increase in breeding adult mortalities per annum
	migration (Oct – Nov)						
	Return migration (Dec – Feb)	0.02 – 0.03	0.003	0.02 – 0.03	0.003	0.0	0.0
	Annual	0.27 – 0.36	0.036 – 0.047	0.30 – 0.39	0.039 – 0.051	6.8 – 7.2	<0.1

3.1.3 Ailsa Craig SPA

Table 18 Summary of gannet operation and maintenance phase collision and displacement (60 – 80% displacement, 1% mortality) impacts apportioned to Ailsa Craig SPA for the 15MW turbine scenario (NF 10) including macro avoidance.

Population Size (Breeding adults)	Season	Applicant's / SNCB's assumed minimum approach collision and displacement impact including sabbatical rates		Applicant's / SNCB's assumed minimum approach collision and displacement impact excluding sabbatical rates		Change in operation and maintenance phase collision and displacement impacts	
		60-80% Disp; 1% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	60-80% Disp; 1% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	Percentage change (%)	Increase in breeding adult mortalities per annum
Citation (46,000)	Full breeding (Mar – Sep)	0.03	0.001	0.03 – 0.04	0.001	10.8	<0.1
	Post-breeding migration (Oct – Nov)	0.12 – 0.15	0.003 - 0.004	0.12 – 0.15	0.003 - 0.004	0.0	0.0
	Return migration (Dec – Feb)	0.04 – 0.05	0.001	0.04 – 0.05	0.001	0.0	0.0
	Annual	0.18 – 0.23	0.005 – 0.006	0.19 – 0.23	0.005 – 0.006	1.6	<0.1
Latest Count (66,452)	Full breeding	0.03	0.001	0.03 – 0.04	0.001	10.8	<0.1

Population Size (Breeding adults)	Season	Applicant's / SNCB's assumed minimum approach collision and displacement impact including sabbatical rates		Applicant's / SNCB's assumed minimum approach collision and displacement impact excluding sabbatical rates		Change in operation and maintenance phase collision and displacement impacts	
		60-80% Disp; 1% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	60-80% Disp; 1% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	Percentage change (%)	Increase in breeding adult mortalities per annum
	(Mar – Sep)						
	Post-breeding migration (Oct – Nov)	0.12 – 0.15	0.002 - 0.003	0.12 – 0.15	0.002 – 0.003	0.0	0.0
	Return migration (Dec – Feb)	0.04 – 0.05	0.001	0.04 – 0.05	0.001	0.0	0.0
	Annual	0.18 – 0.23	0.003 – 0.004	0.19 – 0.23	0.003 – 0.004	1.6	<0.1

Table 19 Summary of gannet operation and maintenance phase collision and displacement (60 – 80% displacement, 1% mortality) impacts apportioned to Ailsa Craig SPA for the 15MW turbine scenario (NF 20) including macro avoidance.

Population Size (Breeding adults)	Season	Applicant's / SNCB's assumed minimum approach collision and displacement impact including sabbatical rates		Applicant's / SNCB's assumed minimum approach collision and displacement impact excluding sabbatical rates		Change in operation and maintenance phase collision and displacement impacts	
		60-80% Disp; 1% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	60-80% Disp; 1% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	Percentage change (%)	Increase in breeding adult mortalities per annum
Citation (46,000)	Full breeding (Mar – Sep)	0.03	0.001	0.03 – 0.04	0.001	10.8	<0.1
	Post-breeding migration (Oct – Nov)	0.12 – 0.15	0.003 – 0.004	0.12 – 0.15	0.003 – 0.004	0.0	0.0
	Return migration (Dec – Feb)	0.04 – 0.05	0.001	0.04 – 0.05	0.001	0.0	0.0
	Annual	0.19 – 0.24	0.005 – 0.006	0.19 – 0.24	0.005 – 0.006	1.5 – 1.6	<0.1
Latest Count (66,452)	Full breeding (Mar – Sep)	0.03	0.001	0.03 – 0.04	0.001	10.8	<0.1

Population Size (Breeding adults)	Season	Applicant's / SNCB's assumed minimum approach collision and displacement impact including sabbatical rates		Applicant's / SNCB's assumed minimum approach collision and displacement impact excluding sabbatical rates		Change in operation and maintenance phase collision and displacement impacts	
		60-80% Disp; 1% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	60-80% Disp; 1% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	Percentage change (%)	Increase in breeding adult mortalities per annum
	Post-breeding migration (Oct – Nov)	0.12 – 0.15	0.002 - 0.003	0.12 – 0.15	0.002 - 0.003	0.0	0.0
	Return migration (Dec – Feb)	0.04 – 0.05	0.001	0.04 – 0.05	0.001	0.0	0.0
	Annual	0.19 – 0.24	0.004	0.19 – 0.24	0.004	1.5 – 1.6	<0.1

Table 20 Summary of gannet operation and maintenance phase collision and displacement (60 – 80% displacement, 10% mortality) impacts apportioned to Ailsa Craig SPA for the 15MW turbine scenario (NF 10) including macro avoidance.

Population Size (Breeding adults)	Season	SNCBs assumed maximum approach collision and displacement impact including sabbatical rates		SNCBs assumed maximum approach collision and displacement impact excluding sabbatical rates		Change in operation and maintenance phase collision and displacement impacts	
		60-80% Disp; 10% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	60-80% Disp; 10% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	Percentage change (%)	Increase in breeding adult mortalities per annum
Citation (46,000)	Full breeding (Mar – Sep)	0.17 – 0.23	0.005 – 0.006	0.19 – 0.25	0.005 – 0.007	10.6	<0.1
	Post-breeding migration (Oct – Nov)	0.88 – 1.16	0.024 – 0.031	0.88 – 1.16	0.024 – 0.031	0.0	0.0
	Return migration (Dec – Feb)	0.37 – 0.50	0.010 – 0.013	0.37 – 0.50	0.010 – 0.013	0.0	0.0
	Annual	1.42 – 1.88	0.038 – 0.050	1.44 – 1.91	0.039 – 0.051	1.5	<0.1
Latest Count (66,452)	Full breeding (Mar – Sep)	0.17 – 0.23	0.003 – 0.004	0.19 – 0.25	0.004 – 0.005	10.6	<0.1
	Post-breeding	0.88 – 1.16	0.016 – 0.022	0.88 – 1.16	0.016 – 0.022	0.0	0.0

Population Size (Breeding adults)	Season	SNCBs assumed maximum approach collision and displacement impact including sabbatical rates		SNCBs assumed maximum approach collision and displacement impact excluding sabbatical rates		Change in operation and maintenance phase collision and displacement impacts	
		60-80% Disp; 10% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	60-80% Disp; 10% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	Percentage change (%)	Increase in breeding adult mortalities per annum
	migration (Oct – Nov)						
	Return migration (Dec – Feb)	0.37 – 0.50	0.007 – 0.009	0.37 – 0.50	0.007 – 0.009	0.0	0.0
	Annual	1.42 – 1.88	0.026 – 0.035	1.44 – 1.91	0.027 – 0.035	1.5	<0.1

Table 21 Summary of gannet operation and maintenance phase collision and displacement (60 – 80% displacement, 10% mortality) impacts apportioned to Ailsa Craig SPA for the 15MW turbine scenario (NF 20) including macro avoidance.

Population Size (Breeding adults)	Season	SNCBs assumed maximum approach collision and displacement impact including sabbatical rates		SNCBs assumed maximum approach collision and displacement impact excluding sabbatical rates		Change in operation and maintenance phase collision and displacement impacts	
		60-80% Disp; 10% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	60-80% Disp; 10% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	Percentage change (%)	Increase in breeding adult mortalities per annum
Citation (46,000)	Full breeding (Mar – Sep)	0.17 – 0.23	0.005 – 0.006	0.19 – 0.25	0.005 – 0.007	10.6	<0.1
	Post-breeding migration (Oct – Nov)	0.88 – 1.16	0.024 – 0.031	0.88 – 1.16	0.024 – 0.031	0.0	0.0
	Return migration (Dec – Feb)	0.37 – 0.50	0.010 – 0.013	0.37 – 0.50	0.010 – 0.013	0.0	0.0
	Annual	1.43 – 1.88	0.038 – 0.051	1.45 – 1.91	0.039 – 0.051	1.5	<0.1
Latest Count (66,452)	Full breeding (Mar – Sep)	0.17 – 0.23	0.003 – 0.004	0.19 – 0.25	0.004 – 0.005	10.6	<0.1
	Post-breeding	0.88 – 1.16	0.016 – 0.022	0.88 – 1.16	0.016 – 0.022	0.0	0.0

Population Size (Breeding adults)	Season	SNCBs assumed maximum approach collision and displacement impact including sabbatical rates		SNCBs assumed maximum approach collision and displacement impact excluding sabbatical rates		Change in operation and maintenance phase collision and displacement impacts	
		60-80% Disp; 10% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	60-80% Disp; 10% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	Percentage change (%)	Increase in breeding adult mortalities per annum
	migration (Oct – Nov)						
	Return migration (Dec – Feb)	0.37 – 0.50	0.007 – 0.009	0.37 – 0.50	0.007 – 0.009	0.0	0.0
	Annual	1.43 – 1.88	0.026 – 0.035	1.45 – 1.91	0.027 – 0.036	1.5	<0.1

Table 22 Summary of gannet operation and maintenance phase collision and displacement (60 – 80% displacement, 1% mortality) impacts apportioned to Ailsa Craig SPA for the 18MW turbine scenario (NF 10) including macro avoidance.

Population Size (Breeding adults)	Season	Applicant's / SNCB's assumed minimum approach collision and displacement impact including sabbatical rates		Applicant's / SNCB's assumed minimum approach collision and displacement impact excluding sabbatical rates		Change in operation and maintenance phase collision and displacement impacts	
		60-80% Disp; 1% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	60-80% Disp; 1% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	Percentage change (%)	Increase in breeding adult mortalities per annum
Citation (46,000)	Full breeding (Mar – Sep)	0.03 – 0.04	0.001	0.03 – 0.04	0.001	10.8 – 10.9	<0.1
	Post-breeding migration (Oct – Nov)	0.13 – 0.16	0.004	0.13 – 0.16	0.004	0.0	0.0
	Return migration (Dec – Feb)	0.04 – 0.05	0.001	0.04 – 0.05	0.001	0.0	0.0
	Annual	0.20 – 0.25	0.005 – 0.007	0.21 – 0.25	0.006 – 0.007	1.6	<0.1
Latest Count (66,452)	Full breeding (Mar – Sep)	0.03 – 0.04	0.001	0.03 – 0.04	0.001	10.8 – 10.9	<0.1

Population Size (Breeding adults)	Season	Applicant's / SNCB's assumed minimum approach collision and displacement impact including sabbatical rates		Applicant's / SNCB's assumed minimum approach collision and displacement impact excluding sabbatical rates		Change in operation and maintenance phase collision and displacement impacts	
		60-80% Disp; 1% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	60-80% Disp; 1% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	Percentage change (%)	Increase in breeding adult mortalities per annum
	Post-breeding migration (Oct – Nov)	0.13 – 0.16	0.003	0.13 – 0.16	0.003	0.0	0.0
	Return migration (Dec – Feb)	0.04 – 0.05	0.001	0.04 – 0.05	0.001	0.0	0.0
	Annual	0.20 – 0.25	0.004 – 0.005	0.21 – 0.25	0.004 – 0.005	1.6	<0.1

Table 23 Summary of gannet operation and maintenance phase collision and displacement (60 – 80% displacement, 1% mortality) impacts apportioned to Ailsa Craig SPA for the 18MW turbine scenario (NF 20) including macro avoidance.

Population Size (Breeding adults)	Season	Applicant's / SNCB's assumed minimum approach collision and displacement impact including sabbatical rates		Applicant's / SNCB's assumed minimum approach collision and displacement impact excluding sabbatical rates		Change in operation and maintenance phase collision and displacement impacts	
		60-80% Disp; 1% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	60-80% Disp; 1% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	Percentage change (%)	Increase in breeding adult mortalities per annum
Citation (46,000)	Full breeding (Mar – Sep)	0.03 – 0.04	0.001	0.04	0.001	10.8 – 10.9	<0.1
	Post-breeding migration (Oct – Nov)	0.14 – 0.17	0.004	0.14 – 0.17	0.004	0.0	0.0
	Return migration (Dec – Feb)	0.04 – 0.05	0.001	0.04 – 0.05	0.001	0.0	0.0
	Annual	0.21 – 0.25	0.006 – 0.007	0.21 – 0.26	0.006 – 0.007	1.6	<0.1
Latest Count (66,452)	Full breeding (Mar – Sep)	0.03 – 0.04	0.001	0.04	0.001	10.8 – 10.9	<0.1

Population Size (Breeding adults)	Season	Applicant's / SNCB's assumed minimum approach collision and displacement impact including sabbatical rates		Applicant's / SNCB's assumed minimum approach collision and displacement impact excluding sabbatical rates		Change in operation and maintenance phase collision and displacement impacts	
		60-80% Disp; 1% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	60-80% Disp; 1% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	Percentage change (%)	Increase in breeding adult mortalities per annum
	Post-breeding migration (Oct – Nov)	0.14 – 0.17	0.003	0.14 – 0.17	0.003	0.0	0.0
	Return migration (Dec – Feb)	0.04 – 0.05	0.001	0.04 – 0.05	0.001	0.0	0.0
	Annual	0.21 – 0.25	0.004 – 0.005	0.21 – 0.26	0.004 – 0.005	1.6	<0.1

Table 24 Summary of gannet operation and maintenance phase collision and displacement (60 – 80% displacement, 10% mortality) impacts apportioned to Ailsa Craig SPA for the 18MW turbine scenario (NF 10) including macro avoidance.

Population Size (Breeding adults)	Season	SNCBs assumed maximum approach collision and displacement impact including sabbatical rates		SNCBs assumed maximum approach collision and displacement impact excluding sabbatical rates		Change in operation and maintenance phase collision and displacement impacts	
		60-80% Disp; 10% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	60-80% Disp; 10% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	Percentage change (%)	Increase in breeding adult mortalities per annum
Citation (46,000)	Full breeding (Mar – Sep)	0.18 – 0.23	0.005 – 0.006	0.20 – 0.26	0.005 – 0.007	10.6 – 10.7	<0.1
	Post-breeding migration (Oct – Nov)	0.89 – 1.17	0.024 – 0.031	0.89 – 1.17	0.024 – 0.031	0.0	0.0
	Return migration (Dec – Feb)	0.37 – 0.50	0.010 – 0.013	0.37 – 0.50	0.010 – 0.013	0.0	0.0
	Annual	1.44 – 1.90	0.039 – 0.051	1.46 – 1.93	0.039 – 0.052	1.5	<0.1
Latest Count (66,452)	Full breeding (Mar – Sep)	0.18 – 0.23	0.003 – 0.004	0.20 – 0.26	0.004 – 0.005	10.6 – 10.7	<0.1
	Post-breeding	0.89 – 1.17	0.017 – 0.022	0.89 – 1.17	0.017 – 0.022	0.0	0.0

Population Size (Breeding adults)	Season	SNCBs assumed maximum approach collision and displacement impact including sabbatical rates		SNCBs assumed maximum approach collision and displacement impact excluding sabbatical rates		Change in operation and maintenance phase collision and displacement impacts	
		60-80% Disp; 10% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	60-80% Disp; 10% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	Percentage change (%)	Increase in breeding adult mortalities per annum
	migration (Oct – Nov)						
	Return migration (Dec – Feb)	0.37 – 0.50	0.007 – 0.009	0.37 – 0.50	0.007 – 0.009	0.0	0.0
	Annual	1.44 – 1.90	0.027 – 0.035	1.46 – 1.93	0.027 – 0.036	1.5	<0.1

Table 25 Summary of gannet operation and maintenance phase collision and displacement (60 – 80% displacement, 10% mortality) impacts apportioned to Ailsa Craig SPA for the 18MW turbine scenario (NF 20) including macro avoidance.

Population Size (Breeding adults)	Season	SNCBs assumed maximum approach collision and displacement impact including sabbatical rates		SNCBs assumed maximum approach collision and displacement impact excluding sabbatical rates		Change in operation and maintenance phase collision and displacement impacts	
		60-80% Disp; 10% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	60-80% Disp; 10% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	Percentage change (%)	Increase in breeding adult mortalities per annum
Citation (46,000)	Full breeding (Mar – Sep)	0.18 – 0.23	0.005 – 0.006	0.20 – 0.26	0.005 – 0.007	10.6 – 10.7	<0.1
	Post-breeding migration (Oct – Nov)	0.90 – 1.18	0.024 – 0.032	0.90 – 1.18	0.024 – 0.032	0.0	0.0
	Return migration (Dec – Feb)	0.37 – 0.50	0.010 – 0.013	0.37 – 0.50	0.010 – 0.013	0.0	0.0
	Annual	1.44 – 1.90	0.039 – 0.051	1.47 – 1.93	0.039 – 0.052	1.5	<0.1
Latest Count (66,452)	Full breeding (Mar – Sep)	0.18 – 0.23	0.003 – 0.004	0.20 – 0.26	0.004 – 0.005	10.6 – 10.7	<0.1
	Post-breeding	0.90 – 1.18	0.017 – 0.022	0.90 – 1.18	0.017 – 0.022	0.0	0.0

Population Size (Breeding adults)	Season	SNCBs assumed maximum approach collision and displacement impact including sabbatical rates		SNCBs assumed maximum approach collision and displacement impact excluding sabbatical rates		Change in operation and maintenance phase collision and displacement impacts	
		60-80% Disp; 10% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	60-80% Disp; 10% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	Percentage change (%)	Increase in breeding adult mortalities per annum
	migration (Oct – Nov)						
	Return migration (Dec – Feb)	0.37 – 0.50	0.007 – 0.009	0.37 – 0.50	0.007 – 0.009	0.0	0.0
	Annual	1.44 – 1.90	0.027 – 0.035	1.47 – 1.93	0.027 – 0.036	1.5	<0.1

4. Consideration of Report to Inform Appropriate Assessment conclusions.

20. Within **Section 3**, a summary of the updated RIAA assessments for displacement and collision risk combined for gannet features of SPAs screened in for assessment during operational and maintenance phase is presented.

21. A screening exercise has been undertaken to review whether the level of predicted impact excluding consideration of sabbatical rates would materially affect the outcomes made within the original RIAA. As presented in **Table 26**, no change has been found to the conclusions of the **RIAA** for each site of no potential for an AEoI alone or in-combination with other projects.

Table 26 Summary of effects presented in the Appropriate Assessment. Combined collision and displacement impacts apportioned to SPAs screened in for assessment annually.

Assessment	RIAA Assessment Conclusion	Change in RIAA conclusions?
Gannet Grassholm SPA	No potential for an AEoI alone or in-combination with other projects and plans	**No change** – combined collision and displacement impacts apportioned to the Grassholm SPA were predicted to increase by a maximum of one (1.2) breeding adult per annum at most. This level of increase does not present a tangible change in the level of impact predicted (<0.3% increase in baseline mortality) and would almost certainly be indistinguishable from natural fluctuations in the population; thus, the conclusions made within the RIAA of no potential for an AEoI alone or in-combination with other projects and plans remain the same.
Gannet Saltee Islands SPA	No potential for an AEoI alone or in-combination with other projects and plans	**No change** – combined collision and displacement impacts apportioned to the Grassholm SPA were predicted to increase by less than a single (<0.1) breeding adult per annum. This level of increase does not present a tangible change in the level of impact predicted (<0.1% increase in baseline mortality) and would almost certainly be indistinguishable from natural fluctuations in the population; thus, the conclusions made within the RIAA of no potential for an AEoI alone or in-combination with other projects and plans remain the same.
Gannet Ailsa Craig SPA	No potential for an AEoI alone or in-combination with other projects and plans	**No change**– combined collision and displacement impacts apportioned to the Grassholm SPA were predicted to increase by less than a single (<0.1) breeding adult per annum. This level of increase does not present a tangible change in the level of impact predicted (<0.06% increase in baseline

Assessment	RIAA Assessment Conclusion	Change in RIAA conclusions?
		mortality) and would almost certainly be indistinguishable from natural fluctuations in the population; thus, the conclusions made within the RIAA of no potential for an AEoI alone or in-combination with other projects and plans remain the same.

5. References

Natural England (2023). Natural England SoS Consultation Response. Annex 1: Interim guidance on collision risk modelling avoidance rates.

Parker, J., Fawcett, A., Banks, A., Rowson, T., Allen, S., Rowell, H., Harwood, A., Ludgate, C., Humphrey, O., Axelsson, M., Baker, A. & Copley, V. (2022). Offshore Wind Marine Environmental Assessments: Best Practice Advice for Evidence and Data Standards. Phase III: Expectations for data analysis and presentation at examination for offshore wind applications. Natural England. Version 1.2. 140 pp.

SNCBs, (2022) Joint SNCB Interim Displacement Advice Note: Advice on how to present assessment information on the extent and potential consequences of seabird displacement from Offshore Wind Farm (OWF) developments (updated January 2022 to include reference to the Joint SNCB Interim Advice on the Treatment of Displacement for Red-Throated Diver).

Woodward, I. et al. (2019) Desk-based revision of seabird foraging ranges used for HRA screening. BTO research report number 724. Thetford.

Appendix 1: Collision Risk Impacts

Grassholm SPA

Table A1 Summary of gannet operation and maintenance phase collision risk impacts apportioned to Grassholm SPA for the 15MW turbine scenario (NF 10 or 20) excluding macro avoidance.

Population Size (Breeding adults)	Season	Collision risk impact including sabbatical rates		Collision risk impact excluding sabbatical rates		Change in operation and maintenance phase collision impacts	
		Breeding adults per annum	Increase in baseline mortality rate (%)	Breeding adults per annum	Increase in baseline mortality rate (%)	Percentage change (%)	Increase in breeding adult mortalities per annum
Citation (66,000)	Full breeding (Mar – Sep)	1.69 – 1.77	0.032 – 0.033	1.87 – 1.97	0.035 – 0.037	11.1	0.2
	Post-breeding migration (Oct – Nov)	0.18 – 0.20	0.003 – 0.004	0.18 – 0.20	0.003 – 0.004	0.0	0.0
	Return migration (Dec – Feb)	0	0	0	0	0.0	0.0
	Annual	1.86 – 1.97	0.035 – 0.037	2.05 – 2.16	0.038 – 0.04	10.0-10.1	0.2
Latest Count (72,022)	Full breeding (Mar – Sep)	1.69 – 1.77	0.029 – 0.030	1.87 – 1.97	0.032 – 0.034	11.1	0.2
	Post-breeding migration (Oct – Nov)	0.18 – 0.20	0.003	0.18 – 0.20	0.003	0.0	0.0
	Return migration (Dec – Feb)	0	0	0	0	0.0	0.0

Population Size (Breeding adults)	Season	Collision risk impact including sabbatical rates		Collision risk impact excluding sabbatical rates		Change in operation and maintenance phase collision impacts	
		Breeding adults per annum	Increase in baseline mortality rate (%)	Breeding adults per annum	Increase in baseline mortality rate (%)	Percentage change (%)	Increase in breeding adult mortalities per annum
	Annual	1.86 – 1.97	0.032 – 0.340	2.05 – 2.16	0.035 – 0.037	10.0-10.1	0.2

Table A2 Summary of gannet operation and maintenance phase collision risk impacts apportioned to Grassholm SPA for the 15MW turbine scenario (NF 10 or 20) including macro avoidance.

Population Size (Breeding adults)	Season	Collision risk impact using a 70% macro-avoidance rate including sabbatical rates		Collision risk impact using a 70% macro-avoidance rate excluding sabbatical rates		Change in operation and maintenance phase collision impacts	
		Breeding adults per annum	Increase in baseline mortality rate (%)	Breeding adults per annum	Increase in baseline mortality rate (%)	Percentage change (%)	Increase in breeding adult mortalities per annum
Citation (66,000)	Full breeding (Mar – Sep)	0.51 – 0.53	0.009 – 0.010	0.56 – 0.59	0.011	10.0	0.1
	Post-breeding migration (Oct – Nov)	0.05 – 0.06	0.001	0.05 – 0.06	0.001	0.0	0.0
	Return migration (Dec – Feb)	0	0	0	0	0.0	0.0
	Annual	0.56 – 0.59	0.010 – 0.011	0.61 – 0.65	0.011 – 0.012	9.1	0.1
Latest Count (72,022)	Full breeding (Mar – Sep)	0.51 – 0.53	0.009	0.56 – 0.59	0.010	10.0	0.1
	Post-breeding migration (Oct – Nov)	0.05 – 0.06	0.001	0.05 – 0.06	0.001	0.0	0.0
	Return migration (Dec – Feb)	0	0	0	0	0.0	0.0
	Annual	0.56 – 0.59	0.010	0.61 – 0.65	0.011	9.1	0.1

Table A3 Summary of gannet operation and maintenance phase collision risk impacts apportioned to Grassholm SPA for the 18MW turbine scenario (NF 10 or 20) excluding macro avoidance.

Population Size (Breeding adults)	Season	Collision risk impact including sabbatical rates		Collision risk impact excluding sabbatical rates		Change in operation and maintenance phase collision impacts	
		Breeding adults per annum	Increase in baseline mortality rate (%)	Breeding adults per annum	Increase in baseline mortality rate (%)	Percentage change (%)	Increase in breeding adult mortalities per annum
Citation (66,000)	Full breeding (Mar – Sep)	2.30 – 2.46	0.043 – 0.046	2.56 – 2.73	0.048 – 0.051	11.1	0.3
	Post-breeding migration (Oct – Nov)	0.24 – 0.26	0.005	0.24 – 0.26	0.005	0.0	0.0
	Return migration (Dec – Feb)	0	0	0	0	0.0	0.0
	Annual	2.55 – 2.72	0.048 – 0.051	2.80 – 2.99	0.052 – 0.056	10.0	0.3
Latest Count (72,022)	Full breeding (Mar – Sep)	2.30 – 2.46	0.040 – 0.042	2.56 – 2.73	0.044 – 0.047	11.1	0.3
	Post-breeding migration (Oct – Nov)	0.24 – 0.26	0.004 – 0.005	0.24 – 0.26	0.004 – 0.005	0.0	0.0
	Return migration (Dec – Feb)	0	0	0	0	0.0	0.0
	Annual	2.55 – 2.72	0.044 – 0.047	2.80 – 2.99	0.048 – 0.051	10.0	0.3

Table A4 Summary of gannet operation and maintenance phase collision risk impacts apportioned to Grassholm SPA for the 18MW turbine scenario (NF 10 or 20) including macro avoidance.

Population Size (Breeding adults)	Season	Collision risk impact using a 70% macro-avoidance rate including sabbatical rates		Collision risk impact using a 70% macro-avoidance rate excluding sabbatical rates		Change in operation and maintenance phase collision impacts	
		Breeding adults per annum	Increase in baseline mortality rate (%)	Breeding adults per annum	Increase in baseline mortality rate (%)	Percentage change (%)	Increase in breeding adult mortalities per annum
Citation (66,000)	Full breeding (Mar – Sep)	0.69 – 0.74	0.013 – 0.014	0.77 – 0.82	0.014 – 0.015	10.0	0.1
	Post-breeding migration (Oct – Nov)	0.07 – 0.08	0.001	0.07 – 0.08	0.001	0.0	0.0
	Return migration (Dec – Feb)	0	0	0	0	0.0	0.0
	Annual	0.76 – 0.82	0.014 – 0.015	0.84 – 0.90	0.016 – 0.017	9.1	0.1
Latest Count (72,022)	Full breeding (Mar – Sep)	0.69 – 0.74	0.012 – 0.013	0.77 – 0.82	0.013 – 0.014	10.0	0.1
	Post-breeding migration (Oct – Nov)	0.07 – 0.08	0.001	0.07 – 0.08	0.001	0.0	0.0
	Return migration (Dec – Feb)	0	0	0	0	0.0	0.0
	Annual	0.76 – 0.82	0.013 – 0.014	0.84 – 0.90	0.014 – 0.015	9.1	0.1

Saltee Islands SPA

Table A5 Summary of gannet operation and maintenance phase collision risk impacts apportioned to Saltee Islands SPA for the 15MW turbine scenario (NF 10 or 20) excluding macro avoidance.

Population Size (Breeding adults)	Season	Collision risk impact including sabbatical rates		Collision risk impact excluding sabbatical rates		Change in operation and maintenance phase collision impacts	
		Breeding adults per annum	Increase in baseline mortality rate (%)	Breeding adults per annum	Increase in baseline mortality rate (%)	Percentage change (%)	Increase in breeding adult mortalities per annum
Citation (4,896)	Full breeding (Mar – Sep)	0.05	0.012	0.05	0.013	11.1	<0.1
	Post-breeding migration (Oct – Nov)	<0.01	0.001	<0.01	0.001	0.0	0.0
	Return migration (Dec – Feb)	0	0	0	0	0.0	0.0
	Annual	0.05	0.013	0.06	0.014 – 0.015	10.1-10.2	<0.1
Latest Count (9,444)	Full breeding (Mar – Sep)	0.05	0.006	0.05	0.007	11.1	<0.1
	Post-breeding migration (Oct – Nov)	<0.01	0.001	<0.01	0.001	0.0	0.0
	Return migration (Dec – Feb)	0	0	0	0	0.0	0.0
	Annual	0.05	0.007	0.06	0.007 – 0.008	10.1-10.2	<0.1

Table A6 Summary of gannet operation and maintenance phase collision risk impacts apportioned to Saltee Islands SPA for the 15MW turbine scenario (NF 10 or 20) including macro avoidance.

Population Size (Breeding adults)	Season	Collision risk impact using a 70% macro-avoidance rate including sabbatical rates		Collision risk impact using a 70% macro-avoidance rate excluding sabbatical rates		Change in operation and maintenance phase collision impacts	
		Breeding adults per annum	Increase in baseline mortality rate (%)	Breeding adults per annum	Increase in baseline mortality rate (%)	Percentage change (%)	Increase in breeding adult mortalities per annum
Citation (4,896)	Full breeding (Mar – Sep)	0.01	0.003 – 0.004	0.02	0.004	11.1	<0.1
	Post-breeding migration (Oct – Nov)	<0.01	<0.001	<0.01	<0.001	0.0	0.0
	Return migration (Dec – Feb)	0	0	0	0	0.0.	0.0
	Annual	0.01 - 0.02	0.004	0.02	0.004	10.1 – 10.2	<0.1
Latest Count (9,444)	Full breeding (Mar – Sep)	0.01	0.002	0.02	0.002	11.1	<0.1
	Post-breeding migration (Oct – Nov)	<0.01	<0.001	<0.01	<0.001	0.0	0.0
	Return migration (Dec – Feb)	0	0	0	0	0.0.	0.0
	Annual	0.01 - 0.02	0.002	0.02	0.002	10.1 – 10.2	<0.1

Table A7 Summary of gannet operation and maintenance phase collision risk impacts apportioned to Saltee Islands SPA for the 18MW turbine scenario (NF 10 or 20) excluding macro avoidance.

Population Size (Breeding adults)	Season	Collision risk impact including sabbatical rates		Collision risk impact excluding sabbatical rates		Change in operation and maintenance phase collision impacts	
		Breeding adults per annum	Increase in baseline mortality rate (%)	Breeding adults per annum	Increase in baseline mortality rate (%)	Percentage change (%)	Increase in breeding adult mortalities per annum
Citation (4,896)	Full breeding (Mar – Sep)	0.06 – 0.07	0.016 - 0.017	0.07	0.018 – 0.019	11.1	<0.1
	Post-breeding migration (Oct – Nov)	0.01	0.001 – 0.002	0.01	0.001 – 0.002	0.0	0.0
	Return migration (Dec – Feb)	0	0	0	0	0.0	0.0
	Annual	0.07	0.017 – 0.018	0.08	0.019 – 0.020	10.1	<0.1
Latest Count (9,444)	Full breeding (Mar – Sep)	0.06 – 0.07	0.008 – 0.009	0.07	0.009 – 0.010	11.1	<0.1
	Post-breeding migration (Oct – Nov)	0.01	0.001	0.01	0.001	0	0.0
	Return migration (Dec – Feb)	0	0	0	0	0	0.0
	Annual	0.07	0.009 – 0.010	0.08	0.010 – 0.011	10.1	<0.1

Table A8 Summary of gannet operation and maintenance phase collision risk impacts apportioned to Saltee Islands SPA for the 18MW turbine scenario (NF 10 or 20) including macro avoidance.

Population Size (Breeding adults)	Season	Collision risk impact using a 70% macro-avoidance rate including sabbatical rates		Collision risk impact using a 70% macro-avoidance rate excluding sabbatical rates		Change in operation and maintenance phase collision impacts	
		Breeding adults per annum	Increase in baseline mortality rate (%)	Breeding adults per annum	Increase in baseline mortality rate (%)	Percentage change (%)	Increase in breeding adult mortalities per annum
Citation (4,896)	Full breeding (Mar – Sep)	0.02	0.005	0.02	0.005 – 0.006	11.1	<0.1
	Post-breeding migration (Oct – Nov)	<0.01	<0.001	<0.01	<0.001	0.0	0.0
	Return migration (Dec – Feb)	0	0	0	0	0.0	0.0
	Annual	0.02	0.005 – 0.006	0.02	0.006	10.1	<0.1
Latest Count (9,444)	Full breeding (Mar – Sep)	0.02	0.002 – 0.003	0.02	0.003	11.1	<0.1
	Post-breeding migration (Oct – Nov)	<0.01	<0.001	<0.01	<0.001	0.0	0.0
	Return migration (Dec – Feb)	0	0	0	0	0.0	0.0
	Annual	0.02	0.003	0.02	0.003	10.1	<0.1

Ailsa Craig SPA

Table A9 Summary of gannet operation and maintenance phase collision risk impacts apportioned to Ailsa Craig SPA for the 15MW turbine scenario (NF 10 or 20) excluding macro avoidance.

Population Size (Breeding adults)	Season	Collision risk impact including sabbatical rates		Collision risk impact excluding sabbatical rates		Change in operation and maintenance phase collision impacts	
		Breeding adults per annum	Increase in baseline mortality rate (%)	Breeding adults per annum	Increase in baseline mortality rate (%)	Percentage change (%)	Increase in breeding adult mortalities per annum
Citation (46,000)	Full breeding (Mar – Sep)	0.04	0.001	0.04	0.001	11.1	<0.1
	Post-breeding migration (Oct – Nov)	0.12 – 0.13	0.003 – 0.004	0.12 – 0.13	0.003 – 0.004	0.0	0.0
	Return migration (Dec – Feb)	0	0	0	0	0.0	0.0
	Annual	0.16 – 0.17	0.004 – 0.005	0.16 – 0.18	0.004 – 0.005	2.5 – 2.6	<0.1
Latest Count (66,452)	Full breeding (Mar – Sep)	0.04	0.001	0.04	0.001	11.1	<0.1
	Post-breeding migration (Oct – Nov)	0.12 – 0.13	0.002 – 0.003	0.12 – 0.13	0.002 – 0.003	0.0	0.0
	Return migration (Dec – Feb)	0	0	0	0	0.0	0.0
	Annual	0.16 – 0.17	0.003	0.16 – 0.18	0.003	2.5 – 2.6	<0.1

Table A10 Summary of gannet operation and maintenance phase collision risk impacts apportioned to Ailsa Craig SPA for the 15MW turbine scenario (NF 10 or 20) including macro avoidance.

Population Size (Breeding adults)	Season	Collision risk impact using a 70% macro-avoidance rate including sabbatical rates		Collision risk impact using a 70% macro-avoidance rate excluding sabbatical rates		Change in operation and maintenance phase collision impacts	
		Breeding adults per annum	Increase in baseline mortality rate (%)	Breeding adults per annum	Increase in baseline mortality rate (%)	Percentage change (%)	Increase in breeding adult mortalities per annum
Citation (46,000)	Full breeding (Mar – Sep)	0.01	<0.001	0.01	<0.001	11.1	<0.1
	Post-breeding migration (Oct – Nov)	0.04	0.001	0.04	0.001	0.0	0.0
	Return migration (Dec – Feb)	0	0	0	0	0.0	0.0
	Annual	0.05	0.001	0.05	0.001	2.5 – 2.6	<0.1
Latest Count (66,452)	Full breeding (Mar – Sep)	0.01	<0.001	0.01	<0.001	11.1	<0.1
	Post-breeding migration (Oct – Nov)	0.04	0.001	0.04	0.001	0.0	0.0
	Return migration (Dec – Feb)	0	0	0	0	0.0	0.0
	Annual	0.05	0.001	0.05	0.001	2.5 – 2.6	<0.1

Table A11 Summary of gannet operation and maintenance phase collision risk impacts apportioned to Ailsa Craig SPA for the 18MW turbine scenario (NF 10 or 20) excluding macro avoidance.

Population Size (Breeding adults)	Season	Collision risk impact including sabbatical rates		Collision risk impact excluding sabbatical rates		Change in operation and maintenance phase collision impacts	
		Breeding adults per annum	Increase in baseline mortality rate (%)	Breeding adults per annum	Increase in baseline mortality rate (%)	Percentage change (%)	Increase in breeding adult mortalities per annum
Citation (46,000)	Full breeding (Mar – Sep)	0.05	0.001	0.06	0.001 – 0.002	11.1	<0.1
	Post-breeding migration (Oct – Nov)	0.17 – 0.18	0.005	0.17 – 0.18	0.005	0.0	0.0
	Return migration (Dec – Feb)	0	0	0	0	0.0	0.0
	Annual	0.22 – 0.23	0.006	0.22 – 0.24	0.006	2.5	<0.1
Latest Count (66,452)	Full breeding (Mar – Sep)	0.05	0.001	0.06	0.001	11.1	<0.1
	Post-breeding migration (Oct – Nov)	0.17 – 0.18	0.003	0.17 – 0.18	0.003	0.0	0.0
	Return migration (Dec – Feb)	0	0	0	0	0.0	0.0
	Annual	0.22 – 0.23	0.004	0.22 – 0.24	0.004	2.5	<0.1

Table A12 Summary of gannet operation and maintenance phase collision risk impacts apportioned to Ailsa Craig SPA for the 18MW turbine scenario (NF 10 or 20) including macro avoidance.

Population Size (Breeding adults)	Season	Collision risk impact using a 70% macro-avoidance rate including sabbatical rates		Collision risk impact using a 70% macro-avoidance rate excluding sabbatical rates		Change in operation and maintenance phase collision impacts	
		Breeding adults per annum	Increase in baseline mortality rate (%)	Breeding adults per annum	Increase in baseline mortality rate (%)	Percentage change (%)	Increase in breeding adult mortalities per annum
Citation (46,000)	Full breeding (Mar – Sep)	0.01 – 0.02	<0.001	0.02	<0.001	11.1	<0.1
	Post-breeding migration (Oct – Nov)	0.05	0.001	0.05	0.001	0.0	0.0
	Return migration (Dec – Feb)	0	0	0	0	0.0	0.0
	Annual	0.07	0.002	0.07	0.002	2.5	<0.1
Latest Count (66,452)	Full breeding (Mar – Sep)	0.01 – 0.02	<0.001	0.02	<0.001	11.1	<0.1
	Post-breeding migration (Oct – Nov)	0.05	0.001	0.05	0.001	0.0	0.0
	Return migration (Dec – Feb)	0	0	0	0	0.0	0.0
	Annual	0.07	0.001	0.07	0.001	2.5	<0.1

Appendix 2: Displacement impacts

Grassholm SPA

Table B1 Summary of gannet operation and maintenance phase displacement impacts apportioned to Grassholm SPA using assumed minimum approach (60 – 80% displacement, 1% mortality).

Population Size (Breeding adults)	Season	Applicant's / SNCB's assumed minimum approach displacement impact including sabbatical rates		Applicant's / SNCB's assumed minimum approach displacement impact excluding sabbatical rates		Change in operation and maintenance phase displacement impacts	
		60-80% Disp; 1% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	60-80% Disp; 1% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	Percentage change (%)	Increase in breeding adult mortalities per annum
Citation (66,000)	Full breeding (Mar – Sep)	0.75 – 1.00	0.014 – 0.019	0.83 -1.11	0.016 – 0.021	10.0	0.1
	Post-breeding migration (Oct – Nov)	0.12 – 0.16	0.002 – 0.003	0.12 – 0.16	0.002 – 0.003	0.0	0.0
	Return migration (Dec – Feb)	0.05 – 0.07	0.001	0.05 – 0.07	0.001	0.0	0.0
	Annual	0.92 – 1.23	0.017 – 0.023	1.01 – 1.34	0.025 – 0.188	8.3	0.1
Latest Count (72,022)	Full breeding (Mar – Sep)	0.75 – 1.00	0.013 – 0.017	0.83 -1.11	0.014 – 0.019	10.0	0.1
	Post-breeding migration (Oct – Nov)	0.12 – 0.16	0.002 – 0.003	0.12 – 0.16	0.002 – 0.003	0.0	0.0
	Return migration (Dec – Feb)	0.05 – 0.07	0.001	0.05 – 0.07	0.001	0.0	0.0
	Annual	0.92 – 1.23	0.016 – 0.021	1.01 – 1.34	0.023 – 0.172	8.3	0.1

Table B2 Summary of gannet operation and maintenance phase displacement impacts apportioned to Grassholm SPA using assumed maximum approach (60 – 80% displacement, 10% mortality).

Population Size (Breeding adults)	Season	Applicant's / SNCB's assumed maximum approach displacement impact including sabbatical rates		Applicant's / SNCB's assumed maximum approach collision and displacement impact excluding sabbatical rates		Change in operation and maintenance phase displacement impacts	
		60-80% Disp; 10% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	60-80% Disp; 10% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	Percentage change (%)	Increase in breeding adult mortalities per annum
Citation (66,000)	Full breeding (Mar – Sep)	7.47 – 9.96	0.140 – 0.186	8.30 – 11.06	0.155 – 0.207	10.0	0.8 – 1.1
	Post-breeding migration (Oct – Nov)	1.22 – 1.62	0.023 – 0.030	1.22 – 1.62	0.023 – 0.030	0.0	0.0
	Return migration (Dec – Feb)	0.54 – 0.72	0.010 – 0.014	0.54 – 0.72	0.010 – 0.014	0.0	0.0
	Annual	9.23 – 12.30	0.173 – 0.230	10.06 – 13.41	0.188 – 0.251	8.3	0.8 – 1.1
Latest Count (72,022)	Full breeding (Mar – Sep)	7.47 – 9.96	0.128 – 0.171	8.30 – 11.06	0.142 – 0.190	10.0	0.8 – 1.1
	Post-breeding migration (Oct – Nov)	1.22 – 1.62	0.021 – 0.028	1.22 – 1.62	0.021 – 0.028	0.0	0.0
	Return migration (Dec – Feb)	0.54 – 0.72	0.009 – 0.012	0.54 – 0.72	0.009 – 0.012	0.0	0.0
	Annual	9.23 – 12.30	0.158 – 0.211	10.06 – 13.41	0.172 – 0.230	8.3	0.8 – 1.1

Saltee Islands SPA

Table B3 Summary of gannet operation and maintenance phase displacement impacts apportioned to Saltee Islands SPA using assumed minimum approach (60 – 80% displacement, 1% mortality).

Population Size (Breeding adults)	Season	Applicant's / SNCB's assumed minimum approach displacement impact including sabbatical rates		Applicant's / SNCB's assumed minimum approach displacement impact excluding sabbatical rates		Change in operation and maintenance phase displacement impacts	
		60-80% Disp; 1% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	60-80% Disp; 1% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	Percentage change (%)	Increase in breeding adult mortalities per annum
Citation (4,892)	Full breeding (Mar – Sep)	0.02 – 0.03	0.006 – 0.007	0.03	0.007 – 0.008	10.0	<0.1
	Post-breeding migration (Oct – Nov)	<0.01	0.001	<0.01	0.001	0.0	0.0
	Return migration (Dec – Feb)	<0.01	0.001	<0.01	0.001	0.0	0.0
	Annual	0.03	0.007 – 0.008	0.03 – 0.04	0.008 – 0.009	8.2	<0.1
Latest Count (9.444)	Full breeding (Mar – Sep)	0.02 – 0.03	0.003 – 0.004	0.03	0.003 – 0.004	10.0	<0.1
	Post-breeding migration (Oct – Nov)	<0.01	0.000 – 0.001	<0.01	0.000 – 0.001	0.0	0.0

Population Size (Breeding adults)	Season	Applicant's / SNCB's assumed minimum approach displacement impact including sabbatical rates		Applicant's / SNCB's assumed minimum approach displacement impact excluding sabbatical rates		Change in operation and maintenance phase displacement impacts	
		60-80% Disp; 1% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	60-80% Disp; 1% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	Percentage change (%)	Increase in breeding adult mortalities per annum
	Return migration (Dec – Feb)	<0.01	<0.001	<0.01	<0.001	0.0	0.0
	Annual	0.03	0.004	0.03 – 0.04	0.004 – 0.005	8.2	<0.1

Table B4 Summary of gannet operation and maintenance phase displacement impacts apportioned to Saltee Islands SPA using assumed maximum approach (60 – 80% displacement, 10% mortality).

Population Size (Breeding adults)	Season	Applicant's / SNCB's assumed maximum approach displacement impact including sabbatical rates		Applicant's / SNCB's assumed maximum approach collision and displacement impact excluding sabbatical rates		Change in operation and maintenance phase displacement impacts	
		60-80% Disp; 10% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	60-80% Disp; 10% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	Percentage change (%)	Increase in breeding adult mortalities per annum
Citation (4,892)	Full breeding (Mar – Sep)	0.12 – 0.13	0.030 – 0.034	0.13 – 0.15	0.033 – 0.038	10.0	<0.1
	Post-breeding migration (Oct – Nov)	0.02	0.004 – 0.005	0.02	0.004 – 0.005	0.0	0.0
	Return migration (Dec – Feb)	0.01	0.003	0.01	0.003	0.0	0.0
	Annual	0.15 – 0.17	0.037 – 0.042	0.16 – 0.18	0.040 – 0.046	8.2	<0.1
Latest Count (9.444)	Full breeding (Mar – Sep)	0.12 – 0.13	0.015 – 0.018	0.13 – 0.15	0.017 – 0.020	10.0	<0.1
	Post-breeding migration (Oct – Nov)	0.02	0.002 – 0.003	0.02	0.002 – 0.003	0.0	0.0
	Return migration (Dec – Feb)	0.01	0.001 – 0.002	0.01	0.001 – 0.002	0.0	0.0
	Annual	0.15 – 0.17	0.019 – 0.022	0.16 – 0.18	0.021 – 0.024	8.2	<0.1

Ailsa Craig SPA

Table B5 Summary of gannet operation and maintenance phase displacement impacts apportioned to Ailsa Craig SPA using assumed minimum approach (60 – 80% displacement, 1% mortality).

Population Size (Breeding adults)	Season	Applicant's / SNCB's assumed minimum approach displacement impact including sabbatical rates		Applicant's / SNCB's assumed minimum approach displacement impact excluding sabbatical rates		Change in operation and maintenance phase displacement impacts	
		60-80% Disp; 1% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	60-80% Disp; 1% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	Percentage change (%)	Increase in breeding adult mortalities per annum
Citation (46,000)	Full breeding (Mar – Sep)	0.02	0.000 – 0.001	0.02	0.000 – 0.001	10.0	<0.1
	Post-breeding migration (Oct – Nov)	0.08 – 0.11	0.002 – 0.003	0.08 – 0.11	0.002 – 0.003	0.0	0.0
	Return migration (Dec – Feb)	0.04 – 0.05	0.001	0.04 – 0.05	0.001	0.0	0.0
	Annual	0.01 – 0.02	0.004 – 0.005	0.01 – 0.02	0.004 – 0.005	1.3	<0.1
Latest Count (66,452)	Full breeding (Mar – Sep)	0.02	<0.001	0.02	<0.001	10.0	<0.1
	Post-breeding migration (Oct – Nov)	0.08 – 0.11	0.002	0.08 – 0.11	0.002	0.0	0.0

Population Size (Breeding adults)	Season	Applicant's / SNCB's assumed minimum approach displacement impact including sabbatical rates		Applicant's / SNCB's assumed minimum approach displacement impact excluding sabbatical rates		Change in operation and maintenance phase displacement impacts	
		60-80% Disp; 1% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	60-80% Disp; 1% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	Percentage change (%)	Increase in breeding adult mortalities per annum
	Return migration (Dec – Feb)	0.04 – 0.05	0.001	0.04 – 0.05	0.001	0.0	0.0
	Annual	0.01 – 0.02	0.003	0.01 – 0.02	0.003	1.3	<0.1

Table B6 Summary of gannet operation and maintenance phase displacement impacts apportioned to Ailsa Craig SPA using assumed maximum approach (60 – 80% displacement, 10% mortality).

Population Size (Breeding adults)	Season	Applicant's / SNCB's assumed maximum approach displacement impact including sabbatical rates		Applicant's / SNCB's assumed maximum approach displacement impact excluding sabbatical rates		Change in operation and maintenance phase displacement impacts	
		60-80% Disp; 10% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	60-80% Disp; 10% Mort (Breeding adults per annum)	Increase in baseline mortality rate (%)	Percentage change (%)	Increase in breeding adult mortalities per annum
Citation (46,000)	Full breeding (Mar – Sep)	0.16 – 0.22	0.004 – 0.006	0.18 – 0.24	0.005 – 0.006	10.0	+<0.1
	Post-breeding migration (Oct – Nov)	0.84 – 1.12	0.023 – 0.030	0.84 – 1.12	0.023 – 0.030	0.0	0.0
	Return migration (Dec – Feb)	0.37 – 0.50	0.010 – 0.013	0.37 – 0.50	0.010 – 0.013	0.0	0.0
	Annual	1.38 – 1.83	0.037 – 0.049	1.39 – 1.86	0.037 – 0.050	1.3	+<0.1
Latest Count (66,452)	Full breeding (Mar – Sep)	0.16 – 0.22	0.003 – 0.004	0.18 – 0.24	0.003 – 0.004	10.0	+<0.1
	Post-breeding migration (Oct – Nov)	0.84 – 1.12	0.016 – 0.021	0.84 – 1.12	0.016 – 0.021	0.0	0.0
	Return migration (Dec – Feb)	0.37 – 0.50	0.007 – 0.009	0.37 – 0.50	0.007 – 0.009	0.0	0.0
	Annual	1.38 – 1.83	0.026 – 0.034	1.39 – 1.86	0.026 – 0.035	1.3	+<0.1

WHITE CROSS

White Cross Offshore Wind Farm ES Addendum

Appendix Q Annex 3: Cumulative and In-Combination Gap Analysis (WHX001-FLO-CON-ENV-ASS-0003)

WHITE CROSS

White Cross Offshore Windfarm: Cumulative Gap Analysis

Appendix Q Annex 3: Cumulative and In-combination Gap Analysis

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Contractor Document Number:		
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Glossary of Acronyms

Acronym	Definition
BDMPS	Biologically Defined Minimum Population Scales
CRM	Collision Risk Modelling
DCO	Development Consent Order
EIA	Environmental Impact Assessment
ES	Environmental Statement
HRA	Habitats Regulation Assessment
JNCC	Joint Nature Conservancy Council
km	Kilometre
Km^2	Square kilometre
m	Metre
MW	Megawatts
NE	Natural England
OWF	Offshore Windfarm
RIAA	Report to Inform Appropriate Assessment
SD	Standard Deviation
SMP	Seabird Monitoring Programme
SNCB	Statutory Nature Conservation Body
WTG	Wind Turbine Generator

Glossary of Terminology

Defined Term	Description
Applicant	Offshore Wind Limited
Cumulative effects	The effect of the Project taken together with similar effects from a number of different projects, on the same single receptor/resource. Cumulative Effects are those that result from changes caused by other past, present or reasonably foreseeable actions together with the Project.
Environmental Impact Assessment (EIA)	Assessment of the potential impact of the proposed Project on the physical, biological and human environment during construction, operation and decommissioning.
Offshore Wind Limited	Offshore Wind Ltd (OWL) is a joint venture between Cobra Instalaciones Servicios, S.A., and Flotation Energy Ltd
the Project	the Project is a proposed floating offshore windfarm called White Cross located in the Celtic Sea with a capacity of up to 100MW. It encompasses the project as a whole, i.e. all onshore and offshore infrastructure and activities associated with the Project.
White Cross Offshore Windfarm	Up to 100MW capacity offshore windfarm including associated onshore and offshore infrastructure
Wind Turbine Generators (WTG)	The wind turbine generators convert wind energy into electrical power. Key components include the rotor blades, nacelle (housing for electrical generator and other electrical and control equipment) and tower. The final selection of project wind turbine model will be made post-consent application
Windfarm Site	The area within which the wind turbines, Offshore Substation Platform and inter-array cables will be present

1. Introduction

1. White Cross Offshore Wind Limited (WCOWL) and Royal HaskoningDHV requested APEM Ltd (APEM) to undertake a gap analysis exercise for White Cross Offshore Wind Farm (OWF) to inform updated cumulative impact values for projects in the western UK waters that are operational but do not have quantified impact on offshore ornithology, due to the differences in how historic OWF projects were assessed. The aim of the gap analysis was to assign impacts to historic OWF projects and consider any changes this may pose to cumulative assessments.

2. Following the submission of **Chapter 13: Offshore Ornithology** of the **Offshore Environmental Statement (ES)** (Document Reference: FLO-WHI-REP-0002-13), Natural England provided comment to the Marine Management Organisation as part of the statutory consultation for the Marine Licence and Section 36 Consent applications (Reference: MLA/2023/00113) (Natural England, 2023a). A key concern highlighted by Natural England is as follows:

   "cumulative and in-combination assessments do not factor in impacts from a number of other projects due to lack of data. Impacts specified as 'unknown' have been treated as zero which will inevitably underestimate impacts, potentially significantly."

3. Following this request, a gap analysis has been conducted in order to provide an estimation of the potential impacts posed by these historic projects.

4. Updated cumulative effects assessments of displacement have been calculated for:

- Guillemot
- Razorbill
- Puffin
- Manx shearwater
- Gannet.

5. Updated collision risk impact values for use in cumulative effects assessments have been calculated for:

- Kittiwake
- Lesser black-backed gull
- Herring gull
- Great black-backed gull
- Gannet.

6. The species that were chosen for updated cumulative assessments for displacement and/ or collision were chosen in order to replicate the species

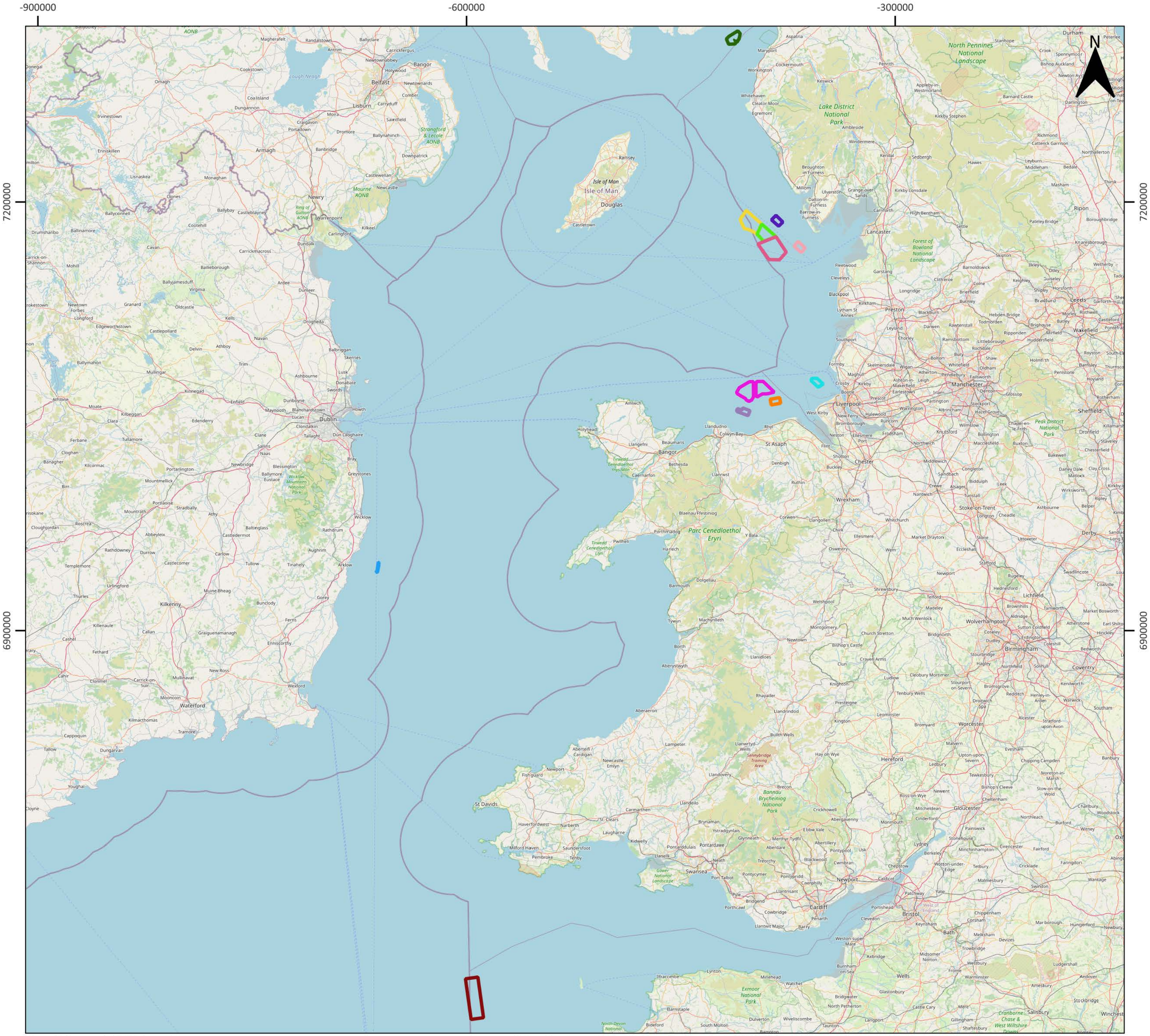
scoped in for assessment within the FLO-WHI-REP-0002-13 **Chapter 13: Offshore Ornithology** of the **Offshore ES**.

7. This report focuses on providing updated cumulative assessments only. This is because as presented within the **Report to Inform Appropriate Assessment (RIAA)** (see **Appendix 6.A** of **Chapter 6 EIA Methodology** of the **Onshore ES** (FLO-WHI-REP-0016-06)), even when considering Natural England's worst case assessment approaches, the Project's contribution to any in-combination effect can confidently be concluded as in-tangible. Additionally, given the geographical location of the historic projects, connectivity is limited to the designated sites and features for which the Project undertook in-combination assessments for. Therefore, it can be confidently concluded that the results of this gap analysis would not materially change the in-combination assessment conclusions originally drawn within the **RIAA**.

1.1 Historic Projects

8. A total of 11 OWF projects were identified as being absent of impact values and thus required attention within the gap analysis exercise. These projects required analysis to assign an estimation of the impact values attributed to them. All 11 projects are located within the Irish sea, with six of the projects situated off the coast of northwest England, three projects situated off the North Wales coast, one is located off the southwest coast of Scotland and the final project is located off the East coast of Ireland (see **Figure 1**). All projects, are predicted to undergo decommissioning 20-30 years post commission and so this timeline is provided for context. Project specific decommissioning information is not currently known for the historic projects.

9. These 11 projects are hereafter referred to as the "historic" projects or wind farms throughout this report.



APEM Group

P14531 White Cross Cumulative Gap Analysis

Offshore Wind Farm Projects Requiring Gap Analysis plus White Cross

Legend

- Arklow Bank Phase 1
- Robin Rigg
- Rhyl Flats
- North Hoyle
- Barrow
- Gwynt y Mor
- Ormonde
- West of Duddon Sands
- Burbo Bank
- Walney Phase 1
- Walney Phase 2
- White Cross
- Maritime Boundary

Notes

Basemap: Contains Ordnance Survey data © Crown copyright and database rights (2024). OS OpenData

Coordinate System: WGS 84 / Pseudo-Mercator

0 60 120 km

Scale:	Date:	Drawn by:	Approved by:
1:3600000 @ A4	19/06/2024	AW	MB

Riverview
A17 The Embankment Business Park
Heaton Mersey
Stockport
SK4 3GN
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+44 (0) 161 442 8938

Figure Reference: P14531 Array Areas

1.1.1 Arklow Bank

10. Arklow Bank OWF is a small site at 1.4km2, located off the east coast of Ireland, approximately 12.7km off Arklow. The project was consented in 2002 and fully commissioned in 2004 and consists of seven turbines with an as-built rotor radius of 52 metres. There is no publicly available information of a decommissioning date for Arklow Bank OWF, but considering a minimum project lifespan of 20-30 years, provides an estimated decommission date between 2022 and 2032. Arklow Bank has not started the decommission process even though 20 years has passed and so a minimum lifespan end of 2032 was assumed. Due to the age of the project, limited information regarding the project is publicly available and it is not known if any surveys of offshore ornithology were conducted.

1.1.2 Barrow

11. Barrow OWF is a relatively small OWF at 10km2, located off the northwest coast of England, approximately 7.2km off the southwestern tip of Walney Island. The project was consented in 2003 and fully commissioned in 2006 and consists of 30 turbines with an as-built rotor radius of 45 metres. There is no publicly available information of a decommissioning date for Barrow OWF, but considering a minimum project lifespan of 20-30 years providing an estimated decommission date between 2026 and 2036. Due to the age of the project limited information regarding the project is publicly available and so it is not possible to understand whether any surveys of offshore ornithology were conducted.

1.1.3 Burbo Bank

12. Burbo Bank OWF is a relatively small OWF at 9.9km2, located off the northwest coast of England, approximately 6.4km off the coast of Crosby within Liverpool Bay. The project was consented in 2001 and fully commissioned in 2007 and consists of 30 turbines, with the consented rotor radius of 45 metres. There is no publicly available information indicating a decommissioning date for Burbo Bank OWF, but considering a minimum project lifespan of 20-30 years, provides an estimated decommission date between 2027 and 2037. The Burbo Bank ES (SeaScape Energy Ltd, 2002a) describes aerial surveys of the Burbo Bank array area were conducted in the winter of 2001 to 2002, specifically for common scoter abundance estimate calculations. Boat based surveys of the Burbo Bank array area plus a 2km buffer were also carried out, but these only included two surveys within December 2001 and February 2002. No abundance estimates are provided within the Burbo Bank ES Chapter (SeaScape Energy Ltd, 2002a).

1.1.4 Gwynt y Môr

13. Gwynt y Môr OWF is a moderate size OWF at 68km2, located off the north coast of North Wales, approximately 13.8km off the coast of Abergele. The project was

consented in 2008 and fully commissioned in 2015 and consists of 250 turbines with consented rotor radius of 45 metres. There is no publicly available information indicating a decommissioning date for Gwynt y Môr OWF, but considering a minimum project lifespan of 20-30 years, provides an estimated decommission date between 2028 and 2038. Due to the age of the project limited information regarding the project is publicly available and so it is not possible to understand whether any surveys of offshore ornithology were conducted.

1.1.5 North Hoyle

14. North Hoyle is a relatively small OWF at 9.6km2, located off the North coast of Wales, approximately 7.6km off the coast of Prestatyn. The project was consented in 2002 and fully commissioned in 2003 and consists of 30 turbines with consented rotor radius of 50 metres. There is no publicly available information indicating a decommissioning date for North Hoyle OWF, but considering a minimum project lifespan of 20-30 years, provides an estimated decommission date between 2022 and 2032. North Hoyle has not started the decommission process even though 20 years has passed and so a lifespan end of 2033 was assumed. Due to the age of the project limited information regarding the project is publicly available and so it is not possible to understand whether any surveys of offshore ornithology were conducted.

1.1.6 Ormonde

15. Ormonde is a relatively small OWF at 9.9km2, located off the northwest coast of England approximately 9.3km off Walney island. The project was consented in 2007 and fully commissioned in 2012 and consists of 30 turbines with a consented rotor radius of 55 metres. There is no publicly available information indicating a decommissioning date for Ormonde OWF, but considering a minimum project lifespan of 20-30 years, provides an estimated decommission date between 2033 and 2043. Due to the age of the project limited information regarding the project is publicly available and so it is not possible to understand the ornithological surveys and abundance data that was collected for the site.

1.1.7 Rhyl Flats

16. Rhyl Flats is a relatively small OWF at 9.7km2, located off the North coast of Wales approximately 9.3km off Abergele. The project was consented in 2002 and fully commissioned in 2009 and consists of 25 turbines with an as-built rotor radius of 53.5 metres. There is no publicly available information indicating a decommissioning date for Rhyl Flats OWF, but considering a minimum project lifespan of 20-30 years, provides an estimated decommission date between 2029 and 2039. Due to the age of the project limited information regarding the project

is publicly available and so it is not possible to understand the ornithological surveys and abundance data that was collected for the site.

1.1.8 Robin Rigg

17. Robin Rigg is a relatively small OWF at 18.4km2, located off the southwest coast of Scotland within the Solway Firth approximately 9.4km from Rascarrel. The project was consented in 2003 and fully commissioned in 2010 and consists of 60 turbines with an as-built rotor radius of 45 metres. There is no publicly available information regarding a decommissioning date for Robin Rigg OWF, but considering a minimum project lifespan of 20-30 years, provides an estimated decommission date between 2030 and 2040. Due to the age of the project limited information regarding the project is publicly available and so it is not possible to understand the ornithological surveys and abundance data that was collected for the site.

1.1.9 Walney Phase 1

18. Walney Phase 1 OWF is a moderately sized array at 27.2km2, located off the West coast of England approximately 14km off Walney island. The project was consented in 2007 and fully commissioned in 2011 and consists of 51 turbines with a consented rotor radius of 60 metres. There is no publicly available information regarding a decommissioning date for Walney Phase 1 OWF, but considering a minimum project lifespan of 20-30 years, provides an estimated decommission date between 2041 and 2051. Due to the age of the project limited information regarding the project is publicly available and so it is not possible to understand the ornithological surveys and abundance data that was collected for the site.

1.1.10 Walney Phase 2

19. Walney Phase 2 OWF is a moderately sized array at 45.9km2, located off the West coast of England approximately 17.7km off Walney island. The project was consented in 2007 and fully commissioned in 2012 and consists of 51 turbines with a consented rotor radius of 60 metres. There is no publicly available information regarding a decommissioning date for Walney Phase 2 OWF, but considering a minimum project lifespan of 20-30 years, provides an estimated decommission date between 2042 and 2052. Due to the age of the project limited information regarding the project is publicly available and so it is not possible to understand the ornithological surveys and abundance data that was collected for the site.

1.1.11 West of Duddon Sands

20. West of Duddon Sands OWF is a moderately sized array at 66.9km2, located off the West coast of England approximately 14.2km off Walney island. The project was consented in 2008 and fully commissioned in 2014 and consists of 139 turbines with a consented rotor radius of 62 metres. There is no publicly available information indicating a decommissioning date for West of Duddon Sands OWF, but considering a minimum project lifespan of 20-30 years, provides an estimated decommission date between 2044 and 2054. Due to the age of the project limited information regarding the project is publicly available and so it is not possible to understand the ornithological surveys and abundance data that was collected for the site.

1.2 Species Accounts

21. As described in **Section 1.1**, the OWFs to be evaluated were all fully commissioned across a timeframe of 13 years, with the first project fully commissioned in 2003 (North Hoyle) and the most recent project in 2015 (Gwynt y Môr). All projects have been operational for at least nine years. Since the commissioning of the first OWF, 21 years has passed and so it is important to consider species trends within the area to understand changes in the seabird species likely to be found at the sites. Full consideration of species trends for the historic projects are provided in **Section 5**. Consideration has therefore been given to the change in national trends between the seabird 2000 census (1998 to 2002; Burnell et al, 2023) and the latest national seabirds count (2015 to 2021; Burnell et al, 2023) to cover the approximate timeframes between commissioning of the earliest and latest projects in Western UK waters.

22. Within the FLO-WHI-REP-0002-13 **Chapter 13: Offshore Ornithology** of the **Offshore ES** (APEM & Royal HaskoningDHV, 2023a) a screening table was provided which indicated the species to be subject to displacement impact analysis and collision impact analysis. The screening process concluded that kittiwake, lesser black-backed gull, herring gull, great black-backed gull and gannet should be assessed for collision impacts. For displacement analysis guillemot, razorbill, puffin, Manx shearwater and gannet were assessed. A further, combined, assessment was conducted for gannet as it was considered for both collision and displacement impact assessments. These are the species that are considered within this report.

1.2.1 Kittiwake

23. Kittiwake numbers around the UK and Ireland have seen a collective decrease of 42% between the Seabird 2000 census (1998 to 2002) and the Seabirds Count (2015 to 2021). Numbers in England have decreased by 4%, with a decline of 57% in the number of kittiwakes in Scottish colonies. In addition, the population of Ireland as a whole has declined by 18% and the Welsh population has declined by 34%. The cause of such declines is understood to be due to the effects of climate change and the consequent impacts this has on the prey species distribution and availability to the kittiwake populations (Burnell et al, 2023).

24. When focused on the areas in which the historic wind farms are located (Irish Sea and surrounding areas) assessments at a more regional level have been considered further. At a regional level, there have been declines in northwest England, Western Scotland, North Wales and Eastern Ireland, with a decrease of 36% in Cumbria, 47% in Argyll and Bute, 35% at Gwynedd, 3% at Wigtown and 5% at Wicklow, from 2000 to 2021. The smaller populations in Lancashire are increasing (Burnell et al, 2023) which is likely due to the occupancy of offshore structures within the Irish Sea (SMP, 2024).

1.2.2 Great black-backed gull

25. Between Seabird 2000 (1998 to 2002) and the recent Seabirds Count (2015 to 2021), great black-backed gull numbers around the UK and Ireland have declined by 43% collectively. Numbers have decreased by 3% in England whereas the Scottish population has decreased by 63%. The reasons for this north-south divide in population trends are unclear, but as with other large gulls, the declines are thought to be primarily driven by a decrease in food availability due to commercial fisheries' activity (Burnell et al, 2023). Numbers in Wales and throughout Ireland have increased by 49% and 43%, respectively. As productivity rate in these areas are sustainable, the increase is likely due to the absence of the impacts in other regions that are affecting adult survival.

26. When focused on the areas in which the historic wind farms are located (Irish Sea and surrounding areas), at a regional level, the populations of Argyll and Bute and Cumbria have declined by 70% and 51%, respectively. Smaller populations in Wigtownshire, Lancashire and North Wales have increased. Similarly, county Wicklow and Wexford in Ireland have also shown population increases of 1% and 50%, respectively.

1.2.3 Herring gull

27. Herring gull numbers around the UK and Ireland have decreased by 44% as a whole, between the colony counts recorded between the Seabird 2000 census (1998 to 2002) and the Seabirds Count (2015 to 2021). Numbers in England have decreased by 60%, with declines of 44% in Scotland and 23% in Wales. A reduction in food availability from fishing discards has likely been one of the main drivers of these declines. Conversely, the population for the whole of Ireland has increased by 108% (Burnell et al, 2023) which could be linked to the close proximity of nesting sites to agricultural habitat supplying a plentiful food source. In addition to naturally nesting birds, there has been an expansion in the urbanisation of herring gulls, with as many as 185,560 pairs nesting in urban habitats around the UK and Ireland (Burnell et al, 2023).

28. When focused on the areas in which the historic wind farms are located (Irish Sea and surrounding areas) assessments at a more regional level have been considered further. At a regional level there have been declines in northwest England and Western Scotland, with a 96% reduction in numbers in Cumbria and an 80% decline in Argyll and Bute. However, the smaller population of Lancashire has remained relatively stable with an 8% decrease. For the East of Ireland there are contrasts in the population trends for herring gull, with an increase of 53% for County Wexford but a decline of 14% at County Wicklow (Burnell et al, 2023).

1.2.4 Lesser black-backed gull

29. From Seabird 2000 (1998 to 2002) until the recent Seabirds Count (2015 to 2021), naturally nesting lesser black-backed gull numbers around the UK and Ireland have declined by 40% (Burnell et al, 2023). Numbers in England have declined by 56%, with similar declines seen in Scotland (48%) and Wales (45%). The main drivers of the decline are thought to be reduced food availability, due to a change in fisheries activity, as well as culling under general licences, which has only recently changed (Burnell et al, 2023). The population of Ireland has increased by 259%, likely due to greater coverage of coastal sites during surveys as well as the dispersal of lesser black-backed gulls from colonies in Britain. In addition to naturally nesting birds, there has been an expansion in the urbanisation of lesser black-backed gulls, with as many as 271,535 pairs nesting in urban habitats around the UK and Ireland (Burnell et al, 2023).

30. When focused on the areas in which the historic wind farms are located (Irish Sea and surrounding areas), at a regional level there have been steep declines in northwest England, particularly in the colonies at Walney Island in Cumbria and Bowland Fells in Lancashire. The populations of these counties declined by 97% and 16% respectively, amounting to a loss of approximately 29,500 breeding pairs (Burnell et al, 2023). Similarly, the population at Argyll and Bute

has declined by 93% and numbers in Gwynedd decreased by 34%. Conversely, the lesser black-backed gull count at County Wexford on the east coast of Ireland has seen an increase of 53%.

1.2.5 Guillemot

31. Between Seabird 2000 (1998 to 2002) and the Seabirds Count (2015 to 2021), guillemot numbers around the UK and Ireland have seen an overall decline of 8%. Numbers have increased by 106% in England, 40% in Ireland and 76% in Wales, with strong declines seen in Scotland (31%) and the Channel Islands (18%) (Burnell et al, 2023). The apparent north south divide in guillemot trend is likely due to prey species availability, which is lower in Scotland compared to the remainder of the UK, thus reducing productivity of guillemot colonies.

32. When focused on the areas in which the historic wind farms are located (Irish Sea and surrounding areas) assessments at a more regional level have been considered further. At the regional level, in Western Scotland the population of Wigtownshire has declined by 56% and that of Lochaber has decreased by 38%. Conversely, the populations of Cumbria in England and Gwynedd in Wales have increased by 146% and 58%, respectively. Populations on the East coast of Ireland have also increased by 21% and 205% for County Wexford and County Wicklow, respectively.

1.2.6 Razorbill

33. Razorbill numbers around the UK and Ireland have seen an increase of 18% from the counts recorded between the Seabird 2000 census (1998 to 2000) and the Seabirds Count census (2015 to 2021). Numbers in England have increased by as much as 260%, with a slight decline of 2% in the number of razorbills in Scottish colonies (Burnell et al, 2023). The population in Ireland has increased by 11% and numbers in Wales have increased by 82%. Potential differences between the north and south colonies are likely due to higher fishing demand in Scotland on razorbill's prey species and an increase in adverse weather effects causing mass mortality events during the non-breeding season (Burnell et al, 2023).

34. When focused on the areas in which the historic wind farms are located (Irish Sea and surrounding areas) assessments at a more regional level have been considered further. Most razorbill populations in northwest England and Western Scotland have declined, with decreases of 51% in Argyll and Bute, 26% in Lochaber, 61% in Wigtown and 70% in Cumbria (Burnell et al, 2023). However, along the North coast of Wales there has been an increase of 95% recorded in Gwynedd. Population trends on the East coast of Ireland are mixed, with a decline of 51% in County Wicklow but an increase of 74% in County Wexford.

1.2.7 Puffin

35. Puffin numbers around the UK and Ireland have decreased by 24% between the Seabird 2000 census (1998 to 2000) and the Seabirds Count census (2015 to 2021). Puffin numbers have increased by 50% in England and 197% in Wales, compared to a reduction of 32% in Scotland and 29% in Ireland. The cause for the difference in numbers between northern and southern colonies is unknown, but likely causes are due to reduced prey availability, with different colonies exhibiting marked differences in the prey species composition and overall biomass (Burnell et al, 2023).

36. When focused on the areas in which the historic wind farms are located (Irish Sea and surrounding areas) assessments at a more regional level have been considered further. Population trends in Western Scotland are largely positive, with increases of 153% in Argyll and Bute and 365% in Lochaber. In northwest England, numbers in Cumbria decreased from 9 to 5 pairs (one small colony at St Bees Head), whereas the population in North Wales increased by 41%. The puffin count at County Wexford on the East coast of Ireland has seen a reduction of 82% (Burnell et al, 2023).

1.2.8 Manx shearwater

37. Between the Seabird 2000 census (1998 to 2002) and the Seabirds Count census (2015 to 2021), numbers of Manx shearwaters around the UK and Ireland have increased by 174% collectively. Numbers in Scotland have increased by 133% with numbers around England showing a large increase of 1,554% (Burnell et al, 2023). Numbers have also increased in Wales (186%) and in Ireland (265%). The increase in the UK and Ireland Manx shearwater population is understood to be due to the effective removal of non-native predators (brown rats and/ or black rats) from known breeding areas (Burnell et al, 2023).

38. Areas in which the historic wind farms are located (Irish Sea and surrounding areas) assessments at a more regional level have been considered further. All Manx shearwater populations in the region have seen an increase. The population in North Wales at Gwynedd has increased by 28% with the population on the East coast of Ireland in County Wexford showing an increase of 324% (Burnell et al, 2023).

1.2.9 Gannet

39. Gannet numbers around the UK and Ireland have increased by 38% between the Gannet Census of 2003 and the Seabirds Count of 2015-2021 (Burnell et al, 2023). Numbers around England have increased by 240% while numbers around Scotland have increased by 40%. The population for Ireland has increased by 33% and the one major colony in Wales, on Grassholm Island, increased by 12%. The increase in gannet numbers is understood to be due to a reduction in human exploitation (egg, chick and adult harvest), reduced levels of bycatch and reduced oiling events allowing the subsequent rise in the population (Burnell et al, 2023).

40. The areas in which the historic wind farms are located (Irish Sea and surrounding areas) assessments at a more regional level have been considered further. This positive population trends is a consistent theme across most gannet colonies in the region. In West Wales, the Grassholm colony has increased by 12%, with an increase also identified at Ireland's Eye (23%) on the East coast of Scotland (Burnell et al, 2023). In Scotland, the population of Ailsa Craig has increased by 22% but the colony at Scar Rocks has shown a small decrease in colony size of 1% between both censuses.

2. Methods

41. Estimated impact values for the historic OWF projects are required for the cumulative effects assessments for displacement and collision. Natural England provided, within their comments on the reviewed FLO-WHI-REP-0002-13 **Chapter 13: Offshore Ornithology** of the **Offshore ES** (Natural England, 2023a), an outlined methodology to calculate proxy displacement and collision values for historic projects. The methods provided are as follows:

42. For displacement – "Review the submitted environmental statement. It is accepted that displacement mortality estimates may not be presented. However, if there is abundance data, utilise this to populate project-specific displacement matrices for relevant species. We also suggest review of the Round 4 plan-level HRA to determine if any suitable estimates are presented therein. If no abundance data available… use a nearby windfarm with a published estimate of mortality arising from displacement as a proxy. Scale this estimate according to the relative area of the two arrays and appropriate buffers."

43. For collision – "Review the submitted environmental statement. It is accepted that collision mortality estimates may not be presented. However, if there is abundance data, utilise this to run project-specific collision risk models (CRM) according to current best practice for relevant species. We also suggest review of the Round 4 plan-level HRA to determine if any suitable estimates are presented therein. If no abundance data available use a nearby windfarm with a published estimate of mortality arising from collision as a proxy. Scale this estimate according to the relative number of turbines in the two arrays. The difference in the turbine specifications should be considered to determine if this method is likely to over or underestimate impact."

44. In-depth methodology of how the values have been calculated are provided in **Section 2.1** for displacement abundance values and **Section 2.2** for collision risk impact values.

2.1 Proxy displacement abundance values

45. Mean peak abundance values for species individual bio-season (Furness, 2015) are required for assessing the cumulative effects from displacement. Ordinarily, mean peak abundances are derived from a minimum of two years of baseline characterisation surveys carried out for the proposed development array area and an appropriate surrounding buffer (SNCB, 2017). However, no such surveys were undertaken for the historic projects prior to construction , so proxy project data from other OWFs were used in order to provide a value.

2.1.1 Obtaining proxy project information

46. Review of the OWF projects within the same area as the historic project, identified Awel y Môr OWF, Walney Extension OWF and Burbo Bank Extension OWF as the only current consented projects with sufficient baseline data to be deemed appropriate to provide proxy abundance values.

2.1.1.1 Awel y Môr

47. Awel y Môr OWF is an extension to the west of the historic Gwynt y Môr OWF with an array area of 78km^2 (excluding consideration of any buffers) and array area plus 2km buffer of 233.9km^2. A programme of 24 months of aerial digital surveys were conducted from March 2019 to February 2021, with full abundance estimate data provided for the project's array area and surveyed buffers within the Awel y Môr Baseline Characterisation Report (RWE, 2022a). The abundance estimates of the five seabird species of interest for the Awel y Môr array area plus 2km buffer are provided in **Table 1**. Abundance estimates for Awel y Môr array area plus 2km buffer are used as proxy for the historic projects.

Table 1 Abundance estimates for Awel y Môr array area plus 2km buffer

Month	Guillemot	Razorbill	Puffin	Manx shearwater	Gannet
Mar-19	1,738	507	0	0	0
Apr-19	532	61	0	0	38
May-19	464	0	0	13	0
Jun-19	184	0	15	0	51
Jul-19	251	0	0	11	538
Aug-19	28	0	0	11	32
Sep-19	92	45	0	0	76
Oct-19	153	76	0	0	203
Nov-19	347	96	0	0	0
Dec-19	375	104	0	0	0
Jan-20	284	140	0	0	0
Feb-20	1,951	165	0	0	0
Mar-20	1,400	0	0	0	0
Apr-20	1,008	220	13	0	42
May-20	1,104	63	0	341	32
Jun-20	242	0	0	0	21
Jul-20	518	185	0	41	21
Aug-20	14	0	0	417	117
Sep-20	89	56	0	0	198
Oct-20	54	25	0	0	10

Month	Guillemot	Razorbill	Puffin	Manx shearwater	Gannet
Nov-20	150	42	0	0	21
Dec-20	704	196	0	0	0
Jan-21	372	183	0	0	0
Feb-21	3,886	317	0	0	0

2.1.1.1 Walney Extension

48. Walney Extension OWF is an extension to the west of the historic Walney Phase 1 & 2 OWF sites and to the north of the historic West of Duddon Sands OWF, with an area of 149.2km2 (excluding consideration of any buffers) and an array area plus 2km buffer of 294.0 km2. From November 2010 to October 2012, 22 digital aerial surveys were conducted, with abundance estimate data provided within Annex B.7.A Walney Extension Ornithology Technical Report (Dong Energy, 2013a). Using the 22 months of data, mean peak abundances for the different bio-seasons for each species were calculated. The Ornithology Technical Report only provides abundance data for the array area or the array area plus 4km buffer and so a proportional reduction was applied in order to obtain abundance estimates for the array area plus 2km buffer.

49. The proportional calculation is as follows:

Walney Extension plus 2km buffer is 0.364 of the size of Walney Extension plus 4km buffer

Therefore, the Walney Extension plus 4km buffer value (1-0.364) = Walney Extension plus 2km buffer value*

50. By using the proportional reduction, an assumption of an even distribution of birds within the site was adhered to, with no further manipulation of the data. The abundance estimates of the five seabird species of interest for the array area plus 4km buffer are provided in **Table 2**, with the calculated proportional abundance estimates for the array area plus 2km buffer being provided in **Table 3** for use as proxy values.

Table 2 Abundance estimates for Walney Extension array area plus 4km buffer

Month	Guillemot	Razorbill	Guillemot/ razorbill	Puffin	Manx shearwater	Gannet
Nov-10	0	0	4,909	0	0	29
Dec-10	0	0	1,054	0	31	0
Feb-11	0	0	1,087	0	0	75
Mar-11	0	0	638	0	42	28
Mar-11	0	0	5,383	4	183	102
Apr-11	0	0	2,428	0	72	509
Apr-11	0	0	690	0	445	67
Jun-11	0	0	1,224	191	124	53
Jun-11	0	0	3,013	0	57	91
Jul-11	0	0	6,523	0	0	99
Aug-11	0	0	3,628	0	434	172
Oct-11	71	657	2,972	134	4	224
Nov-11	28	97	10,329	187	57	65
Jan-12	29	86	748	99	0	0
Jan-12	11	95	810	23	0	0
Mar-12	81	38	254	49	0	0
Mar-12	163	81	1,669	0	0	41
Apr-12	0	0	1,118	0	0	120
May-12	276	151	2,179	70	1,417	32
Jul-12	122	0	6,515	84	13	141
Sep-12	207	466	4,521	8	1,017	186
Oct-12	10	1,218	6,989	0	21	592

Table 3 Calculated abundance estimates for Walney Extension array area plus 2km buffer

Month	Guillemot	Razorbill	Guillemot/ razorbill	Puffin	Manx shearwater	Gannet
Nov-10	0	0	3,120	0	0	18
Dec-10	0	0	670	0	20	0
Feb-11	0	0	691	0	0	48
Mar-11	0	0	406	0	27	18
Mar-11	0	0	3,421	3	116	65
Apr-11	0	0	1,543	0	46	324
Apr-11	0	0	439	0	283	43
Jun-11	0	0	778	121	79	34
Jun-11	0	0	1,915	0	36	58

Month	Guillemot	Razorbill	Guillemot/ razorbill	Puffin	Manx shearwater	Gannet
Jul-11	0	0	4,146	0	0	63
Aug-11	0	0	2,306	0	276	109
Oct-11	45	418	1,889	85	3	142
Nov-11	18	62	6,565	119	36	41
Jan-12	18	55	475	63	0	0
Jan-12	7	60	515	15	0	0
Mar-12	51	24	161	31	0	0
Mar-12	104	51	1,061	0	0	26
Apr-12	0	0	711	0	0	76
May-12	175	96	1,385	44	901	20
Jul-12	78	0	4,141	53	8	90
Sep-12	132	296	2,874	5	646	118
Oct-12	6	774	4,442	0	13	376

52. Within the Walney Extension Ornithology Technical Report (Dong Energy, 2013a) abundance values for seabird species were presented as species level values. Due to difficulty in identification, a number of guillemot and razorbill remained in a broader species group level. In order to obtain the realistic number of guillemot and razorbills recording within the Walney Extension surveys, apportionment of the guillemot/ razorbill group was conducted as part of the calculations within this report and added to the species level values. Considering the species being assessed for displacement impacts for White Cross, no other apportionment of species groups was required from the Walney Extension data.

53. When apportioning the unapportioned guillemot/ razorbill group the following rules were applied, in order of preference:

54. 1) Use the proportion of individuals identified to speciated species level within the specific species group for the same month;

55. 2) Use the total overall proportion within the same bio-season.

56. After apportionment, the Walney Extension guillemot and razorbill abundances are as follows:

Table 4 Abundance estimates for guillemot and razorbill for Walney Extension array area plus 2km buffer following apportionment

Month	Guillemot	Razorbill
Nov-10	561	2,559
Dec-10	120	550
Feb-11	124	567
Mar-11	73	333
Mar-11	615	2,806
Apr-11	1,119	424
Apr-11	318	121
Jun-11	564	214
Jun-11	1,388	527
Jul-11	3,006	1,140
Aug-11	414	1,891
Oct-11	229	2,122
Nov-11	1,488	5,156
Jan-12	138	410
Jan-12	60	522
Mar-12	161	76
Mar-12	812	404
Apr-12	515	195
May-12	1,071	586
Jul-12	4,218	0
Sep-12	1,015	2,286
Oct-12	43	5,180

2.1.1.2 Burbo Bank Extension

57. Burbo Bank Extension OWF is an extension to the west of the historic Burbo Bank OWF with an area of 39.7km2 (excluding consideration of any buffers) and an array area plus 2km buffer of 112.5km2. The Burbo Bank Extension ES (Dong Energy, 2013b) describes six digital aerial surveys that were conducted within the array area plus 4km buffer and six boat based surveys were conducted within the array area plus 1km buffer between 2010 and 2011.

58. Within the Burbo Bank Extension Displacement Analysis report (Dong Energy, 2013c) mean peak abundance estimates from these surveys were provided within displacement matrices for guillemot, razorbill and Manx shearwater. The Ornithology Technical Report (2013b) did not provide a mean peak abundance value for gannet and puffin and the maximum counts for both gannet and puffin were used as an alternative. All values provided were for the Burbo Bank

Extension plus 4km buffer and so a proportional reduction has been applied in order to obtain abundance estimates for the array area plus 2km buffer.

59. The proportional calculation is as follows:

Burbo Bank Extension plus 2km buffer value is 0.464 of the size of Burbo Bank Extension plus 4km buffer.

100-46.4 = 53.6

Proportion: 53.6/100=0.54

Burbo Bank Extension plus 4km buffer value(1- 0.464) = Burbo Bank Extension plus 2km buffer value.*

60. When conducting the proportional reductions for Burbo Bank Extension, all birds were assumed to be evenly distributed within the array area plus relevant buffers, with no further manipulation of the data. The abundance estimates of the five seabird species of interest for the array area plus 4km buffer are provided in **Table 5** with the calculated proportional abundance estimates for the array area plus 2km buffer provided in **Table 6.**

61. Further consideration was taken when assessing puffin numbers recorded at Burbo Bank Extension. Within the six months of digital aerial surveys that were conducted, a peak abundance estimate of 493 was recorded for puffin, compared to a peak of three individuals recorded during six months of boat based surveys. Within the Burbo Bank Extension ES (Dong Energy, 2013b) it is noted that boat-based surveys provide high levels of precision for species identification, in-comparison to digital aerial surveys, based on the available technology at the time. This therefore suggests that the puffins identified through digital aerial surveys could have been mis-identified, significantly inflating the abundance estimate. Historic puffin records near Burbo Bank and Burbo Bank Extension are consistently low within the area (eBird, 2024) with no more than 10 individuals recorded at each count. This further highlights the disparity between the large number identified through the digital aerial surveys and the low number recorded via boat-based observations. Due to the lack of confidence in this value (493 individuals), precaution should be taken when considering these values within the cumulative assessment.

62. When considering puffin, the Burbo Bank abundance value was originally assigned to the breeding season within the FLO-WHI-REP-0002-13 **Chapter 13: Offshore Ornithology** of the **Offshore ES**, however on further inspection the peak abundance of 493 was found to actually be in the non-breeding season (February 2011; Dong Energy, 2013c). This alteration has been taken forward within this report.

Table 5 Mean peak abundance estimates for Burbo Bank Extension array area plus 4km buffer

Season	Guillemot	Razorbill	Puffin*	Manx shearwater	Gannet*
Breeding	1,869	120	-	828	429
Non-breeding	2,917	54	493	-	-
Return migration	-	-	-	-	14
Post-breeding migration	-	-	-	-	17

*Table Note: The values for gannet and puffin are the maximum values within the season, not the mean-peak abundances.

Table 6 Mean peak abundance estimates for Burbo Bank Extension array area plus 2km buffer

Season	Guillemot	Razorbill	Puffin*	Manx shearwater	Gannet*
Breeding	1,002	64	-	444	230
Non-breeding	1,564	29	264	-	-
Return migration	-	-	-	-	8
Post-breeding migration	-	-	-	-	9

*Table Note: The values for gannet and puffin are the maximum values within the season, not the mean-peak abundances.

2.1.2 Proxy project selection

63. Two different approaches were taken when calculating the values for the historic OWF sites. The first approach only used Awel y Môr data as the proxy dataset due to it being the most recent development within the North West region to gain consent and followed best practice approach to baseline collection (Parker et al., 2022a), whereas the second approach used a mixture of three geographically separate proxy projects in order to consider the effect that different environmental variables may have on proxy abundance predictions. The approach using Awel y Môr as proxy for all sites is only considered for comparison purposes and is not taken through for cumulative assessment. Only the geographical approach is considered within the updated cumulative tables in **Section 6**.

2.1.2.1 Awel y Môr as the proxy for all sites

64. Given that Awel y Môr data spans a full 24 month period and has the most recent survey data of the proxy projects, this was used as an initial proxy for all projects requiring values as it was considered the most robust.

2.1.2.2 Geographical proxy sites

65. Due to the different geographical areas in which the historic OWF projects requiring proxy values are situated, different proxy sites were used to provide a comparison against the values obtained utilising solely Awel y Môr data. Walney Extension was used as a proxy for those projects off the coast of Walney and further north. Burbo Bank Extension was used as a proxy site for Burbo Bank.

66. For ease, the projects that are within closest proximity to Awel y Môr include:

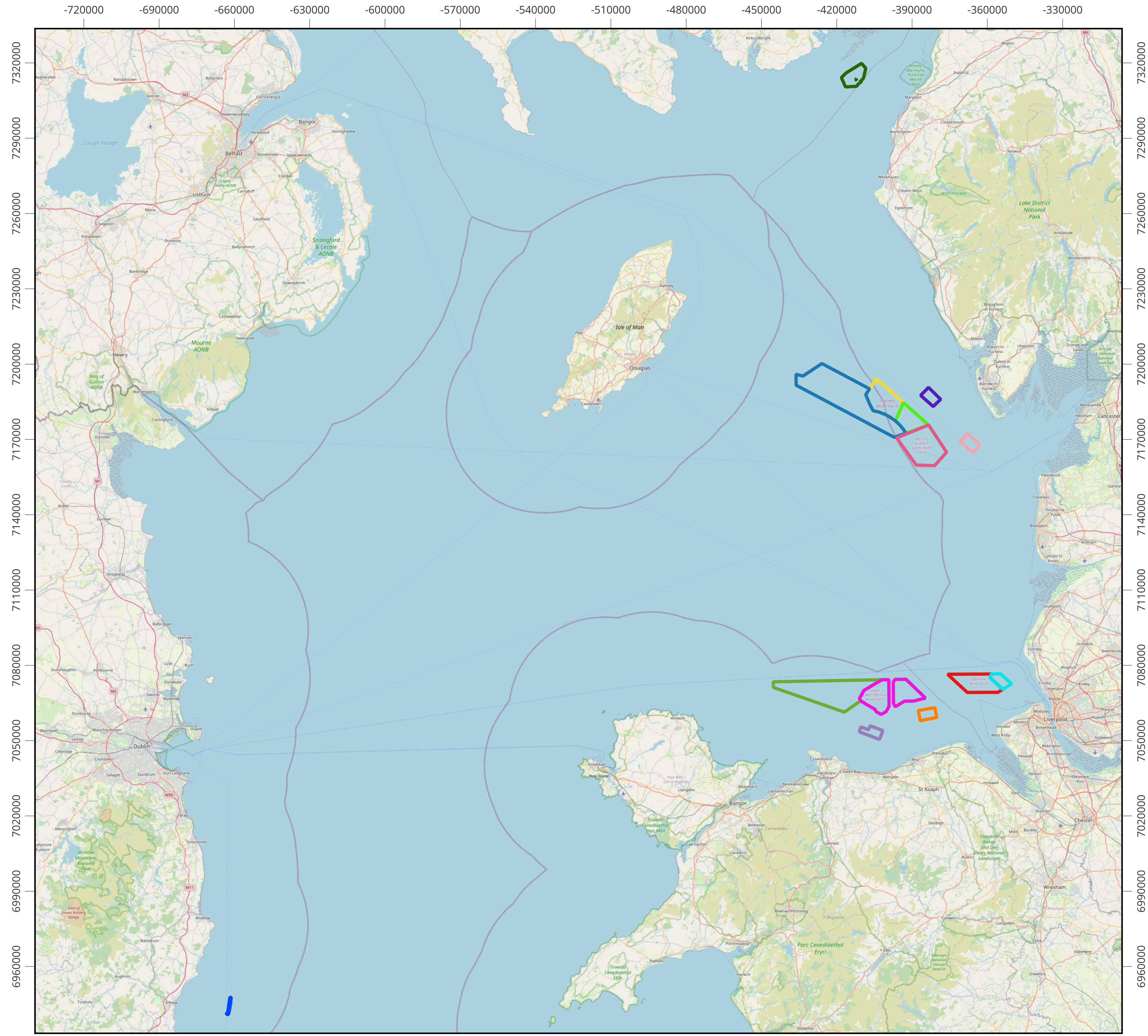
- Arklow Bank
- Gwynt y Môr
- North Hyle
- Rhyl Flats

67. The projects with closest proximity to Walney Extension include:

- Barrow
- Ormonde
- Robin Rigg
- Walney Phase 1
- Walney Phase 2
- West of Duddon Sands

68. The project with closest proximity to Burbo Bank Extension includes Burbo Bank only.

69. An overview of the proximity of the various proxy and historic projects is provided in **Figure 2**.



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P14531 White Cross Cumulative Gap Analysis

Offshore Wind Farm Projects Requiring Gap Analysis plus Proxy Sites

Legend

- Robin Rigg
- Walney Extension
- Walney Phase 2
- Walney Phase 1
- Ormonde
- West of Duddon Sands
- Barrow
- Awel y Mor
- Gwynt y Mor
- Burbo Bank Extension
- Burbo Bank
- North Hoyle
- Rhyl Flats
- Arklow

Notes

Basemap: Kartendaten: OpenStreetMap and OpenStreetMap Foundation (CC-BY-SA). © https://www.openstreetmap.org and contributors.

Coordinate System: WGS 84 / Pseudo-Mercator

0 60 km

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Scale:	Date:	Drawn by:	Checked by:	Approved by:
1:2000000 @A4	15/05/2024	JK	AW	AW

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Figure Reference: P14531 All array areas

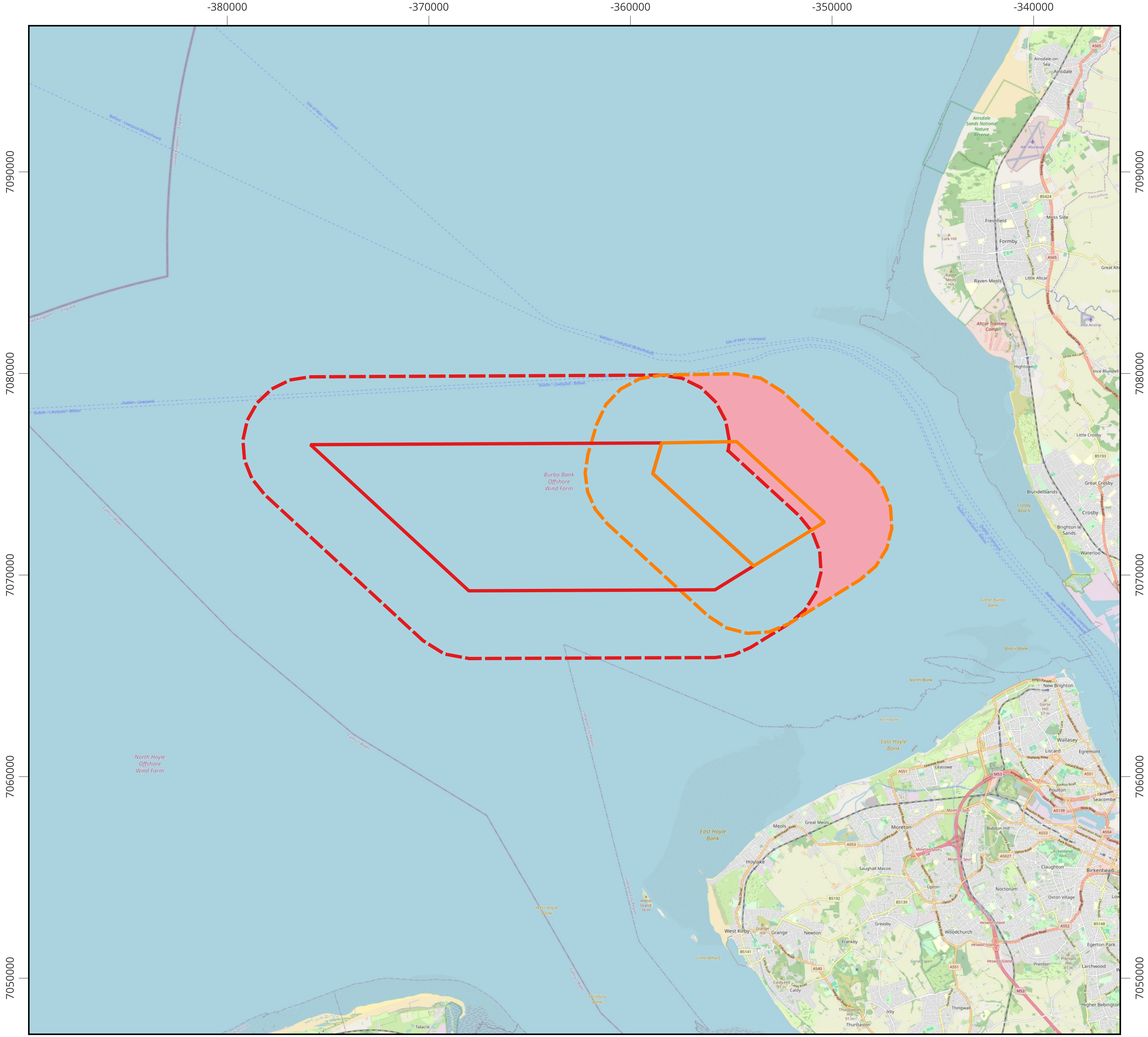
2.1.3 Double counting of clustered wind farms

70. Due to the close proximity of some historic OWF sites, when the required 2km buffer is applied overlap between project areas occurs. Due consideration of overlap between project area buffers is therefore required to avoid double counting of impacts. To avoid double counting, certain OWF array area plus 2km buffer measurements have been reduced to exclude the area that would be overlapped by a neighbouring wind farm and the relevant buffer. The OWF sites that have had a reduction in the array area plus 2km buffer include Burbo Bank, Gwynt y Môr, North Hoyle, Ormonde, Rhyl Flats, Walney Phase 1, Walney Phase 2 and West of Duddon Sands. Illustrations of the overlap of sites are provided in **Figure 3**, **Figure 4** and **Figure 5**.

71. An overview of the sites with overlap of buffers and how this has been addressed is as follows:

- Burbo Bank overlaps with Burbo Bank Extension when the 2km buffers are applied to both sites and so Burbo Bank array area plus 2km buffer has been refined to exclude the area of overlap with Burbo Bank Extension.
- Burbo Bank Extension has overlap with Burbo Bank when the 2km buffers are applied to both sites. However, as Burbo Bank has been reduced to account for this, Burbo Bank Extension plus 2km buffer remains.
- Gwynt y Môr overlaps with Awel y Môr when the 2km buffers are applied to both sites. Gwynt y Môr array area plus 2km buffer has been refined to exclude the area of overlap with Awel y Môr.
- Awel y Môr overlaps with Gwynt y Môr when the 2km buffers are applied to both sites. However, as Gwynt y Môr has been reduced to account for this, Awel y Môr plus 2km buffer remains.
- North Hoyle overlaps with Gwynt y Môr when the 2km buffers are applied to both sites. North Hoyle array area plus 2km buffer has been refined to exclude the area of overlap with Gwynt y Môr.
- Ormonde overlaps with Walney Phase 1 when the 2km buffers are applied to both sites and so the Ormonde array area plus 2km buffer has been refined to exclude the area of overlap with Walney Phase 1.
- Rhyl Flats overlaps with Gwynt y Môr when the 2km buffers are applied to both sites and so Rhyl Flats array area plus 2km buffer has been refined to exclude the area of overlap with Gwynt y Môr.
- Walney Phase 1 overlaps with Walney Phase 2 and Walney Extension when the 2km buffers are applied to the sites and so Walney Phase 1 array area plus 2km buffer has been refined to exclude the area of overlap with Walney Phase 2 and Walney Extension.

- Walney Phase 2 overlaps with Walney Extension when the 2km buffers are applied to both sites. Walney Phase 2 array area plus 2km buffer has been refined to exclude the area of overlap with Walney Extension.
- West of Duddon Sands overlaps with Walney Phase 1 and Walney Extension when the 2km buffers are applied to each site .West of Duddon Sands array area plus 2km buffer has been refined to exclude the area of overlap with Walney Phase 1 and Walney Extension.
- Walney Extension overlaps with several sites when the 2km buffers are applied including Walney Phase 1, Walney Phase 2 and West of Duddon Sands. However, as the latter three sites' buffers have all been reduced to account for this, Walney Extension plus 2km buffer remains.



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P14531 White Cross Cumulative Gap Analysis

Burbo Bank and Burbo Bank Extension array areas plus 2km buffer amendment to avoid double counting

Legend

Burbo Bank

- Burbo Bank
- Burbo Bank 2km buffer
- Burbo Bank Extension
- Burbo Bank Extension 2km buffer
- Burbo Bank 2km buffer excluding overlap with Burbo Bank Extension plus 2km buffer

Notes

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Coordinate System: WGS 84 / Pseudo-Mercator

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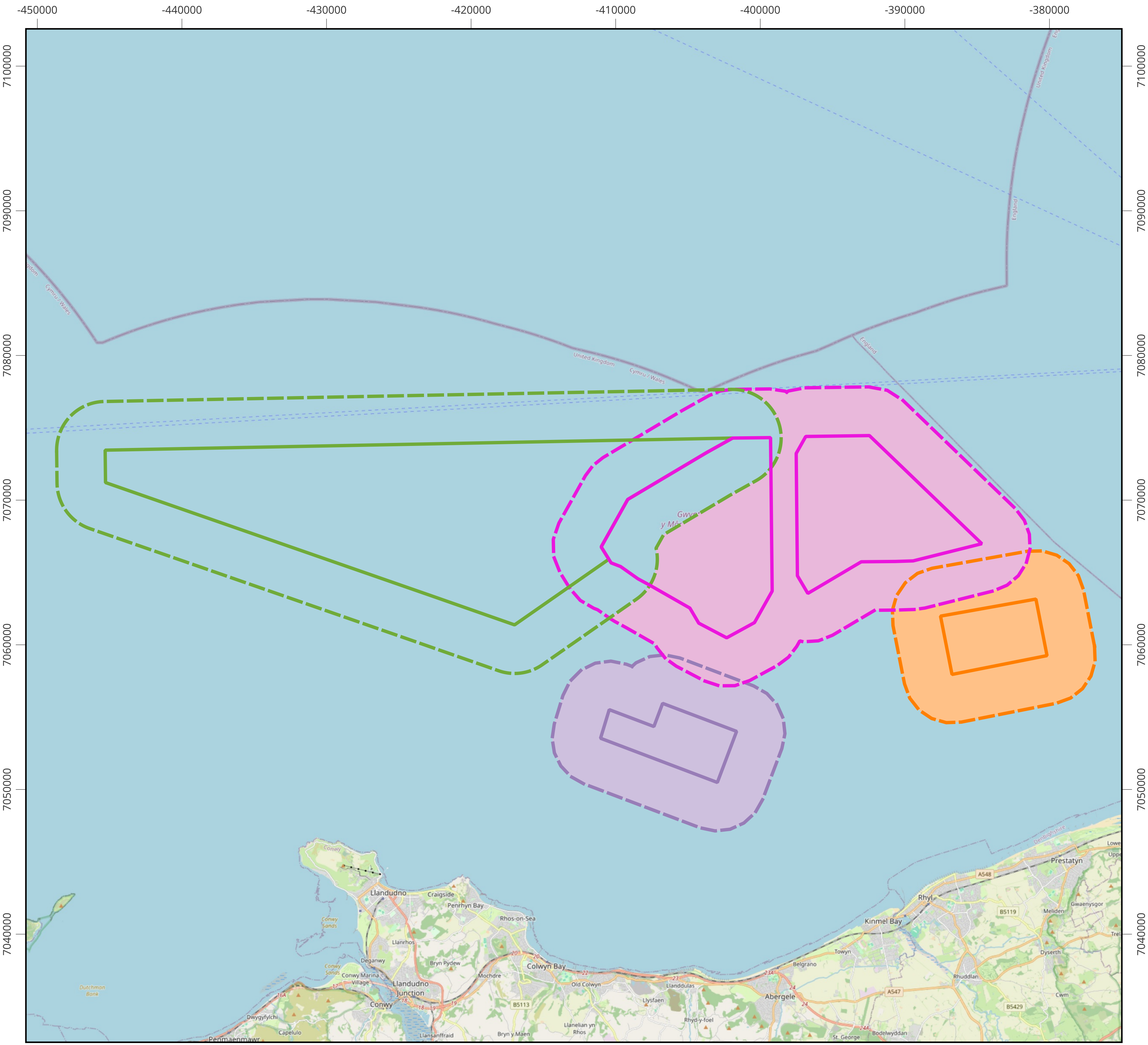
Figure Reference: P14531 Burbo Bank and Burbo Bank Extension plus 2km buffer



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P14531 White Cross Cumulative Gap Analysis

Awel y Mor Group array areas plus 2km buffer amendments to avoid double counting

Legend

Awel y Mor Group

- Awel y Mor
- Awel y Mor 2km buffer
- Gwynt y Mor
- Gwynt y Mor 2km buffer
- Gwynt y Mor plus 2km buffer excluding Awel y Mor plus 2km buffer
- Rhyl Flats
- Rhyl Flats plus 2km buffer
- Rhyl Flats plus 2km buffer excluding Gwynt y Mor plus 2km buffer
- North Hoyle
- North Hoyle plus 2km buffer
- North Hoyle plus 2km buffer excluding Gwynt y Mor plus 2km buffer

Notes

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Coordinate System: WGS 84 / Pseudo-Mercator

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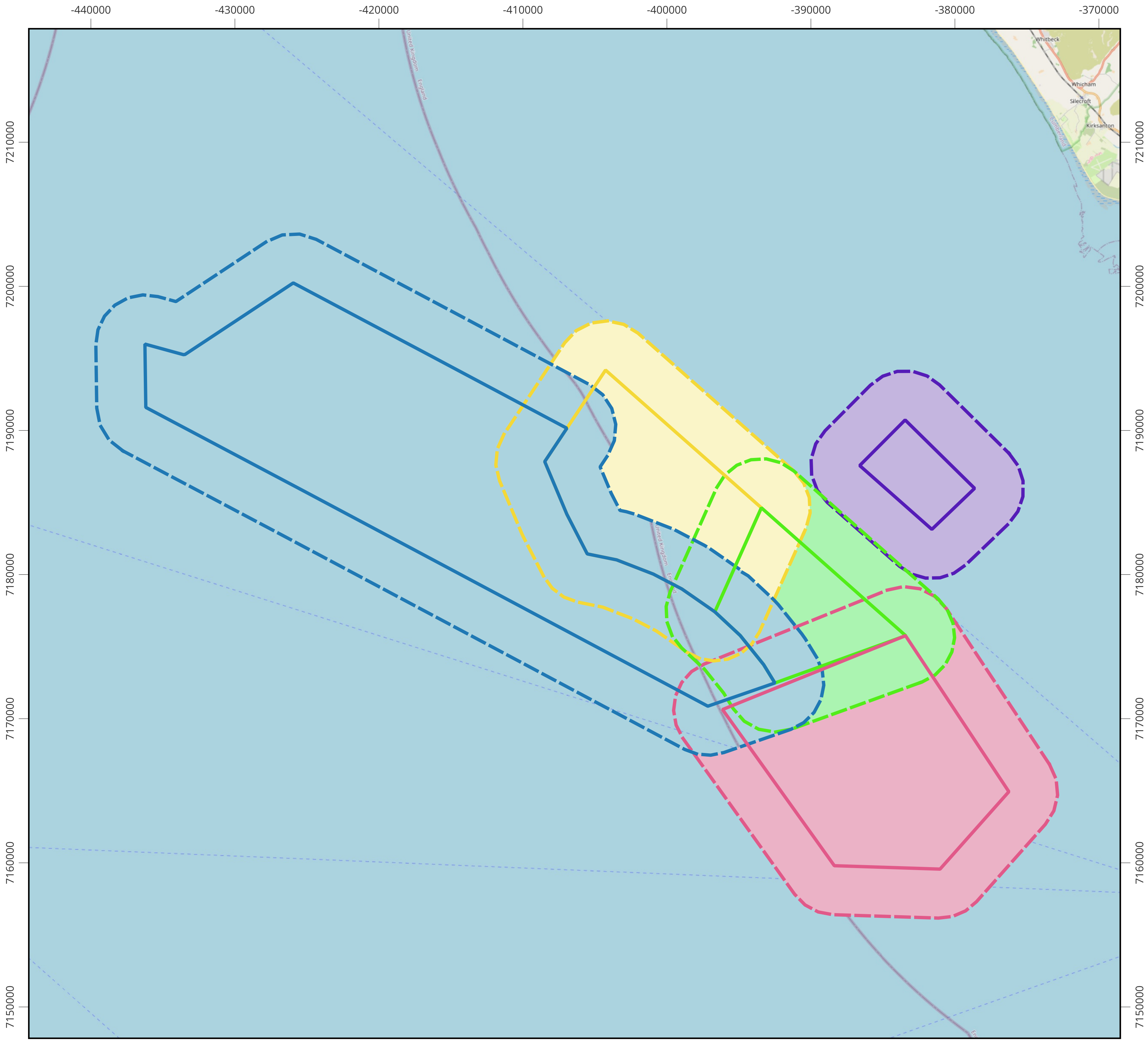
Figure Reference: P14531 Awel y Mor group plus 2km buffer



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P14531 White Cross Cumulative Gap Analysis

Walney Group array areas plus 2km buffer amendments to avoid double counting

Legend

Walney Group

- Walney Extension
- Walney Extension plus 2km buffer
- Walney 2
- Walney 2 plus 2km buffer
- Walney 2 plus 2km buffer excluding Walney Extension plus 2km buffer
- Walney 1
- Walney 1 plus 2km buffer
- Walney 1 plus 2km buffer excluding Walney Extension and Walney 2 plus 2km buffer
- Ormonde
- Ormonde plus 2km buffer
- Ormonde plus 2km buffer excluding Walney 1 plus 2km buffer
- West of Duddon Sands
- West of Duddon Sands plus 2km buffer
- West of Duddon Sands plus 2km buffer excluding Walney Extension and Walney 1 plus 2km buffer

Notes

Basemap: Kartendaten: OpenStreetMap and OpenStreetMap Foundation (CC-BY-SA). © https://www.openstreetmap.org and contributors.

Coordinate System: WGS 84 / Pseudo-Mercator

0 3 6 km

N

Scale:	Date:	Drawn by:	Checked by:	Approved by:
1:350000 @A4	15/05/2024	JK	AW	AW

Riverview
A17 The Embankment Business Park
Heaton Mersey
Stockport
SK4 3GN
http://www.apemltd.com
+44 (0) 161 442 8938

Figure Reference: P14531 Walney group plus 2km buffer

2.1.4 Abundance estimate conversions by project area

72. In order to obtain abundance estimates for the historic OWF projects, the proxy project abundance estimates from **Section 2.1.1** were used. The proportional size difference in the array area plus 2km buffers were applied to the proxy abundance estimates in order to provide an estimated value for the historic OWF projects.

2.1.4.1 Awel y Môr as the proxy for all sites

73. Area comparison against the Awel y Môr array area plus 2km buffer are provided in **Table 7**.

Table 7 Percentage reduction of OWF project array areas against Awel y Môr array area plus 2km buffer (233.9km^2)

Project	Array area plus 2km buffer (km2)	% change from Awel y Môr array area plus 2km buffer
Arklow Bank	32.4	-86.2
Barrow	48.3	-79.4
Burbo Bank (excluding overlap from Burbo Bank Extension)	16.7	-92.9
Gwynt y Môr (excluding overlap from Awel y Môr)	118.5	-49.3
North Hoyle (excluding overlap with Gwynt y Môr)	40.5	-82.7
Ormonde (excluding overlap with Walney Phase 1)	48.0	-79.5
Rhyl Flats (excluding overlap with Gwynt y Môr)	49.8	-78.7
Robin Rigg	64.6	-72.4
Walney Phase 1 (excluding overlap with Walney Extension and Walney Phase 2)	37.8	-83.8
Walney Phase 2 (excluding overlap with Walney Extension)	53.9	-77.0
West of Duddon Sands (excluding overlap with Walney Extension and Walney Phase 1)	100.2	-57.2

2.1.4.2 Geographical proxy sites

The abundance conversions for the six OWFs that used Walney Extension data as a proxy are provided below in **Table 8**, with the conversions for Burbo Bank using Burbo Bank Extension as a proxy provided in **Table 9**.

Table 8 Percentage reduction of OWF project array areas against Walney Extension array area plus 2km buffer (294km^2)

Project	Array area plus 2km buffer (km2)	% change from Walney Extension array area plus 2km buffer
Barrow	48.3	-83.6
Ormonde (excluding overlap with Walney Phase 1)	48.0	-83.7
Robin Rigg	64.6	-78
Walney Phase 1 (excluding overlap with Walney Extension and Walney Phase 2)	37.8	-87.1
Walney Phase 2 (excluding overlap with Walney Extension)	53.9	-81.7
West of Duddon Sands (excluding overlap with Walney Extension and Walney Phase 1)	100.2	-65.9

Table 9 Percentage reduction of OWF project array areas against Burbo Bank Extension array area plus 4km buffer (209.7km^2)

Project	Array area plus 2km buffer (km2)	% change from Burbo Bank Extension Extension array area plus 2km buffer
Burbo Bank	16.7	-92.0%

2.1.4.3 Example proxy abundance estimate calculation

74. An example calculation for March 2019 abundance conversion of guillemot for Barrow OWF using Awel y Môr data as proxy is provided:

Proportionally Barrow is 0.794 of the size of Awel y Môr.

March 2019 Awel y Môr value for guillemot is 1,738.

Therefore, the Barrow value for March 2019 is: 1,738(1-0.794) = 358.*

75. Monthly abundance estimate predictions for all historic projects are provided in **Annex 1.**

2.1.5 Mean peak abundance calculations

76. For the historic OWF projects that used Awel y Môr data as a proxy (i.e. when using Awel y Môr data as proxy for all sites or for sites within geographical proximity), mean peak abundances were able to be calculated due to there being 24 months of data. Mean peak abundances for projects using Walney Extension data as a proxy were also able to be calculated due to the availability of 22 months of data. Burbo Bank Extension data for guillemot, razorbill and Manx shearwater were already provided as mean peak abundances and so these did not require further consideration. Similarly, gannet and puffin values were provided as the peak overall count within a season therefore no further adjustment was required.

77. The mean peak abundance values and peak abundance values assigned to the historic OWF projects are presented in **Section 3**.

2.1.6 Review of method used in comparison to Natural England's outlined methods

78. As described in the introductory paragraph for **Section 2**, Natural England provided a recommended approach for calculating displacement values for the historic OWF projects, to be used in the cumulative assessment for White Cross Offshore Windfarms. The first option of using project specific information was not viable as no abundance data for the projects was publicly available; neither is it available in the Round 4 plan-level HRA. Therefore, the second approach of using proxy sites was adopted. Natural England suggested scaling the mortality estimates due to displacement, however, the approach within this report scales the abundance estimates as these are the values used to populate the cumulative assessments, rather than the mortality values. Calculating proxy abundance values, rather than displacement and mortality estimates allows for a range of displacement and subsequent mortality rates to be considered for cumulative assessments.

2.2 Collision impact values

79. As previously noted in **Section 2.1**, predicted collision impact values for OWF projects are usually informed by site specific baseline characterisation surveys carried out for the proposed development. As this data is currently absent for historic OWF projects, calculation of proxy predicted collision impact values are required.

2.2.1 Obtaining proxy project information

80. On review of the more recent OWF projects within the same area as the historic projects, Awel y Môr OWF, Burbo Bank Extension and Walney Extension were identified as projects with sufficient collision risk estimate data to be deemed appropriate to be used as a proxy. However, for all three projects the input parameters and approach used to originally inform collision impacts varied to that now recommended within Natural England's interim guidance on CRM (2023b). Therefore, prior to calculation of proxy impact values updated CRM was undertaken for these projects to ensure that modelling conforms to the latest guidance. This updated modelling is provided in **Annex 2** of this document. Additionally, updated collision risk modelling was identified as being required for the following projects in Western Waters (and the English Channel where applicable):

- White Cross
- Erebus
- Rampion 1.

81. Updated collision risk modelling for Rampion 1 is provided in **Annex 2** of this document, based on turbine parameters and seabird density estimates being available within the Project's Ornithology Technical Appendix (RSK, 2012). For Erebus, updated collision risk estimates were based on correction factor calculations undertaken by Sheringham Shoal and Dudgeon Offshore Wind Farm Extension Projects presented within the CRM Updates Technical Note (Royal HaskoningDHV, 2023). Complete recalculation was not undertaken for Erebus due to uncertainty regarding the final bird density estimates used to inform the consent decision. Revised impact values for White Cross have also been calculated and included within the updated cumulative assessments within **Section 7**.

2.2.1.1 Awel y Môr

82. Recalculated collision impacts for Awel y Môr OWF are presented in **Table 10** based on the modelling presented in **Annex 2** of this document. Awel y Môr OWF predicted collisions are used as proxy for Arklow Bank, Gwynt y Môr, North Hoyle and Rhyl Flats OWF projects due to the sites being within closest proximity to this proxy site.

2.2.1.2 Walney Extension

83. Recalculated collision impacts for Walney Extension are presented in **Table 11** based on the modelling presented in **Annex 2** of this document. These impact values are used as a proxy for Barrow, Ormonde, Robin Rigg, Walney Phase 1, Walney Phase 2 and West of Duddon Sands OWF projects.

2.2.1.3 Burbo Bank Extension

84. Recalculated collision impacts for Burbo Bank Extension are presented in **Table 12** based on the modelling presented in **Annex 2**. These impact values are used as a proxy for the Burbo Bank OWF project only.

Table 10 Awel y Môr recalculated monthly collision risk impact values using Natural England's updated interim guidance (Natural England, 2023b)

Species	January	February	March	April	May	June	July	August	September	October	November	December	Annual
Kittiwake	4.6	4.7	7.5	8.5	5.7	0.3	3.8	0.7	1.1	2.1	6.3	1.9	47.2
Great black-backed gull	0.0	0.0	1.1	0.0	0.9	1.1	1.9	0.9	0.0	0.0	0.8	0.0	6.7
Herring gull	1.4	0.7	0.0	1.5	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	4.3
Lesser black-backed gull	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.7
Gannet	0.0	0.0	0.0	0.2	0.1	0.2	1.7	0.5	1.0	0.9	0.1	0.0	4.7

Table 11 Walney Extension recalculated monthly collision risk impact values using Natural England's updated interim guidance (Natural England, 2023b)

Species	January	February	March	April	May	June	July	August	September	October	November	December	Annual
Kittiwake	3.0	1.0	12.9	7.6	2.1	3.8	5.3	2.1	2.2	27.0	50.9	15.9	133.7
Great black-backed gull	0.5	1.1	5.6	1.1	0.0	0.0	0.0	0.2	1.1	6.6	6.9	9.4	32.6
Herring gull	2.3	1.1	17.9	15.3	0.0	1.7	8.0	2.6	0.0	7.1	9.6	8.8	74.4
Lesser black-backed gull	0.0	0.5	3.1	1.2	1.2	0.7	4.7	1.0	1.7	5.7	15.0	0.3	35.2
Gannet	0.0	0.2	0.3	1.1	0.1	0.5	1.1	1.3	0.5	4.5	0.1	0.0	9.8

Table 12 Burbo Bank Extension recalculated monthly collision risk impact values using Natural England's updated interim guidance (Natural England, 2023b)

Species	January	February	March	April	May	June	July	August	September	October	November	December	Annual
Kittiwake	1.0	0.9	1.0	1.2	6.1	6.0	6.4	5.7	1.7	1.8	1.0	1.0	33.9
Great black-backed gull	1.9	1.8	1.2	1.4	0.8	0.7	0.8	0.7	3.0	3.0	1.9	1.9	19.1
Herring gull	5.9	5.6	13.6	15.9	2.3	2.3	2.4	2.2	1.0	1.0	6.0	5.9	64.1
Lesser black-backed gull	0.2	0.2	1.3	1.5	10.8	10.6	11.2	10.1	2.3	2.4	0.2	0.2	50.9
Gannet	0.1	0.1	0.0	0.0	1.9	1.9	2.0	1.7	0.7	0.7	0.1	0.1	9.3

2.2.2 Turbine parameters of OWF sites requiring impact values

85. Turbine parameters for each of the proxy and historic OWF projects were collated to enable a comparative approach to the predicted collision risk values. The parameters that were attained were the number of turbines consented for each project and the consented rotor radius. Consented rotor radius values were not available for Arklow Bank, Barrow, Rhyl Flats or Robin Rigg and so the as-built design values were used.. Due to a lack of available information, the air gap below the minimum rotor tip for all OWFs was assumed as 22m as this is the required legal minimum. Using the number of turbines and rotor radius allows for the calculation of the total wind-swept area of a site which is a more robust metric to use for scaling the collision impact values than scaling to the differences in the individual parameters alone. This is calculated as follows:

*Total wind-swept area = number of turbines*PI()*radius^2*

86. The parameters for each OWF project can be found in **Table 13**.

Table 13 Turbine parameters for all OWF array areas

Project	Number of turbines	Source of information for number of turbines	Rotor radius (m)	Source of information for rotor radius	Total wind-swept area (m2)
Arklow Bank	7	As-built design as stated on the SSE website (SSE Renewables, 2024)	52	GE Wind (2003)	59,464
Burbo Bank Ext	69	Consented design as stated within the DCO (Secretary of State, 2014a).	60	The Crown Estate Ornithology Headroom CRM spreadsheet 2017.	780,372
Barrow	30	As-built design as stated on the Orsted website (Orsted, 2024)	45	The Crown Estate Ornithology Headroom CRM spreadsheet 2017.	190,852
Burbo Bank	30	Consented design as stated in the	45	The Crown Estate Ornithology	190,852

Project	Number of turbines	Source of information for number of turbines	Rotor radius (m)	Source of information for rotor radius	Total wind-swept area (m2)
		non-technical summary (SeaScape Energy Ltd, 2002b).		Headroom CRM spreadsheet 2017.	
Gwynt y Môr	250	Consented design as stated within the Non-technical summary (npower renewables, 2005).	45	The Crown Estate Ornithology Headroom CRM spreadsheet 2017.	159,0431
North Hoyle	30	As-built design as stated within the Crown Estate Offshore Wind Report (2022).	50	The Crown Estate Ornithology Headroom CRM spreadsheet 2017.	235,619
Ormonde	30	As-built design as stated on the Vattenfall website (Vattenfall (2024).	55	The Crown Estate Ornithology Headroom CRM spreadsheet 2017.	285,100
Rhyl Flats	25	As-built design as stated on the RWE website (RWE, 2024).	53.5	The Crown Estate Ornithology Headroom CRM spreadsheet 2017.	269,761
Robin Rigg	60	Consented design as stated within the ES Chapter (Natural Power, 2002)	45	The Crown Estate Ornithology Headroom CRM spreadsheet 2017.	381,704
Walney Phase 1	51	As-built design as	60	The Crown Estate	1,696,460

Project	Number of turbines	Source of information for number of turbines	Rotor radius (m)	Source of information for rotor radius	Total wind-swept area (m2)
		stated on the Orsted website (Orsted, 2024)		Ornithology Headroom CRM spreadsheet 2017.	
Walney Phase 2	51	As-built design as stated on the Orsted website (Orsted, 2024)	60	The Crown Estate Ornithology Headroom CRM spreadsheet 2017.	1,696,460
Walney Extension	207	Consented design as stated within the DCO (Secretary of State, 2014b).	60	The Crown Estate Ornithology Headroom CRM spreadsheet 2017.	2,341,115
West of Duddon Sands	139	Consented design as stated within the non-technical summary (Morecambe Wind Ltd, 2006)	62	The Crown Estate Ornithology Headroom CRM spreadsheet 2017.	1,678,603
Awel y Môr	50	Consented design as stated with the ES Chapter (RWE, 2022b)	125	Design as stated with the ES Chapter (REW, 2022b)	2,454,369

2.2.3 Collision impact calculations using proxy sites

87. All of the historic OWF projects, apart from Arklow Bank (due to the lack of rotor radius information), had a ratio calculation applied to the proxy project collision risk impact values in order to scale impacts according to project specific parameters. The adjusted calculation considered the total wind-swept areas of the proxy and historic OWF projects as well as the rotor radiuses. Aside from the project specific wind-swept area and rotor radius, all other parameters are those

of the proxy wind farm, including density of birds incorporated into the model. The calculation used to obtain collision risk estimates for the historic OWF projects is as follows:

88. *Proxy site collision risk impact value*(historic OWF project total wind-swept area/ proxy project total wind-swept area)*(proxy project rotor radius/historic project rotor radius)*

89. Monthly collision impact predictions for all historic projects are provided in **Annex 2**.

2.2.4 Review of method used in comparison to Natural England's outlined methods

90. As described in the introductory paragraph for **Section 2**, Natural England provided a recommended approach for calculating the values for the historic OWF projects to be used in the collision risk cumulative assessments. The first option of using project specific information was not viable as no collision risk impact assessments for the historic projects were publicly available. Therefore, the second approach of using proxy site impact values was adopted. Natural England suggested scaling the mortality estimates due to collision, incorporating various turbine parameter differences. In accordance with the Natural England method a scaling approach of collision impacts was taken considering the difference in the total wind-swept area and number of turbines between the historic projects and the proxy sites.

3. Displacement – Abundance estimates calculated by proxy

91. Mean peak abundances for each of the five key species being assessed for potential cumulative impacts due to displacement are provided below. As described in **Section 2.1.1**, Awel y Môr data was used as the initial proxy for all projects requiring values. Walney Extension was also used as a proxy for those within closer proximity, with Burbo Bank Extension being used as a proxy for Burbo Bank. As such, mean peak abundance results for all scenarios are provided for each species for comparison.

92. Mean peak abundances are presented for the individual species bio-season definitions, derived from Furness (2015). Detail on the component months for each species bio-season is presented in **Annex 3**.

3.1 Guillemot

93. The estimated guillemot mean peak abundances for the historic OWF projects are provided in **Table 14** when using only Awel y Môr data as proxy. The mean peak abundances considering the Awel y Môr, Walney Extension and Burbo Bank Extension proxy projects are provided in **Table 15**.

Table 14 Guillemot mean peak abundances for the historic project array areas (plus 2km buffer) using Awel y Môr data as a proxy

Project	Breeding	Non-breeding	Annual
Arklow Bank	217	403	619
Barrow	323	601	924
Burbo Bank	111	207	318
Gwynt y Môr	800	1,488	2,288
North Hoyle	271	505	776
Ormonde	164	305	469
Rhyl Flats	334	622	956
Robin Rigg	433	806	1,239
Walney Phase 1	254	473	727
Walney Phase 2	361	671	1,032
West of Duddon Sands	672	1,249	1,921

Table 15 Guillemot mean peak abundances for the historic project array areas (plus 2km buffer) using data from proxy project with closest proximity

Project	Breeding	Non-breeding	Annual	Proxy project
Arklow Bank	217	403	619	Awel y Môr
Barrow	592	205	797	Walney Extension
Burbo Bank	150	233	383	Burbo Bank Extension
Gwynt y Môr	800	1,488	2,288	Awel y Môr
North Hoyle	271	505	776	Awel y Môr
Ormonde	589	204	793	Walney Extension
Rhyl Flats	334	622	956	Awel y Môr
Robin Rigg	795	275	1,070	Walney Extension
Walney Phase 1	466	161	627	Walney Extension
Walney Phase 2	661	229	890	Walney Extension
West of Duddon Sands	1,232	427	1,659	Walney Extension

3.2 Razorbill

94. The estimated razorbill mean peak abundances for the historic projects are provided in **Table 16** when using only Awel y Môr data as proxy. The mean peak abundances considering the Awel y Môr, Walney Extension and Burbo Bank Extension proxy projects are provided in **Table 17**.

Table 16 Razorbill mean peak abundances for the gap analysis projects using Awel y Môr data as a proxy

Project	Return migration	Migration-free breeding	Post-breeding migration	Migration-free winter	Annual
Arklow Bank	46	19	9	21	96
Barrow	69	29	14	31	143
Burbo Bank	24	10	5	11	50
Gwynt y Môr	171	72	24	77	344
North Hoyle	58	24	11	26	119

Project	Return migration	Migration-free breeding	Post-breeding migration	Migration-free winter	Annual
Ormonde	69	29	14	31	143
Rhyl Flats	72	30	14	32	148
Robin Rigg	93	39	18	41	191
Walney Phase 1	54	23	11	24	112
Walney Phase 2	77	32	15	35	159
West of Duddon Sands	144	60	28	64	296

Table 17 Razorbill mean peak abundances for the gap analysis projects using the data from proxy project with closest proximity

Project	Return migration	Migration-free breeding	Post-breeding migration	Migration-free winter	Annual	Proxy project
Arklow Bank	46	19	9	21	96	Awel y Môr
Barrow	273	142	599	633	1,647	Walney Extension
Burbo Bank	-	10	-	4	14	Burbo Bank Extension
Gwynt y Môr	171	72	24	77	344	Awel y Môr
North Hoyle	58	24	11	26	119	Awel y Môr
Ormonde	271	141	595	629	1,636	Walney Extension
Rhyl Flats	72	30	14	32	148	Awel y Môr
Robin Rigg	366	190	803	849	2,208	Walney Extension
Walney Phase 1	215	111	471	498	1,295	Walney Extension
Walney Phase 2	305	158	668	706	1,837	Walney Extension
West of Duddon Sands	567	294	1,245	1,315	3,421	Walney Extension

3.3 Puffin

95. The estimated puffin mean peak abundances for the historic OWF projects are provided in **Table 18** when using only Awel y Môr data as proxy. The mean peak abundances using the Awel y Môr,Walney Extension and Burbo Bank Extension proxy projects are provided in **Table 19**.

Table 18 Puffin mean peak abundances for the historic project array areas (plus 2km buffer) using Awel y Môr data as a proxy

Project	Breeding	Non-breeding	Annual
Arklow Bank	2	0	2
Barrow	3	0	3
Burbo Bank	1	0	1
Gwynt y Môr	7	0	7
North Hoyle	2	0	2
Ormonde	3	0	3
Rhyl Flats	3	0	3
Robin Rigg	4	0	4
Walney Phase 1	2	0	2
Walney Phase 2	3	0	3
West of Duddon Sands	1	0	1

Table 19 Puffin mean peak abundances for the historic project array areas (plus 2km buffer) using the data from proxy project with closest proximity

Project	Breeding	Non-breeding	Annual	Proxy project
Arklow Bank	2	0	2	Awel y Môr
Barrow	20	14	34	Walney Extension
Burbo Bank	0	39	39	Burbo Bank Extension
Gwynt y Môr	7	0	7	Awel y Môr
North Hoyle	2	0	2	Awel y Môr
Ormonde	19	14	33	Walney Extension
Rhyl Flats	3	0	3	Awel y Môr
Robin Rigg	26	19	45	Walney Extension
Walney Phase 1	15	11	26	Walney Extension

Project	Breeding	Non-breeding	Annual	Proxy project
Walney Phase 2	22	16	38	Walney Extension
West of Duddon Sands	41	30	71	Walney Extension

3.4 Manx shearwater

96. The estimated Manx shearwater mean peak abundances for the historic OWF projects are provided in **Table 20** when using only Awel y Môr data as proxy. The mean peak abundances considering the Awel y Môr, Walney Extension and Burbo Bank Extension proxy projects are provided in **Table 21**.

Table 20 Manx shearwater mean peak abundances for the historic project array areas (plus 2km buffer) using Awel y Môr data as a proxy

Project	Return migration	Breeding	Post-breeding migration	Annual
Arklow Bank	0	30	0	30
Barrow	0	44	0	44
Burbo Bank	0	15	0	15
Gwynt y Môr	0	110	0	110
North Hoyle	0	37	0	37
Ormonde	0	44	0	44
Rhyl Flats	0	46	0	46
Robin Rigg	0	59	0	59
Walney Phase 1	0	35	0	35
Walney Phase 2	0	49	0	49
West of Duddon Sands	0	92	0	92

Table 21 Manx shearwater mean peak abundances for the historic project array areas (plus 2km buffer) using the data from proxy project with closest proximity

Project	Return migration	Breeding	Post-breeding migration	Annual	Proxy project
Arklow Bank	0	30	0	30	Awel y Môr
Barrow	10	97	53	160	Walney Extension

Project	Return migration	Breeding	Post-breeding migration	Annual	Proxy project
Burbo Bank	-	66	-	66	Burbo Bank Extension
Gwynt y Môr	0	110	0	110	Awel y Môr
North Hoyle	0	37	0	37	Awel y Môr
Ormonde	9	96	53	158	Walney Extension
Rhyl Flats	0	46	0	46	Awel y Môr
Robin Rigg	13	130	71	214	Walney Extension
Walney Phase 1	8	76	42	126	Walney Extension
Walney Phase 2	11	108	59	178	Walney Extension
West of Duddon Sands	20	202	111	333	Walney Extension

3.5 Gannet

97. The estimated gannet mean peak abundances for the historic OWF projects are provided in **Table 22** when using only Awel y Môr data as proxy. The mean peak abundances considering the Awel y Môr, Walney Extension and Burbo Bank Extension proxy projects are provided in **Table 23**.

Table 22 Gannet mean peak abundances for the historic project array areas (plus 2km buffer) using Awel y Môr data as a proxy

Project	Return migration	Breeding	Post-breeding migration	Annual
Arklow Bank	0	51	15	66
Barrow	0	76	23	99
Burbo Bank	0	26	8	34
Gwynt y Môr	0	188	57	245
North Hoyle	0	64	19	83
Ormonde	0	75	23	98
Rhyl Flats	0	78	24	102
Robin Rigg	0	102	31	132
Walney Phase 1	0	60	18	78

Project	Return migration	Breeding	Post-breeding migration	Annual
Walney Phase 2	0	85	26	111
West of Duddon Sands	0	158	48	205

Table 23 Gannet mean peak abundances for the historic project array areas (plus 2km buffer) using the data from proxy project with closest proximity

Project	Return migration	Breeding	Post-breeding migration	Annual	Proxy project
Arklow Bank	0	51	15	66	Awel y Môr
Barrow	4	36	43	83	Walney Extension
Burbo Bank	1	34	1	36	Burbo Bank Extension
Gwynt y Môr	0	188	57	245	Awel y Môr
North Hoyle	0	64	19	83	Awel y Môr
Ormonde	4	36	42	82	Walney Extension
Rhyl Flats	0	78	24	102	Awel y Môr
Robin Rigg	5	49	57	111	Walney Extension
Walney Phase 1	3	28	33	64	Walney Extension
Walney Phase 2	4	40	47	91	Walney Extension
West of Duddon Sands	8	75	88	171	Walney Extension

4. Collision risk impact estimates by proxy

98. Collision risk impact values for each of the five key species being assessed for potential cumulative impacts due to collision are provided below, using the methodology set out in **Section 2.1**. impacts are presented within the following sections as bio-season impact totals (Furness, 2015), with monthly proxy collision estimates presented in **Annex 2** of this document. Detail on the component months for each species bio-season is presented in **Annex 3**.

4.1 Kittiwake

99. The collision risk values for the historic OWF array areas for kittiwake are provided in **Table 24** when using Awel y Môr, Walney Extension and Burbo Bank Extension data as proxies.

Table 24 Estimated kittiwake collision risk impact values for historic OWF projects using proxy data

Project	Return migration	Breeding	Post-breeding migration	Annual	Proxy project
Arklow Bank	0.5	1.5	0.7	2.8	Awel y Môr
Barrow	0.4	3.7	10.4	14.5	Walney Extension
Burbo Bank	0.6	8.3	1.7	10.6	Burbo Bank Extension
Gwynt y Môr	16.6	47.8	20.6	85.0	Awel y Môr
North Hoyle	2.2	6.4	2.7	11.3	Awel y Môr
Ormonde	0.5	4.5	12.8	17.8	Walney Extension
/Rhyl Flats	2.0	5.7	2.4	10.1	Awel y Môr
Robin Rigg	0.9	7.3	20.9	29.1	Walney Extension
Walney Phase 1	1.0	8.3	23.7	32.9	Walney Extension
Walney Phase 2	1.0	8.3	23.7	32.9	Walney Extension
West of Duddon Sands	2.8	23.4	66.6	92.8	Walney Extension

4.2 Great black-backed gull

100. The collision risk values for the various OWF array areas for great black-backed gull are provided in **Table 25** when using Awel y Môr, Walney Extension and Burbo Bank Extension data as proxies.

Table 25 Estimated great black-backed gull collision risk impact values for historic OWF projects using proxy data

Project	Breeding	Non-breeding	Annual	Proxy project
Arklow Bank	0.3	0.1	0.4	Arklow Bank
Barrow	0.8	2.8	3.6	Barrow
Burbo Bank	1.8	4.2	5.9	Burbo Bank
Gwynt y Môr	10.6	1.4	12.0	Gwynt y Môr
North Hoyle	1.4	0.2	1.6	North Hoyle
Ormonde	0.9	3.4	4.3	Ormonde
Rhyl Flats	1.3	0.2	1.5	Rhyl Flats
Robin Rigg	1.5	5.	7.1	Robin Rigg
Walney Phase 1	1.7	6.3	8.0	Walney Phase 1
Walney Phase 2	1.7	6.3	8.0	Walney Phase 2
West of Duddon Sands	4.8	17.8	22.6	West of Duddon Sands

4.3 Herring gull

101. The collision risk values for the various OWF array areas for great black-backed gull are provided in **Table 26** when using Awel y Môr, Walney Extension and Burbo Bank Extension data as proxies.

Table 26 Estimated herring gull collision risk impact values for historic OWF projects using proxy data

Project	Breeding	Non-breeding	Annual	Proxy project
Arklow Bank	0.1	0.1	0.2	Awel y Môr
Barrow	5.0	3.1	8.1	Walney Extension
Burbo Bank	12.3	7.9	20.2	Burbo Bank Extension
Gwynt y Môr	4.1	3.7	7.8	Awel y Môr
North Hoyle	0.5	0.5	1.0	Awel y Môr
Ormonde	6.1	3.8	9.9	Walney Extension
Rhyl Flats	0.5	0.4	0.9	Awel y Môr
Robin Rigg	9.9	6.3	16.2	Walney Extension

Project	Breeding	Non-breeding	Annual	Proxy project
Walney Phase 1	11.2	7.1	18.3	Walney Extension
Walney Phase 2	11.2	7.1	18.3	Walney Extension
West of Duddon Sands	31.6	20.0	51.6	Walney Extension

4.4 Lesser black-backed gull

102. The collision risk values for the various OWF array areas for lesser black-backed gull are provided in **Table 27** when using Awel y Môr, Walney Extension and Burbo Bank Extension data as proxies.

Table 27 Estimated lesser black-backed gull collision risk impact values for historic OWF projects using proxy data

Project	Return migration	Breeding	Post-breeding migration	Migration-free winter	Annual	Proxy project
Arklow Bank	0.0	0.0	0.0	0.0	0.0	Awel y Môr
Barrow	0.3	1.0	0.8	1.7	3.8	Walney Extension
Burbo Bank	0.5	13.8	1.4	0.2	15.9	Burbo Bank Extension
Gwynt y Môr	0.0	1.2	0.0	0.0	1.2	Awel y Môr
North Hoyle	0.0	0.2	0.0	0.0	0.2	Awel y Môr
Ormonde	0.4	1.2	1.0	2.1	4.7	Walney Extension
Rhyl Flats	0.0	0.1	0.0	0.0	0.1	Awel y Môr
Robin Rigg	0.7	1.9	1.6	3.4	7.7	Walney Extension
Walney Phase 1	1.2	2.2	1.9	3.9	8.7	Walney Extension
Walney Phase 2	1.2	2.2	1.9	3.9	8.7	Walney Extension
West of Duddon Sands	2.2	6.1	5.2	11.0	24.4	Walney Extension

4.5 Gannet

103. The collision risk values for the various OWF array areas for gannet are provided in **Table 28** when using Awel y Môr, Walney Extension and Burbo Bank Extension data as proxies.

Table 28 Estimated gannet collision risk impact values for historic OWF projects using proxy data

Project	Return migration	Breeding	Post-breeding migration	Annual	Proxy project
Arklow Bank	0	0.2	0.1	0.3	Awel y Môr
Barrow	-	-	-	1.0	Walney Extension
Burbo Bank	0.1	2.6	0.2	2.9	Burbo Bank Extension
Gwynt y Môr	0	14.1	9.5	23.6	Awel y Môr
North Hoyle	0	1.9	1.3	3.1	Awel y Môr
Ormonde	-	-	-	1.2	Walney Extension
Rhyl Flats	0.0	1.7	1.1	2.8	Awel y Môr
Robin Rigg	-	-	-	1.9	Walney Extension
Walney Phase 1	-	-	-	2.2	Walney Extension
Walney Phase 2	-	-	-	2.2	Walney Extension
West of Duddon Sands	-	-	-	6.1	Walney Extension

5. Confidence assessment of cumulative assessment values calculated by proxy projects

5.1 Variable considered to determine confidence in proxy vales

104. When using proxy projects to assign values to the historic OWF sites it is important to consider factors which may influence the usage of an area when interpreting the results and applying confidence to these. The age of a project, as well as physical features such as bathymetry and sediment layer at the site can affect the number of seabirds utilising an area.

105. Bathymetry data has been examined to understand the differences in sea depths for the various OWF projects. The sea depth at a project is influential in terms of the seabirds that could be utilising an area as an increase in depth is typically attributed to a larger number of prey species through increased plankton availability as a consequence of upwelling events (Carr & Kearns, 2003). This increase in prey will in turn result in an increase in seabirds present. Both Walney Extension and Awel y Môr are in deeper waters than the other OWFs and so the densities of seabirds found at Awel y Môr and Walney Extension sites may not be mirrored across the other sites given the varying environmental variables such as water depth and seabed composition at which they are located (**Figure 6**).

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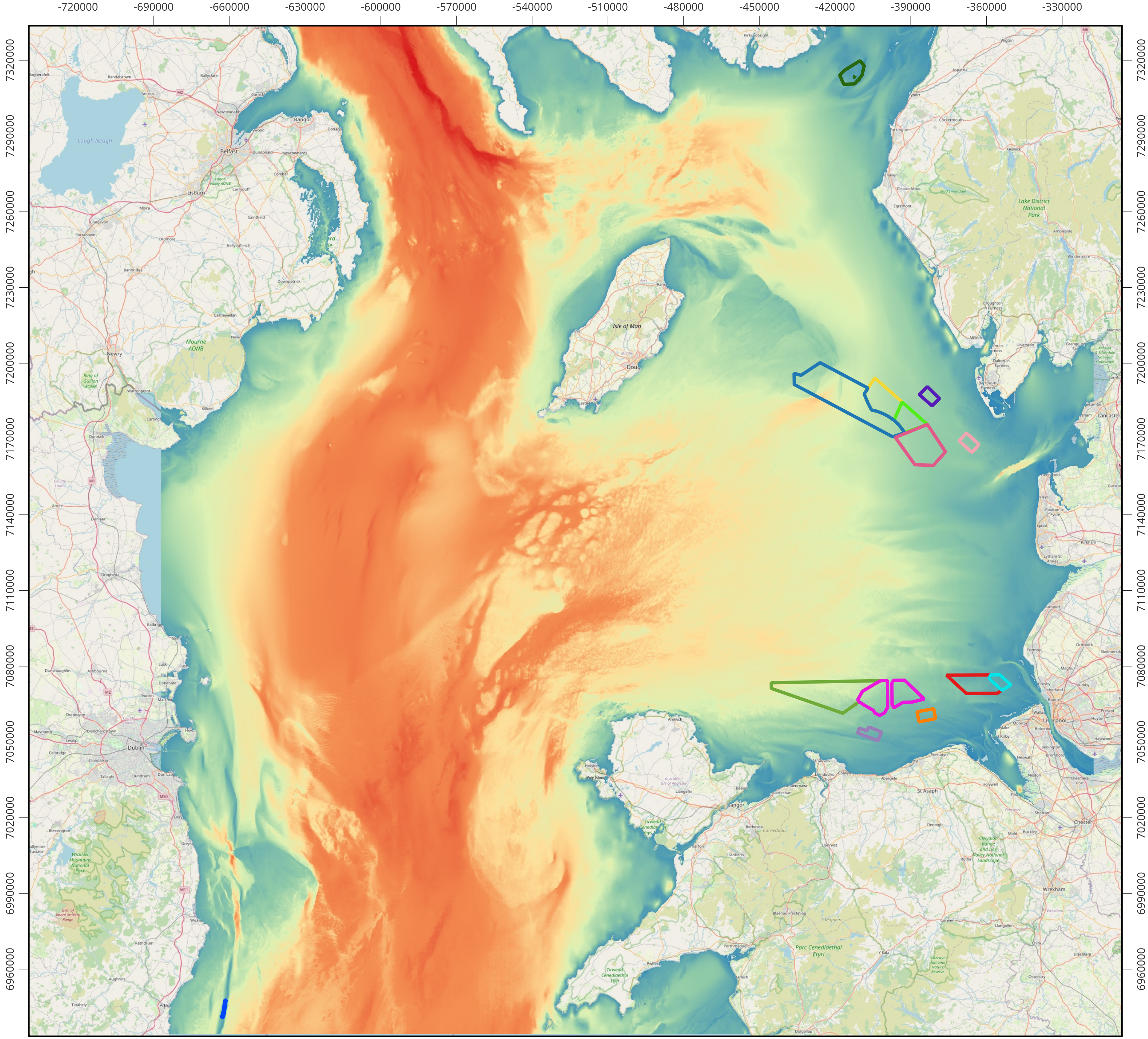
P14531 White Cross Cumulative Gap Analysis

Offshore Wind Farm Projects Requiring Gap Analysis with Mean Depth



Legend

- Robin Rigg
- Walney Extension
- Walney Phase 2
- Walney Phase 1
- Ormonde
- West of Duddon Sands
- Barrow
- Awel y Mor
- Gwynt y Mor
- Burbo Bank Extension
- Burbo Bank
- North Hoyle
- Rhyl Flats
- Arklow

Mean depth (metres)

0

-283.63

Notes

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Coordinate System: WGS 84 / Pseudo-Mercator

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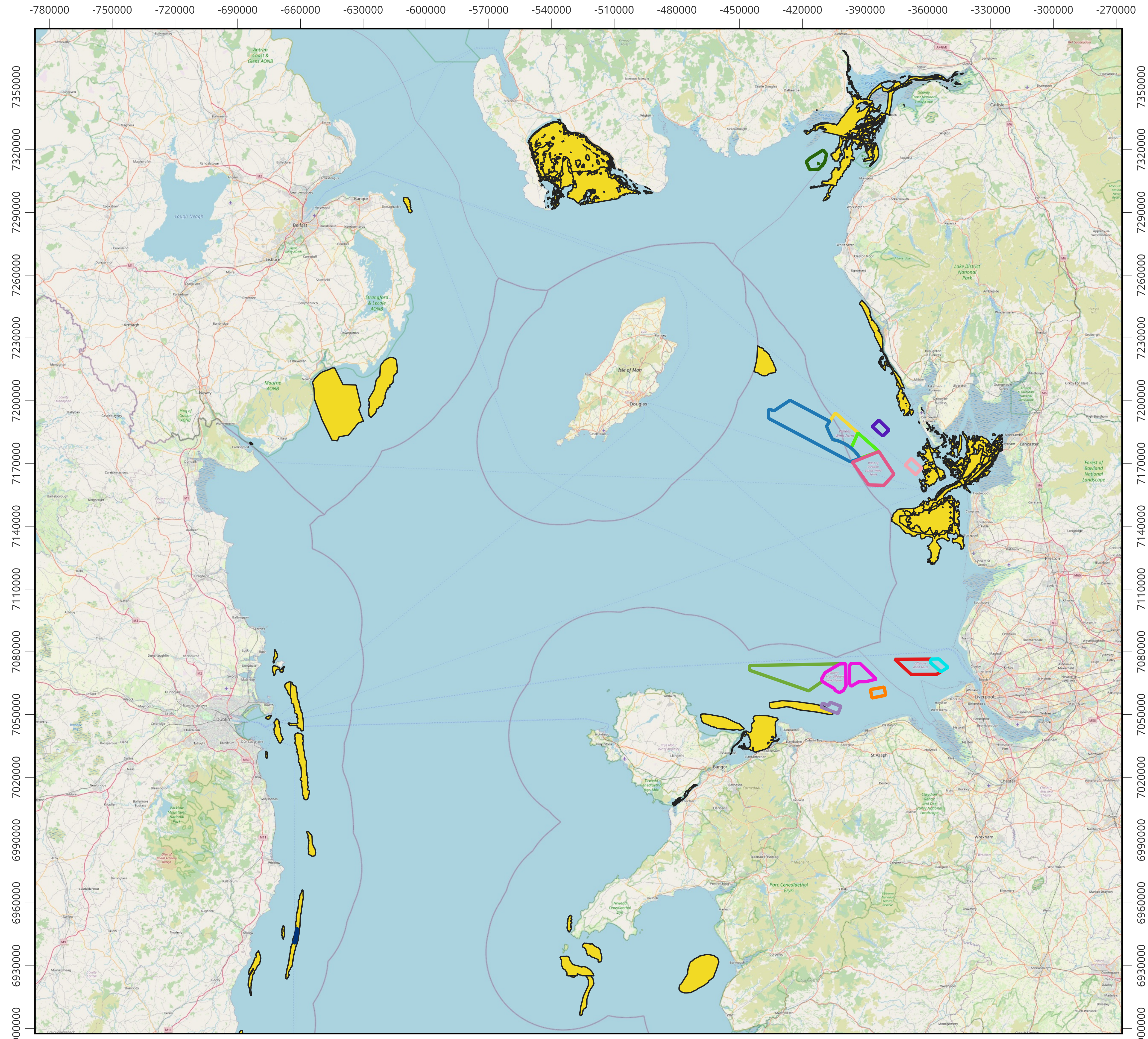
Figure Reference: P14531 Array areas plus bathymetry data

106. In addition to bathymetry, the differences in substrate type and presence of nearby sandbars have also been examined (**Figure 6**). Sandbars and the presence of sandy substrate on the seabed provides the ideal habitat for prey species of seabirds (Wright et al, 2000) and so the presence of this habitat will also likely lead to higher seabird utilisation. The sediment type differs between the Awel y Môr and Walney Extension proxy projects and could alter the prey species within the areas (**Figure 8**). As explained, the presence of sandy habitat and sandbar presence is influential to seabird species presence. Awel y Môr is near the Menai Strait and Conwy Bay sand banks, which could lead to an increased bird presence in the area. This is compared to Walney Extension which is further from sandbanks (**Figure 7**).



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P14531 White Cross Cumulative Gap Analysis

Sandbanks in the vicinity of the OWF projects

Legend

- Robin Rigg
- Walney Extension
- Walney Phase 2
- Walney Phase 1
- Ormonde
- West of Duddon Sands
- Barrow
- Awel y Mor
- Gwynt y Mor
- Burbo Bank Extension
- Burbo Bank
- North Hoyle
- Rhyl Flats
- Arklow
- Sandbanks

Notes

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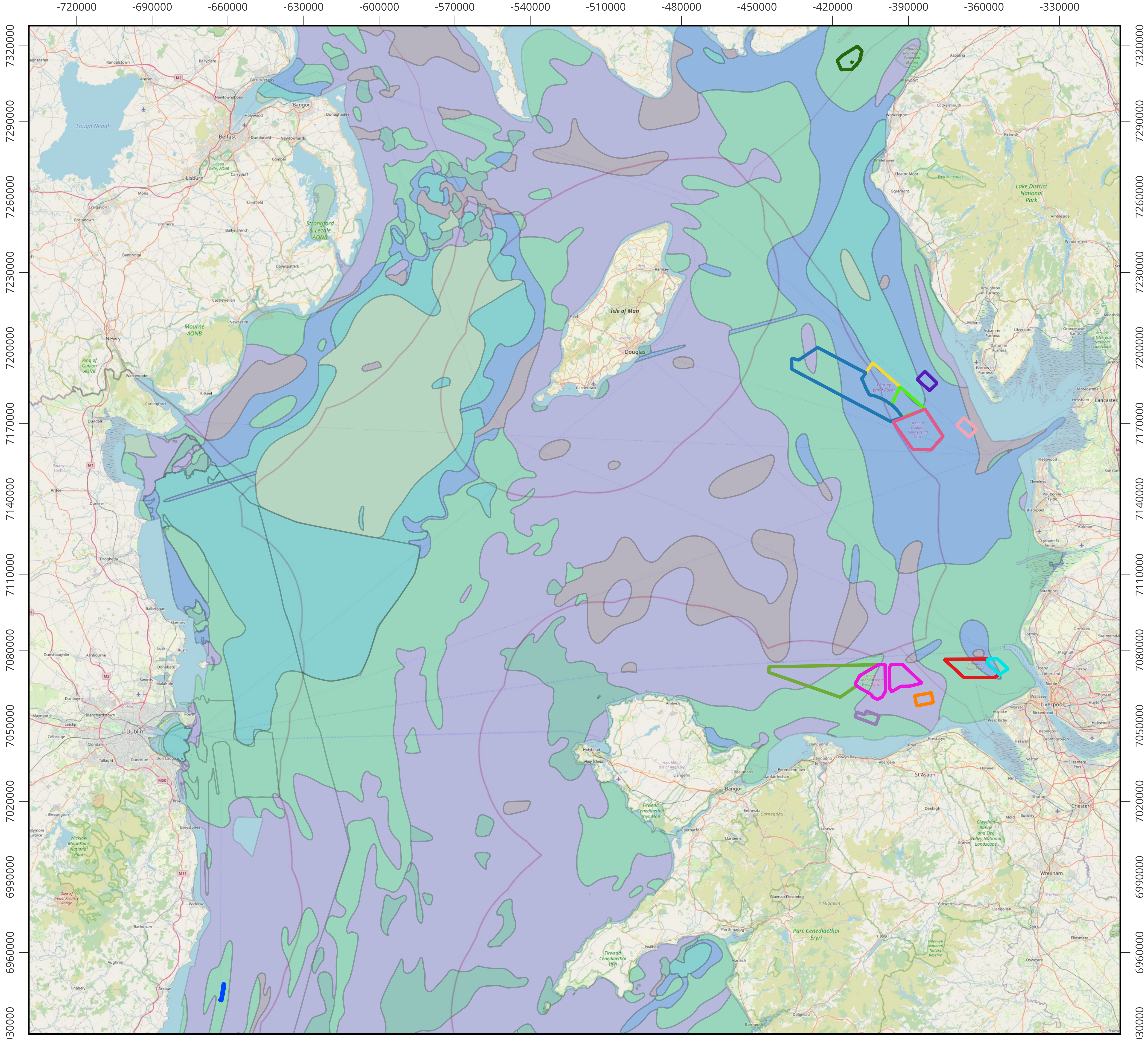
Figure Reference: P14531 Sandbanks in the vicinity of OWF projects



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P14531 White Cross Cumulative Gap Analysis

Seabed sediment at the OWF project areas

Legend

- Robin Rigg
- Walney Extension
- Walney Phase 2
- Walney Phase 1
- Ormonde
- West of Duddon Sands
- Barrow
- Awel y Mor
- Gwynt y Mor
- Burbo Bank Extension
- Burbo Bank
- North Hoyle
- Rhyl Flats
- Arklow

Seabed sediment

- Mud
- Sandy Mud
- Muddy Sand
- Sand
- Coarse-grained sediment
- Mixed sediment
- Rock & boulders

Notes

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0 60 km

N

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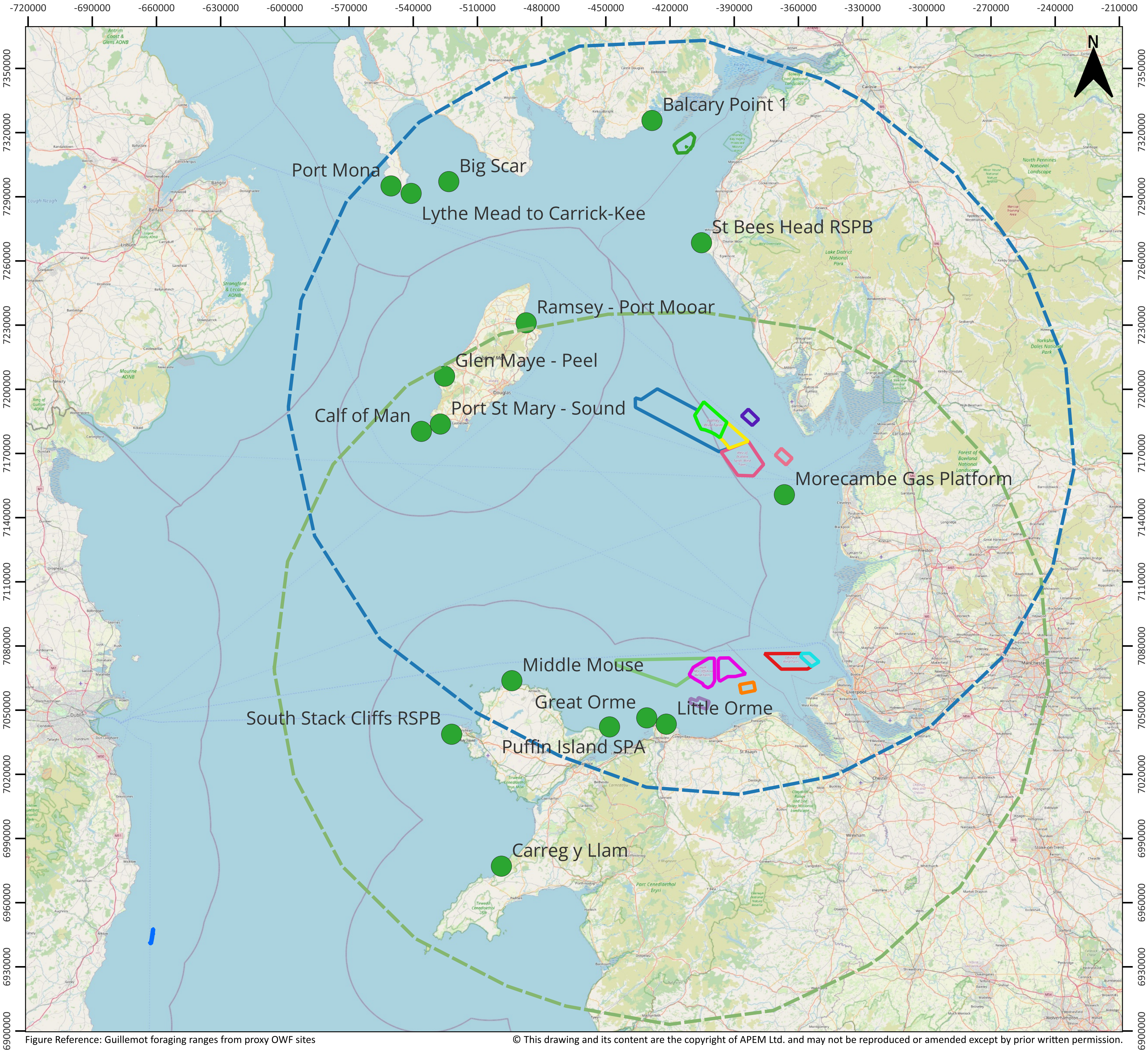
Figure Reference: P14531 Seabed sediment at the OWF project areas

107. Distance of OWF projects to seabird colonies and their connectivity is another factor to consider within this analysis. Certain OWF sites may have more connectivity to breeding colonies which could increase the likelihood of birds utilising that area. In order to identify such colonies with connectivity to OWF sites, the known mean maximum plus one Standard Deviation (SD) foraging ranges (Woodward et al., 2019) for relevant seabird species were reviewed. Colonies were identified using the Seabird Monitoring Programme (SMP) database (SMP, 2023), using the maps for each species to determine which breeding colonies would fall inside the foraging range. The identification of colonies focussed on the Irish Sea and surrounding areas, due to this area hosting the likely colonies with greatest connectivity based on proximity. Identification of colonies was further refined to take into account potential barriers, flight behaviour, the size of the colony and expert opinion to narrow the focus of this review to the colonies with the greatest likelihood for connectivity and potential influence on the baseline characterisation for the projects. It must therefore be noted that this is not an exhaustive list of all colonies with potential connectivity to the OWF array areas. Puffin, kittiwake, Manx shearwater and gannet have very large foraging ranges that lead to considerable overlap with the connectivity to local colonies and therefore, there is no difference in potential connectivity between either proxy site. However, guillemot, razorbill, lesser black-backed gull, herring gull and great black-backed gull have foraging ranges that lead to differences in connectivity to colonies when comparing the Awel y Môr and Walney Extension proxy sites. Walney Extension has more connectivity to guillemot, razorbill and lesser black-backed gull colonies whereas Awel y Môr has increased connectivity to great black-backed gull and herring gull colonies (**Figure 9** to **Figure 13**).



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Guillemot foraging ranges from proxy OWF projects

Legend
- Awel y Mor array area
- Guillemot mean max foraging area from Awel y Mor
- Walney Extension array area
- Guillemot mean max foraging area from Walney Extension
- Barrow
- Burbo Bank
- Burbo Bank Extension
- Gwynt y Mor
- North Hoyle
- Ormonde
- Rhyl Flats
- Robin Rigg
- Walney Phase 1
- Walney Phase 2
- Walney Extension
- West of Duddon Sands
- Arklow
- Guillemot colonies

Notes

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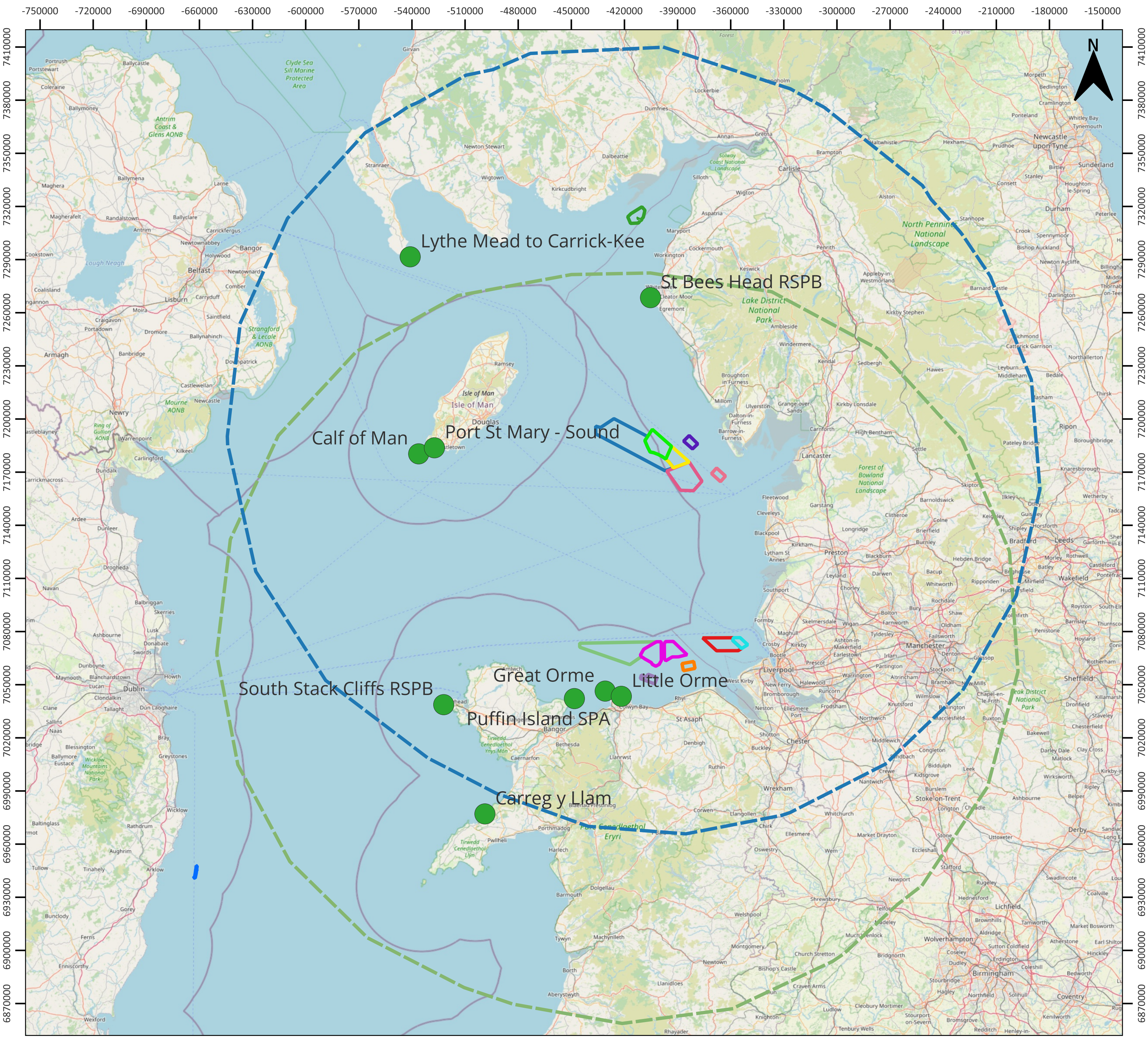
Figure Reference: Guillemot foraging ranges from proxy OWF sites



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P14531 White Cross Cumulative GAP Analysis

Razorbill foraging ranges from proxy OWF projects

Legend

- Awel y Mor array area
- Razorbill mean max foraging area from Awel y Mor
- Walney Extension array area
- Razorbill mean max foraging area from Walney Extension
- Barrow
- Burbo Bank
- Burbo Bank Extension
- Gwynt y Mor
- North Hoyle
- Ormonde
- Rhyl Flats
- Robin Rigg
- Walney Phase 1
- Walney Phase 2
- Walney Extension
- West of Duddon Sands
- Razorbill colonies

Notes

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0 50 100 km

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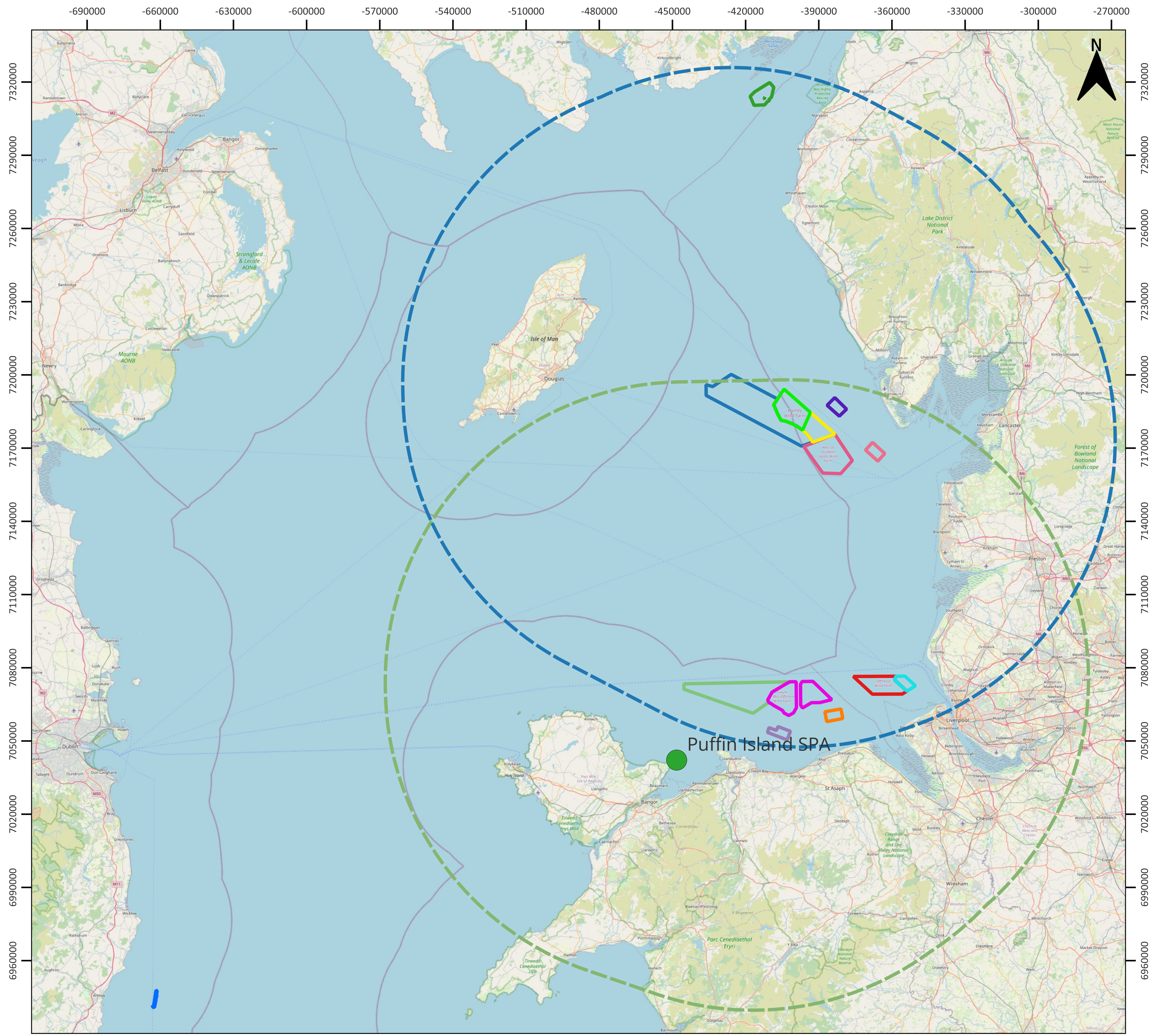
Figure Reference: Razorbill foraging ranges from proxy OWF sites



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P14531 White Cross Cumulative GAP Analysis

Great black-backed gull foraging ranges from proxy OWF projects

Legend

- Awel y Mor array area
- Great black-backed gull mean max foraging area from Awel y Mor
- Walney Extension array area
- Great black-backed gull mean max foraging area from Walney Extension
- Barrow
- Burbo Bank
- Burbo Bank Extension
- Gwynt y Mor
- North Hoyle
- Ormonde
- Rhyl Flats
- Robin Rigg
- Walney Phase 1
- Walney Phase 2
- Walney Extension
- West of Duddon Sands
- Arklow
- Great black-backed gull colonies

Notes

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0 30 60 km

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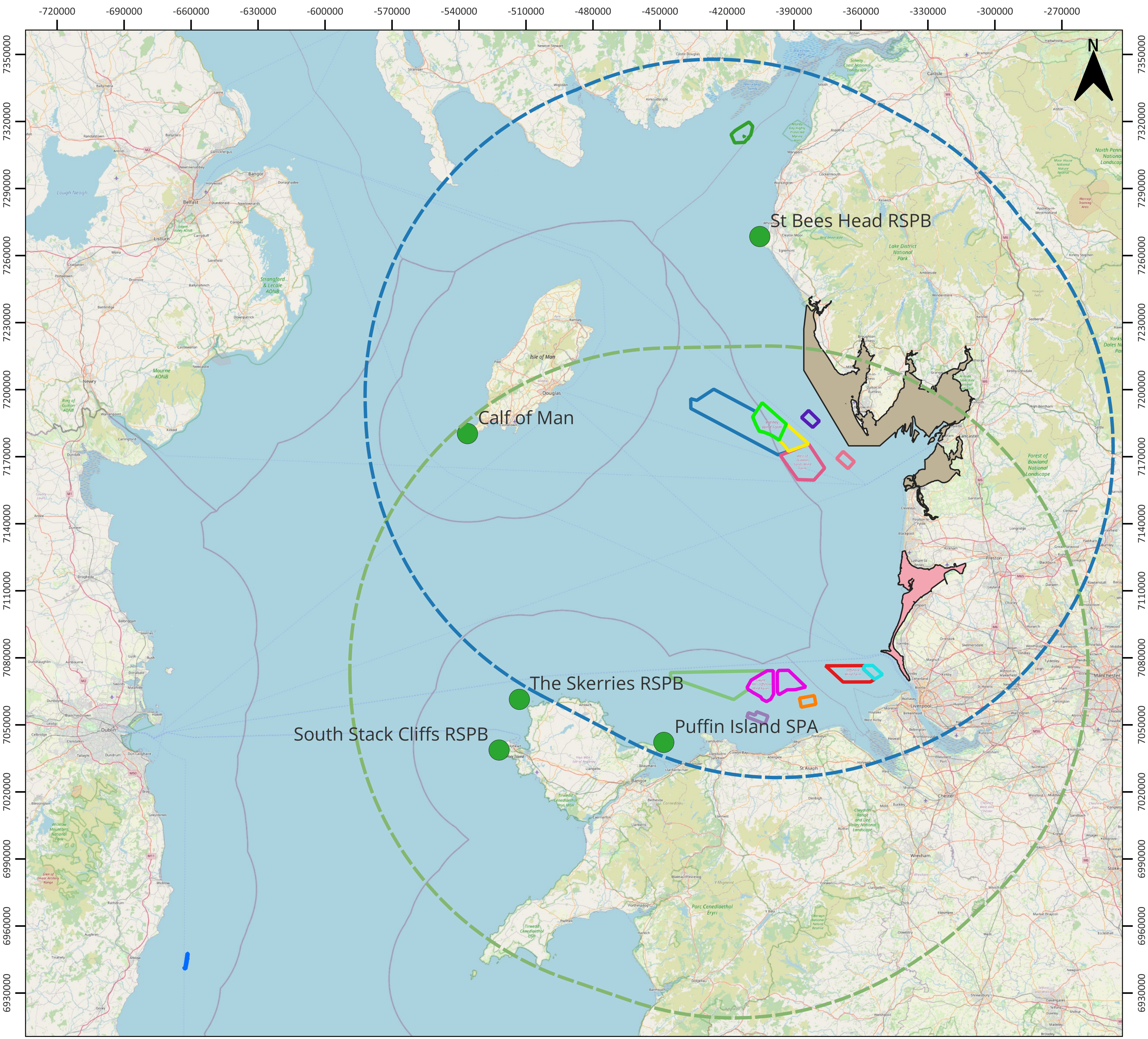
Figure Reference: Great black-backed gull foraging ranges from proxy OWF sites



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P14531 White Cross Cumulative GAP Analysis

Herring gull foraging ranges from proxy OWF projects

Legend
- Awel y Mor array area
- Herring gull mean max foraging area from Awel y Mor
- Walney Extension array area
- Herring gull mean max foraging area from Walney Extension
- Barrow
- Burbo Bank
- Burbo Bank Extension
- Gwynt y Mor
- North Hoyle
- Ormonde
- Rhyl Flats
- Robin Rigg
- Walney Phase 1
- Walney Phase 2
- Walney Extension
- West of Duddon Sands
- Arklow
- Herring gull colonies
- Morecambe Bay and Duddon Estuary SPA
- Ribble and Alt Estuary SPA

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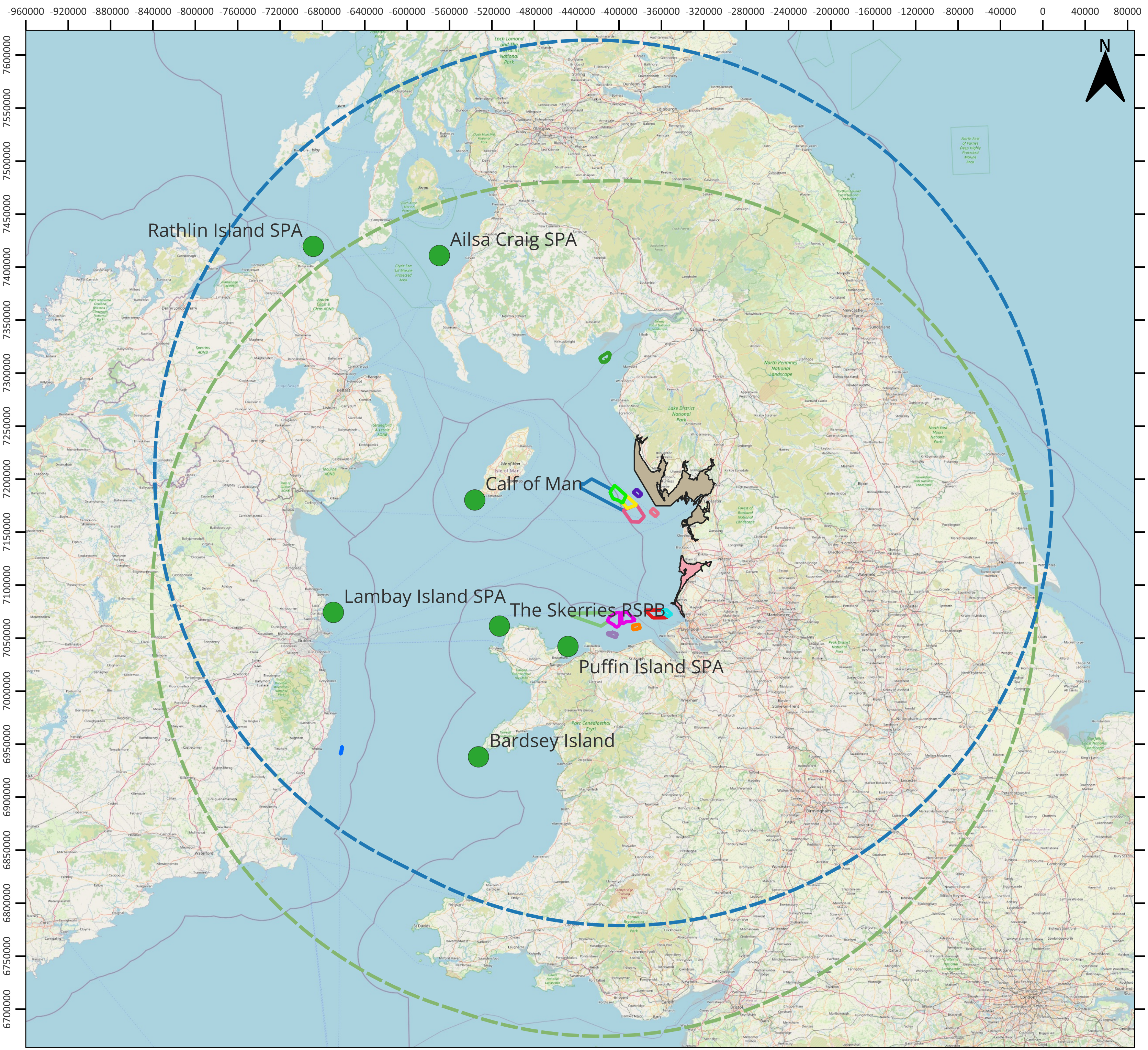
Figure Reference: Herring gull foraging ranges from proxy OWF sites



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P14531 White Cross Cumulative GAP Analysis

Lesser black-backed gull foraging ranges from proxy OWF projects

Legend
- Awel y Mor array area
- Lesser black-backed gull mean max foraging area from Awel y Mor
- Walney Extension array area
- Lesser black-backed gull mean max foraging area from Walney Extension
- Barrow
- Burbo Bank
- Burbo Bank Extension
- Gwynt y Mor
- North Hoyle
- Ormonde
- Rhyl Flats
- Robin Rigg
- Walney Phase 1
- Walney Phase 2
- Walney Extension
- West of Duddon Sands
- Arklow
- Lesser black-backed gull colonies
- Morecambe Bay and Duddon Estuary SPA
- Ribble and Alt Estuary SPA

Notes

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Scale: 0 90 180 km

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Figure Reference: Lesser black-backed gull foraging ranges from proxy OWF sites

108. As described in **Section1.2**, seabird species trends around the UK and Ireland have experienced large changes in recent years, and so the difference in a project's age may also affect the expected abundance for historic OWF projects.

109. When assigning a measure of confidence to the predicted collision impacts attributed to historic OWF projects, it is important to consider the most recent evidence. Vattenfall (2023) published a study, for the European Offshore Wind Deployment Centre (EOWDC) in Aberdeen, that indicates that there were no collisions detected at the Aberdeen OWF site between 2020 and 2021. Additionally, the findings of the Bird Collision Avoidance Study funded by ORJIP (Offshore Renewables Joint Industry Programme), which undertook a study to understand seabird behaviour at sea around the Thanet offshore wind farm (Skov et al., 2018) made up of a total of 100 WTGs with a rotor radius of 45m, should be considered. The ORJIP project studied birds around Thanet offshore wind farm for a two-year period (between 2014 and 2016) recording over 12,000 bird movements throughout the day and night (Skov et al., 2018). The findings of this study reported that only six birds (all gull species) collided with WTGs from over 12,000 birds recorded during the two-year period.

110. Finally, when focussing on CRM values assigned to historic projects, it is important to be considerate of the assumptions assigned to these. Although total rotor swept area, the number of turbines and the rotor radius is project specific, other parameters such as rotation speed, pitch and wind availability will affect the level of impact predicted, in addition to the densities of birds recorded at the proxy sites. Consideration of such differences should be recognised when interpreting the CRM results.

111. A review of the appropriateness of the two proxy scenarios (**Section 2.1.2**) for each historic OWF project has been conducted and a level of confidence in the results discussed below.

5.1.1 Arklow Bank

5.1.1.1 Project timeframes

112. The time difference between the commission date of Arklow Bank and the survey dates for Awel y Môr span 13 years.

5.1.1.2 Habitat type

113. Arklow Bank OWF is located in water depths of 14.2m compared to the deeper areas of Awel y Môr at 31m (**Figure 6**). Therefore, no obvious similarities can be made between the Arklow Bank site and the proxy project, using sea depth as a metric. The seabed sediment layer of Arklow Bank is sand, which is similar to Awel y Môr (**Figure 8**), although Awel y Môr is also situated over coarse grained sediment. A final geological factor to consider is the proximity to

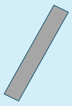
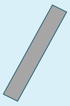
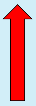
sandbanks. Arklow Bank and Awel y Môr are both situated in very close proximity to a sand bank (**Figure 7**).

5.1.1.3 Colony connectivity and species trends

114. As previously described, there are differences in the connectivity to seabird breeding colonies between the two proxy sites. Arklow Bank is located a significant distance away from either proxy site therefore colony connectivity is likely to be significantly different (**Figure 9** to **Figure 13**). In addition to connectivity between sites, colony count data for seabird species at the time of Arklow Bank commissioning and the survey years of Awel y Môr (2019-2021) can be compared to aid the understanding of differences in seabird abundances and densities between project dates (**Table 29**).

Table 29 Seabird species trends for Awel y Môr (2019 – 2021) and survey dates since the Arklow Bank (2004) commissioning date. (Arrow direction indicated trend in comparison to historic OWF site. Green= similar trend, orange= marginal change and red= significant change. The grey line represents data deficiency)

Species	Awel y Môr	Notes
Kittiwake	↓ (orange)	Kittiwake numbers were marginally lower in the proxy site survey years that at Arklow Bank commissioning (JNCC, 2021f).
Great black-backed gull	— (green)	Great black-backed gull numbers are similar in Awel y Mor survey years and the Arklow Bank commissioning date (JNCC, 2021g)
Herring gull	↓ (red)	Herring gull numbers were significantly lower in the Awel y Môr survey years, compared to the Arklow Bank commissioning date (JNCC, 2021h).
Lesser black-backed gull	↓ (red)	Lesser black-backed gull numbers were significantly lower in the Awel y Môr survey years, compared to the Arklow Bank commissioning date (JNCC, 2021i).
Guillemot	↑ (red)	Guillemot numbers were significantly higher in the Awel y Môr survey years compared to the Arklow Bank commissioning date (JNCC, 2021a).
Razorbill	↑ (orange)	Razorbill numbers were marginally higher in the Awel y Môr survey years compared to the Arklow Bank commissioning date (JNCC, 2021b).

Species	Awel y Môr	Notes
Puffin		There is insufficient data for puffin population trends to allow for a comparison between the proxy site and Arklow Bank (JNCC, 2021d).
Manx shearwater		There is insufficient data for Manx shearwater population trends to allow for a comparison between the proxy site and Arklow Bank (JNCC, 2021c).
Gannet		Gannet numbers were significantly higher in the Awel y Môr survey years compared to the Arklow Bank commissioning date (JNCC, 2021e).

5.1.1.4 Turbine parameters

115. When attributing collision risk impact values to Arklow Bank using Awel y Môr as a proxy, it is important to address parameter differences between the sites. Although the ratio calculations comparing the rotor swept areas used project specific parameters, the bird densities assumed were those of the proxy site. Like abundances of birds, the densities between the two sites will differ and so assuming the same density to assign collision impact values adds a lack of precision to the values.

5.1.1.5 Summary

116. When assigning a measure of confidence in the calculated collision impacts attributed to Arklow Bank, it is important to consider the most recent evidence. As mentioned above, Vattenfall (2023) published a study for the European Offshore Wind Deployment Centre (EOWDC) in Aberdeen, that indicates that there were no collisions detected at the Aberdeen OWF site between 2020 and 2021. The EOWDC is composed of 11 WTGs (rotor radius 82m) in contrast to the seven WTGs (rotor radius 52m) for Arklow Bank in terms of number, making the monitoring results highly relevant and so this should be considered when placing confidence on the collision values presented.

117. Considering both the temporal, physical and demographic aspects of the projects, using Awel y Môr data as a proxy has been chosen as the most appropriate data set. However, there are still stark contrasts in the two areas and so confidence in using Awel y Môr data for Arklow Bank is low.

5.1.2 Barrow

5.1.2.1 Project timeframes

118. The time difference between the commission date of Barrow and the survey dates for Awel y Môr and Walney Extension span 15 and six years, respectively.

5.1.2.2 Habitat type

119. Barrow OWF is located in shallower water (15m) than Awel y Môr (31m) and Walney Extension (40m) proxy OWF sites (**Figure 6**) and so no obvious connections can be made with either proxy site using this metric. The seabed sediment layer of Barrow is most similar to that of Walney Extension (**Figure 8**) however, Barrow is neighbouring a large sandbank (**Figure 7**), unlike Walney Extension, which could lead to a difference in seabird assemblage and number. The position in relation to a sandbank is similar to that of Awel y Môr.

5.1.2.3 Colony connectivity and species trends

120. Barrow OWF is located in shallower water (15m) than Awel y Môr (31m) and Walney Extension (40m) proxy OWF sites (**Figure 6**) and so no obvious connections can be made with either proxy site using this metric. The seabed sediment layer of Barrow is most similar to that of Walney Extension (**Figure 8**) however, Barrow is neighbouring a large sandbank (**Figure 7**), unlike Walney Extension, which could lead to a difference in seabird assemblage and number. The position in relation to a sandbank is similar to that of Awel y Môr.

121. Barrow shares similar connectivity to seabird colonies as Walney Extension and so considering connectivity as a metric, Walney Extension would be the most appropriate proxy site (**Figure 9** to **Figure 13**). In addition to connectivity between sites, colony count data for seabird species at the time of Barrow commissioning and the survey years of Awel y Môr (2019-2021) and Walney Extension (2010-2012) can be compared to aid in the understanding of differences in seabird abundances and densities between project dates (**Table 30**).

Table 30 Seabird species trends for Awel y Môr (2019 – 2021) survey dates since the Barrow (2006) commissioning date. (Arrow direction indicated trend in comparison to historic OWF site. Green= similar trend, orange= marginal change and red= significant change)

Species	Awel y Môr	Walney Extension	Notes
Kittiwake	↓	↓	Kittiwake numbers were marginally lower in the proxy site survey years than at Barrow commissioning (JNCC, 2021f).
Great black-backed gull	↓	↓	Great black-backed gull numbers were marginally lower in the proxy site survey years than at Barrow commissioning (JNCC, 2021g)
Herring gull	↓	↓	Herring gull numbers were marginally lower in the proxy site survey years compared to the Barrow commissioning date (JNCC, 2021h).
Lesser black-backed gull	↓	↓	Lesser black-backed gull numbers were marginally lower in the Walney Extension survey years and significantly lower in the Awel y Môr survey years, compared to the Barrow commissioning date (JNCC, 2021i).
Guillemot	↑	—	Guillemot numbers were similar to those in the Walney Extension survey years. Guillemot numbers were significantly higher in the Awel y Môr survey years compared to the Barrow commissioning date (JNCC, 2021a).
Razorbill	↑	↓	Razorbill numbers were marginally lower in Walney Extension survey years and significantly higher in the Awel y Môr survey years compared to the Barrow commissioning date (JNCC, 2021b).
Puffin	/	/	There is insufficient data for puffin population trends to allow for a comparison between the proxy sites and Barrow (JNCC, 2021d).

Species	Awel y Môr	Walney Extension	Notes
Manx shearwater			There is insufficient data for Manx shearwater population trends to allow for a comparison between the proxy sites and Barrow (JNCC, 2021c).
Gannet			Gannet numbers were marginally higher in Walney Extension survey years and significantly higher in the Awel y Môr survey years compared to the Barrow commissioning date (JNCC, 2021e).

5.1.2.4 Turbine parameters

122. When attributing collision risk impact values to Barrow using Walney Extension as a proxy, it is important to address parameter differences between the sites. Although the ratio calculations comparing the rotor swept areas used project specific parameters, the bird densities assumed were those of the proxy site. Like abundances of birds, the densities between the two sites will differ and so assuming the same density to assign collision impact values adds a lack of precision to the values.

5.1.2.5 Summary

123. Considering both the temporal, physical and demographic aspects of the projects, using Walney Extension data as a proxy has been chosen as the most appropriate data set. However, although the features are most similar of the potential proxy sites, there are still stark contrasts in the two areas and so confidence in using Walney Extension data for Barrow is low.

5.1.3 Burbo Bank

5.1.3.1 Project timeframes

124. The time difference between the commission date of Burbo Bank and the survey dates for Awel y Môr and Burbo Bank Extension span 14 and four years, respectively.

5.1.3.2 Habitat type

125. Burbo Bank OWF is located in water depths of 4.5m, only slightly shallower than Burbo Bank Extension that is located in waters of approximately 11m depth. This is compared to much deeper waters in which Awel y Môr (31m) is located (**Figure 6**). Therefore, considering sea depth as a metric, Burbo Bank Extension,

as the adjoining site, would be the most appropriate proxy for attaining Burbo Bank values. In addition, the seabed sediment layer at Burbo Bank and Burbo Bank Extension is also the same (**Figure 8**), differing to Awel y Môr which is over coarse grained sediment. A final geological factor to consider is the proximity to sandbanks. Burbo Bank and Burbo Bank Extension are not in direct proximity to a sand bank, unlike Awel y Môr that neighbours the Menai Strait and Conwy Bay sand bank (**Figure 7**). This difference in association to the sand bank habitat will likely influence in differences in the number of birds utilising the area.

5.1.3.3 Colony connectivity and species trends

126. Burbo Bank abuts Burbo Bank Extension and so will share connectivity to the different seabird species colonies (**Figure 9** to **Figure 13**). In addition to connectivity between sites, colony count data for seabird species at the time of Burbo Bank commissioning and the survey years of Awel y Môr (2019-2021) and Burbo Bank Extension (2010-2011) can be compared to aid in the understanding of differences in seabird abundances and densities between project dates (**Table 31**).

Table 31 Seabird species trends for Awel y Môr (2019 – 2021) and Burbo Bank Extension (2010 – 2011) survey dates since the Burbo Bank (2007) commissioning date. (Arrow direction indicated trend in comparison to historic OWF site. Green= similar trend, orange= marginal change and red= significant change)

Species	Awel y Môr	Walney Extension	Notes
Kittiwake	↓	↓	Kittiwake numbers were marginally lower in the proxy site survey years than at Burbo Bank commissioning (JNCC, 2021f).
Great black-backed gull	↓	↓	Great black-backed gull numbers were marginally lower in the proxy site survey years than at Burbo Bank commissioning (JNCC, 2021g)
Herring gull	↓	↓	Herring gull numbers were marginally lower in the Burbo Bank Extension survey years and significantly lower in the Awel y Môr survey years, compared to the Burbo Bank commissioning date (JNCC, 2021h).
Lesser black-backed gull	↓	↓	Lesser black-backed gull numbers were marginally lower in the Burbo Bank Extension survey years and

Species	Awel y Môr	Walney Extension	Notes
			significantly lower in the Awel y Môr survey years, compared to the Burbo Bank commissioning date (JNCC, 2021i).
Guillemot	↑	↓	Guillemot numbers were marginally lower in Burbo Bank Extension survey years and significantly higher in the Awel y Môr survey years compared to the Burbo Bank commissioning date (JNCC, 2021a).
Razorbill	↑	↑	Razorbill numbers were marginally higher in Burbo Bank Extension survey years and significantly higher in the Awel y Môr survey years compared to the Burbo Bank commissioning date (JNCC, 2021b).
Puffin	/	/	There is insufficient data for puffin population trends to allow for a comparison between the proxy sites and Burbo Bank (JNCC, 2021d).
Manx shearwater	/	/	There is insufficient data for Manx shearwater population trends to allow for a comparison between the proxy sites and Burbo Bank (JNCC, 2021c).
Gannet	↑	↑	Gannet numbers were marginally higher in Burbo Bank Extension survey years and significantly higher in the Awel y Môr survey years compared to the Burbo Bank commissioning date (JNCC, 2021e).

5.1.3.4 Turbine parameters

127. When attributing collision risk impact values to Burbo Bank using Burbo Bank Extension as a proxy, it is important to address parameter differences between the sites. Although the ratio calculations comparing the rotor swept areas used project specific parameters, the densities assumed were those of the proxy site. Like abundances of birds, the densities between the two sites will differ and so assuming the same density to assign collision impact values adds a lack of precision to the values.

5.1.3.5 Summary

128. Considering both the temporal, physical and demographic aspects of the projects, using Burbo Bank Extension data as a proxy has been chosen as the most appropriate data set for all species apart from puffin. Although the features for Burbo Bank and Burbo Bank Extension are most similar, there are still contrasts between the two areas and so confidence in using Burbo Bank Extension data for Burbo Bank is moderate.

5.1.4 Gwynt y Môr

5.1.4.1 Project timeframes

129. The time difference between the commission date of Gwynt y Môr and the survey dates for Awel y Môr span six years.

5.1.4.2 Habitat type

130. Gwynt y Môr OWF is located in water depths of 18m compared to the deeper areas of Awel y Môr at 31m, (**Figure 6**). Therefore, no obvious similarities can be made between the Gwynt y Môr site and the proxy project using sea depth as a metric. Due to the fact that Gwynt y Môr abuts the Awel y Môr site, the seabed sediment layer of both sites is the same (**Figure 8**), consisting of sand and coarse grained sediment. A final geological factor to consider is the proximity to sandbanks. Gwynt y Môr and Awel y Môr both neighbour the Menai Strait and Conwy Bay sand bank (**Figure 7**).

5.1.4.3 Colony connectivity and species trends

131. Gwynt y Môr abuts the Awel y Môr proxy site and so will share connectivity to the same seabird colonies (**Figure 9** to **Figure 13**). In addition to connectivity between sites, colony count data for seabird species at the time of Gwynt y Môr commissioning and the survey years of Awel y Môr (2019-2021) can be compared to aid in the understanding of differences in seabird abundances and densities between project dates (**Table 32**).

Table 32 Seabird species trends for Awel y Môr (2019 – 2021) and Walney Extension (2010 – 2012) survey dates since the Gwynt y Môr (2015) commissioning date. (Arrow direction indicated trend in comparison to historic OWF site. Green= similar trend, orange= marginal change and red= significant change)

Species	Awel y Môr	Notes
Kittiwake	—	Kittiwake numbers were similar for the proxy site survey years and the Gwynt y Môr commissioning date (JNCC, 2021f).
Great black-backed gull	↓	Great black-backed gull numbers were marginally lower in the proxy site survey years than at Gwynt y Môr commissioning (JNCC, 2021g)
Herring gull	↑	Herring gull numbers were marginally higher in the proxy site survey years compared to the Gwynt y Môr commissioning date (JNCC, 2021h).
Lesser black-backed gull	↓	Lesser black-backed gull numbers were marginally lower in the Awel y Môr survey years, compared to the Gwynt y Môr commissioning date (JNCC, 2021i).
Guillemot	↑	Guillemot numbers were significantly higher in the Awel y Môr survey years compared to the Gwynt y Môr commissioning date (JNCC, 2021a).
Razorbill	↑	Razorbill numbers were marginally higher in the Awel y Môr survey years compared to the Gwynt y Môr commissioning date (JNCC, 2021b).
Puffin	/	There is insufficient data for puffin population trends to allow for a comparison between the proxy site and Gwynt y Môr (JNCC, 2021d).
Manx shearwater	/	There is insufficient data for Manx shearwater population trends to allow for a comparison between the proxy site and Gwynt y Môr (JNCC, 2021c).
Gannet	↑	Gannet numbers were marginally higher in the Awel y Môr survey years compared to the Gwynt y Môr commissioning date (JNCC, 2021e).

5.1.4.4 Turbine parameters

132. When assigning collision risk impact values to Gwynt y Môr using Awel y Môr as a proxy, it is important to address parameter differences between the sites. Although the ratio calculations comparing the rotor swept areas used project specific parameters, the densities assumed were those of the proxy site. Like abundances of birds, the densities between the two sites will differ and so assuming the same density to assign collision impact values adds lack of precision. Although Gwynt y Môr and Awel y Môr are adjoining, the dates of the baseline data for the projects differs, causing potential changes to densities of birds in the area.

5.1.4.5 Summary

133. Although the two projects abut each other, there are still contrasts in the two areas and so confidence in using Awel y Môr data for Gwynt y Môr is considered as moderate.

5.1.5 North Hoyle

5.1.5.1 Project timeframes

134. The time difference between the commission date of North Hoyle and the survey dates for Awel y Môr span 18 years.

5.1.5.2 Habitat type

135. North Hoyle OWF is located in shallower water (9m) than the Awel y Môr (31m) proxy OWF site (**Figure 6**). The seabed sediment layer of North Hoyle is similar to Awel y Môr, being situated in an area of coarse grained sediment (**Figure 8**). A final geographical factor to consider is the fact that North Hoyle, like Awel y Môr, is situated close to the Menai Strait and Conwy Bay Sandbank (**Figure 7**) which could lead to a difference in seabird assemblage and number.

5.1.5.3 Colony connectivity and species trends

136. North Hoyle shares similar connectivity to seabird colonies as Awel y Môr and so considering connectivity as a metric, Awel y Môr would be the most appropriate proxy site (**Figure 9** to **Figure 13**). In addition to connectivity between sites, colony count data for seabird species at the time of North Hoyle commissioning and the survey years of Awel y Môr (2019-2021) can be compared to aid in the understanding of differences in seabird abundances and densities between project dates (**Table 33**).

Table 33 Seabird species trends for Awel y Môr (2019 – 2021) survey dates since the North Hoyle (2003) commissioning date. (Arrow direction indicated trend in comparison to historic OWF site. Green= similar trend, orange= marginal change and red= significant change)

Species	Awel y Môr	Notes
Kittiwake	↓	Kittiwake numbers were marginally lower in the proxy site survey years than at North Hoyle commissioning (JNCC, 2021f).
Great black-backed gull	↓	Great black-backed gull numbers were marginally lower in the proxy site survey years than at North Hoyle commissioning (JNCC, 2021g)
Herring gull	↓	Herring gull numbers were significantly lower in the Awel y Môr survey years, compared to the North Hoyle commissioning date (JNCC, 2021h).
Lesser black-backed gull	↓	Lesser black-backed gull numbers were significantly lower in the Awel y Môr survey years, compared to the North Hoyle commissioning date (JNCC, 2021i).
Guillemot	↑	Guillemot numbers were significantly higher in the Awel y Môr survey years compared to the North Hoyle commissioning date (JNCC, 2021a).
Razorbill	↑	Razorbill numbers marginally higher in the Awel y Môr survey years compared to the North Hoyle commissioning date (JNCC, 2021b).
Puffin	/	There is insufficient data for puffin population trends to allow for a comparison between the proxy site and North Hoyle (JNCC, 2021d).
Manx shearwater	/	There is insufficient data for Manx shearwater population trends to allow for a comparison between the proxy site and North Hoyle (JNCC, 2021c).
Gannet	↑	Gannet numbers were significantly higher in the Awel y Môr survey years compared to the North Hoyle commissioning date (JNCC, 2021e).

5.1.5.4 Turbine parameters

137. When assigning collision risk impact values to North Hoyle using Awel y Môr as a proxy, it is important to address parameter differences between the sites. Although the ratio calculations comparing the rotor swept areas used project specific parameters, the densities assumed were those of the proxy site. Like abundances of birds, the densities between the two sites will differ and so assuming the same density to assign collision impact values adds lack of precision.

5.1.5.5 Summary

138. Considering both the temporal, physical and demographic aspects of the projects, using Awel y Môr data as a proxy is considered the most appropriate data set. However, although the features are the most similar of the potential proxy sites, there are still stark contrasts in the two areas and so confidence in using Awel y Môr data for North Hoyle is low.

5.1.6 Ormonde

5.1.6.1 Project timeframes

139. The time difference between the commission date of Ormonde and the survey dates for Awel y Môr is nine years, whereas the Walney Extension data was collected the same year as the Ormonde commissioning.

5.1.6.2 Habitat type

140. Ormonde OWF is located in shallower water (18m) than Awel y Môr (31m) and Walney Extension (40m) proxy OWF sites (**Figure 6**) and so no obvious connections can be made with either proxy site using this metric. The seabed sediment layer of Ormonde is most similar to that of Walney Extension (**Figure 8**). In addition, Ormonde and Walney extension are relatively distant from the nearest sandbanks at 6.1 and 8.6km, respectively (**Figure 7**). This is unlike Awel y Môr which has a sandbank within 3.5km. This could lead to a difference in seabird assemblage and number.

5.1.6.3 Colony connectivity and species trends

141. Ormonde shares similar connectivity to seabird colonies as Walney Extension and so considering connectivity as a metric, Walney Extension would be the most appropriate proxy site (**Figure 9** to **Figure 13**). In addition to connectivity between sites, colony count data for seabird species at the time of Ormonde commissioning and the survey years of Awel y Môr (2019-2021) and Walney Extension (2010-2012) can be compared to aid in the understanding of differences in seabird abundances and densities between project dates (**Table 34**). Ormonde was commissioned in 2012, coinciding with the Walney Extension

survey years and so comparison between these two projects is considered as similar.

Table 34 Seabird species trends for Awel y Môr (2019 – 2021) and Walney Extension (2010 – 2012) survey dates since the Ormonde (2012) commissioning date. (Arrow direction indicated trend in comparison to historic OWF site. Green= similar trend, orange= marginal change and red= significant change)

Species	Awel y Môr	Walney Extension	Notes
Kittiwake	↑	—	Kittiwake numbers were marginally higher in the Awel y Môr survey years than at the Ormonde commissioning date (JNCC, 2021f).
Great black-backed gull	↑	—	Great black-backed gull numbers were marginally higher in the Awel y Môr survey years than at the Ormonde commissioning date (JNCC, 2021g)
Herring gull	↓	—	Herring gull numbers were marginally lower Awel y Môr survey years compared to the Ormonde commissioning date (JNCC, 2021h).
Lesser black-backed gull	↓	—	Lesser black-backed gull numbers were marginally lower in the Awel y Môr survey years compared to the Ormonde commissioning date (JNCC, 2021i).
Guillemot	↑	—	Guillemot numbers were significantly higher in the Awel y Môr survey years compared to the Ormonde commissioning date (JNCC, 2021a).
Razorbill	↑	—	Razorbill numbers were significantly higher in the Awel y Môr survey years compared to the Ormonde commissioning date (JNCC, 2021b).
Puffin	/	—	There is insufficient data for puffin population trends to allow for a comparison between Awel y Môr and Ormonde (JNCC, 2021d).
Manx shearwater	/	—	There is insufficient data for Manx shearwater population trends to allow for a comparison between Awel y Môr and Ormonde (JNCC, 2021c).

Species	Awel y Môr	Walney Extension	Notes
Gannet	↑	—	Gannet numbers were marginally higher in the Awel y Môr survey years compared to the Ormonde commissioning date (JNCC, 2021e).

5.1.6.4 Turbine parameters

142. When attributing collision risk impact values to Ormonde using Walney Extension as a proxy, it is important to address parameter differences between the sites. Although the ratio calculations comparing the rotor swept areas used project specific parameters, the densities assumed were those of the proxy site. Like abundances of birds, the densities between the two sites will differ and so assuming the same density to assign collision impact values adds a lack of precision to the values.

5.1.6.5 Summary

143. Considering both the temporal, physical and demographic aspects of the projects, using Walney Extension data as a proxy has been chosen as the most appropriate data set. However, although the features are most similar of the proxy site options, there are still stark contrasts in the two areas and so confidence in using Walney Extension data for Ormonde is low.

5.1.7 Rhyl Flats

5.1.7.1 Project timefames

144. The time difference between the commission date of Burbo Bank and the survey dates for Awel y Môr span 14 years.

5.1.7.2 Habitat type

145. Rhyl Flats OWF is located in water depths of 8m compared to the deeper areas of Awel y Môr at 31m (**Figure 6**). Therefore, no obvious similarities can be made between the Rhyl Flats site and the proxy project using sea depth as a metric. The seabed sediment layer of Rhyl Flats is similar to that of Awel y Môr being situated of coarse-grained sediment (**Figure 8**). However, Awel y Môr is also over areas of sand. A final geological factor to consider is the proximity to sandbanks. The southwest corner of Rhyl Flats directly overlaps the Constable Sandbank in Llandudno Bay. This is a direct difference compared to the proxy site, however Awel y Môr is within close proximity to a sandbank, being 3.5km from the Menai Strait and Conwy Bay sandbank (**Figure 7**). This difference in

association to the sand bank habitat will likely result in differences in the number of birds utilising the area.

5.1.7.3 Colony connectivity and species trends

146. Rhyl Flats shares similar connectivity to seabird colonies as Awel y Môr and so considering connectivity as a metric, Awel y Môr would be the most appropriate proxy site (**Figure 9** to **Figure 13**). In addition to connectivity between sites, colony count data for seabird species at the time of Rhyl Flats commissioning and the survey years of Awel y Môr (2019-2021) can be compared to aid in the understanding of differences in seabird abundances and densities between project dates (**Table 35**).

Table 35 Seabird species trends for Awel y Môr (2019 – 2021) survey dates since the Rhyl Flats (2009) commissioning date. (Arrow direction indicated trend in comparison to historic OWF site. Green= similar trend, orange= marginal change and red= significant change)

Species	Awel y Môr	Notes
Kittiwake	(green bar)	Kittiwake numbers were similar for Awel y Mor survey years and the Rhyl Flats commissioning (JNCC, 2021f).
Great black-backed gull	(green bar)	Great black-backed gull numbers were similar for the proxy site survey years and the Rhyl Flats commissioning date (JNCC, 2021g)
Herring gull	↓ (orange)	Herring gull numbers were marginally lower in the Awel y Môr survey years compared to the Rhyl Flats commissioning date (JNCC, 2021h).
Lesser black-backed gull	↓ (red)	Lesser black-backed gull numbers were significantly lower in the Awel y Môr survey years, compared to the Rhyl Flats commissioning date (JNCC, 2021i).
Guillemot	↑ (red)	Guillemot numbers were significantly higher in the Awel y Môr survey years compared to the Rhyl Flats commissioning date (JNCC, 2021a).
Razorbill	↑ (red)	Razorbill numbers were significantly higher in the Awel y Môr survey years compared to the Rhyl Flats commissioning date (JNCC, 2021b).
Puffin	(grey bar)	There is insufficient data for puffin population trends to allow for a comparison between the proxy sitesand Rhyl Flats (JNCC, 2021d).

Species	Awel y Môr	Notes
Manx shearwater		There is insufficient data for Manx shearwater population trends to allow for a comparison between the proxy sitesand Rhyl Flats (JNCC, 2021c).
Gannet		Gannet numbers were significantly higher in the Awel y Môr survey years compared to the Rhyl Flats commissioning date (JNCC, 2021e).

5.1.7.4 Turbine parameters

147. When assigning collision risk impact values to Rhyl Flats using Awel y Môr as a proxy, it is important to address parameter differences between the sites. Although the ratio calculations comparing the rotor swept areas used project specific parameters, the densities assumed were those of the proxy site. Like abundances of birds, the densities between the two sites will differ and so assuming the same density to assign collision impact values adds lack of precision.

5.1.7.5 Summary

148. Considering both the temporal, physical and demographic aspects of the projects, using Awel y Môr data as a proxy has been chosen as the most appropriate data set. However, although the features are most similar of the potential proxy sites, there are still stark contrasts in the two areas and so confidence in using Awel y Môr data for Rhyl Flats is low.

5.1.8 Robin Rigg

5.1.8.1 Project timeframes

149. The time difference between the commission date of Robin Rigg and the survey dates for Awel y Môr and Walney Extension span 11 and two years, respectively.

5.1.8.2 Habitat type

150. Robin Rigg OWF is located in shallower water than Awel y Môr and Waleny Extension OWF sites (**Figure 6**) and so no obvious connections can be made with either proxy site using this metric. Similarly, the seabed sediment layer of Robin Rigg has similarities to both proxy sites and so no obvious connection can be assigned to a particular proxy site (**Figure 8**). However, Robin Rigg is in close proximity to a large sandbank (**Figure 7**), unlike both the proxy projects, which could lead to a difference in seabird assemblage and number. Considering the temporal and physical aspects of the projects, using Walney Extension data as a proxy has been chosen as the most appropriate data set. However, although the

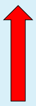
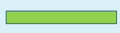
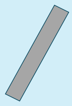
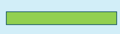
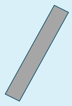
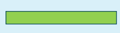
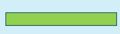
features are most similar of the potential proxy sites, there are still stark contrasts in the two areas and so confidence in using Walney Extension data for Robin Rigg is low.

5.1.8.3 Colony connectivity and species trends

151. Robin Rigg is not in close proximity to either of the proxy sites and so an obvious connection in terms of seabird colony connectivity cannot be made (**Figure 9** to **Figure 13**). In addition to connectivity between sites, colony count data for seabird species at the time of Robin Rigg commissioning and the survey years of Awel y Môr (2019-2021) and Walney Extension (2010-2012) can be compared to aid in the understanding of differences in seabird abundances and densities between project dates (**Table 36**). Robin Rigg was commissioned in 2010, coinciding with the Walney Extension survey years and so all comparison between these two projects is described as similar.

Table 36 Seabird species trends for Awel y Môr (2019 – 2021) and Walney Extension (2010 – 2012) survey dates since the Robin Rigg (2010) commissioning date. (Arrow direction indicated trend in comparison to historic OWF site. Green= similar trend, orange= marginal change and red= significant change)

Species	Awel y Môr	Walney Extension	Notes
Kittiwake	—	—	Kittiwake numbers were similar for both the Awel y Môr survey years and the Robin Rigg commissioning date (JNCC, 2021f).
Great black-backed gull	—	—	Great black-backed gull numbers were similar for the Awel y Môr survey years and the Robin Rigg commissioning date (JNCC, 2021g)
Herring gull	↓	—	Herring gull numbers were marginally lower Awel y Môr survey years compared to the Robin Rigg commissioning date (JNCC, 2021h).
Lesser black-backed gull	↓	—	Lesser black-backed gull numbers were marginally lower in the Awel y Môr survey years compared to the Robin Rigg commissioning date (JNCC, 2021i).
Guillemot	↑	—	Guillemot numbers were significantly higher in the Awel y Môr survey years compared to the Robin Rigg commissioning date (JNCC, 2021a).

Species	Awel y Môr	Walney Extension	Notes
Razorbill			Razorbill numbers were significantly higher in the Awel y Môr survey years compared to the Robin Rigg commissioning date (JNCC, 2021b).
Puffin			There is insufficient data for puffin population trends to allow for a comparison between Awel y Môr and Robin Rigg (JNCC, 2021d).
Manx shearwater			There is insufficient data for Manx shearwater population trends to allow for a comparison between Awel y Môr and Robin Rigg (JNCC, 2021c).
Gannet			Gannet numbers were marginally higher in the Awel y Môr survey years compared to the Robin Rigg commissioning date (JNCC, 2021e).

5.1.8.4 Turbine parameters

152. When attributing collision risk impact values to Robin Rigg using Walney Extension as a proxy, it is important to address parameter differences between the sites. Although the ratio calculations comparing the rotor swept areas used project specific parameters, the densities assumed were those of the proxy site. Like abundances of birds, the densities between the two sites will differ and so assuming the same density to assign collision impact values adds a lack of precision to the values.

5.1.8.5 Summary

153. Considering both the temporal, physical and demographic aspects of the projects, using Walney Extension data as a proxy has been chosen as the most appropriate data set. However, although the features are most similar, there are still stark contrasts in the two areas and so confidence in using Walney Extension data for Robin Rigg is low.

5.1.9 Walney Phase 1

5.1.9.1 Project timeframes

154. The time difference between the commission date of Walney Phase 1 and the survey dates for Awel y Môr and Walney Extension span ten years and one year, respectively.

5.1.9.2 Habitat type

155. Walney Phase 1 OWF is located in water depths of 21m compared to the deeper areas of Awel y Môr and Walney Extension at 31 and 40 metres, respectively (**Figure 6**). Therefore, no obvious similarities can be made between the Walney Extension site and the two proxy projects using sea depth as a metric. Due to the fact that Walney Phase 1 abuts Walney Extension, the seabed sediment layer of both of the sites is the same (**Figure 8**), in contrast to Awel y Môr. A final geological factor to consider is the proximity to sandbanks. Both Walney Phase 1 and Walney Extension are not in close proximity to a sand bank (**Figure 7**). This is a difference to Awel y Môr which is just 3.5km from the Menai Strait and Conwy Bay sandbank. This difference in association to the sand bank habitat will likely result in differences in the number of birds utilising the area.

5.1.9.3 Colony connectivity and species trends

156. Walney Phase 1 abuts the Walney Extension proxy site and so will share connectivity to the same seabird colonies (**Figure 9** to **Figure 13**). In addition to connectivity between sites, colony count data for seabird species at the time of Walney Phase 1 commissioning and the survey years of Awel y Môr (2019-2021) and Walney Extension (2010-2012) can be compared to aid in the understanding of differences in seabird abundances and densities between project dates (**Table 37**). Walney Phase 1 was commissioned in 2011, coinciding with the Walney Extension survey years and so all comparison between these two projects is described as similar.

Table 37 Seabird species trends for Awel y Môr (2019 – 2021) and Walney Extension (2010 – 2012) survey dates since the Walney Phase 1 (2011) commissioning date. (Arrow direction indicated trend in comparison to historic OWF site. Green= similar trend, orange= marginal change and red= significant change)

Species	Awel y Môr	Walney Extension	Notes
Kittiwake	↑	—	Kittiwake numbers were marginally higher in the Awel y Môr survey years than at the Walney Phase 1 commissioning date (JNCC, 2021f).
Great black-backed gull	↑	—	Great black-backed gull numbers were marginally higher in the Awel y Môr survey years than at the Walney Phase 1 commissioning date (JNCC, 2021g)
Herring gull	↓	—	Herring gull numbers were marginally lower Awel y Môr survey years compared to the Walney Phase 1 commissioning date (JNCC, 2021h).
Lesser black-backed gull	↓	—	Lesser black-backed gull numbers were marginally lower in the Awel y Môr survey years compared to the Walney Phase 1 commissioning date (JNCC, 2021i).
Guillemot	↑	—	Guillemot numbers were significantly higher in the Awel y Môr survey years compared to the Walney Phase 1 commissioning date (JNCC, 2021a).
Razorbill	↑	—	Razorbill numbers were significantly higher in the Awel y Môr survey years compared to the Walney Phase 1 commissioning date (JNCC, 2021b).
Puffin	/	—	There is insufficient data for puffin population trends to allow for a comparison between Awel y Môr and Walney Phase 1 (JNCC, 2021d).
Manx shearwater	/	—	There is insufficient data for Manx shearwater population trends to allow for a comparison between Awel y Môr and Walney Phase 1 (JNCC, 2021c).

Species	Awel y Môr	Walney Extension	Notes
Gannet	↑	—	Gannet numbers were marginally higher in the Awel y Môr survey years compared to the Walney Phase 1 commissioning date (JNCC, 2021e).

5.1.9.4 Turbine parameters

157. When assigning collision risk impact values to Watney Phase 1 using Walney Extensaion as a proxy, it is important to address parameter differences between the sites. Although the ratio calculations comparing the rotor swept areas used project specific parameters, the densities assumed were those of the proxy site. Like abundances of birds, the densities between the two sites will differ and so assuming the same density to assign collision impact values adds lack of precision. Although Walney Phase 1 and Walney Extension are adjoining, the dates of the baseline data for the projects differs, causing potential changes to densities of birds in the area.

5.1.9.5 Summary

158. Considering both the temporal, physical and demographic aspects of the projects, using Walney Extension data as a proxy has been chosen as the most appropriate data set. However, although the features are most similar, there are still contrasts in the two areas and so confidence in using Walney Extension data for Walney Phase 1 is low.

5.1.10 Walney Phase 2

5.1.10.1 Project timeframes

159. The time difference between the commission date of Walney Phase 2 and the survey dates for Awel y Môr is nine years, whereas the Walney Extension data was collected the same year as the Walney Phase 2 commissioning.

5.1.10.2 Habitat type

160. Walney Phase 2 OWF is located in shallower water (25m) than Awel y Môr (31m) and Walney Extension (40m) proxy OWF sites (**Figure 6**) and so no obvious connections can be made with either proxy site using this metric. Due to the fact that Walney Phase 2 abuts Walney Extension, the seabed sediment layer of both sites is the same (**Figure 8**), in contrast to Awel y Môr. In addition, Walney Phase 2 and Walney Extension are relatively distant from the nearest sandbanks at 14.7 and 8.6km, respectively (**Figure 7**). This is unlike Awel y Môr which has

a sandbank within 3.5km. This could lead to a difference in seabird assemblage and number.

5.1.10.3 Colony connectivity and species trends

161. Walney Phase 1 abuts the Walney Extension proxy site and so will share connectivity to the same seabird colonies (**Figure 9** to **Figure 13**). In addition to connectivity between sites, colony count data for seabird species at the time of Walney Phase 2 commissioning and the survey years of Awel y Môr (2019-2021) and Walney Extension (2010-2012) can be compared to aid in the understanding of differences in seabird abundances and densities between project dates (**Table 38**). Walney Phase 2 was commissioned in 2012, coinciding with the Walney Extension survey years and so all comparison between these two projects is described as similar.

Table 38 Seabird species trends for Awel y Môr (2019 – 2021) and Walney Extension (2010 – 2012) survey dates since the Walney Phase 2 (2012) commissioning date. (Arrow direction indicated trend in comparison to historic OWF site. Green= similar trend, orange= marginal change and red= significant change)

Species	Awel y Môr	Walney Extension	Notes
Kittiwake	↑ (orange)	— (green)	Kittiwake numbers were marginally higher in the Awel y Môr survey years than at the Walney Phase 2 commissioning date (JNCC, 2021f).
Great black-backed gull	↑ (orange)	— (green)	Great black-backed gull numbers were marginally higher in the Awel y Môr survey years than at the Walney Phase 2 commissioning date (JNCC, 2021g)
Herring gull	↓ (orange)	— (green)	Herring gull numbers were marginally lower Awel y Môr survey years compared to the Walney Phase 2 commissioning date (JNCC, 2021h).
Lesser black-backed gull	↓ (orange)	— (green)	Lesser black-backed gull numbers were marginally lower in the Awel y Môr survey years compared to the Walney Phase 2 commissioning date (JNCC, 2021i).
Guillemot	↑ (red)	— (green)	Guillemot numbers were significantly higher in the Awel y Môr survey years compared to the Walney Phase 2 commissioning date (JNCC, 2021a).

Species	Awel y Môr	Walney Extension	Notes
Razorbill			Razorbill numbers were significantly higher in the Awel y Môr survey years compared to the Walney Phase 2 commissioning date (JNCC, 2021b).
Puffin			There is insufficient data for puffin population trends to allow for a comparison between Awel y Môr and Walney Phase 2 (JNCC, 2021d).
Manx shearwater			There is insufficient data for Manx shearwater population trends to allow for a comparison between Awel y Môr and Walney Phase 2 (JNCC, 2021c).
Gannet			Gannet numbers were marginally higher in the Awel y Môr survey years compared to the Walney Phase 2 commissioning date (JNCC, 2021e).

5.1.10.4 Turbine parameters

162. When assigning collision risk impact values to Walney Phase 2 using Walney Extension as a proxy, it is important to address parameter differences between the sites. Although the ratio calculations comparing the rotor swept areas used project specific parameters, the densities assumed were those of the proxy site. Like abundances of birds, the densities between the two sites will differ and so assuming the same density to assign collision impact values adds lack of precision. Although Walney Phase 2 and Walney Extension are adjoining, the dates of the baseline data for the projects differs, causing potential changes to densities of birds in the area.

5.1.10.5 Summary

163. Considering both the temporal, physical and demographic aspects of the projects, using Walney Extension data as a proxy has been chosen as the most appropriate data set. However, although the features are most similar, there are still contrasts in the two areas and so confidence in using Walney Extension data for Walney Phase 2 is low.

5.1.11 West of Duddon Sands

5.1.11.1 Project timeframes

164. The time difference between the commission date of West of Duddon Sands and the survey dates for Awel y Môr and Walney Extension span seven and two years, respectively.

5.1.11.2 Habitat type

165. West of Duddon Sands OWF is located in shallower water (20m) than Awel y Môr (31m) and Walney Extension (40m) proxy OWF sites (**Figure 6**) and so no obvious connections can be made with either proxy site using this metric. Due to the fact that West of Duddon Sands abuts Walney Extension, the seabed sediment layer of both sites is the same (**Figure 8**), in contrast to Awel y Môr. A final geographical factor to consider is the fact that West of Duddon Sands, like Walney Extension, is not situated in close proximity to a sandbank, unlike Awel y Môr which is situated close to the Menai Strait and Conwy Bay Sandbank (**Figure 7**). The distance from a sandbank could lead to a difference in seabird assemblage and number.

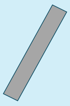
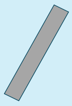
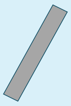
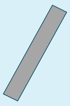
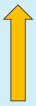
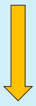
5.1.11.3 Colony connectivity and species trends

166. West of Duddon Sands abuts the Walney Extension proxy site and so will share connectivity to the same seabird colonies (**Figure 9** to **Figure 13**). In addition to connectivity between sites, colony count data for seabird species at the time of West of Duddon Sands commissioning and the survey years of Awel y Môr (2019-2021) and Walney Extension (2010-2012) can be compared to aid in the understanding of differences in seabird abundances and densities between project dates (**Table 39**).

Table 39 Seabird species trends for Awel y Môr (2019 – 2021) and Walney Extension (2010 – 2012) survey dates since the West of Duddon Sands (2014) commissioning date. (Arrow direction indicated trend in comparison to historic OWF site. Green= similar trend, orange= marginal change and red= significant change)

Species	Awel y Môr	Walney Extension	Notes
Kittiwake	▬	▬	Kittiwake numbers were similar for the proxy site survey years and the West of Duddon Sands commissioning date (JNCC, 2021f).
Great black-backed gull	↓	↓	Great black-backed gull numbers were marginally lower in the proxy site survey years than at West of Duddon Sands

Species	Awel y Môr	Walney Extension	Notes
			commissioning (JNCC, 2021g)
Herring gull	↑	—	Herring gull numbers were marginally higher in the Awel y Môr survey years compared to the West of Duddon Sands commissioning date (JNCC, 2021h). Numbers during Walney Extension surveys and West of Duddon Sands commissioning were similar.
Lesser black-backed gull	↓	↑	Lesser black-backed gull numbers were marginally higher in the Walney Extension survey years and marginally lower in the Awel y Môr survey years, compared to the West of Duddon Sands commissioning date (JNCC, 2021i).
Guillemot	↑	↓	Guillemot numbers were marginally lower in the Walney Extension survey years and significantly higher in the Awel y Môr survey years compared to the West of Duddon Sands commissioning date (JNCC, 2021a).
Razorbill	↑	↓	Razorbill numbers were marginally lower in Walney Extension survey years and marginally higher in the Awel y Môr survey years compared to the West of Duddon Sands commissioning date (JNCC, 2021b).

Species	Awel y Môr	Walney Extension	Notes
Puffin			There is insufficient data for puffin population trends to allow for a comparison between the proxy sites and West of Duddon Sands (JNCC, 2021d).
Manx shearwater			There is insufficient data for Manx shearwater population trends to allow for a comparison between the proxy sites and West of Duddon Sands (JNCC, 2021c).
Gannet			Gannet numbers were marginally lower in Walney Extension survey years and marginally higher in the Awel y Môr survey years compared to the West of Duddon Sands commissioning date (JNCC, 2021e).

5.1.11.4 Summary

167. Considering both the temporal, physical and demographic aspects of the projects, using Walney Extension data as a proxy has been chosen as the most appropriate data set. However, although the features are most similar, there are still stark contrasts in the two areas and so confidence in using Walney Extension data for West of Duddon Sands is low.

6. Displacement – Updated cumulative assessments

168. Following the assignment of mean peak abundance values to the OWF projects, using proxy projects with the closest proximity, an updated cumulative assessment for displacement was completed for the five seabird species of interest. In addition, comparisons between the assessment used to inform the FLO-WHI-REP-0002-13 **Chapter 13: Offshore Ornithology** of the **Offshore ES** and the updated assessment within this report have been conducted. Displacement matrices for each species illustrate where the 1% threshold has been exceeded and the displacement and mortality rates that contribute to this.

169. Since the submission of the FLO-WHI-REP-0002-13 **Chapter 13: Offshore Ornithology** of the **Offshore ES**, SNCB's have provided an updated interim guidance note on the reference populations that should be used for EIA assessments (SNCB, 2024). Following this guidance, the displacement matrices provided below consider the updated reference populations and provide the most up-to-date assessment.

170. Additionally, following the cumulative assessments presented within the FLO-WHI-REP-0002-13 **Chapter 13: Offshore Ornithology** of the **Offshore ES**, there has been several updates for other plans and projects which need to be considered:

- Inclusion of West of Orkney impact values for relevant species based on the information presented within the West of Orkney Windfarm Offshore Ornithology EIA Report (MacArthur Green, 2023a) and Technical Supporting Study (MacArthur Green, 2023b).
- Updated impact estimates for Mona, Morgan and Morecambe based on the information presented within the Mona Offshore Wind Project Offshore ornithology ES (RPS, 2024).

171. Developments considered within the cumulative assessments are at varying stages within the planning process. To incorporate this uncertainty, developments were categorised into different tiers dependent on the project status (**Table 40**).

Table 40 Description of tiers of other developments considered for cumulative effects assessment

Tier	Description
Tier 1	Built and operational projects.
Tier 2	Projects under construction.
Tier 3	Projects that have been consented (but construction has not yet commenced).
Tier 4	Projects that have an application submitted to the appropriate regulatory body that have not yet been determined.
Tier 5	Projects that the regulatory body are expecting to be submitted for determination (e.g., projects listed under the Planning Inspectorate programme of projects).
Tier 6	Projects that have been identified in relevant strategic plans or programmes.

173. Since the submission of the ES Chapter for White Cross Mona OWF and West of Orkney have submitted applications. The values presented within the cumulative tablets for Morecambe OWF, Mona OWF and Morgan OWF are those presented within the Mona ES Chapter (RPS, 2024). For the West of Orkney values, only breeding and non-breeding seasons were reported and so for razorbill, gannet and Manx shearwater the non-breeding values have been attributed to the return-migration bio-season within this report (MacArthur Green, 2023).

6.1 Guillemot

174. The updated cumulative assessment for displacement for guillemot is provided below with comparisons between the assessment submitted to support the ES Chapter (**Table 41**). Annual displacement matrices for the total of all developments are provided for the cumulative value presented within the ES Chapter (**Table 45**) and the updated cumulative value presented within this report (**Table 46**). Red highlighting within the matrices (**Table 45**) - provides a visual representation of where a 1% threshold above the baseline mortality is reached. It should also be noted that the values within the displacement matrices include the impact values from the collisions attributed to the species from the Morlais tidal project.

Table 41 Guillemot cumulative bio-season abundance estimates

Project	Predicted abundance			
	Breeding	Non-breeding	Annual	Tier
Arklow Bank	217	403	620	1
Burbo Bank Extension	1,002	1,564	2,566	1
Barrow	592	205	797	1
Burbo Bank	150	233	383	1
Gwynt y Môr	800	1,488	2,288	1
North Hoyle	271	505	776	1
Ormonde	589	204	793	1
Rhyl Flats	334	622	956	1
Robin Rigg	795	275	1,070	1
Walney Phase 1	466	161	627	1
Walney Phase 2	661	229	890	1
Walney Extension	3,612	1,252	4,864	1
West of Duddon Sands	1,232	427	1,659	1
Twin Hub	-	-	0	3
Erebus	7,001	28,338	35,339	3
Awel y Môr	1,569	2,919	4,488	3
Total (Consented)	19,291	38,825	58,116	
White Cross	3,304	1,059	4,363	4
Total (Consented + White Cross)	22,595	39,884	62,479	
West of Orkney	4,861	4,275	9,136	4
Morecambe OWF	4,050	7,647	11,697	5
Morgan OWF	4,893	4,101	8,994	5
Mona OWF	4,220	3,756	7,976	4
Arklow Bank Phase 2	-	0	0	6
Mooir Vannin	-	-	-	6
LLYR Projects	-	-	-	6
Total (All developments)	40,619	59,663	100,282	
Predicted mortality (predicted collisions from tidal sites)				
Morlais	38	8.1	46.1	2

175. When considering the Natural England recommended displacement rates of 30-70% and the mortality rates of 1-10%, the annual estimated cumulative number of guillemots subject to mortality is 347 – 7,066 individuals for the updated approach (**Table 43**). This can be compared to the original ES assessment that estimated 186 - 3,319 individuals would be subject to mortality due to displacement. The addition of the displacement values for the historic projects that were not previously included in the cumulative assessment represents a 86.6 – 112.9% increase in the number of individuals subject to mortality due to displacement.

176. Using the UK Western Waters BDMPS population of 1,145,528 as a proxy for total BDMPS population across the year, the natural baseline mortality is 160,947 individuals (based on an EIA mortality rate of 0.1405). The addition of 347 to 7,066 mortalities, from cumulative displacement and from Morlais collisions, would increase baseline mortality by 0.22 – 4.39%. The difference between the increase in baseline mortality within the ES chapter and that updated cumulative assessment is 0.10 – 2.33% (**Table 44**). This level of potential cumulative impact annually exceeds the 1% increase in baseline mortality threshold at the higher end of the displacement and mortality rate range (**Table 46**).

Table 42 Comparison between cumulative assessment for guillemot used to inform the ES chapter and the cumulative assessment within this report, excluding collision impacts from Morlais

	Cumulative assessment values used to inform ES Chapter			Cumulative assessment values reassessed for this report			Percentage change from ES value to those reassessed in the current report (%)		
Scenario	Breeding	Non-breeding	Annual	Breeding	Non-breeding	Annual	Breeding	Non-breeding	Annual
Total Consented	8,004	29,903	37,907	19,291	38,825	58,116	+141.0%	+29.8%	+53.3%
Total Consented + White Cross	11,308	30,962	42,270	22,595	39,884	62,479	+99.8%	+28.8%	+47.8%
Total All Developments	12,877	33,881	46,758	40,619	59,663	100,282	+215.4%	+76.1%	+114.5%

Table 43 Comparison of number of guillemots subject to mortality, with 30-70% displacement and 1-10% mortality rates, between ES cumulative assessment and updated cumulative assessment, including collision impacts from Morlais

	Number of individuals subject to mortality (ES cumulative assessment)		Number of individuals subject to mortality (cumulative assessment in current report)		% change from ES cumulative assessment to updated cumulative assessment	
Season	30% Displacement and 1% Mortality	70% Displacement and 10% Mortality	30% Displacement and 1% Mortality	70% Displacement and 10% Mortality	30% Displacement and 1% Mortality	70% Displacement and 10% Mortality
Annual	186	3,319	347	7,066	+86.6%	+112.9%

Table 44 Comparison of increases in baseline mortality rate for guillemot, with 30-70% displacement and 1-10% mortality rates, between ES cumulative assessment and updated cumulative assessment, including collision impacts from Morlais

Season	Increase in baseline mortality (ES cumulative assessment)		Increase in baseline mortality (cumulative assessment in current report)		Change from ES cumulative assessment to updated cumulative assessment	
	30% Displacement and 1% Mortality	70% Displacement and 10% Mortality	30% Displacement and 1% Mortality	70% Displacement and 10% Mortality	30% Displacement and 1% Mortality	70% Displacement and 10% Mortality
Annual	0.12%	2.06%	0.22%	4.39%	+0.10%	+2.33%

Table 45 Guillemot annual displacement matrix comprised of values used to inform the ES chapter with the addition of predicted tidal collision mortalities (cells shaded red represent an increase of over 1% in baseline mortality), including collision impacts from Morlais

Guillemot annual displacement matrix																
Displacement (%)	Mortality rates (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46
1	46	51	55	60	65	69	93	140	186	233	280	327	373	420	467	514
10	46	93	140	186	233	280	514	981	1,449	1,916	2,384	2,852	3,319	3,787	4,254	4,722
15	46	116	186	257	327	397	747	1,449	2,150	2,852	3,553	4,254	4,956	5,657	6,358	7,060
20	46	140	233	327	420	514	981	1,916	2,852	3,787	4,722	5,657	6,592	7,527	8,463	9,398
25	46	163	280	397	514	631	1,215	2,384	3,553	4,722	5,891	7,060	8,229	9,398	10,567	11,736
30	46	186	327	467	607	747	1,449	2,852	4,254	5,657	7,060	8,463	9,865	11,268	12,671	14,074
35	46	210	373	537	701	864	1,683	3,319	4,956	6,592	8,229	9,865	11,502	13,138	14,775	16,411
40	46	233	420	607	794	981	1,916	3,787	5,657	7,527	9,398	11,268	13,138	15,009	16,879	18,749
50	46	280	514	747	981	1,215	2,384	4,722	7,060	9,398	11,736	14,074	16,411	18,749	21,087	23,425
60	46	327	607	888	1,168	1,449	2,852	5,657	8,463	11,268	14,074	16,879	19,684	22,490	25,295	28,101
70	46	373	701	1,028	1,355	1,683	3,319	6,592	9,865	13,138	16,411	19,684	22,958	26,231	29,504	32,777
80	46	420	794	1,168	1,542	1,916	3,787	7,527	11,268	15,009	18,749	22,490	26,231	29,971	33,712	37,453
90	46	467	888	1,309	1,729	2,150	4,254	8,463	12,671	16,879	21,087	25,295	29,504	33,712	37,920	42,128
100	46	514	981	1,449	1,916	2,384	4,722	9,398	14,074	18,749	23,425	28,101	32,777	37,453	42,128	46,804

Table 46 Guillemot annual displacement matrix following updates to cumulative totals with the addition of predicted tidal collision mortalities (cells shaded red represent an increase of over 1% in baseline mortality), including collision impacts from Morlais

Guillemot annual displacement matrix																
Displacement (%)	Mortality rates (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46
1	46	56	66	76	86	96	146	247	347	447	548	648	748	848	949	1,049
10	46	146	247	347	447	548	1,049	2,052	3,055	4,057	5,060	6,063	7,066	8,069	9,071	10,074
15	46	197	347	497	648	798	1,550	3,055	4,559	6,063	7,567	9,071	10,576	12,080	13,584	15,088
20	46	247	447	648	848	1,049	2,052	4,057	6,063	8,069	10,074	12,080	14,086	16,091	18,097	20,103
25	46	297	548	798	1,049	1,300	2,553	5,060	7,567	10,074	12,581	15,088	17,595	20,103	22,610	25,117
30	46	347	648	949	1,249	1,550	3,055	6,063	9,071	12,080	15,088	18,097	21,105	24,114	27,122	30,131
35	46	397	748	1,099	1,450	1,801	3,556	7,066	10,576	14,086	17,595	21,105	24,615	28,125	31,635	35,145
40	46	447	848	1,249	1,651	2,052	4,057	8,069	12,080	16,091	20,103	24,114	28,125	32,136	36,148	40,159
50	46	548	1,049	1,550	2,052	2,553	5,060	10,074	15,088	20,103	25,117	30,131	35,145	40,159	45,173	50,187
60	46	648	1,249	1,851	2,453	3,055	6,063	12,080	18,097	24,114	30,131	36,148	42,165	48,181	54,198	60,215
70	46	748	1,450	2,152	2,854	3,556	7,066	14,086	21,105	28,125	35,145	42,165	49,184	56,204	63,224	70,244
80	46	848	1,651	2,453	3,255	4,057	8,069	16,091	24,114	32,136	40,159	48,181	56,204	64,227	72,249	80,272
90	46	949	1,851	2,754	3,656	4,559	9,071	18,097	27,122	36,148	45,173	54,198	63,224	72,249	81,275	90,300
100	46	1,049	2,052	3,055	4,057	5,060	10,074	20,103	30,131	40,159	50,187	60,215	70,244	80,272	90,300	100,328

6.2 Razorbill

177. The updated cumulative assessment for displacement for razorbill is provided below with comparisons between the assessment submitted to support the ES Chapter (**Table 47**). Annual displacement matrices for the total of all developments are provided for the value presented within the ES Chapter (**Table 51**) and the updated value presented within this report (**Table 52**).

178. The red highlight within the matrices provides a visual representation of where a 1% threshold above the baseline mortality is reached. It should also be noted that the values within the displacement matrices include the impact values from the collision attributed to the species.

Table 47 Razorbill cumulative bio-season abundance estimates

Project	Predicted abundance					
	Return migration	Migration-free breeding	Post-breeding migration	Migration-free winter	Annual	Tier
Arklow Bank	46	19	9	21	95	1
Burbo Bank Extension	-	64	-	29	93	1
Barrow	273	142	599	633	1,647	1
Burbo Bank	-	10	-	4	14	1
Gwynt y Môr	171	72	24	77	344	1
North Hoyle	58	24	11	26	119	1
Ormonde	271	141	595	629	1,636	1
Rhyl Flats	72	30	14	32	148	1
Robin Rigg	366	190	803	849	2,208	1
Walney Phase 1	215	111	471	498	1,295	1
Walney Phase 2	305	158	668	706	1,837	1
Walney Extension	1,664	863	3,651	3,858	10,036	1
West of Duddon Sands	567	294	1,245	1,315	3,421	1
Erebus	896	194	1,708	1069	3,867	3
Twin Hub	1	-	0	0	1	3
Awel y Môr	336	140	66	150	692	3
Total (Consented)	**5,241**	**2,452**	**9,864**	**9,896**	**27,453**	
White Cross	345	40	40	361	786	4
Total (Consented + White Cross)	**5,586**	**2,492**	**9,904**	**10,257**	**28,239**	

Project	Predicted abundance					
	Return migration	Migration-free breeding	Post-breeding migration	Migration-free winter	Annual	Tier
West of Orkney	144*	70	-	-	214	4
Morecambe OWF	389	222	674	596	1,881	5
Morgan OWF	166	120	103	233	622	5
Mona OWF	1,924	83	91	421	2,519	4
Mooir Vannin	-	-	-	-	-	6
LLYR Projects	-	-	-	-	-	6
Total (All developments)	**8,209**	**2,987**	**10,772**	**11,507**	**33,475**	
Predicted mortality (predicted collisions from tidal sites)						
Morlais	-	11.7	-	11.7	23.4	2

Table Note: *Value represents the non-breeding value presented in the West of Orkney EIA (MacArthur Green, 2023a).

179. When considering the Natural England recommended displacement rates of 30-70% and the mortality rates of 1-10%, the annual estimated cumulative number of razorbills subject to mortality is 124 – 2,367 individuals for the updated approach (**Table 49**). This can be compared to the original ES assessment that estimated 40 - 404 individuals would be subject to mortality due to displacement. The addition of the displacement values for projects that were not previously included in the cumulative assessment represents a 210.0 – 485.9% increase in the number of individuals subject to mortality due to displacement.

180. Using the UK Western Waters BDMPS population of 606,915 as a proxy for total BDMPS population across the year, the natural baseline mortality is 79,020 individuals (based on an EIA mortality rate of 0.1302). The addition of 124 to 2,367 mortalities, from cumulative displacement and from Morlais collisions, would increase baseline mortality by 0.16 – 3.00%. The difference between the increase in baseline mortality within the ES chapter and that updated cumulative assessment is 0.11 – 2.49% (**Table 50**). This level of potential cumulative impact annually exceeds the 1% increase in baseline mortality threshold at the higher end of the displacement and mortality rate range (**Table 52**).

Table 48 Comparison between cumulative assessment for razorbill used to inform the ES chapter and the cumulative assessment within this report, excluding collision impacts from Morlais

Scenario	Cumulative assessment values used to inform ES Chapter					Cumulative assessment values reassessed for this report					Percentage change from ES value to those reassessed in the current report (%)				
	Return migration	Breeding	Post-breeding migration	Migration-free winter	Annual	Return migration	Breeding	Post-breeding migration	Migration-free winter	Annual	Return migration	Breeding	Post-breeding migration	Migration-free winter	Annual
Total Consented	897	258	1,708	1,098	3,960	5,241	2,452	9,864	9,896	27,453	+484.3%	+850.4%	+477.5%	+801.3%	+593.3%
Total Consented + White Cross	1,242	298	1,748	1,459	4,746	5,586	2,492	9,904	10,257	28,239	+349.8%	+736.2%	+466.6%	+603.0%	+495.0%
Total All Developments	1,578	438	1,814	1,609	5,438	8,209	2,987	10,772	11,507	33,475	+420.2%	+582.0%	+493.8%	+615.2%	+515.6%

Table 49 Comparison of number of razorbills subject to mortality, with 30-70% displacement and 1-10% mortality rates, between ES cumulative assessment and updated cumulative assessment, including collision impacts from Morlais

Season	Number of individuals subject to mortality (ES cumulative assessment)		Number of individuals subject to mortality (cumulative assessment in current report)		% change from ES cumulative assessment to updated cumulative assessment	
	30% Displacement and 1% Mortality	70% Displacement and 10% Mortality	30% Displacement and 1% Mortality	70% Displacement and 10% Mortality	30% Displacement and 1% Mortality	70% Displacement and 10% Mortality
Annual	40	404	124	2,367	+210.0%	+485.9%

Table 50 Comparison of increases in baseline mortality rate for razorbill, with 30-70% displacement and 1-10% mortality rates, between ES cumulative assessment and updated cumulative assessment, including collision impacts from Morlais

Season	Increase in baseline mortality (ES cumulative assessment)		Increase in baseline mortality (cumulative assessment in current report)		Change from ES cumulative assessment to updated cumulative assessment	
	30% Displacement and 1% Mortality	70% Displacement and 10% Mortality	30% Displacement and 1% Mortality	70% Displacement and 10% Mortality	30% Displacement and 1% Mortality	70% Displacement and 10% Mortality
Annual	0.05%	0.51%	0.16%	3.00%	+0.11%	+2.49%

Table 51 Razorbill annual displacement matrix comprised of values used to inform the ES chapter with the addition of predicted tidal collision mortalities (cells shaded red represent an increase of over 1% in baseline mortality), including collision impacts from Morlais

Razorbill annual displacement matrix																
Displacement (%)	Mortality rates (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
1	23	24	24	25	26	26	29	34	40	45	51	56	61	67	72	78
10	23	29	34	40	45	51	78	132	187	241	295	350	404	458	513	567
15	23	32	40	48	56	64	105	187	268	350	431	513	594	676	758	839
20	23	34	45	56	67	78	132	241	350	458	567	676	785	893	1,002	1,111
25	23	37	51	64	78	91	159	295	431	567	703	839	975	1,111	1,247	1,383
30	23	40	56	72	89	105	187	350	513	676	839	1,002	1,165	1,329	1,492	1,655
35	23	42	61	80	100	119	214	404	594	785	975	1,165	1,356	1,546	1,736	1,927
40	23	45	67	89	110	132	241	458	676	893	1,111	1,329	1,546	1,764	1,981	2,199
50	23	51	78	105	132	159	295	567	839	1,111	1,383	1,655	1,927	2,199	2,471	2,742
60	23	56	89	121	154	187	350	676	1,002	1,329	1,655	1,981	2,307	2,634	2,960	3,286
70	23	61	100	138	176	214	404	785	1,165	1,546	1,927	2,307	2,688	3,069	3,449	3,830
80	23	67	110	154	197	241	458	893	1,329	1,764	2,199	2,634	3,069	3,504	3,939	4,374
90	23	72	121	170	219	268	513	1,002	1,492	1,981	2,471	2,960	3,449	3,939	4,428	4,918
100	23	78	132	187	241	295	567	1,111	1,655	2,199	2,742	3,286	3,830	4,374	4,918	5,461

Table 52 Razorbill annual displacement matrix following updates to cumulative totals with the addition of predicted tidal collision mortalities (cells shaded red represent an increase of over 1% in baseline mortality), including collision impacts from Morlais

Razorbill annual displacement matrix																
Displacement (%)	Mortality rates (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
1	23	27	30	33	37	40	57	90	124	157	191	224	258	291	325	358
10	23	57	90	124	157	191	358	693	1,028	1,362	1,697	2,032	2,367	2,701	3,036	3,371
15	23	74	124	174	224	274	526	1,028	1,530	2,032	2,534	3,036	3,538	4,040	4,543	5,045
20	23	90	157	224	291	358	693	1,362	2,032	2,701	3,371	4,040	4,710	5,379	6,049	6,718
25	23	107	191	274	358	442	860	1,697	2,534	3,371	4,208	5,045	5,882	6,718	7,555	8,392
30	23	124	224	325	425	526	1,028	2,032	3,036	4,040	5,045	6,049	7,053	8,057	9,062	10,066
35	23	141	258	375	492	609	1,195	2,367	3,538	4,710	5,882	7,053	8,225	9,396	10,568	11,740
40	23	157	291	425	559	693	1,362	2,701	4,040	5,379	6,718	8,057	9,396	10,735	12,074	13,413
50	23	191	358	526	693	860	1,697	3,371	5,045	6,718	8,392	10,066	11,740	13,413	15,087	16,761
60	23	224	425	626	827	1,028	2,032	4,040	6,049	8,057	10,066	12,074	14,083	16,091	18,100	20,108
70	23	258	492	726	961	1,195	2,367	4,710	7,053	9,396	11,740	14,083	16,426	18,769	21,113	23,456
80	23	291	559	827	1,095	1,362	2,701	5,379	8,057	10,735	13,413	16,091	18,769	21,447	24,125	26,803
90	23	325	626	927	1,229	1,530	3,036	6,049	9,062	12,074	15,087	18,100	21,113	24,125	27,138	30,151
100	23	358	693	1,028	1,362	1,697	3,371	6,718	10,066	13,413	16,761	20,108	23,456	26,803	30,151	33,498

6.3 Puffin

181. The updated cumulative assessment for displacement for puffin is provided below with comparisons between the assessment submitted to support the ES Chapter (**Table 53**). Annual displacement matrices for the total of all developments are provided for the value presented within the ES Chapter (**Table 57**) and the updated value presented within this report (**Table 58**).

182. The red highlight within the matrices provides a visual representation of where a 1%threshold above the baseline mortality is reached. It should also be noted that the values within the displacement matrices include the impact values from the collision attributed to the species.

Table 53 Puffin cumulative bio-season abundance estimates

Project	Predicted abundance			
	Breeding	Non-breeding	Annual	Tier
Arklow Bank	2	0	2	1
Burbo Bank Extension*	-	264	264	1
Barrow	20	14	34	1
Burbo Bank	-	39	39	1
Gwynt y Môr	7	0	7	1
North Hoyle	2	0	2	1
Ormonde	19	14	33	1
Rhyl Flats	3	0	3	1
Robin Rigg	26	19	45	1
Walney Phase 1	15	11	26	1
Walney Phase 2	22	16	38	1
Walney Extension	119	87	206	1
West of Duddon Sands	41	30	71	1
Erebus	1,416	160	1,576	3
Twin Hub	-	-	0	3
Awel y Môr	-	-	0	3
Total (Consented)	**1,692**	**654**	**2,346**	
White Cross	49	31	80	4
Total (Consented + White Cross)	**1,741**	**685**	**2,426**	
West of Orkney	5,272	2,663	7,935	4
Morecambe OWF	57	10	67	5
Morgan OWF	18	-	18	5
Mona OWF	15	-	15	4
Arklow Bank Phase 2	-	-	0	6

Project	Predicted abundance			
	Breeding	Non-breeding	Annual	Tier
Mooir Vannin	-	-	-	6
LLYR Projects	-	-	-	6
Total (All developments)	**7,103**	**3,358**	**10,461**	
Predicted mortality (predicted collisions from tidal sites)				
Morlais	-	-	-	2

Table Note: *Burbo Bank abundance value was originally assigned to the breeding season within the White Cross ES, however on further inspection the peak abundance of 493 was found to actually be in the non-breeding season (February 2011; Dong Energy, 2013c). This abundance has then been proportionally reduced due to being the abundance within the array area plus 4km buffer.

183. When considering the Natural England recommended displacement rates of 30-70% and the mortality rates of 1-10%, the annual estimated cumulative number of puffins subject to mortality is 31 – 732- individuals for the updated approach (**Table 55**). This can be compared to the original ES assessment that estimated 8 - 177 individuals would be subject to mortality due to displacement. The addition of the displacement values for projects that were not previously included in the cumulative assessment represents a 287.5 – 313.6% increase in the number of individuals subject to mortality due to displacement.

184. Using the UK Western Waters BDMPS population of 1,482,791 as a proxy for total BDMPS population across the year, the natural baseline mortality is 176,452 individuals (based on an EIA mortality rate of 0.1190). The addition of 31 to 732 mortalities, from cumulative displacement and from Morlais collisions, would increase baseline mortality by 0.02 – 0.42%. The difference between the increase in baseline mortality within the ES chapter and that updated cumulative assessment is 0.01 – 0.32% (**Table 56**). This level of potential cumulative impact annually does not exceed the 1% baseline mortality increase threshold.

Table 54 Comparison between cumulative assessment for puffin used to inform the ES chapter and the cumulative assessment within this report

Scenario	Cumulative assessment values used to inform ES Chapter			Cumulative assessment values reassessed for this report			Percentage change from ES value to those reassessed in the current report (%)		
	Breeding	Non-breeding	Annual	Breeding	Non-breeding	Annual	Breeding	Non-breeding	Annual
Total Consented	2,100	347	2,447	1,692	654	2,346	-19.4%	88.5%	-4.1%
Total Consented + White Cross	2,149	378	2,527	1,741	685	2,426	-19.0%	81.2%	-4.0%
Total All Developments	2,149	378	2,527	7,103	3,358	10,461	+230.5%	+788.4%	+314.0%

Table 55 Comparison of number of puffins subject to mortality, with 30-70% displacement and 1-10% mortality rates, between ES cumulative assessment and updated cumulative assessment

Season	Number of individuals subject to mortality (ES cumulative assessment)		Number of individuals subject to mortality (cumulative assessment in current report)		% change from ES cumulative assessment to updated cumulative assessment	
	30% Displacement and 1% Mortality	70% Displacement and 10% Mortality	30% Displacement and 1% Mortality	70% Displacement and 10% Mortality	30% Displacement and 1% Mortality	70% Displacement and 10% Mortality
Annual	8	177	31	732	+287.5%	+313.6%

Table 56 Comparison of increases in baseline mortality rate for puffin, with 30-70% displacement and 1-10% mortality rates, between ES cumulative assessment and updated cumulative assessment

Season	Increase in baseline mortality (ES cumulative assessment)		Change in baseline mortality (cumulative assessment in current report)		Change from ES cumulative assessment to updated cumulative assessment	
	30% Displacement and 1% Mortality	70% Displacement and 10% Mortality	30% Displacement and 1% Mortality	70% Displacement and 10% Mortality	30% Displacement and 1% Mortality	70% Displacement and 10% Mortality
Annual	<0.01%	0.10%	0.02%	0.42%	+0.01%	+0.32%

Table 57 Puffin annual displacement matrix comprised of values used to inform the ES chapter (cells shaded red represent an increase of over 1% in baseline mortality)

Puffin annual displacement matrix																
Displacement (%)	Mortality rates (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	1	1	1	1	3	5	8	10	13	15	18	20	23	25
10	0	3	5	8	10	13	25	51	76	101	126	152	177	202	227	253
15	0	4	8	11	15	19	38	76	114	152	190	227	265	303	341	379
20	0	5	10	15	20	25	51	101	152	202	253	303	354	404	455	505
25	0	6	13	19	25	32	63	126	190	253	316	379	442	505	569	632
30	0	8	15	23	30	38	76	152	227	303	379	455	531	606	682	758
35	0	9	18	27	35	44	88	177	265	354	442	531	619	708	796	884
40	0	10	20	30	40	51	101	202	303	404	505	606	708	809	910	1,011
50	0	13	25	38	51	63	126	253	379	505	632	758	884	1,011	1,137	1,264
60	0	15	30	45	61	76	152	303	455	606	758	910	1,061	1,213	1,365	1,516
70	0	18	35	53	71	88	177	354	531	708	884	1,061	1,238	1,415	1,592	1,769
80	0	20	40	61	81	101	202	404	606	809	1,011	1,213	1,415	1,617	1,819	2,022
90	0	23	45	68	91	114	227	455	682	910	1,137	1,365	1,592	1,819	2,047	2,274
100	0	25	51	76	101	126	253	505	758	1,011	1,264	1,516	1,769	2,022	2,274	2,527

Table 58 Puffin annual displacement matrix following updates to cumulative totals (cells shaded red represent an increase of over 1% in baseline mortality)

Puffin annual displacement matrix																
Displacement (%)	Mortality rates (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	1	2	3	4	5	10	21	31	42	52	63	73	84	94	105
10	0	10	21	31	42	52	105	209	314	418	523	628	732	837	941	1,046
15	0	16	31	47	63	78	157	314	471	628	785	941	1,098	1,255	1,412	1,569
20	0	21	42	63	84	105	209	418	628	837	1,046	1,255	1,465	1,674	1,883	2,092
25	0	26	52	78	105	131	262	523	785	1,046	1,308	1,569	1,831	2,092	2,354	2,615
30	0	31	63	94	126	157	314	628	941	1,255	1,569	1,883	2,197	2,511	2,824	3,138
35	0	37	73	110	146	183	366	732	1,098	1,465	1,831	2,197	2,563	2,929	3,295	3,661
40	0	42	84	126	167	209	418	837	1,255	1,674	2,092	2,511	2,929	3,348	3,766	4,184
50	0	52	105	157	209	262	523	1,046	1,569	2,092	2,615	3,138	3,661	4,184	4,707	5,231
60	0	63	126	188	251	314	628	1,255	1,883	2,511	3,138	3,766	4,394	5,021	5,649	6,277
70	0	73	146	220	293	366	732	1,465	2,197	2,929	3,661	4,394	5,126	5,858	6,590	7,323
80	0	84	167	251	335	418	837	1,674	2,511	3,348	4,184	5,021	5,858	6,695	7,532	8,369
90	0	94	188	282	377	471	941	1,883	2,824	3,766	4,707	5,649	6,590	7,532	8,473	9,415
100	0	105	209	314	418	523	1,046	2,092	3,138	4,184	5,231	6,277	7,323	8,369	9,415	10,461

6.4 Manx shearwater

185. The updated cumulative assessment for displacement for Manx shearwater is provided below with comparisons between the assessment submitted to support the ES Chapter (**Table 59**). Annual displacement matrices for the total of all developments are provided for the value presented within the ES Chapter (**Table 63**) and the updated value presented within this report (**Table 64**). The red highlight within the matrices provides a visual representation of where a 1%threshold above the baseline mortality is reached. It should also be noted that the values within the displacement matrices include the impact values from the collision attributed to the species.

Table 59 Manx shearwater cumulative bio-season abundance estimates

Project	Predicted abundance				
	Return migration	Migration-free Breeding	Post-breeding migration	Annual	Tier
Arklow Bank	0	30	0	30	1
Burbo Bank Extension*	-	444	-	444	1
Barrow	10	97	53	160	1
Burbo Bank	-	66	-	66	1
Gwynt y Môr	0	110	0	110	1
North Hoyle	0	37	0	37	1
Ormonde	9	96	53	158	1
Rampion 1	0	33	0	33	1
Rhyl Flats	0	46	0	46	1
Robin Rigg	13	130	71	214	1
Walney Phase 1	8	76	42	126	1
Walney Phase 2	11	108	59	178	1
Walney Extension	58	592	324	974	1
West of Duddon Sands	20	202	111	333	1
Erebus	18	1,540	557	2,115	3
Twin Hub	-	-	-	0	3
Awel y Môr	177	26	214	417	3
Total (Consented)	**324**	**3,633**	**1,484**	**5,441**	
White Cross	33	12,126	22	12,181	4
Total (Consented + White Cross)	**357**	**15,759**	**1,506**	**17,622**	
West of Orkney	-	8		8	4
Rampion II (PIER)	-	-	-	-	5

Project	Predicted abundance				
	Return migration	Migration-free Breeding	Post-breeding migration	Annual	Tier
Morecambe OWF	0	7,577	6	7,583	5
Morgan OWF	59	467	467	993	5
Mona OWF	3	1,249	182	1,434	4
Mooir Vannin	-	-	-	-	6
LLYR Projects	-	-	-	-	6
Total (All developments)	**419**	**25,060**	**2,161**	**27,640**	
Predicted mortality (predicted collisions from tidal sites)					
Morlais		0.3		0.3	2

Table Note: * Burbo Bank Extension abundance estimate now based on the mean peak count reduced down to fit the 2km buffer, rather than considering the 4km buffer as originally used within the ES.

186. When considering the Natural England recommended displacement rate of 10% and the mortality rates of 1-10%, the annual estimated cumulative number of Manx shearwaters subject to mortality is 28 – 277 individuals for the updated approach (**Table 61**). This can be compared to the original ES assessment that estimated 21 – 203 individuals would be subject to mortality due to displacement. The addition of the displacement values for projects that were not previously included in the cumulative assessment represents a 33.3 – 36.5% increase in the number of individuals subject to mortality due to displacement.

187. Using the UK Western Waters BDMPS population of 1,821,518 as a proxy for total BDMPS population across the year, the natural baseline mortality is 236,797 individuals (based on an EIA mortality rate of 0.1300). The addition of 28 – 277 mortalities, from cumulative displacement and from Morlais collisions, would increase baseline mortality by 0.01 – 0.12%. The difference between the increase in baseline mortality within the ES chapter and that updated cumulative assessment is at most 0.01% (**Table 62**). This level of potential cumulative impact annually does not exceed the 1% baseline mortality increase threshold.

Table 60 Comparison between cumulative assessment for Manx shearwater used to inform the ES chapter and the cumulative assessment within this report

Scenario	Cumulative assessment values used to inform ES Chapter				Cumulative assessment values reassessed for this report				Percentage change from ES value to those reassessed in the current report (%)			
	Return migration	Breeding	Post-breeding migration	Annual	Return migration	Breeding	Post-breeding migration	Annual	Return migration	Breeding	Post-breeding migration	Annual
Total Consented	201	5,927	1,574	7,702	324	3,633	1,484	5,441	+61.2%	-38.7%	-5.7%	-29.4%
Total Consented + White Cross	234	18,053	1,596	19,883	357	15,759	1,506	17,622	+52.6%	-12.7%	-5.6%	-11.4%
Total All Developments	411	18,079	1,810	20,300	419	25,060	2,161	27,640	+2.0%	+38.6%	+19.4%	+36.2%

Table 61 Comparison of number of Manx shearwaters subject to mortality, with 10% displacement and 1-10% mortality rates, between ES cumulative assessment and updated cumulative assessment

Season	Number of individuals subject to mortality (ES cumulative assessment)		Number of individuals subject to mortality (cumulative assessment in current report)		% change from ES cumulative assessment to updated cumulative assessment	
	10% Displacement and 1% Mortality	10% Displacement and 10% Mortality	10% Displacement and 1% Mortality	10% Displacement and 10% Mortality	10% Displacement and 1% Mortality	10% Displacement and 10% Mortality
Annual	21	203	28	277	+33.33%	+36.45%

Table 62 Comparison of increases in baseline mortality rate for Manx shearwater, with 10% displacement and 1-10% mortality rates, between ES cumulative assessment and updated cumulative assessment

Season	Increase in baseline mortality (ES cumulative assessment)		Increase in baseline mortality (cumulative assessment in current report)		Change from ES cumulative assessment to updated cumulative assessment	
	10% Displacement and 1% Mortality	10% Displacement and 10% Mortality	10% Displacement and 1% Mortality	10% Displacement and 1% Mortality	10% Displacement and 1% Mortality	10% Displacement and 10% Mortality
Annual	<0.00%	0.04%	0.01%	0.12%	<0.00%	+0.01%

Table 63 Manx shearwater annual displacement matrix comprised of values used to inform the ES chapter with the addition of predicted tidal collision mortalities (cells shaded red represent an increase of over 1% in baseline mortality)

Manx shearwater annual displacement matrix																
Displacement (%)	Mortality rates (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	2	4	6	8	10	20	41	61	81	102	122	142	162	183	203
10	0	20	41	61	81	102	203	406	609	812	1,015	1,218	1,421	1,624	1,827	2,030
15	0	30	61	91	122	152	305	609	914	1,218	1,523	1,827	2,132	2,436	2,741	3,045
20	0	41	81	122	162	203	406	812	1,218	1,624	2,030	2,436	2,842	3,248	3,654	4,060
25	0	51	102	152	203	254	508	1,015	1,523	2,030	2,538	3,045	3,553	4,060	4,568	5,075
30	0	61	122	183	244	305	609	1,218	1,827	2,436	3,045	3,654	4,263	4,872	5,481	6,090
35	0	71	142	213	284	355	711	1,421	2,132	2,842	3,553	4,263	4,974	5,684	6,395	7,105
40	0	81	162	244	325	406	812	1,624	2,436	3,248	4,060	4,872	5,684	6,496	7,308	8,120
50	0	102	203	305	406	508	1,015	2,030	3,045	4,060	5,075	6,090	7,105	8,120	9,135	10,150
60	0	122	244	365	487	609	1,218	2,436	3,654	4,872	6,090	7,308	8,526	9,744	10,962	12,180
70	0	142	284	426	568	711	1,421	2,842	4,263	5,684	7,105	8,526	9,947	11,368	12,789	14,210
80	0	162	325	487	650	812	1,624	3,248	4,872	6,496	8,120	9,744	11,368	12,992	14,616	16,240
90	0	183	365	548	731	914	1,827	3,654	5,481	7,308	9,135	10,962	12,789	14,616	16,443	18,270
100	0	203	406	609	812	1,015	2,030	4,060	6,090	8,120	10,150	12,180	14,210	16,240	18,270	20,300

Table 64 Manx shearwater annual displacement matrix following updates to cumulative totals with the addition of predicted tidal collision mortalities (cells shaded red represent an increase of over 1% in baseline mortality)

Manx shearwater annual displacement matrix																
Displacement (%)	Mortality rates (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	3	6	9	11	14	28	56	83	111	139	166	194	221	249	277
10	0	28	56	83	111	139	277	553	830	1,106	1,382	1,659	1,935	2,212	2,488	2,764
15	0	42	83	125	166	208	415	830	1,244	1,659	2,073	2,488	2,903	3,317	3,732	4,146
20	0	56	111	166	221	277	553	1,106	1,659	2,212	2,764	3,317	3,870	4,423	4,976	5,528
25	0	69	139	208	277	346	691	1,382	2,073	2,764	3,455	4,146	4,837	5,528	6,219	6,910
30	0	83	166	249	332	415	830	1,659	2,488	3,317	4,146	4,976	5,805	6,634	7,463	8,292
35	0	97	194	291	387	484	968	1,935	2,903	3,870	4,837	5,805	6,772	7,740	8,707	9,674
40	0	111	221	332	443	553	1,106	2,212	3,317	4,423	5,528	6,634	7,740	8,845	9,951	11,056
50	0	139	277	415	553	691	1,382	2,764	4,146	5,528	6,910	8,292	9,674	11,056	12,438	13,820
60	0	166	332	498	664	830	1,659	3,317	4,976	6,634	8,292	9,951	11,609	13,268	14,926	16,584
70	0	194	387	581	774	968	1,935	3,870	5,805	7,740	9,674	11,609	13,544	15,479	17,414	19,348
80	0	221	443	664	885	1,106	2,212	4,423	6,634	8,845	11,056	13,268	15,479	17,690	19,901	22,112
90	0	249	498	747	995	1,244	2,488	4,976	7,463	9,951	12,438	14,926	17,414	19,901	22,389	24,876
100	0	277	553	830	1,106	1,382	2,764	5,528	8,292	11,056	13,820	16,584	19,348	22,112	24,876	27,640

6.5 Gannet

188. The updated cumulative assessment for displacement for gannet is provided below with comparisons between the assessment submitted to support the ES Chapter (**Table 65**). Annual displacement matrices for the total of all developments are provided for the value presented within the ES Chapter (**Table 69**) and the updated value presented within this report (**Table 70**). The red highlight within the matrices provides a visual representation of where a 1% threshold above the baseline mortality is reached. It should also be noted that the values within the displacement matrices include the impact values from the collision attributed to the species.

Table 65 Gannet cumulative bio-season abundance estimates

Project	Predicted abundance				
	Return migration	Breeding	Post-breeding migration	Annual	Tier
Arklow Bank	0	51	15	66	1
Burbo Bank Extension	8	230	9	247	1
Barrow	4	36	43	83	1
Burbo Bank	1	34	1	36	1
Gwynt y Môr	0	188	57	245	1
North Hoyle	0	64	19	83	1
Ormonde	4	36	42	82	1
Rhyl Flats	0	78	24	102	1
Robin Rigg	5	49	57	111	1
Walney Phase 1	3	28	33	64	1
Walney Phase 2	4	40	47	91	1
Walney Extension	24	221	259	504	1
West of Duddon Sands	8	75	88	171	1
Erebus	100	224	334	658	3
Twin Hub	-	-	-	0	3
Awel y Môr	0	328	201	528	3
Total (Consented)	**161**	**1,682**	**1,229**	**3,072**	
White Cross	76	239	141	456	4
Total (Consented + White Cross)	**237**	**1,921**	**1,370**	**3,528**	
West of Orkney	1,171*	958	-	2,129	
Morecambe OWF	0	748	164	912	5
Morgan OWF	53	209	192	454	5
Mona OWF	28	251	58	337	4

Project	Predicted abundance				
	Return migration	Breeding	Post-breeding migration	Annual	Tier
Mooir Vannin	-	-	-	-	6
LLYR Projects	-	-	-	-	6
Total (All developments)	**1,489**	**4,087**	**1,784**	**7,360**	

Table Note: *Value represents the non-breeding value presented in the West of Orkney EIA (MacArthur Green, 2023a).

189. When considering the Natural England recommended displacement rates of 60-80% and the mortality rates of 1-10%, the annual estimated cumulative number of gannets subject to mortality is 44 – 589 individuals for the updated approach (**Table 67**). This can be compared to the original ES assessment that estimated 18 – 244 individuals would be subject to mortality due to displacement. The addition of the displacement values for projects that were not previously included in the cumulative assessment represents a 141.4 – 144.4% increase in the number of individuals subject to mortality due to displacement.

190. Using the UK Western Waters BDMPS population of 661,888 as a proxy for total BDMPS population across the year, the natural baseline mortality is 123,508 individuals (based on an EIA mortality rate of 0.1866). The addition of 44 – 589 mortalities, from cumulative displacement and from Morlais collisions, would increase total mortality by 0.04 – 0.48%. The difference between the increase in baseline mortality within the ES chapter and that updated cumulative assessment is 0.03-0.28% (**Table 68**). This level of potential cumulative impact annually does not exceed the 1% baseline mortality increase threshold.

Table 66 Comparison between cumulative assessment for gannet used to inform the ES chapter and the cumulative assessment within this report

Scenario	Cumulative assessment values used to inform ES Chapter				Cumulative assessment values reassessed for this report				Percentage change from ES value to those reassessed in the current report (%)			
	Return migration	Breeding	Post-breeding migration	Annual	Return migration	Breeding	Post-breeding migration	Annual	Return migration	Breeding	Post-breeding migration	Annual
Total Consented	609	825	626	2,060	161	1,682	1,229	3,072	-73.6%	+103.9%	+96.3%	+49.1%
Total Consented + White Cross	685	1,064	767	2,516	237	1,921	1,370	3,528	-65.4%	+80.5%	+78.6%	+40.2%
Total All Developments	685	1,392	968	3,044	1,489	4,087	1,784	7,360	+117.4%	+193.6%	+84.3%	+141.8%

Table 67 Comparison of number of gannets subject to mortality, with 60-80% displacement and 1-10% mortality rates, between ES cumulative assessment and updated cumulative assessment

Season	Number of individuals subject to mortality (ES cumulative assessment)		Number of individuals subject to mortality (cumulative assessment in current report)		% change from ES cumulative assessment to updated cumulative assessment	
	60% Displacement and 1% Mortality	80% Displacement and 10% Mortality	60% Displacement and 1% Mortality	80% Displacement and 10% Mortality	60% Displacement and 1% Mortality	80% Displacement and 10% Mortality
Annual	18	244	44	589	+144.4%	+141.4%

Table 68 Comparison of increases in baseline mortality rate for gannet, with 60-80% displacement and 1-10% mortality rates, between ES cumulative assessment and updated cumulative assessment

Season	Increase in baseline mortality (ES cumulative assessment)		Increase in baseline mortality (cumulative assessment in current report)		Change from ES cumulative assessment to updated cumulative assessment	
	60% Displacement and 1% Mortality	80% Displacement and 10% Mortality	60% Displacement and 1% Mortality	80% Displacement and 10% Mortality	60% Displacement and 1% Mortality	80% Displacement and 10% Mortality
Annual	0.01%	0.20%	0.04%	0.48%	0.03%	0.28%

Table 69 Gannet annual displacement matrix comprised of values used to inform the ES chapter (cells shaded red represent an increase of over 1% from the baseline mortality)

Gannet annual displacement matrix																
Displacement (%)	Mortality rates (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	1	1	1	2	3	6	9	12	15	18	21	24	27	30
10	0	3	6	9	12	15	30	61	91	122	152	183	213	244	274	304
15	0	5	9	14	18	23	46	91	137	183	228	274	320	365	411	457
20	0	6	12	18	24	30	61	122	183	244	304	365	426	487	548	609
25	0	8	15	23	30	38	76	152	228	304	381	457	533	609	685	761
30	0	9	18	27	37	46	91	183	274	365	457	548	639	731	822	913
35	0	11	21	32	43	53	107	213	320	426	533	639	746	852	959	1,065
40	0	12	24	37	49	61	122	244	365	487	609	731	852	974	1,096	1,218
50	0	15	30	46	61	76	152	304	457	609	761	913	1,065	1,218	1,370	1,522
60	0	18	37	55	73	91	183	365	548	731	913	1,096	1,278	1,461	1,644	1,826
70	0	21	43	64	85	107	213	426	639	852	1,065	1,278	1,492	1,705	1,918	2,131
80	0	24	49	73	97	122	244	487	731	974	1,218	1,461	1,705	1,948	2,192	2,435
90	0	27	55	82	110	137	274	548	822	1,096	1,370	1,644	1,918	2,192	2,466	2,740
100	0	30	61	91	122	152	304	609	913	1,218	1,522	1,826	2,131	2,435	2,740	3,044

Table 70 Gannet annual displacement matrix following updates to cumulative totals (cells shaded red represent an increase of over 1% from the baseline mortality)

Gannet annual displacement matrix																
Displacement (%)	Mortality rates (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	1	1	2	3	4	7	15	22	29	37	44	52	59	66	74
10	0	7	15	22	29	37	74	147	221	294	368	442	515	589	662	736
15	0	11	22	33	44	55	110	221	331	442	552	662	773	883	994	1,104
20	0	15	29	44	59	74	147	294	442	589	736	883	1,030	1,178	1,325	1,472
25	0	18	37	55	74	92	184	368	552	736	920	1,104	1,288	1,472	1,656	1,840
30	0	22	44	66	88	110	221	442	662	883	1,104	1,325	1,546	1,766	1,987	2,208
35	0	26	52	77	103	129	258	515	773	1,030	1,288	1,546	1,803	2,061	2,318	2,576
40	0	29	59	88	118	147	294	589	883	1,178	1,472	1,766	2,061	2,355	2,650	2,944
50	0	37	74	110	147	184	368	736	1,104	1,472	1,840	2,208	2,576	2,944	3,312	3,680
60	0	44	88	132	177	221	442	883	1,325	1,766	2,208	2,650	3,091	3,533	3,974	4,416
70	0	52	103	155	206	258	515	1,030	1,546	2,061	2,576	3,091	3,606	4,122	4,637	5,152
80	0	59	118	177	236	294	589	1,178	1,766	2,355	2,944	3,533	4,122	4,710	5,299	5,888
90	0	66	132	199	265	331	662	1,325	1,987	2,650	3,312	3,974	4,637	5,299	5,962	6,624
100	0	74	147	221	294	368	736	1,472	2,208	2,944	3,680	4,416	5,152	5,888	6,624	7,360

7. Collision – Updated cumulative assessments

191. Following the assignment of collision mortality values to the OWF projects, an updated cumulative assessment for collision was completed. In addition, comparisons between the assessment used to inform the ES chapter and the updated assessment were conducted.

192. Since the submission of **Chapter 13: Offshore Ornithology** of the **Offshore ES** (FLO-WHI-REP-0002-13), SNCB's have provided an updated interim guidance note on the reference populations that should be used for EIA assessments (SNCB, 2024). Following this guidance, the increase in mortality calculations for both the original ES Chapter and this report consider the updated reference populations and provide the most up-to-date assessment.

193. Additionally, following the cumulative assessments presented within **Chapter 13: Offshore Ornithology** of the **Offshore ES** (FLO-WHI-REP-0002-13), there has been several updates for other plans and projects which need to be considered:

- Inclusion of West of Orkney impact values for relevant species based on the information presented within the West of Orkney EIA Report (MacArthur Green, 2023a) and Technical Supporting Study (MacArthur Green, 2023b); and
- Updated impact estimates for Mona, Morgan and Morecambe based on the information presented within the Mona ES Chapter (RPS, 2024).
- Updated impact estimates for Rampion 2 based on the information presented within the Rampion 2 ES Chapter (GoBe, 2023).

194. Updated cumulative assessments for collision risk are presented following a tiering approach as described in **Table 40**.

195. Predicted impacts are presented for the individual species bio-season definitions, derived from Furness (2015). Detail on the component months for each species bio-season is presented in 0.

7.1 Kittiwake

196. The updated cumulative assessment for collision for kittiwake is provided below with comparisons between the assessment submitted to support the ES Chapter (**Table 71**).

Table 71 Kittiwake cumulative collision risk estimates

Development	Predicted collision mortalities				Tier
	Return Migration	Breeding	Post-breeding migration	Annual	
Arklow Bank	0.5	1.5	0.7	2.8	1
Barrow	0.4	3.7	10.4	14.5	1
Burbo Bank	0.6	8.3	1.7	10.6	1
Burbo Bank Extension	1.9	25.4	5.1	32.4	1
Gwynt y Môr	16.6	47.8	20.6	85.0	1
North Hoyle	2.2	6.4	2.7	11.3	1
Ormonde	0.5	4.5	12.8	17.8	1
Rampion I	6.1	18.6	6.2	30.9	1
Rhyl Flats	2.0	5.7	2.4	10.1	1
Robin Rigg	0.9	7.3	20.9	29.1	1
Walney Phase 1	1.0	8.3	23.7	32.9	1
Walney Phase 2	1.0	8.3	23.7	32.9	1
Walney Extension	4.0	33.7	96.0	133.7	1
West of Duddon Sands	2.8	23.4	66.6	92.8	1
Awel y Môr	9.2	26.6	11.4	47.2	3
TwinHub	-	-	-	0.0	3
Erebus	19.1	0.8	37.6	57.5	3
Total (Consented)	**68.8**	**230.4**	**342.4**	**641.6**	
White Cross	9.0	3.6	1.8	14.4	4
Total consented + White Cross	**77.8**	**234.0**	**344.2**	**656.0**	
West of Orkney	24.8*	9.6	-	34.4	4
Rampion II	17.3	1.2	9.8	28.2	4
Morecambe OWF	5.0	15.0	12.0	32.0	5

Development	Predicted collision mortalities				Tier
	Return Migration	Breeding	Post-breeding migration	Annual	
Morgan OWF	13.0	5.0	22.0	40.0	5
Mona OWF	16.0	8.0	8.0	32.0	4
Mooir Vannin	-	-	-	-	6
LLYR Projects	-	-	-	-	6
Total all projects	**153.8**	**272.8**	**396.0**	**822.6**	

Table Note: *Value represents the non-breeding value presented in the West of Orkney EIA (MacArthur Green, 2023a).

197. The annual estimated cumulative number of kittiwakes subject to mortality due to collision is 822.6 individuals for the updated approach (**Table 71**). This can be compared to the original ES assessment that estimated 473.2 individuals would be subject to mortality due to collision (**Table 72**). Using the UK Western Waters BDMPS population of 911,585 as a proxy for total BDMPS population across the year, the natural baseline mortality is 143,757 individuals (based on an EIA mortality rate of 0.1577). The addition of 822.6 mortalities, from cumulative collisions, would increase total baseline mortality by 0.57%. The difference between the increase in baseline mortality within the ES chapter and that updated cumulative assessment is 0.24% (**Table 73**). This level of potential cumulative impact annually does not exceed the 1% baseline mortality increase threshold.

Table 72 Comparison of number of kittiwakes subject to mortality between ES cumulative assessment and updated cumulative assessment

Season	Number of individuals subject to mortality (ES cumulative assessment)	Number of individuals subject to mortality (cumulative assessment in current report)	% change from ES cumulative assessment to updated cumulative assessment
Annual	473.2	822.6	+73.8%

Table 73 Comparison of increases in baseline mortality rate for kittiwake between ES cumulative assessment and updated cumulative assessment

Season	Increase in baseline mortality (ES cumulative assessment)	Increase in baseline mortality (cumulative assessment in current report)	Change from ES cumulative assessment to updated cumulative assessment
Annual	0.33%	0.57%	+0.24%

7.2 Great black-backed gull

198. The updated cumulative assessment for collision for great black-backed gull is provided below with comparisons between the assessment submitted to support the ES Chapter (**Table 74**).

Table 74 Great black-backed gull cumulative collision risk estimates

Development	Predicted collision mortalities			Tier
	Breeding	Non-breeding	Annual	
Arklow Bank	0.3	0.1	0.4	1
Barrow	0.8	2.8	3.6	1
Burbo Bank	1.8	4.2	5.9	1
Burbo Bank Extension	5.4	12.8	18.1	1
Gwynt y Môr	10.6	1.4	12.0	1
North Hoyle	1.4	0.2	1.6	1
Ormonde	0.9	3.4	4.3	1
Rampion I	3.4	16.6	20.0	1
Rhyl Flats	1.3	0.2	1.5	1
Robin Rigg	1.5	5.6	7.1	1
Walney Phase 1	1.7	6.3	8.0	1
Walney Phase 2	1.7	6.3	8.0	1
Walney Extension	6.9	25.7	32.6	1
West of Duddon Sands	4.8	17.8	22.6	1
TwinHub	-	-	0.0	3

Development	Predicted collision mortalities			Tier
	Breeding	Non-breeding	Annual	
Awel y Môr	5.9	0.8	6.7	3
Erebus	0.0	0.7	0.7	3
Total (Consented)	**48.4**	**104.9**	**153.3**	
White Cross	0.9	0.4	1.3	4
Total consented + White Cross	**49.3**	**105.3**	**154.6**	
West of Orkney	-	-	0.0	4
Morecambe OWF	0.5	0.5	1.0	5
Morgan Offshore Windfarm	2.1	0.7	2.8	5
Mona OWF	1.6	3.2	4.8	4
Rampion II	6.3	13.6	19.8	4
Mooir Vannin	-	-	-	6
LLYR Projects	-	-	-	6
Total all projects	**59.8**	**123.2**	**183.1**	

199. The annual estimated cumulative number of great black-backed gulls subject to mortality due to collision is 183.1 individuals for the updated approach (**Table 74**). This can be compared to the original ES assessment that estimated 64.4 individuals would be subject to mortality due to collision (**Table 75**). Using the UK South-west and Channel BDMPS population of 17,742 as a proxy for total BDMPS population across the year, the natural baseline mortality is 1,719 individuals (based on an EIA mortality rate of 0.0969). The addition of 183.1 mortalities, from cumulative collisions, would increase baseline mortality by 10.65%. The difference between the increase in baseline mortality within the ES chapter and that updated cumulative assessment is 3.81% (**Table 76**). This level of potential cumulative impact annually exceeds the 1% baseline mortality increase threshold.

Table 75 Comparison of number of great black-backed gulls subject to mortality between ES cumulative assessment and updated cumulative assessment

Season	Number of individuals subject to mortality (ES cumulative assessment)	Number of individuals subject to mortality (cumulative assessment in current report)	% change from ES cumulative assessment to updated cumulative assessment
Annual	64.4	183.1	+184.3%

Table 76 Comparison of increases in baseline mortality rate for great black-backed gull between ES cumulative assessment and updated cumulative assessment

Season	Increase in baseline mortality (ES cumulative assessment)	Increase in baseline mortality (cumulative assessment in current report)	Change from ES cumulative assessment to updated cumulative assessment
Annual	6.84%	10.65%	3.81%

7.3 Herring gull

200. The updated cumulative assessment for collision for herring gull is provided below with comparisons between the assessment submitted to support the ES Chapter (**Table 77**).

Table 77 Herring gull cumulative collision risk estimates

Development	Predicted collision mortalities			Tier
	Breeding	Non-breeding	Annual	
Arklow Bank	0.1	0.1	0.2	1
Barrow	5.0	3.1	8.1	1
Burbo Bank	12.3	7.9	20.2	1
Burbo Bank Extension	37.8	24.2	62.0	1
Gwynt y Môr	4.1	3.7	7.8	1
North Hoyle	0.5	0.5	1.0	1
Ormonde	6.1	3.8	9.9	1

Development	Predicted collision mortalities			Tier
	Breeding	Non-breeding	Annual	
Rhyl Flats	0.5	0.4	0.9	1
Robin Rigg	9.9	6.3	16.2	1
Walney Phase 1	11.2	7.1	18.3	1
Walney Phase 2	11.2	7.1	18.3	1
Walney Extension	45.6	28.8	74.4	1
West of Duddon Sands	31.6	20.0	51.6	1
TwinHub	-	-	0.0	3
Awel y Môr	2.3	2.0	4.3	3
Erebus	2.3	1.5	3.8	3
Total (Consented)	**180.5**	**116.5**	**297.0**	
White Cross	0.0	0.3	0.3	4
Total consented + White Cross	**180.5**	**116.8**	**297.3**	
West of Orkney	-	-	0.0	4
Morecambe OWF	0.5	0.5	1.0	5
Morgan Offshore Windfarm	2.1	0.7	2.8	5
Mona OWF	1.6	3.2	4.8	4
Mooir Vannin	-	-	0.0	6
LLYR Projects	-	-	0.0	6
Total all projects	**184.7**	**121.2**	**305.9**	

201. The annual estimated cumulative number of herring gulls subject to mortality due to collision is 305.9 individuals for the updated approach (**Table 77**). This can be compared to the original ES assessment that estimated 73.7 individuals would be subject to mortality due to collision (**Table 78**). Using the UK Western Waters BDMPS population of 217,167 as a proxy for total BDMPS population across the year, the natural baseline mortality is 37,440 individuals (based on an EIA mortality rate of 0.1724). The addition of 305.9 mortalities, from cumulative collisions, would increase baseline mortality by 0.82%. The difference between the increase in baseline mortality within the ES chapter and that updated

cumulative assessment is 0.62% (**Table 79**). This level of potential cumulative impact annually does not exceed the 1% baseline mortality increase threshold.

Table 78 Comparison of number of herring gulls subject to mortality between ES cumulative assessment and updated cumulative assessment

Season	Number of individuals subject to mortality (ES cumulative assessment)	Number of individuals subject to mortality (cumulative assessment in current report)	% change from ES cumulative assessment to updated cumulative assessment
Annual	73.7	305.9	+319.0%

Table 79 Comparison of increases in baseline mortality rate for herring gull between ES cumulative assessment and updated cumulative assessment

Season	Increase in baseline mortality (ES cumulative assessment)	Increase in baseline mortality (cumulative assessment in current report)	Change from ES cumulative assessment to updated cumulative assessment
Annual	0.20%	0.82%	0.62%

7.4 Lesser black-backed gull

202. The updated cumulative assessment for collision for lesser black-backed gull is provided below with comparisons between the assessment submitted to support the ES Chapter (**Table 80**).

Table 80 Lesser black-backed gull cumulative collision risk estimates

Development	Predicted collision mortalities					Tier
	Return Migration	Breeding	Post-breeding migration	Migration-free winter	Annual	
Arklow Bank	0.0	0.0	0.0	0.0	0.0	1
Barrow	0.3	1.0	0.8	1.7	3.8	1
Burbo Bank	0.5	13.8	1.4	0.2	15.9	1

Development	Predicted collision mortalities					Tier
	Return Migration	Breeding	Post-breeding migration	Migration-free winter	Annual	
Burbo Bank Extension	1.4	42.2	4.3	0.7	48.7	1
Gwynt y Môr	0.0	1.2	0.0	0.0	1.2	1
North Hoyle	0.0	0.2	0.0	0.0	0.2	1
Ormonde	0.4	1.2	1.0	2.1	4.7	1
Rhyl Flats	0.0	0.1	0.0	0.0	0.1	1
Robin Rigg	0.7	1.9	1.6	3.4	7.7	1
Walney Phase 1 & 2	1.5	4.4	3.7	7.8	17.4	1
Walney Extension	3.1	8.8	7.5	15.8	35.2	1
West of Duddon Sands	2.2	6.1	5.2	11.0	24.4	1
Awel y Môr	0.0	0.7	0.0	0.0	0.7	3
TwinHub	-	-	-	-	-	3
Erebus	0.0	6.2	0.5	-	6.7	3
Total (Consented)	**10.1**	**87.8**	**26.0**	**42.8**	**166.7**	
White Cross	0.0	0.4	0.0	0.0	0.4	4
Total consented + White Cross	**10.1**	**88.2**	**26.0**	**42.8**	**167.1**	
West of Orkney	-	-	-	-	0.0	4
Morecambe OWF	0.0	2.0	2.0	0.3	4.4	5
Morgan Offshore Windfarm	0.0	0.0	0.6	0.0	0.6	5
Mona OWF	0.8	0.3	0.0	0.8	1.9	4
Mooir Vannin	-	-	-	-	-	6
LLYR Projects	-	-	-	-	-	6

Development	Predicted collision mortalities					Tier
	Return Migration	Breeding	Post-breeding migration	Migration-free winter	Annual	
Total all projects	**10.9**	**90.5**	**28.6**	**43.9**	**173.9**	

203. The annual estimated cumulative number of great black-backed gulls subject to mortality due to collision is 173.9 individuals for the updated approach (**Table 80**). This can be compared to the original ES assessment that estimated 151.3 individuals would be subject to mortality due to collision (**Table 81**). Using the UK Western Waters BDMPS population of 240,750 as a proxy for total BDMPS population across the year, the natural baseline mortality is 29,781 individuals (based on an EIA mortality rate of 0.1237). The addition of 173.9 mortalities, from cumulative collisions, would increase baseline mortality by 0.58%. The difference between the increase in baseline mortality within the ES chapter and that updated cumulative assessment is 0.07% (**Table 82**). This level of potential cumulative impact annually does not exceed the 1% baseline mortality increase threshold.

Table 81 Comparison of number of lesser black-backed gulls subject to mortality between ES cumulative assessment and updated cumulative assessment

Season	Number of individuals subject to mortality (ES cumulative assessment)	Number of individuals subject to mortality (cumulative assessment in current report)	% change from ES cumulative assessment to updated cumulative assessment
Annual	151.3	173.9	+14.9%

Table 82 Comparison of increases in baseline mortality rate for lesser black-backed gull between ES cumulative assessment and updated cumulative assessment

Season	Increase in baseline mortality (ES cumulative assessment)	Increase in baseline mortality (cumulative assessment in current report)	Change from ES cumulative assessment to updated cumulative assessment
Annual	0.51%	0.58%	+0.07%

7.5 Gannet

204. The updated cumulative assessment for collision for gannet is provided below with comparisons between the assessment submitted to support the ES Chapter.

Table 83 Gannet cumulative collision risk estimates

Development	Predicted collision mortalities				Tier
	Return Migration	Breeding	Post-breeding migration	Annual	
Arklow	0.0	0.2	0.1	0.3	1
Barrow	0.0	0.5	0.5	1.1	1
Burbo Bank	0.1	2.6	0.2	2.9	1
Burbo Bank Extension	0.3	7.9	0.7	8.9	1
Gwynt y Môr	0.0	6.8	1.7	8.5	1
North Hoyle	0.0	0.9	0.2	1.1	1
Ormonde	0.0	0.7	0.6	1.3	1
Rhyl Flats	0.0	0.5	0.1	0.7	1
Robin Rigg	0.1	1.1	1.0	2.1	1
Walney Phase 1	0.1	1.2	1.1	2.4	1
Walney Phase 2	0.1	1.2	1.1	2.4	1
Walney Extension	0.2	4.9	4.6	9.8	1
West of Duddon Sands	0.2	3.4	3.2	6.8	1
Morlais Demonstration Zone Phase One	-	-	-	0.0	2
AyM	0.0	3.8	0.9	4.7	3
Erebus	0.9	5.2	0.9	7.0	3
Twinhub	-	-	-	0.0	3
Total (consented)	**1.9**	**41.0**	**17.1**	**60.1**	
White Cross	0	3.3	1.2	4.5	4
Total consented + White Cross	**1.9**	**44.3**	**18.3**	**64.6**	

Development	Predicted collision mortalities				Tier
	Return Migration	Breeding	Post-breeding migration	Annual	
West of Orkney	7.6	22.9	-	30.5	4
Morecambe OWF	0.0	0.1	0.0	0.1	5
Morgan OWF	0.2	1.7	0.3	2.2	5
Mona OWF	0.6	3.9	1.2	5.6	4
Mooir Vannin	-	-	-	-	6
LLYR Projects	-	-	-	-	6
Total all projects	**10.4**	**72.8**	**19.7**	**102.9**	

205. The annual estimated cumulative number of gannets subject to mortality due to collision is 102.9 individuals for the updated approach (**Table 83**). This can be compared to the original ES assessment that estimated 81.9 individuals would be subject to mortality due to collision (**Table 84**). Using the UK Western Waters BDMPS population of 661,888 as a proxy for total BDMPS population across the year, the natural baseline mortality is 123,508 individuals (based on an EIA mortality rate of 0.1866). The addition of 102.9 mortalities, from cumulative collisions, would increase baseline mortality by 0.08%. The difference between the increase in baseline mortality within the ES chapter and that updated cumulative assessment is 0.01% (**Table 85**). This level of potential annually does not exceed the 1% baseline mortality increase threshold.

Table 84 Comparison of number of gannet subject to gannet between ES cumulative assessment and updated cumulative assessment

Season	Number of individuals subject to mortality (ES cumulative assessment)	Number of individuals subject to mortality (cumulative assessment in current report)	% change from ES cumulative assessment to updated cumulative assessment
Annual	81.9	102.9	+25.6%

Table 85 Comparison of increases in baseline mortality rate for gannet between ES cumulative assessment and updated cumulative assessment

Season	Increase in baseline mortality (ES cumulative assessment)	Increase in baseline mortality (cumulative assessment in current report)	Change from ES cumulative assessment to updated cumulative assessment
Annual	0.07%	0.08%	0.01%

8. Combined collision and displacement – Updated assessment for gannet

206. Due to gannet being scoped in for both displacement and collision risk assessment during the operational and maintenance phase, there is a potential for these two potential impacts to adversely affect gannet populations cumulatively. Previous sections have concluded negligible predicted magnitudes of impact with respect to collision risk or displacement acting alone. However, the combined impact of both collision risk and displacement may be greater than either one acting alone. Further consideration of both impacts acting together is therefore required. However, it is recognised that assessing these two potential impacts together amounts to double counting, as birds that are subject to displacement would not be subject to potential collision risk as they are already assumed to have not entered the Windfarm Site. Equally, birds estimated to be subject to collision risk mortality would not be able to be subjected to consequent displacement mortality as well. As a more refined method to consider displacement and collision together whilst reducing any double counting of impacts is not agreed with SNCBs the precautionary and highly unlikely approach is presented in this assessment. Furthermore, attaining impact values for the various historic projects has levels of uncertainty and precaution, enhancing the already over-precautionary combined assessment.

207. When considering the Natural England recommended displacement rates of 60-80% and the mortality rates of 1-10% along with collision risk modelling, the annual estimated cumulative number of gannets subject to mortality is 147.1 – 691.7 individuals for the updated approach. This can be compared to the original ES assessment that estimated 100.1 – 325.4 individuals would be subject to mortality due to displacement. The addition of the displacement and collision values for projects that were not previously included in the cumulative assessment represents a 47.0 – 112.6% increase in the number of individuals subject to mortality (**Table 86**).

208. Using the UK Western Waters BDMPS population of 661,888 as a proxy for total BDMPS population across the year, the natural baseline mortality is 124,435 individuals. The addition of 148.0 – 692.6 mortalities would increase baseline mortality by 0.12 – 0.56%. The difference between the increase in baseline mortality within the ES chapter and that updated cumulative assessment is 0.04 – 0.30% (**Table 87**). This level of potential cumulative impact annually does not exceed the 1% baseline mortality rate threshold even considering the higher end of the displacement and mortality rate range.

Table 86 Comparison of number of gannets subject to mortality, with 60-80% displacement and 1-10% mortality rates plus collision risk modelling, between ES cumulative assessment and updated cumulative assessment

Season	Number of individuals subject to mortality (ES cumulative assessment)		Number of individuals subject to mortality (updated cumulative assessment)		% change from ES cumulative assessment to updated cumulative assessment	
	60% Displacement and 1% Mortality plus Collision Risk	80% Displacement and 10% Mortality plus Collision Risk	60% Displacement and 1% Mortality plus Collision Risk	80% Displacement and 10% Mortality plus Collision Risk	60% Displacement and 1% Mortality plus Collision Risk	80% Displacement and 10% Mortality plus Collision Risk
Annual	100.1	325.4	147.1	691.7	+47.0%	+112.6%

Table 87 Comparison of increases in baseline mortality rate for gannet, with 60-80% displacement and 1-10% mortality rates plus collision risk modelling, between ES cumulative assessment and updated cumulative assessment

Season	Increase in baseline mortality (ES cumulative assessment)		Increase in baseline mortality (updated cumulative assessment)		Change from ES cumulative assessment to updated cumulative assessment	
	60% Displacement and 1% Mortality plus Collision Risk	80% Displacement and 10% Mortality plus Collision Risk	60% Displacement and 1% Mortality plus Collision Risk	80% Displacement and 10% Mortality plus Collision Risk	60% Displacement and 1% Mortality plus Collision Risk	80% Displacement and 10% Mortality plus Collision Risk
Annual	0.08%	0.26%	0.12%	0.56%	+0.04%	+0.30%

9. Conclusion

209. Following the updated cumulative assessments for White Cross the following species have exceeded the 1% threshold and subsequently trigger Population Viability Analysis (PVA):

- Guillemot (displacement)
- Razorbill (displacement)
- Great black-backed gull (collision)

210. The results of the PVA (and therefore the full final conclusions of the cumulative gap analysis) are presented in **Appendix Q Annex 1: Population Viability Analysis**. However, conclusions are summarised below.

211. Cumulatively, the 1% threshold is exceeded, however, White Cross's contribution to the cumulative assessment totals can be concluded as non-tangible for guillemot, razorbill and great black-backed gull, based on the level of effect predicted for the Project alone.

212. As discussed within **Section 5** confidence in the displacement values assigned to the historic projects using proxy project data is low due to physical and geographical differences between sites. It should also be noted that guillemot and razorbill have only exceeded the 1% threshold at the higher end of Natural England's recommended displacement range. If considering the lower end of Natural England's recommended parameters, or the Applicant's approach, then the 1% increase in baseline mortality threshold is not exceeded.

213. For collision impact values assigned to the historic projects, there is also low confidence due to differences in turbine parameters between the proxy and historic sites as well as differences in the bird densities (See **Section 5** for details).

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Annex 1: Monthly abundance estimates

Using Awel y Môr data

Arklow Bank monthly abundance estimates for guillemot, razorbill, puffin, Manx shearwater and gannet using Awel y Môr as proxy

Month	Guillemot	Razorbill	Puffin	Manx shearwater	Gannet
Mar-19	240	70	0	0	0
Apr-19	73	8	0	0	5
May-19	64	0	0	2	0
Jun-19	25	0	2	0	7
Jul-19	35	0	0	2	74
Aug-19	4	0	0	2	4
Sep-19	13	6	0	0	10
Oct-19	21	10	0	0	28
Nov-19	48	13	0	0	0
Dec-19	52	14	0	0	0
Jan-20	39	19	0	0	0
Feb-20	269	23	0	0	0
Mar-20	193	0	0	0	0
Apr-20	139	30	2	0	6
May-20	152	9	0	47	4
Jun-20	33	0	0	0	3
Jul-20	71	25	0	6	3
Aug-20	2	0	0	58	16
Sep-20	12	8	0	0	27
Oct-20	7	3	0	0	1
Nov-20	21	6	0	0	3
Dec-20	97	27	0	0	0
Jan-21	51	25	0	0	0
Feb-21	536	44	0	0	0

Barrow monthly abundance estimates for guillemot, razorbill, puffin, Manx shearwater and gannet using Awel y Môr as proxy

Month	Guillemot	Razorbill	Puffin	Manx shearwater	Gannet
Mar-19	358	105	0	0	0
Apr-19	110	13	0	0	8
May-19	96	0	0	3	0
Jun-19	38	0	3	0	11
Jul-19	52	0	0	2	111
Aug-19	6	0	0	2	7
Sep-19	19	9	0	0	16
Oct-19	32	16	0	0	42
Nov-19	71	20	0	0	0
Dec-19	77	21	0	0	0
Jan-20	59	29	0	0	0
Feb-20	402	34	0	0	0
Mar-20	288	0	0	0	0
Apr-20	208	45	3	0	9
May-20	227	13	0	70	7
Jun-20	50	0	0	0	4
Jul-20	107	38	0	8	4
Aug-20	3	0	0	86	24
Sep-20	18	12	0	0	41
Oct-20	11	5	0	0	2
Nov-20	31	9	0	0	4
Dec-20	145	40	0	0	0
Jan-21	77	38	0	0	0
Feb-21	801	65	0	0	0

Burbo Bank monthly abundance estimates for guillemot, razorbill, puffin, Manx shearwater and gannet using Awel y Môr as proxy

Month	Guillemot	Razorbill	Puffin	Manx shearwater	Gannet
Mar-19	123	36	0	0	0
Apr-19	38	4	0	0	3
May-19	33	0	0	1	0
Jun-19	13	0	1	0	4
Jul-19	18	0	0	1	38
Aug-19	2	0	0	1	2
Sep-19	7	3	0	0	5
Oct-19	11	5	0	0	14
Nov-19	25	7	0	0	0
Dec-19	27	7	0	0	0
Jan-20	20	10	0	0	0
Feb-20	139	12	0	0	0
Mar-20	99	0	0	0	0
Apr-20	72	16	1	0	3
May-20	78	4	0	24	2
Jun-20	17	0	0	0	1
Jul-20	37	13	0	3	1
Aug-20	1	0	0	30	8
Sep-20	6	4	0	0	14
Oct-20	4	2	0	0	1
Nov-20	11	3	0	0	1
Dec-20	50	14	0	0	0
Jan-21	26	13	0	0	0
Feb-21	276	22	0	0	0

Burbo Bank Extension monthly abundance estimates for guillemot, razorbill, puffin, Manx shearwater and gannet using Awel y Môr as proxy

Month	Guillemot	Razorbill	Puffin	Manx shearwater	Gannet
Mar-19	836	244	0	0	0
Apr-19	256	31	0	0	18
May-19	223	0	0	6	0
Jun-19	89	0	7	0	25
Jul-19	121	0	0	5	259
Aug-19	13	0	0	5	15
Sep-19	44	9	0	0	37
Oct-19	74	21	0	0	98
Nov-19	167	16	0	0	0
Dec-19	180	24	0	0	0
Jan-20	137	176	0	0	0
Feb-20	938	71	0	0	0
Mar-20	673	0	0	0	0
Apr-20	485	0	6	0	20
May-20	531	0	0	164	15
Jun-20	116	0	0	0	10
Jul-20	249	0	0	20	10
Aug-20	7	0	0	201	56
Sep-20	43	0	0	0	95
Oct-20	26	0	0	0	5
Nov-20	72	0	0	0	10
Dec-20	339	0	0	0	0
Jan-21	179	0	0	0	0
Feb-21	1,869	0	0	0	0

Gwynt y Môr monthly abundance estimates for guillemot, razorbill, puffin, Manx shearwater and gannet using Awel y Môr as proxy

Month	Guillemot	Razorbill	Puffin	Manx shearwater	Gannet
Mar-19	886	259	0	0	0
Apr-19	271	31	0	0	19
May-19	237	0	0	7	0
Jun-19	94	0	8	0	26
Jul-19	128	0	0	6	274
Aug-19	14	0	0	6	16
Sep-19	47	23	0	0	39
Oct-19	78	39	0	0	104
Nov-19	177	49	0	0	0
Dec-19	191	53	0	0	0
Jan-20	145	71	0	0	0
Feb-20	995	84	0	0	0
Mar-20	714	0	0	0	0
Apr-20	514	112	7	0	21
May-20	563	32	0	174	16
Jun-20	123	0	0	0	11
Jul-20	264	94	0	21	11
Aug-20	7	0	0	213	60
Sep-20	45	29	0	0	101
Oct-20	28	13	0	0	5
Nov-20	77	21	0	0	11
Dec-20	359	100	0	0	0
Jan-21	190	93	0	0	0
Feb-21	1,982	162	0	0	0

North Hoyle monthly abundance estimates for guillemot, razorbill, puffin, Manx shearwater and gannet using Awel y Môr as proxy

Month	Guillemot	Razorbill	Puffin	Manx shearwater	Gannet
Mar-19	301	88	0	0	0
Apr-19	92	11	0	0	7
May-19	80	0	0	2	0
Jun-19	32	0	3	0	9
Jul-19	43	0	0	2	93
Aug-19	5	0	0	2	6
Sep-19	16	8	0	0	13
Oct-19	26	13	0	0	35
Nov-19	60	17	0	0	0
Dec-19	65	18	0	0	0
Jan-20	49	24	0	0	0
Feb-20	338	29	0	0	0
Mar-20	242	0	0	0	0
Apr-20	174	38	2	0	7
May-20	191	11	0	59	6
Jun-20	42	0	0	0	4
Jul-20	90	32	0	7	4
Aug-20	2	0	0	72	20
Sep-20	15	10	0	0	34
Oct-20	9	4	0	0	2
Nov-20	26	7	0	0	4
Dec-20	122	34	0	0	0
Jan-21	64	32	0	0	0
Feb-21	672	55	0	0	0

Ormonde monthly abundance estimates for guillemot, razorbill, puffin, Manx shearwater and gannet using Awel y Môr as proxy

Month	Guillemot	Razorbill	Puffin	Manx shearwater	Gannet
Mar-19	189	104	0	0	0
Apr-19	58	12	0	0	8
May-19	50	0	0	3	0
Jun-19	20	0	3	0	10
Jul-19	27	0	0	2	110
Aug-19	3	0	0	2	7
Sep-19	10	9	0	0	16
Oct-19	17	16	0	0	42
Nov-19	38	20	0	0	0
Dec-19	41	21	0	0	0
Jan-20	31	29	0	0	0
Feb-20	212	34	0	0	0
Mar-20	152	0	0	0	0
Apr-20	109	45	3	0	9
May-20	120	13	0	70	7
Jun-20	26	0	0	0	4
Jul-20	56	38	0	8	4
Aug-20	2	0	0	85	24
Sep-20	10	11	0	0	41
Oct-20	6	5	0	0	2
Nov-20	16	9	0	0	4
Dec-20	76	40	0	0	0
Jan-21	40	38	0	0	0
Feb-21	422	65	0	0	0

Rhyl Flats monthly abundance estimates for guillemot, razorbill, puffin, Manx shearwater and gannet using Awel y Môr as proxy

Month	Guillemot	Razorbill	Puffin	Manx shearwater	Gannet
Mar-19	370	108	0	0	0
Apr-19	113	13	0	0	8
May-19	99	0	0	3	0
Jun-19	39	0	3	0	11
Jul-19	53	0	0	2	115
Aug-19	6	0	0	2	7
Sep-19	20	10	0	0	16
Oct-19	33	16	0	0	43
Nov-19	74	20	0	0	0
Dec-19	80	22	0	0	0
Jan-20	60	30	0	0	0
Feb-20	416	35	0	0	0
Mar-20	298	0	0	0	0
Apr-20	215	47	3	0	9
May-20	235	13	0	73	7
Jun-20	52	0	0	0	4
Jul-20	110	39	0	9	4
Aug-20	3	0	0	89	25
Sep-20	19	12	0	0	42
Oct-20	12	5	0	0	2
Nov-20	32	9	0	0	4
Dec-20	150	42	0	0	0
Jan-21	79	39	0	0	0
Feb-21	828	67	0	0	0

Robin Rigg monthly abundance estimates for guillemot, razorbill, puffin, Manx shearwater and gannet using Awel y Môr as proxy

Month	Guillemot	Razorbill	Puffin	Manx shearwater	Gannet
Mar-19	480	140	0	0	0
Apr-19	147	17	0	0	10
May-19	128	0	0	4	0
Jun-19	51	0	4	0	14
Jul-19	69	0	0	3	148
Aug-19	8	0	0	3	9
Sep-19	25	13	0	0	21
Oct-19	42	21	0	0	56
Nov-19	96	27	0	0	0
Dec-19	104	29	0	0	0
Jan-20	78	39	0	0	0
Feb-20	538	45	0	0	0
Mar-20	386	0	0	0	0
Apr-20	278	61	4	0	12
May-20	305	17	0	94	9
Jun-20	67	0	0	0	6
Jul-20	143	51	0	11	6
Aug-20	4	0	0	115	32
Sep-20	25	15	0	0	55
Oct-20	15	7	0	0	3
Nov-20	41	11	0	0	6
Dec-20	194	54	0	0	0
Jan-21	103	51	0	0	0
Feb-21	1,073	87	0	0	0

***Walney Phase 1 monthly abundance estimates for guillemot, razorbill, puffin, Manx shearwater and gannet using Awel y Môr as** proxy*

Month	Guillemot	Razorbill	Puffin	Manx shearwater	Gannet
Mar-19	282	82	0	0	0
Apr-19	86	10	0	0	6
May-19	75	0	0	2	0
Jun-19	30	0	2	0	8
Jul-19	41	0	0	2	87
Aug-19	5	0	0	2	5
Sep-19	15	7	0	0	12
Oct-19	25	12	0	0	33
Nov-19	56	16	0	0	0
Dec-19	61	17	0	0	0
Jan-20	46	23	0	0	0
Feb-20	316	27	0	0	0
Mar-20	227	0	0	0	0
Apr-20	163	36	2	0	7
May-20	179	10	0	55	5
Jun-20	39	0	0	0	3
Jul-20	84	30	0	7	3
Aug-20	2	0	0	68	19
Sep-20	14	9	0	0	32
Oct-20	9	4	0	0	2
Nov-20	24	7	0	0	3
Dec-20	114	32	0	0	0
Jan-21	60	30	0	0	0
Feb-21	630	51	0	0	0

***Walney Phase 2 monthly abundance estimates for guillemot, razorbill, puffin, Manx shearwater and gannet using Awel y Môr as** proxy*

Month	Guillemot	Razorbill	Puffin	Manx shearwater	Gannet
Mar-19	400	117	0	0	0
Apr-19	122	14	0	0	9
May-19	107	0	0	3	0
Jun-19	42	0	3	0	12
Jul-19	58	0	0	3	124
Aug-19	6	0	0	3	7
Sep-19	21	10	0	0	17
Oct-19	35	17	0	0	47
Nov-19	80	22	0	0	0
Dec-19	86	24	0	0	0
Jan-20	65	32	0	0	0
Feb-20	449	38	0	0	0
Mar-20	322	0	0	0	0
Apr-20	232	51	3	0	10
May-20	254	14	0	78	7
Jun-20	56	0	0	0	5
Jul-20	119	42	0	9	5
Aug-20	3	0	0	96	27
Sep-20	20	13	0	0	46
Oct-20	12	6	0	0	2
Nov-20	35	10	0	0	5
Dec-20	162	45	0	0	0
Jan-21	86	42	0	0	0
Feb-21	894	73	0	0	0

***Walney Extension monthly abundance estimates for guillemot, razorbill, puffin, Manx shearwater and gannet using Awel y Môr as** proxy*

Month	Guillemot	Razorbill	Puffin	Manx shearwater	Gannet
Mar-19	2,185	638	0	0	0
Apr-19	669	77	0	0	48
May-19	583	0	0	16	0
Jun-19	231	0	19	0	64
Jul-19	316	0	0	14	676
Aug-19	35	0	0	14	40
Sep-19	116	57	0	0	96
Oct-19	192	95	0	0	255
Nov-19	436	121	0	0	0
Dec-19	471	131	0	0	0
Jan-20	357	176	0	0	0
Feb-20	2,452	207	0	0	0
Mar-20	1,760	0	0	0	0
Apr-20	1,267	276	16	0	53
May-20	1,388	79	0	429	40
Jun-20	304	0	0	0	26
Jul-20	651	232	0	52	26
Aug-20	18	0	0	524	147
Sep-20	112	70	0	0	249
Oct-20	68	32	0	0	13
Nov-20	189	52	0	0	26
Dec-20	885	247	0	0	0
Jan-21	468	230	0	0	0
Feb-21	4,885	398	0	0	0

West of Duddon Sands monthly abundance estimates for guillemot, razorbill, puffin, Manx shearwater and gannet using Awel y Môr as proxy

Month	Guillemot	Razorbill	Puffin	Manx shearwater	Gannet
Mar-19	744	217	0	0	0
Apr-19	228	26	0	0	16
May-19	199	0	0	6	0
Jun-19	79	0	1	0	22
Jul-19	107	0	0	5	230
Aug-19	12	0	0	5	14
Sep-19	39	19	0	0	33
Oct-19	65	32	0	0	87
Nov-19	149	41	0	0	0
Dec-19	161	44	0	0	0
Jan-20	122	60	0	0	0
Feb-20	835	71	0	0	0
Mar-20	599	0	0	0	0
Apr-20	431	94	1	0	18
May-20	473	27	0	146	14
Jun-20	104	0	0	0	9
Jul-20	222	79	0	18	9
Aug-20	6	0	0	178	50
Sep-20	38	24	0	0	85
Oct-20	23	11	0	0	4
Nov-20	64	18	0	0	9
Dec-20	301	84	0	0	0
Jan-21	159	78	0	0	0
Feb-21	1,663	136	0	0	0

Using Walney Extension data

Barrow monthly abundance estimates for guillemot, razorbill, puffin, Manx shearwater and gannet using Walney Extension as proxy

Month	Guillemot	Razorbill	Guillemot/ razorbill	Total guillemot (with apportioning)	Total razorbill (with apportioning)	Puffin	Manx shearwater	Gannet
Nov-10	0	0	512	92	420	0	0	3
Dec-10	0	0	110	20	90	0	3	0
Feb-11	0	0	113	20	93	0	0	8
Mar-11	0	0	67	12	55	0	4	3
Mar-11	0	0	561	101	460	0	19	11
Apr-11	0	0	253	183	70	0	8	53
Apr-11	0	0	72	52	20	0	46	7
Jun-11	0	0	128	92	35	20	13	6
Jun-11	0	0	314	228	86	0	6	9
Jul-11	0	0	680	493	187	0	0	10
Aug-11	0	0	378	68	310	0	45	18
Oct-11	7	68	310	38	348	14	0	23
Nov-11	3	10	1,077	244	846	19	6	7
Jan-12	3	9	78	23	67	10	0	0
Jan-12	1	10	84	10	86	2	0	0
Mar-12	8	4	26	26	12	5	0	0
Mar-12	17	8	174	133	66	0	0	4
Apr-12	0	0	117	84	32	0	0	13
May-12	29	16	227	176	96	7	148	3
Jul-12	13	0	679	692	0	9	1	15
Sep-12	22	49	471	167	375	1	106	19

Month	Guillemot	Razorbill	Guillemot/ razorbill	Total guillemot (with apportioning)	Total razorbill (with apportioning)	Puffin	Manx shearwater	Gannet
Oct-12	1	127	729	7	850	0	2	62

Ormonde monthly abundance estimates for guillemot, razorbill, puffin, Manx shearwater and gannet using Walney Extension as proxy

Month	Guillemot	Razorbill	Guillemot/ razorbill	Total guillemot (with apportioning)	Total razorbill (with apportioning)	Puffin	Manx shearwater	Gannet
Nov-10	0	0	509	91	417	0	0	3
Dec-10	0	0	109	20	90	0	3	0
Feb-11	0	0	113	20	92	0	0	8
Mar-11	0	0	66	12	54	0	4	3
Mar-11	0	0	558	100	457	0	19	11
Apr-11	0	0	252	182	69	0	7	53
Apr-11	0	0	71	52	20	0	46	7
Jun-11	0	0	127	92	35	20	13	5
Jun-11	0	0	312	226	86	0	6	9
Jul-11	0	0	676	490	186	0	0	10
Aug-11	0	0	376	68	308	0	45	18
Oct-11	7	68	308	37	346	14	0	23
Nov-11	3	10	1,070	243	840	19	6	7
Jan-12	3	9	77	23	67	10	0	0
Jan-12	1	10	84	10	85	2	0	0
Mar-12	8	4	26	26	12	5	0	0
Mar-12	17	8	173	132	66	0	0	4
Apr-12	0	0	116	84	32	0	0	12
May-12	29	16	226	175	95	7	147	3
Jul-12	13	0	675	688	0	9	1	15
Sep-12	21	48	468	166	373	1	105	19
Oct-12	1	126	724	7	844	0	2	61

Robin Rigg monthly abundance estimates for guillemot, razorbill, puffin, Manx shearwater and gannet using Walney Extension as proxy

Month	Guillemot	Razorbill	Guillemot/ razorbill	Total guillemot (with apportioning)	Total razorbill (with apportioning)	Puffin	Manx shearwater	Gannet
Nov-10	0	0	686	123	563	0	0	4
Dec-10	0	0	147	26	121	0	4	0
Feb-11	0	0	152	27	125	0	0	10
Mar-11	0	0	89	16	73	0	6	4
Mar-11	0	0	753	135	617	1	26	14
Apr-11	0	0	340	246	93	0	10	71
Apr-11	0	0	96	70	27	0	62	9
Jun-11	0	0	171	124	47	27	17	7
Jun-11	0	0	421	305	116	0	8	13
Jul-11	0	0	912	661	251	0	0	14
Aug-11	0	0	507	91	416	0	61	24
Oct-11	10	92	416	50	467	19	1	31
Nov-11	4	14	1,444	327	1,134	26	8	9
Jan-12	4	12	105	30	90	14	0	0
Jan-12	2	13	113	13	115	3	0	0
Mar-12	11	5	36	36	17	7	0	0
Mar-12	23	11	233	179	89	0	0	6
Apr-12	0	0	156	113	43	0	0	17
May-12	39	21	305	236	129	10	198	4
Jul-12	17	0	911	928	0	12	2	20
Sep-12	29	65	632	223	503	1	142	26
Oct-12	1	170	977	9	1,140	0	3	83

Walney Phase 1 monthly abundance estimates for guillemot, razorbill, puffin, Manx shearwater and gannet using Walney Extension as proxy

Month	Guillemot	Razorbill	Guillemot/ razorbill	Guillemot total (with apportioning)	Razorbill total (with apportioning)	Puffin	Manx shearwater	Gannet
Nov-10	0	0	403	72	330	0	0	2
Dec-10	0	0	86	16	71	0	3	0
Feb-11	0	0	89	16	73	0	0	6
Mar-11	0	0	52	9	43	0	3	2
Mar-11	0	0	441	79	362	0	15	8
Apr-11	0	0	199	144	55	0	6	42
Apr-11	0	0	57	41	16	0	36	5
Jun-11	0	0	100	73	28	16	10	4
Jun-11	0	0	247	179	68	0	5	7
Jul-11	0	0	535	388	147	0	0	8
Aug-11	0	0	297	53	244	0	36	14
Oct-11	6	54	244	30	274	11	0	18
Nov-11	2	8	847	192	665	15	5	5
Jan-12	2	7	61	18	53	8	0	0
Jan-12	1	8	66	8	67	2	0	0
Mar-12	7	3	21	21	10	4	0	0
Mar-12	13	7	137	105	52	0	0	3
Apr-12	0	0	92	66	25	0	0	10
May-12	23	12	179	138	76	6	116	3
Jul-12	10	0	534	544	0	7	1	12
Sep-12	17	38	371	131	295	1	83	15
Oct-12	1	100	573	5	668	0	2	49

Walney Phase 2 monthly abundance estimates for guillemot, razorbill, puffin, Manx shearwater and gannet using Walney Extension as proxy

Month	Guillemot	Razorbill	Guillemot/ razorbill	Total guillemot (with apportioning)	Total razorbill (with apportioning)	Puffin	Manx shearwater	Gannet
Nov-10	0	0	571	103	468	0	0	3
Dec-10	0	0	123	22	101	0	4	0
Feb-11	0	0	126	23	104	0	0	9
Mar-11	0	0	74	13	61	0	5	3
Mar-11	0	0	626	113	514	0	21	12
Apr-11	0	0	282	205	78	0	8	59
Apr-11	0	0	80	58	22	0	52	8
Jun-11	0	0	142	103	39	22	14	6
Jun-11	0	0	350	254	96	0	7	11
Jul-11	0	0	759	550	209	0	0	12
Aug-11	0	0	422	76	346	0	50	20
Oct-11	8	76	346	42	388	16	0	26
Nov-11	3	11	1,201	272	944	22	7	8
Jan-12	3	10	87	25	75	12	0	0
Jan-12	1	11	94	11	95	3	0	0
Mar-12	9	4	30	30	14	6	0	0
Mar-12	19	9	194	149	74	0	0	5
Apr-12	0	0	130	94	36	0	0	14
May-12	32	18	253	196	107	8	165	4
Jul-12	14	0	758	772	0	10	2	16
Sep-12	24	54	526	186	418	1	118	22
Oct-12	1	142	813	8	948	0	2	69

West of Duddon Sands monthly abundance estimates for guillemot, razorbill, puffin, Manx shearwater and gannet using Walney Extension as proxy

Month	Guillemot	Razorbill	Guillemot/ razorbill	Total guillemot (with apportioning)	Total razorbill (with apportioning)	Puffin	Manx shearwater	Gannet
Nov-10	0	0	1,064	191	873	0	0	6
Dec-10	0	0	228	41	187	0	7	0
Feb-11	0	0	236	42	193	0	0	16
Mar-11	0	0	138	25	113	0	9	6
Mar-11	0	0	1,167	210	957	1	40	22
Apr-11	0	0	526	382	145	0	16	110
Apr-11	0	0	150	108	41	0	96	15
Jun-11	0	0	265	192	73	41	27	11
Jun-11	0	0	653	473	180	0	12	20
Jul-11	0	0	1,414	1,025	389	0	0	21
Aug-11	0	0	786	141	645	0	94	37
Oct-11	15	142	644	78	724	29	1	49
Nov-11	6	21	2,239	508	1,758	41	12	14
Jan-12	6	19	162	47	140	21	0	0
Jan-12	2	21	176	21	178	5	0	0
Mar-12	18	8	55	55	26	11	0	0
Mar-12	35	18	362	277	138	0	0	9
Apr-12	0	0	242	176	67	0	0	26
May-12	60	33	472	365	200	15	307	7
Jul-12	26	0	1,412	1,439	0	18	3	31
Sep-12	45	101	980	346	779	2	220	40

Month	Guillemot	Razorbill	Guillemot/ razorbill	Total guillemot (with apportioning)	Total razorbill (with apportioning)	Puffin	Manx shearwater	Gannet
Oct-12	2	264	1,515	15	1,766	0	5	128

Annex 2: Updated Collision Risk Calculations for Western Waters BDMPS Projects (WHX001-FLO-CON-ENV-DTA-0001)

White Cross Offshore Windfarm: Cumulative gap analysis

Appendix Q Annex 2: Updated Collision Risk Calculations for Western Waters

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Version Number	**Reason for Issue / Major Changes**	**Date of Change**
00	For Issue	26/06/2024

1. BDMPS Projects

1. Due to the age of the Projects used as proxy sites (Burbo Bank Extension and Walney Extension) in the **Cumulative and In-combination Gap Analysis for Western Waters Projects** (WHX001-FLO-CON-ENV-ASS-0003), the values and modelling approach previously employed to inform collision risk estimates differed significantly from those now recommended as best practice by Natural England (2023b). This meant that the correction factor calculation derived for the Sheringham Shoal and Dudgeon Offshore Wind Farm Extension Projects (Royal HaskoningDHV, 2023), which only accounted for adjusting the change in avoidance rates, was not feasible for the projects detailed in this document. This is also the case for Awel y Mor and Rampion 1 for which updated collision risk values was also be calculated using latest guidance.

2. Revised collision risk modelling has been undertaken using the deterministic Band (2012) model, developed by the British Trust for Ornithology (BTO) as one of the Strategic Ornithological Support Services (SOSS) projects. The Band (2012) model was used to provide consistency in the modelling approach taken for the majority of the Western Waters Projects requiring remodelling. The results of the updated modelling are presented in **Section 4.**

3. The modelling approach and biometric input parameters are based on Natural England interim guidance (2023b), the values of which are summarised in **Table 1.** Windfarm and turbine parameters were sourced from the Proxy Projects' accompanying technical reports, sources of which are provided in the corresponding tables in **Section 3**.

4. Following revised collision risk modelling, monthly collision impact values are presented for each of the Projects to be used as proxy in **Section 4.**

5. Additionally, collision impact values by bio-season are also provided.

2. Bird Data

Table 1 CRM input data for kittiwake, great black-backed gull, herring gull, lesser black-backed gull and gannet

Species	Length (m)	Wingspan (m)	Flight speed (m/s)	Nocturnal Activity Factor (1-5)	Flight type	Source
Kittiwake	0.39	1.08	13.1	3	Flapping	Natural England (2023b)
Great black-backed gull	0.71	1.58	13.7	3	Flapping	
Herring gull	0.60	1.44	12.8	3	Flapping	

Species	Length (m)	Wingspan (m)	Flight speed (m/s)	Nocturnal Activity Factor (1-5)	Flight type	Source
Lesser black-backed gull	0.58	1.42	13.1	3	Flapping	
Gannet	0.94	1.72	14.9	1.32	Flapping	

3. Turbine and Bird Survey Data

3.1 Awel y Môr

Table 2 Windfarm data for Awel y Môr OWF

Project	Latitude (degrees)	Number of turbines	Width of windfarm (km)	Tidal offset (m)	Source
Awel y Môr	53.46	50	17.3	0*	Awel y Môr Offshore Wind Farm Environmental Statement. Annex 4.3: Offshore Ornithology Collision Risk Modelling

Table Note: Tidal offset value to account for the difference between Mean Sea Level (MSL) and Highest Astronomical Tide (HAT) accounted for within the hub height value in **Table 3.**

Table 3 Turbine data for Awel y Môr OWF

Project	Number of blades	Rotation Speed (rpm)	Rotor radius (m)	MSL Hub height (m)	Max blade width (m)	Pitch (degrees)	Source
Awel y Môr	3	5.46	125	150.65	7	2.27	Awel y Môr Offshore Wind Farm Environmental Statement. Annex 4.3: Offshore Ornithology Collision Risk Modelling

Table 4 Monthly proportions of operational time for Awel y Môr wind turbines

Project	Monthly proportion of time operational (%)												Source
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	
Awel y Môr	89.2%	88.4 %	87.1 %	83.5 %	84.2 %	80.5 %	81.1 %	84.4 %	86.5 %	89.6 %	91.2 %	89.9 %	Awel y Môr Offshore Wind Farm Environmental Statement. Annex 4.3: Offshore Ornithology Collision Risk Modelling

Table 5 Daytime bird density data by month in Awel y Môr Array Area for kittiwake, great black-backed gull, herring gull, lesser black-backed gull and gannet

Species	Daytime bird density (birds/km2)												Source
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	
Kittiwake	0.73	0.79	1.10	1.26	0.78	0.05	0.53	0.10	0.16	0.31	1.00	0.31	Awel y Môr Offshore Wind Farm Environmental Statement. Annex 4.3: Offshore Ornithology Collision Risk Modelling
Great black-backed gull	0.00	0.00	0.06	0.00	0.05	0.06	0.11	0.05	0.00	0.00	0.05	0.00	
Herring gull	0.10	0.05	0.00	0.10	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	
Lesser black-backed gull	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	
Gannet	0.00	0.00	0.00	0.04	0.02	0.03	0.26	0.08	0.19	0.17	0.02	0.00	

3.2 Burbo Bank Extension

Table 6 Windfarm data for Burbo Bank Extension OWF

Project	Latitude (degrees)	Number of turbines	Width of windfarm (km)	Tidal offset (m)	Source
Burbo Bank Extension	53.48	69	13.59	0*	Burbo Bank Extension Offshore Wind Farm Environmental Statement. Annex 15 - Ornithology

Table Note: Tidal offset value to account for the difference between Mean Sea Level (MSL) and Highest Astronomical Tide (HAT) accounted for within the hub height value in **Table 7**.

Table 7 Turbine data for Burbo Bank Extension OWF

Project	Number of blades	Rotation Speed (rpm)	Rotor radius (m)	MSL Hub height (m)	Max blade width (m)	Pitch (degrees)	Source
Burbo Bank Extension	3	13	60	82	4.2	6	Burbo Bank Extension Offshore Wind Farm Environmental Statement. Annex 15 - Ornithology

Table 8 Monthly proportions of operational time for Burbo Bank Extension wind turbines

Project	Monthly proportion of time operational (%)												Source
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	
Burbo Bank Extension	90%	85%	86%	80%	82%	77%	81%	81%	82%	87%	89%	86%	Burbo Bank Extension Offshore Wind Farm Environmental Statement. Annex 15 - Ornithology

Table 9 Daytime bird density data by month in Burbo Bank Extension Array Area for kittiwake, great black-backed gull, herring gull, lesser black-backed gull and gannet

Species	Daytime bird density (birds/km2)												Source
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	
Kittiwake	0.12	0.12	0.12	0.12	0.62	0.62	0.62	0.62	0.18	0.18	0.12	0.12	Burbo Bank Extension Offshore Wind Farm Environmental Statement. Annex 15 - Ornithology
Great black-backed gull	0.10	0.10	0.06	0.06	0.03	0.03	0.03	0.03	0.14	0.14	0.10	0.10	
Herring gull	0.34	0.34	0.80	0.80	0.12	0.12	0.12	0.12	0.05	0.05	0.34	0.34	
Lesser black-backed gull	0.01	0.01	0.09	0.09	0.62	0.62	0.62	0.62	0.14	0.14	0.01	0.01	
Gannet	0.02	0.02	0.01	0.01	0.18	0.18	0.18	0.18	0.08	0.08	0.02	0.02	

3.3 Rampion I

Table 10 Windfarm data for Rampion I OWF

Project	Latitude (degrees)	Number of turbines	Width of windfarm (km)	Tidal offset (m)	Source
Rampion I	50.65	175	16	0*	Rampion Offshore Wind Farm ES Section 11 Marine Ornithology.

Table Note: Tidal offset value to account for the difference between Mean Sea Level (MSL) and Highest Astronomical Tide (HAT) accounted for within the hub height value in **Table 11**.

Table 11 Turbine data for Rampion I OWF

Project	Turbine Model	Number of blades	Rotation Speed (rpm)	Rotor radius (m)	MSL Hub height (m)	Max blade width (m)	Pitch (degrees)	Source
Rampion I	4MW	3	10	65	100	4.000	15	Rampion Offshore Wind Farm ES Section 11 Marine Ornithology.

Table 12 Monthly proportions of operational time for Rampion I wind turbines

Project	Monthly proportion of time operational (%)												Source
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	
Rampion I	90%	84%	87%	88%	85%	80%	79%	77%	83%	81%	90%	82%	Rampion Offshore Wind Farm ES Section 11 Marine Ornithology.

Table 13 Daytime bird density data by month in Rampion I Array Area for kittiwake, great black-backed gull, herring gull, lesser black-backed gull and gannet

Species	Daytime bird density (birds/km2)												Source
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	
Kittiwake	0.53	0.57	0.11	0.06	0.02	2.21	0.10	0.48	0.02	0.40	0.21	0.49	Rampion Offshore Wind Farm ES Section 11 Marine Ornithology.
Great black-backed gull	0.24	0.00	0.03	0.00	0.03	0.02	0.02	0.04	0.05	0.19	0.25	0.07	

3.4 Walney Extension

Table 14 Windfarm data for Walney Extension OWF

Project	Latitude (degrees)	Number of turbines	Width of windfarm (km)	Tidal offset (m)	Source
Walney Extension	54.09	207	15.71	0*	Walney Extension Offshore Wind Farm Environmental Statement Annexes. Annex B.7.D. CRM and Migration Assessment

Table Note: Tidal offset value to account for the difference between Mean Sea Level (MSL) and Highest Astronomical Tide (HAT) accounted for within the hub height value in **Table 15**.

Table 15 Turbine data for Walney Extension OWF

Project	Turbine Model	Number of blades	Rotation Speed (rpm)	Rotor radius (m)	MSL Hub height (m)	Max blade width (m)	Pitch (degrees)	Source
Walney Extension	3.6MW	3	13	60	82	4.2	6	Walney Extension Offshore Wind Farm Environmental Statement Annexes. Annex B.7.D. CRM and Migration Assessment

Table 16 Monthly proportions of operational time for Walney Extension wind turbines

Project	Monthly proportion of time operational (%)												Source
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	
Walney Extension	91%	90%	79%	90%	84%	83%	86%	81%	89%	94%	93%	93%	Walney Extension Offshore Wind Farm Environmental Statement Annexes. Annex B.7.D. CRM and Migration Assessment

Table 17 Daytime bird density data by month in Walney Extension Array Area for kittiwake, great black-backed gull, herring gull, lesser black-backed gull and gannet

Species	Daytime bird density (birds/km2)												Source
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	
Kittiwake	0.12	0.04	0.51	0.26	0.07	0.13	0.17	0.07	0.08	0.93	1.95	0.61	Walney Extension Offshore Wind Farm Environmental Statement Annexes. Annex B.7.A: Ornithology Technical Report
Great black-backed gull	0.01	0.02	0.10	0.02	0.00	0.00	0.00	0.00	0.02	0.10	0.12	0.16	
Herring gull	0.04	0.02	0.35	0.26	0.00	0.03	0.13	0.05	0.00	0.12	0.18	0.17	
Lesser black-backed gull	0.00	0.01	0.07	0.02	0.02	0.01	0.09	0.02	0.03	0.11	0.33	0.01	
Gannet	0.00	0.01	0.01	0.04	0.00	0.02	0.03	0.04	0.02	0.18	0.01	0.00	

4. CRM Impact Values

4.1 Awel y Môr

Table 18 CRM impact values for Awel y Môr by month

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
Great black-backed gull	0.0	0.0	1.1	0.0	0.9	1.1	1.9	0.9	0.0	0.0	0.8	0.0	6.7
Gannet	0.0	0.0	0.0	0.2	0.1	0.2	1.7	0.5	1.0	0.9	0.1	0.0	4.7
Herring gull	1.4	0.7	0.0	1.5	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	4.3
Kittiwake	4.6	4.7	7.5	8.5	5.7	0.3	3.8	0.7	1.1	2.1	6.3	1.9	47.2
Lesser black-backed gull	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.7

Table 19 CRM impact values for Awel y Môr by bio-season

Species	Return Migration	Breeding	Post-breeding Migration	Migration-free Winter	Non-breeding	Annual
Great black-backed gull	-	5.9	-	-	0.8	6.7
Gannet	0.0	3.8	0.9	-	-	4.7
Herring gull	-	2.3	-	-	2.0	4.3
Kittiwake	9.2	26.6	11.4	-	-	47.2
Lesser black-backed gull	0.0	0.7	0.0	0.0	-	0.7

4.2 Burbo Bank Extension

Table 20 CRM impact values for Burbo Bank Extension by month

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
Great black-backed gull	1.9	1.7	1.3	1.2	0.7	0.7	0.7	0.7	2.7	2.8	1.8	1.8	18.1
Gannet	0.1	0.1	0.0	0.0	1.8	1.7	1.9	1.7	0.7	0.6	0.1	0.1	8.9
Herring gull	5.9	5.3	14.8	14.1	2.3	2.1	2.3	2.2	0.9	1.0	5.7	5.5	62.0
Kittiwake	1.0	0.9	1.1	1.1	6.0	5.6	6.0	5.7	1.6	1.6	1.0	0.9	32.4
Lesser black-backed gull	0.2	0.2	1.4	1.3	10.5	9.8	10.5	10.1	2.1	2.2	0.2	0.2	48.7

Table 21 CRM impact values for Burbo Bank Extension by bio-season

Species	Return Migration	Breeding	Post-breeding Migration	Migration-free Winter	Non-breeding	Annual
Great black-backed gull	-	5.4	-	-	12.8	18.1
Gannet	0.3	7.9	0.7	-	-	8.9
Herring gull	-	37.8	-	-	24.2	62.0
Kittiwake	1.9	25.4	5.1	-	-	32.4
Lesser black-backed gull	1.4	42.2	4.3	0.7	-	48.7

4.3 Rampion I

Table 22 CRM impact values for Rampion I by month

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
Great black-backed gull	5.1	0.0	0.7	0.0	0.8	0.5	0.5	0.8	1.1	3.9	5.2	1.3	20.0
Kittiwake	3.1	3.0	0.7	0.4	0.1	13.9	0.6	2.9	0.1	2.3	1.2	2.6	30.9

Table 23 CRM impact values for Rampion I by bio-season

Species	Return Migration	Breeding	Post-breeding Migration	Migration-free Winter	Non-breeding	Annual
Great black-backed gull	-	3.4	-	-	16.6	20.0
Kittiwake	6.1	18.6	6.2	-	-	30.9

4.4 Walney Extension

Table 24 CRM impact values for Walney Extension by month

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
Great black-backed gull	0.5	1.1	5.6	1.1	0.0	0.0	0.0	0.2	1.1	6.6	6.9	9.4	32.6
Gannet	0.0	0.2	0.3	1.1	0.1	0.5	1.1	1.3	0.5	4.5	0.1	0.0	9.8
Herring gull	2.3	1.1	17.9	15.3	0.0	1.7	8.0	2.6	0.0	7.1	9.6	8.8	74.4
Kittiwake	3.0	1.0	12.9	7.6	2.1	3.8	5.3	2.1	2.2	27.0	50.9	15.9	133.7
Lesser black-backed gull	0.0	0.5	3.1	1.2	1.2	0.7	4.7	1.0	1.7	5.7	15.0	0.3	35.2

Table 25 CRM impact values for Walney Extension by bio-season

Species	Return Migration	Breeding	Post-breeding Migration	Migration-free Winter	Non-breeding	Annual
Great black-backed gull	-	6.9	-	-	25.7	32.6
Gannet	0.2	4.9	4.6			9.8
Herring gull	-	45.6	-	-	28.8	74.4
Kittiwake	4.0	33.7	96.0	-	-	133.7
Lesser black-backed gull	3.1	8.8	7.5	15.8	-	35.2

Annex 3: Bio-season Definitions

Species	Migration-free breeding / Breeding	Post-breeding migration	Migration-free winter	Return migration	Non-breeding	Source
Kittiwake	May – Jul.	Aug. – Dec.	-	Jan. – Apr.	-	Furness (2015)
Great black-backed gull	Mar. – Aug.	-	-	-	Sep. – Feb.	Furness (2015)
Herring gull	Mar. – Aug.	-	-	-	Sep. – Feb.	Furness (2015)
Guillemot	Mar. – Jul.	-	-	-	Aug. – Feb.	Furness (2015)
Razorbill	Apr. – Jul.	Aug. – Oct.	Nov. – Dec	Jan. – Mar.	-	Furness (2015)
Puffin	Apr. – Aug.	-	-	-	Sep. – Mar.	Furness (2015)
Manx shearwater	Apr. – Aug.	Sep. – Oct.	Nov. – Feb.	Mar.	-	Furness (2015)
Gannet	Mar. – Sep.	Oct. – Nov.	-	Dec. – Feb.	-	Furness (2015)