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Volume 2 Proposed Development (Offshore)

Chapter 6 Offshore Ornithology

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Acronyms and Abbreviations

BDMPS	Biologically Defined Minimum Population Scales
BoCCI	Birds of Conservation Concern
BTO	British Trust for Ornithology
CIA	Cumulative Impact Assessment
CEF	Cumulative Effects Framework
CEH	Centre of Ecology & Hydrology
CIEEM	Chartered Institute for Ecology and Environmental Management
CLV	Cable Laying Vessel
CMS	Construction Method Statement
CPGR	Counterfactual of Population Growth-Rate
CPS	Counterfactual of Population Size
CRM	Collision Risk Modelling
DAS	Digital Aerial Survey
DE	Design Envelope
EC	European Commission
EEA	European Economic Area
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
FWTG	Floating Wind Turbine Generator
HDD	Horizontal Directional Drilling
HAT	High Astronomical Tide

HPAI	Highly Pathogenic Avian Influenza
HRA	Habitats Regulations Appraisal
IEMA	Institute of Environmental Management and Assessment
JNCC	Joint Nature Conservation Committee
LAT	Lowest Astronomical Tide
LMP	Lighting and Marking Plan
LSE	Likely Significant Effect
MarPAMM	Marine Protected Areas Management and Monitoring
mCRM	Migratory Collision Risk Modelling
MD-LOT	Marine Directorate - Licensing Operations Team
MDS	Maximum Design Scenario
MHWS	Mean High Water Springs
MMFR	Mean-Maximum Foraging Range
MPCP	Marine Pollution Contingency Plan
MRSea	Marine Renewables Strategic Environmental Assessment
MSL	Mean Sea Level
NEEOG	North East & East Ornithology Group
NMP	(Scotland) National Marine Plan
NPS	National Policy Statement
NSIP	Nationally Significant Infrastructure Project
NTS	Non-Technical Summary
OECC	Offshore Export Cable Corridor
OfTI	Offshore Transmission Infrastructure

OSP	Offshore Substation Platform
OWF	Offshore Wind Farm
PEMP	Project Environmental Monitoring Programme
PINS	Planning Inspectorate
PS	Piling Strategy
PVA	Population Viability Analysis
RIAA	Report to Inform Appropriate Assessment
RSPB	Royal Society for the Protection of Birds
sCRM	Stochastic Collision Risk Modelling
SD	Standard Deviation
SMP	Seabird Monitoring Programme
SMR	Scottish Marine Region
SNCB	Statutory Nature Conservation Body
SPA	Special Protection Area
SSSI	Sites of Special Scientific Interest
THC	The Highland Council
UN	United Nations
VMP	Vessel Management Plan
WTG	Wind Turbine Generator
WWT	Wildfowl and Wetlands Trust
ZoI	Zone of Influence

Executive Summary

This Offshore Ornithology chapter of the Caledonia Offshore Wind Farm Environmental Impact Assessment Report presents an overview of the existing offshore and intertidal ornithology environment and identifies the potential effects on these receptors associated with the construction, operation, and decommissioning of the Proposed Development (Offshore).

The study area has been determined based upon the Proposed Development (Offshore) location and proposed infrastructure. Site-specific digital aerial surveys (DAS) were undertaken to provide an up-to-date survey of species occurring within the array area of the Proposed Development (Offshore). A programme of 24 DAS took place monthly between May 2021 and April 2023 inclusive.

The following key ornithological receptors were recorded within the array area of the Proposed Development (Offshore) during the 24 months of DAS:

- Kittiwake (*Rissa tridactyla*)
- Great black-backed gull (*Larus marinus*)
- Herring gull (*Larus argentatus*)
- Great skua (*Stercorarius skua*)
- Common guillemot (*Uria aalge*)
- Razorbill (*Alca torda*)
- Puffin (*Fratercula arctica*)
- Red-throated diver (*Gavia stellata*)
- Fulmar (*Fulmarus glacialis*)
- Gannet (*Morus bassanus*)

The full list of ornithological receptors recorded within the Caledonia OWF (i.e., Array Area) during the 24 months of DAS is provided within the baseline description.

Consideration of the Design Envelope has been undertaken to identify Realistic Worst Case Scenarios with respect to offshore and intertidal ornithology characteristics. Adopting a source-pathway-receptor approach, the potential impacts associated with the Proposed Development (Offshore) have been assessed, in accordance with the Scoping Opinion and subsequent stakeholder engagement, using a suite of methodologies which include numerical modelling, the evidence-base, and expert judgement. Receptors identified include both designated sites with qualifying ornithological features and non-designated sites. Specifically, the following impacts have been considered:

- Distributional Responses (including Barrier Effects): Caledonia OWF
- Distributional Responses: Export Cable Corridor and Landfall Site
- Distributional Responses: Vessel Transit (Moray Firth Special Protection Area)
- Collision Risk

- Indirect Impacts on Prey Species
- Artificial Light

The results of this impact assessment demonstrate that the Proposed Development (Offshore) may have a negligible to minor significance, which is considered not significant in Environmental Impact Assessment (EIA) terms. Cumulative assessment also demonstrates that the impact of the Proposed Development (Offshore) may have a negligible to minor significance when considering the wider cumulative impact of other projects, which is considered not significant in EIA terms.

6 Offshore Ornithology

6.1 Introduction

6.1.1.1 This chapter of the Environmental Impact Assessment Report (EIAR) identifies the potential effects on Offshore Ornithology associated with the construction, operation and decommissioning of the Proposed Development (Offshore). This includes all offshore aspects comprising of up to 140 Wind Turbine Generators (WTGs) and associated foundations, inter-array and interconnector cables, up to four Offshore Substation Platforms (OSPs), up to four offshore export cables within the Caledonia Offshore Export Cable Corridor (OECC) and Landfall Site seaward of Mean High-Water Springs (MHWS).

6.1.1.2 Caledonia Offshore Wind Farm Ltd, hereafter referred to as the 'Applicant', is proposing to develop the Proposed Development (Offshore). The northern limit of the Caledonia Offshore Wind Farm (OWF) (i.e., Array Area) is approximately 22km off the coast of Wick, Highland and the southern limit is approximately 38km off the coast of Banff, Aberdeenshire. It will be the fourth commercial scale OWF project to be developed in the Moray Firth, located directly to the east of the Moray East, Moray West, and Beatrice sites (with Caledonia OWF abutting Moray East). The Proposed Development (Offshore) is expected to be developed in two phases (see Volume 1, Chapter 5: Proposed Development Phasing).

6.1.1.3 Within the Caledonia OWF there are several design scenarios, with either 140 bottom-fixed WTGs or up to 39 floating WTGs in the southern extent of the array area, assuming the remaining composition of bottom-fixed WTGs add up to a combined total of 140. This chapter of the EIAR assesses the worst case scenario for each combination of WTGs, which is based on the parameters presented in Volume 1, Chapter 3: Proposed Development Description (Offshore). Caledonia OWF and the Offshore Transmission Infrastructure (OfTI) that will carry the power generated by the Caledonia OWF ashore to the Landfall Site on the Aberdeenshire coast (up to MHWS) are collectively referred to as the Proposed Development (Offshore) in this EIAR.

6.1.1.4 This chapter is supported by the following Technical Appendices, which provide further detail on the survey methods, and subsequent data processing, analysis, and modelling approaches employed by the project to inform the baseline, and in turn the predicted impacts:

- Volume 7B, Appendix 6-1: Offshore Ornithology Baseline Characterisation Report;
- Volume 7B, Appendix 6-2: Offshore Ornithology Distributional Responses Technical Report;
- Volume 7B, Appendix 6-3: Offshore Ornithology Collision Risk Modelling Technical Report;

- Volume 7B, Appendix 6-4: Population Viability Analysis; and
- Volume 7B, Appendix 6-5: Migratory Collision Risk Modelling Technical Report.

6.1.1.5 The following supporting studies relate to and should be read in conjunction with this chapter:

- Volume 1, Chapter 3: Proposed Development Description (Offshore);
- Volume 1, Chapter 5: Proposed Development Phasing;
- Volume 2, Chapter 4: Benthic Subtidal and Intertidal Ecology (to be read in conjunction due to habitat intersections at MHWS);
- Volume 2, Chapter 5: Fish and Shellfish Ecology (to be read in conjunction due to the potential indirect effects from potential changes in distribution and abundance of forage fish species); and
- Volume 5, Chapter 3: Terrestrial Ecology and Biodiversity (to be read in conjunction as includes intertidal birds baseline characterisation).

6.2 Legislation, Policy and Guidance

6.2.1 Overview

6.2.1.1 This section identifies the relevant legislation, policy and other documentation that has informed the assessment of the effects with respect to offshore ornithology. Further information on policies and legislation associated with the Proposed Development (Offshore) relevant to the EIA and their status is provided in Volume 1, Chapter 2: Legislation and Policy.

6.2.1.2 The assessment in the EIAR chapter has been completed reference to the Chartered Institute for Ecology and Environmental Management (CIEEM) guidance for the completion of marine EIA (CIEEM, 2022[1]).

6.2.2 Legislation

6.2.2.1 There are a number of international and national (UK and Scottish) pieces of legislation that need to be considered regarding the protection of wildlife and the marine environment with respect to Offshore Ornithology receptors.

6.2.2.2 Table 6-1 lists the legislation relevant to the assessment of the effects on Offshore Ornithology receptors. As well as national legislation, the Ramsar Convention on Wetlands of International Importance 1971 has been taken into account when undertaking this assessment.

Table 6-1: Legislation relevant to Offshore Ornithology.

Legislation Description	Relevance to Assessment
Conservation (Natural Habitats, &c.) Regulations 1994 (as amended in Scotland) [Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019 in relation to certain specific activities]. Part IV of the 2019 Habitats Regulations transfer functions from the European Commission to the appropriate authorities in Scotland, with all the processes or terms unchanged. The 2019 Habitats Regulations transpose aspects of the Birds Directive and the Habitats Directive into national law. Part IV of the 2019 Regulations implements Article 6(3) and 6(4) of the European Parliament Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (the 'Habitats Directive') in Scotland and within 12 nm (terrestrial and inshore habitats).	A competent authority – before deciding to undertake, or give any consent, permission or other authorisation for a plan or project which is likely to have a significant effect on a European site in Great Britain or a European offshore marine site (either alone or in combination with other plans or projects) and that is not directly connected with or necessary to the management of the site – shall make an appropriate assessment of the implications for the site in view of that site's conservation objectives. A person applying for any such consent, permission or other authorisation shall provide such information as the competent authority may reasonably require for the purposes of the assessment.
The Conservation of Offshore Marine Habitats and Species Regulations 2017. Part 2 Known as the 'Offshore Marine Regulations', they provide similar provisions to the 2017 Habitats Regulations in the offshore environment throughout the UK by implementing the species protection requirements of the Habitats and Birds Directives offshore. Part 2 of the 2017 Regulations implements Article 6(3) and 6(4) of the Habitats Directive beyond 12 nm (offshore habitats).	A competent authority before deciding to undertake, or give any consent, permission or other authorisation for a relevant plan or project must make an appropriate assessment of the implications for the site in view of that site's conservation objectives. A relevant plan or project plan is one which is likely to have a significant effect on a European offshore marine site or a European site (either alone or in combination with other plans or projects) and is not directly connected with or necessary to the management of the site. A person applying for any such consent, permission or other authorisation shall provide such information as the competent authority may reasonably require for the purposes of the assessment.
Wildlife and Countryside Act 1981 (as amended in Scotland). The Wildlife and Countryside Act 1981 operates in conjunction with the Habitats Regulations and is the principal mechanism for the legislative protection of wildlife in the UK. The Wildlife and Countryside Act 1981 has also been amended following EU withdrawal so that species of wild birds found in or regularly visiting either the UK or the European territory of a Member State will continue to be protected on land and in	Implements Article 1 and 5 of the European Parliament Council Directive 2009/147/EC on the conservation of wild birds (the 'Birds Directive) making it an offence to intentionally or recklessly: ▪ Kill, injure or take any wild bird; ▪ Take, damage, destroy or otherwise interfere with the nest of any wild bird which that nest is in use or being built; ▪ At any other time take, damage, destroy or otherwise interfere with any nest habitually

Legislation Description	Relevance to Assessment
intertidal areas down to Mean Low Water Springs (MLWS). Part 1 These Regulations ensure compliance with Council Directive on the Conservation of Wild Birds as amended by Commission Directive 91/244/EEC, Council Directive 94/24/EC and Commission Directive 97/49/EC. The 1981 Act applies to the Scottish terrestrial environment and inshore waters up to 12 nm. Part 1 of the 1981 Act details a large number of offences in relation to the killing and taking of wild birds, other animals and plants.	used by any wild bird included in Schedule 1A; ▪ Harass any wild bird included in Schedule 1A; ▪ Obstruct or prevent any wild bird from using its nest; and ▪ Take or destroy an egg of any wild bird. The Act makes it an offence for a public body or office-holder to carry out or cause or permit to carry out any operation which is likely to damage any natural feature specified in a SSSI notification except, inter alia, with the written consent of NatureScot given on an application. Public body includes a statutory undertaker.
Nature Conservation (Scotland) Act 2004 (as amended). *Part 2* The Act sets out a series of measures which are designed to conserve biodiversity and to protect and enhance the biological and geological natural heritage of Scotland, requiring public bodies and office-holders to consider the effect of their actions at a local, regional, national and international level. Measures relating to the protection of species and habitats also recognise the importance of the wider international context. Part 2 of the Act sets out a system for conserving and enhancing particular areas of Scotland which are considered to be of particularly high quality in terms of their natural heritage. The provisions within this Part significantly extend and develop the SSSI system which was brought into being by Part II of the 1981 Act.	The Act makes it an offence for a public body or office-holder to carry out or cause or permit to carry out any operation which is likely to damage any natural feature specified in a SSSI notification except, inter alia, with the written consent of NatureScot given on an application. Public body includes a statutory undertaker.

6.2.3 Policy

6.2.3.1 The general policy background regarding offshore renewables developments are discussed in Volume 1, Chapter 2: Legislation and Policy. The following policy documents are of particular relevance for the assessment of impacts of the Proposed Development (Offshore) on offshore ornithology:

- The Scottish Biodiversity strategy, consisting of:
  - 'Scotland's Biodiversity: It's in Your Hands' (Scottish Executive, 2004[2]);
  - '2020 Challenge for Scotland's Biodiversity' (The Scottish Government, 2013[3]); and
  - Scottish Biodiversity Strategy Post-2020: A Statement of Intent (The Scottish Government, 2020[4]);
- The UK Biodiversity Framework (JNCC, 2024a[5]); and
- Scotland's National Marine Plan (NMP) (The Scottish Government, 2015[6]). The NMP is a policy framework for determining the sustainability and suitability of new or existing marine activity. Relevant for offshore ornithology are:
  - General Policy 9 (GEN 9) - Natural heritage: "*Development and use of the marine environment must: (a) Comply with legal requirements for protected areas and protected species. (b) Not result in significant impact on the national status of Priority Marine Features. (c) Protect and, where appropriate, enhance the health of the marine area*"; and
  - Chapter 11 – Offshore Wind and Marine Renewable Energy.

6.2.4 Guidance

6.2.4.1 In addition to the NPS, there are a number of pieces of guidance applicable to the assessment of offshore ornithology. This chapter has been compiled with reference to the following relevant guidance for conducting EIA:

- CIEEM (2022[1]) Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal and Marine;
- Institute of Environmental Management and Assessment ('IEMA') (2017[7]) Delivering Proportionate Environmental Impact Assessment ('EIA'): A Collaborative Strategy for Enhancing UK Environmental Impact Assessment Practice;
- Planning Inspectorate (PINS) (2019[8]) - Advice Note Seventeen: Cumulative Effects Assessment; and
- Scottish Government (2018[9]) - Offshore wind, wave and tidal energy applications: Consenting and Licensing Manual.

6.2.4.2 Consideration has also been given to the latest guidance documents for the assessment of potential OWF impacts on offshore ornithology receptors produced by NatureScot (Table 6-2). Those relating to distributional response analysis and collision risk modelling are also detailed within Volume 7B, Appendix 6-2: Offshore Ornithology Distributional Responses Technical Report and Volume 7B, Appendix 6-3: Offshore Ornithology Collision Risk Modelling Technical Report.

Table 6-2: Guidance documents relevant for the assessment of offshore ornithology receptors.

Guidance Notes	Description
NatureScot, 2023a[10]	NatureScot Guidance to support Offshore Wind Applications: Guidance Notes 1–9 and 11 (Guidance Note 10 unavailable at time of assessment)
NatureScot, 2020[11]	NatureScot Seasonal Periods for Birds in the Scottish Marine Environment
NatureScot, 2018[12]	Interim Guidance on Apportioning Impacts from Marine Renewable Developments to Breeding Seabird Populations in Special Protection Areas
SNCB, 2022[13]	Joint Statutory Nature Conservation Bodies (SNCB) Interim Displacement Advice Note

6.3 Stakeholder Engagement

6.3.1 Overview

6.3.1.1 The Offshore Scoping Report (Volume 7, Appendix 2) was submitted to Marine Directorate - Licensing Operations Team (MD-LOT)[i] in September 2022, who then circulated the report to relevant consultees. A Scoping Opinion (Volume 7, Appendix 3) was received from MD-LOT on 13 January 2023.

6.3.1.2 Relevant comments from the Scoping Opinion specific to Offshore Ornithology are provided in Table 6-3.

6.3.1.3 Further consultation has been undertaken throughout the pre-application stage. Table 6-4 summarises the consultation activities carried out relevant to Offshore Ornithology.

6.3.1.4 In addition to consultation activities, the Applicant has engaged with relevant bodies throughout the pre-application stage via bilateral meetings (see Volume 1, Chapter 8: Consultation Summary). An ornithology consultation agreement log is provided in Volume 7B, Appendix 6-6.

[i] In 2023, Marine Scotland was renamed Marine Directorate, and thus the marine licensing and consents team is now referred to as Marine Directorate - Licensing Operations Team (MD-LOT).

Table 6-3: Scoping Opinion responses from key stakeholders.

Consultee	Comment	Response
MD-LOT, NatureScot and RSPB	The following comments regard the impacts scoped in/out of the Offshore Ornithology EIA Report. Within Table 10.4 of the Scoping Report the Developer details the potential impact pathways to be scoped in or out for assessment within the EIA Report. The Scottish Ministers broadly agree with the Developer's proposals, however in line with the NatureScot representation, impacts from wet storage must be scoped in for further assessment in the EIA Report. The NatureScot representation must be addressed in full in this regard. The Scottish Ministers agree with the NatureScot and RSPB representations that barrier effects must be scoped into the EIA Report. However, the Scottish Ministers are content for the Developer to consider these effects alongside the displacement pathways that are already being scoped into the EIA Report. Additionally, the displacement analysis should also consider kittiwake. The Scottish Ministers advise that operational disturbance and displacement within the OECC should not be scoped out of the EIA Report. This impact pathway should be scoped in and the NatureScot representation in this regard fully addressed. The Scottish Ministers advise that impacts of lighting on ornithological receptors must be scoped into the EIA Report for both fixed WTGs and OSP and floating WTGs for all phases of the Proposed Development (Offshore). The NatureScot representation in this regard must be addressed in full by the Developer.	The Applicant welcomes the comments regarding the impacts scoped in/out of assessment. The assessment of potential impacts from wet storage have been discussed with MD-LOT, NatureScot and RSPB. It was concluded that consideration of wet storage would not be necessary within this assessment as this impact will be assessed through other marine licence applications for the Proposed Development (Offshore) as required. The requirement for barrier effects to be scoped in has been noted. The impact pathway termed "distributional responses" has been included within the scoping table which covers both potential impacts due to disturbance/displacement and barrier effects (Table 6-12). As requested, kittiwake have been considered within the distributional responses assessment (presented in Volume 7B, Appendix 6-2: Offshore Ornithology Distributional Responses Technical Report). Since the submission of the Offshore Scoping Report, the location of the Caledonia OECC has refined, and no longer overlaps with the Moray Firth SPA. Therefore, as discussed in post-scoping consultation (Table 6-4), the impact pathway regarding the disturbance and displacement of the Caledonia OECC have been scoped out of the assessment. Potential disturbance impacts due to vessel traffic through the Moray Firth SPA during the operational phase of the Proposed Development (Offshore) have been scoped in as a result of post-scoping consultation. These are considered within the Report to Inform Appropriate Assessment (RIAA) (Application Document 13:

Consultee	Comment	Response
	The Scottish Ministers confirmed that indirect impacts of accidental pollution on bird species can be scoped out of the ornithological receptor chapter within the EIA Report, provided the effects of accidental pollution are adequately addressed in another relevant chapter.	Caledonia North Report to Inform Appropriate Assessment and Application Document 14: Caledonia South Report to Inform Appropriate Assessment). The Applicant notes the request to include impacts of lighting. The impact pathway has been discussed further in consultation (Table 6-4) and included within the scoping table (Table 6-12). The Applicant can confirm that accidental pollution has been discussed within the relevant EIA chapter (Chapter 3: Marine Water and Sediment Quality).
MD-LOT and NatureScot	With regards to the proposed assessment methods, the Scottish Ministers advise that the Developer must refer to breeding and non-breeding season definitions as NatureScot refer to them in its guidance. This will require Table 10.3 to be updated in the EIA Report with any reference to "bio-seasons" amended	The Applicant has confirmed the breeding and non-breeding seasons with NatureScot. The relevant guidance (NatureScot, 2020[11]) has been referred to throughout the EIAR. Further details provided in Section 6.4.3 with defined seasons for offshore ornithology receptors presented in Table 6-7.
MD-LOT and NatureScot	In addition, in line with the NatureScot representation, the Scottish Ministers advise that with regard to displacement and barrier effects, the SeabORD tool should be used for Atlantic puffin, common guillemot, razorbill and black legged kittiwake during the breeding seasons. The Scottish Ministers also highlight the advice regarding the use of SeabORD within NatureScot's representation. All other species should be assessed using the matrix approach. If it is possible to undertake a bespoke individual based model, agreement from NatureScot is required. For the species where SeabORD is used during the breeding season, the matrix approach should be used during the non-breeding season, with the exception of common guillemot where the population and impacts should be	The requirement for barrier effects to be scoped into the assessment has been noted. The impact pathway termed "distributional responses" has been included within the scoping table which covers both disturbance/displacement and barrier effects (Table 6-12). As requested by both the Scottish Ministers, and the relevant NatureScot (2023a[10]) guidance, kittiwake have been considered within the distributional responses assessment. Following advice from MD-LOT regarding the use of SeabORD, The Applicant attempted to use this tool for Atlantic puffin, common guillemot, razorbill and black-legged kittiwake during the breeding season with the intention to provide the results as an additional note. However, the tool provided would not run and, after

Consultee	Comment	Response
	based on an assessment derived from the breeding season foraging range.	troubleshooting and consultation with MD-LOT, it was agreed that SeabORD outputs would not be required.
MD-LOT and NatureScot	In regard to displacement the Scottish Ministers advise that the displacement and mortality ranges contained within with the NatureScot representation must be used for the assessment in the EIA Report. The Scottish Ministers advise that the NatureScot representation in regard to barrier and displacement is addressed in full in the EIA Report. The Developer must also make it clear which approach has been applied to which species, for both breeding and nonbreeding seasons	Displacement and mortality ranges have been presented using both the Guidance Approach (i.e. according to NatureScot's 2023 guidance[10]) and Applicant Approach throughout the EIAR and relevant appendices (Volume 7B, Appendix 6-2: Offshore Ornithology Distributional Responses Technical Report). Further evidence on auk displacement rates has become available during the preparation of the assessment, and therefore has been taken into account within the Applicant Approach, Volume 7B, Appendix 6-2, Annex 4: Review of Relevant Evidence.
MD-LOT, NatureScot and RSPB	In regard to collision risk, in line with the NatureScot and RSPB representations, the Scottish Ministers advise that in addition to deterministic Collision Risk Modelling, stochastic models should also be presented. Flight height distribution from Johnston *et al*., (2014a[14], 2014b[15]) with corrigendum should be used, in line with the RSPB and NatureScot representations. In regard to flight speed, the Developer should engage with NatureScot to discuss appropriate, evidence-based values to be used.	The CRM assessment has been carried out following the NatureScot Guidance Note 7 (2023b[16]) presenting the outputs of both deterministic and stochastic model runs (see CRM report and annexes; Volume 7B, Appendix 6-3: Offshore Ornithology Collision Risk Modelling Technical Report). The Applicant can confirm that flight height distributions from Johnston *et al.,* (2014a[14]) with corrigendum (Johnston *et al.,* 2014b[15]) have been used within the CRM assessment. Flight speeds and associated SDs presented within NatureScot Guidance Note 7 (2023b[16]) have been used within the assessment (Volume 7B, Appendix 6-3: Offshore Ornithology Collision Risk Modelling Technical Report) and have been agreed in consultation with NatureScot and RSPB.

Consultee	Comment	Response
MD-LOT and NatureScot	In regard to avoidance rates the Scottish Ministers advise that the Statutory Nature Conservation Body guidance (2014[17]) on avoidance rates should be used with a standard deviation of +/- 2. For species where there are no agreed avoidance rates, The Scottish Ministers recommend use of 98% as default and where there are terrestrial estimates based on the species in question, those rates should be used. Outputs from each model should be supplied in full as appendices with input parameters stored. This advice is in line with the NatureScot representation and for the avoidance of doubt, the NatureScot representation in regard to collision risk, avoidance rates, presentation of outputs and strategic collision risk must be addressed in full in the EIA Report by the developer.	The CRM assessment has been carried out following the NatureScot (2023b[16]) Guidance Note 7, using the appropriate avoidance rates and SDs provided within the guidance note. To note, since this comment was raised, an update to the guidance has occurred based on the latest evidence and therefore, the updated avoidance rates have been used instead of the now superseded SNCB (2014)[18] rates. The CRM report and annexes (Volume 7B, Appendix 6-3: Offshore Ornithology Collision Risk Modelling Technical Report) provide the full methodology, input model parameters and full outputs from the assessment.
MD-LOT	The Scottish Ministers stated potential collision risk to migratory species should be assessed qualitatively with reference to the survey results and the Marine Scotland commissioned strategic level report. The Scottish Ministers also noted the commissioning of an updated strategic review of migratory routes via ScotMER. This update should be used if available within assessment timescales.	Migratory CRM (mCRM) has been carried out following the NatureScot (2023b[16]) Guidance note 7. The updated strategic level report (Woodward *et al*., 2023[19]) was used to carry out the assessment. The methodology, inputs and outputs have been presented in Volume 7B, Appendix 6-5: Migratory Collision Risk Modelling Technical Report.
MD-LOT, NatureScot and RSPB	With regards to population consequences the Scottish Ministers agree with the intention to use the Natural England Population Viability Analysis ("PVA") tool. The NatureScot and RSPB representations with regards to PVA must be fully considered by the Developer in the EIA Report	PVA has been carried out using the Natural England Population Viability Analysis ("PVA") tool, as agreed in consultation. The methodology, inputs and results have been presented within the PVA report (Volume 7B, Appendix 6-4: Population Viability Analysis).
MD-LOT and NatureScot	The Scottish Ministers are content with the use the Cumulative Effects Framework. The Developer should	As discussed and agreed upon in post-scoping consultation, the Cumulative Effects Framework (CEF)

Consultee	Comment	Response
	agree the proposed list for the cumulative assessment with NatureScot and Marine Scotland. The Developer must implement the NatureScot representation regarding the cumulative assessment for breeding and non-breeding seasons within the EIA Report	tool has not become available within the timeframe for the preparation of the assessment of the Proposed Development (Offshore). It has therefore not been possible to include it within the assessment. A strategic project undertaken on behalf of the North East & East Ornithology Group (NEEOG) of ScotWind developers has produced a baseline dataset for the Cumulative impacts assessment. The use of this dataset for this purpose has been agreed with NatureScot in consultation.
MD-LOT and NatureScot	The Scottish Ministers advise that where significant impact pathways have been identified, the full range of mitigation techniques and published guidance is considered and discussed in the EIA Report. In line with the NatureScot representation, the Scottish Ministers advise that the embedded mitigation looks appropriate, but a wet storage plan is included within the embedded mitigation and that operational and maintenance activities are included within the vessel management plan.	The assessment of potential impacts from wet storage have been discussed with MD-LOT, NatureScot and RSPB. It was concluded that consideration of wet storage would not be necessary within this assessment as this impact will be assessed through other marine licence applications for the Proposed Development (Offshore) as required.
MD-LOT and NatureScot	The Scoping Report does not make reference to the recent outbreak of Highly Pathogenic Avian Influenza ("HPAI"). In line with the NatureScot representation, a qualitative assessment of the Proposed Development (Offshore) in light of HPAI should be presented in the EIA Report.	The Applicant has noted the request for a qualitative assessment of the impacts of HPAI and has addressed this in Section 6.4.4 and 6.4.5.
MD-LOT and NatureScot	The Scottish Ministers note the NatureScot representation that derogations will likely be required under the Habitats Regulations. The Developer must provide evidence in the EIA Report of how all	Applicant has noted the comment and will develop a compensation and derogation package. This is presented in derogation case and compensation report documents (Application Documents 15 and 16)

Consultee	Comment	Response
	associated tests are met and present a suitable compensation package.	
MD-LOT	The Scottish Ministers broadly agree with the use Woodward *et al*., (2019[20]) in regard to foraging ranges, with the exception of gannets, guillemots and razorbills. The NatureScot advise contained in Annex 1 of its representation must be fully addressed by the Developer in the EIA Report. Additionally, the Scottish Ministers advise that shag must be scoped in for further assessment for the Moray Firth SPA. Impacts on Sandwich tern at Ythan Estuary SPA must also be scoped in for assessment during the construction phase within the export cable corridor.	The applicant has noted the comment and both shag and Sandwich tern have been included in the assessment.
NatureScot	Generally, we accept and support the data sources listed. However, the report suggests that data from post consent monitoring will be used to inform baseline characterisation. The data sources presented are regionally relevant to the present proposal. However, some caution needs to be applied with consideration to data that exceeds 5 years, particularly in the context of the recent outbreak of Avian Influenza. This data should be treated as context only and should not be used to determine baseline characterisation. Additional advice pertaining to this is provided on site specific surveys below.	These datasets were used alongside the site specific digital aerial surveys conducted to provide contextual information in which to support the primary baseline data source.
NatureScot	The report states (Section 10.8.1.1) that "Site specific digital aerial surveys are currently being undertaken (between May 2021 and April 2023) covering the array area plus a 4 km buffer." We would have anticipated seeing at least preliminary, data from the initial 12 months of these surveys (i.e. up to and including May	Baseline survey results and subsequent analysis can be found in Volume 7B, Appendix 6-1: Offshore Ornithology Baseline Characterisation Report and Volume 7B, Appendix 6-1, Annex 16: MRSea Modelling Report of key seabird species. The baseline report was shared with NatureScot in May 2024.

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	2022) being presented in this Scoping report to support baseline characterisation, with published sources and data from other OWF projects being used to a) provide wider context for the area surveyed; and b) indicate potential ornithological interest across the Offshore Export Cable Corridor (OECC). The 4 km buffer is acceptable, although note we have not yet seen an interim survey report showing species present.	
NatureScot	The report states (Section 10.8.3.7) that the proposed approach to baseline characterisation will be undertaken using a combination of the site-specific digital aerial survey data as well as data from other Moray Firth development surveys including Moray East OWF pre-construction surveys and Moray West OWF EIA Report data. However, there is no description of the proposed analyses of the DAS survey data or how additional data from other Moray Firth OWF will be dealt with and incorporated into baseline characterisation. Furthermore, the implications will be very dependent on the DAS survey design and the survey designs for previous OWF projects (transects detailed at Figure 10.2) e.g. boat-based survey design.	Details of the methodology carried out for DAS analysis can be found in Volume 7B, Appendix 6-1: Offshore Ornithology Baseline Characterisation Report and Volume 7B, Appendix 6-1, Annex 16: MRSea Modelling Report of key seabird species. References are made to studies carried out at other Moray Firth OWFs where relevant.
NatureScot	We require further detail of how they intend to analyse the site-specific DAS and how they plan to combine datasets for baseline characterisation.	Details of the methodology carried out for DAS analysis can be found in Volume 7B, Appendix 6-1: Offshore Ornithology Baseline Characterisation Report and Volume 7B, Appendix 6-1, Annex 16: MRSea Modelling Report of key seabird species.
NatureScot	Pathways receptors and potential impacts - In general terms the standard pathways of collision, disturbance, displacement, and barrier effects have been captured	The assessment of potential impacts from wet storage have been discussed with MD-LOT, NatureScot and RSPB. It was concluded that consideration of wet

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	(Table 10.4, p.193). With respect to project definition, we are concerned that wet storage aspects are scoped out of the EIA and are inadequately captured. Wet storage could represent a very significant impact pathway with respect to floating wind. However, the only mention of wet storage is in Table 10.4 where both displacement and collision risk from wet storage are scoped out. It is unclear from the project description if there are any plans for wet storage of assembled floating turbines during the construction phase, what this would entail, or potential locations identified. Wet storage might also presumably be required for floating turbine maintenance operations, but this is not mentioned in the document. Consideration of impacts of wet storage on bird receptors is required.	storage would not be necessary within this assessment as this impact will be assessed through other marine licences for the Proposed Development (Offshore) as required.
NatureScot	The report states in Table 10.4 that barrier effects are scoped out. We disagree that they should be scoping out barrier effects from the assessment. However, we accept that this can be hard to separate from displacement and we agree that these can both be dealt with together in the assessment.	The requirement for barrier effects to be scoped in has been noted. The impact pathway termed "distributional responses" has been included within the scoping table which covers both disturbance/displacement and barrier effects (Table 6-12). As requested, kittiwake have been considered within the distributional responses assessment.
NatureScot	Indirect impacts from accidental pollution during construction are scoped out. We agree that this can be scoped out of the ornithology specific assessment assuming that it is dealt with within the relevant EIA chapter.	The Applicant can confirm that accidental pollution has been discussed within the relevant EIAR chapter (Volume 2, Chapter 3: Marine Water and Sediment Quality).
NatureScot	Operational disturbance and displacement within the OECC is scoped out (Table 10.4). However, we note that the OECC overlaps with the Moray Firth SPA. The	Since the submission of the Offshore Scoping Report, the OECC has reduced, and no longer overlaps with the Moray Firth SPA. Therefore, as discussed in

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	report states that operational impacts would be highly localised and episodic. In general, we accept that impacts arising from operational phase within the OECC is likely to be limited. However, due to the overlap with the SPA, and potential disturbance from cable maintenance and vessel movement associated with the operational phase within the OECC, there is a likely significant effect with the qualifying species of the Moray Firth SPA.	consultation (Table 6-4), the impact pathway regarding the distributional responses of the OECC have been scoped out, with the inclusion of vessel traffic through the Moray Firth SPA scoped in instead. These are considered within the RIAA (Application Document 13: Caledonia North Report to Inform Appropriate Assessment and Application Document 14: Caledonia South Report to Inform Appropriate Assessment).
NatureScot	With respect to nocturnal species, impacts of lighting on ornithological receptors is not considered sufficiently. There is no mention of the potential effects of lighting attraction with respect to species such as European storm petrels, Leach's storm-petrels and Manx shearwaters. This should be recognised as presenting additional potential risk to these species; in particular attraction to turbine lighting and/or lighting on vessels could impact assessment of both displacement and collision risk. We recognise at this point that this can only be assessed qualitatively.	The Applicant notes the request to include impacts of lighting. The impact pathway has been discussed further in consultation (Table 6-4) and included within the scoping table (Table 6-12).
NatureScot	'Important Ornithological Features' - In general the species listed as 'Important Ornithological Features' is what might be expected for this area. However, the method for defining this list is not provided and the report scopes out some species at this early stage. (See HRA advice below for further detail regarding species).	Within the EIAR, key species have been determined using the DAS data and have been agreed in consultation (see Table 6-4).
NatureScot	On p.182, 183, 184, fulmar, kittiwake, guillemot, razorbill, puffin, herring gull, lesser black-backed gull, great black-backed gull, gannet, great skua and Arctic tern are identified as the "key species" as defined by	Within the EIAR, key species have been determined using the DAS data and have been agreed in consultation (see Table 6-4).

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	presence in surveys of adjacent OWFs. While this seems broadly appropriate, we are concerned this does not use site specific data from the development site. The report goes on to state on p. 184 for sooty shearwater, Manx shearwater, European storm petrel, Leach's storm petrel, pomarine skua, long tailed skua, black headed gull, common gull, Iceland gull, Sandwich tern, common tern and black guillemot that "due to being recorded in such low numbers/ and or low sensitivity to potential impacts these species are not considered as important ornithological features". "This assertion is based on historic data from neighbouring sites (see Table 10.1) rather than recent data from site specific surveys for this development. Our concern is that this data is limited in temporal coverage and/ or aging. For example, the most recent data provided from Moray East OWF pre-construction aerial survey report in 2018 only surveyed between May and July. Additionally, the report does not share counts of each of these species, so it is unclear what constitutes 'low numbers' of each of these species. We require two years of site-specific surveys before any species can be scoped out of further consideration. The site-specific surveys should be used to define species presence within the project area with any additional data as context only." With respect to nocturnal species (i.e. Manx shearwater, European storm petrel, Leach's storm petrel) we advise that another important consideration at this site will be degree of confidence, or otherwise, in likelihood and ability of DAS to detect petrels. Alternative sources relating to nocturnal species distributions should also be used to consider the	A qualitative assessment of nocturnal species has been carried out (see paragraphs 6.7.2.237 to 6.7.2.249).

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	likelihood of these species' presence within the project area (e.g. Waggitt *et al*., 2019[21]) and any available tracking data.	
NatureScot	Proposed approach to assessment - We outline below our advice with respect to assessment methodologies to be used for those key impact pathways as discussed above. Overall, we are content with the approach outlined in section 10.8 of the Scoping Report for impact assessment.	The Applicant has confirmed assessment approaches with NatureScot.
NatureScot	NatureScot guidance on seasonal definition for birds in the Scottish marine environment should be used for breeding and non-breeding season definitions. Note that our guidance has been replicated in the report (Table 10.3) as species specific 'bio-seasons'. To avoid confusion, and for consistency, we recommend the use of seasons rather than 'bio-seasons'. It is unclear what the adaptation of our guidance in the table is presenting (for instance, it is unclear what the different widths mean). We advise that seasonal definitions retain the months for clarity. We do not recommend adapting our guidance.	The Applicant has confirmed the breeding and non-breeding seasons with NatureScot. The relevant guidance (NatureScot, 2020[11]) has been referred to throughout the EIAR.
NatureScot	Barrier/ displacement - The report states an intention to use the SNCB (2017[22]) matrix method approach for assessing displacement and mortality rates for each species. We advise that the SeabORD tool should be used in their barrier/ displacement assessment during the breeding season for Atlantic puffin, common guillemot, razorbill and black-legged kittiwake. Regarding the use of SeabORD, we advise the following:	The applicant recognises that SeabORD is the advised approach for barrier/displacement assessment. However, due to technical issues with the SeabORD tool, this assessment was not possible.

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	▪ SeabORD can currently be undertaken for the chick-rearing period. Other periods of the year require the use of the matrix approach. ▪ SeabORD can be run both with and without site-specific tracking data. The two key parts of this are the forage site selection and prey availability. ▪ The forage site selection method uses either distance decay (where tracking data are not available) or the tool can be used to create a map where these data are available. ▪ The prey distribution can either be a uniform distribution or when the "map" option is selected, data can be uploaded (as described in the user guide) to create a heterogeneous distribution. All other species require an alternative assessment using the matrix approach. If it is possible to undertake a bespoke Individual Based Model (IBM) (e.g. if there is sufficient data) this would require agreement with NatureScot and Marine Scotland. For species where SeabORD should be used in the breeding season, the matrix approach should be undertaken during the non-breeding season. For the non-breeding season, population sizes should be derived from the zones determined by the BDMPS Report (Furness, 2015[23]). The exception to this being guillemot where the population and impacts should be based on an assessment area derived from the breeding season foraging range (Buckingham *et al.*, 2022[24]).	
NatureScot	Displacement rates - For displacement assessments we advocate adoption of a range of mortality figures, including consideration of potential seasonal	Displacement and mortality ranges have been presented using both the Guidance Approach and Applicant Approach throughout the EIAR (see Volume

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	differences. We advise the following values for auks (guillemots, razorbills and puffins), gannet and kittiwake as per Table 1 [see Appendix I of Scoping response from NatureScot].	7B, Appendix 6-2: Offshore Ornithology Distributional Responses Technical Report). Further evidence on auk displacement rates have been submitted since the Scoping Opinion, and therefore have been taken into account within the Applicant Approach (Volume 7B, Appendix 6-2: Offshore Ornithology Distributional Responses Technical Report).
NatureScot	Additionally, a correction factor of 0.67 must be applied for large auks (guillemot and razorbill) for converting individual counts to breeding pairs for use in SeabORD, see Harris *et al*. (2015[25]) for further details.	Correction factor noted for use in the SeabORD assessment. However, due to technical issues with the SeabORD tool, this assessment was not possible.
NatureScot	Collision risk - We note and support the intention to use the stochastic Collision Risk Model (sCRM) App developed by Masden (2015[26]) to assess collision risk (10.8.3.8). The report also states that it will be run deterministically. We accept the use of deterministic CRM but advise that the stochastic models should also be presented.	The collision risk assessment has been carried out using the stochastic and deterministic version of the sCRM tool, as agreed in consultation. The results are presented from the stochastic model within this EIAR, with all results presented within the CRM technical report and the Annexes (Volume 7B, Appendix 6-3: Offshore Ornithology Collision Risk Modelling Technical Report).
NatureScot	The report states that they will use option 2 and 3 of the basic and extended Band (2012[27]) models which is in line with our guidance. They refer to generic flight height and distributions from Johnston *et al*. (2014a; 2014b[15]) which is appropriate. For flight speed, we rely on published data (i.e. Pennycuick 1997[28]; Alerstam *et al*. 2007[29]), however we recognise 'in the field' measurements are contributing to new evidence so would welcome further discussion on appropriate,	As agreed in consultation, Band (2012[27]) options 2 has been used as option 3 is no longer required by NatureScot. All other parameters have followed the NatureScot (2023a[10]) Guidance and have been agreed in consultation. Details of the CRM parameters can be found in the CRM report (Volume 7B, Appendix 6-3: Offshore Ornithology Collision Risk Modelling Technical Report).

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	evidence-based values to be used, in consultation with Marine Scotland.	
NatureScot	Avoidance rates - We are currently advising that the SNCB guidance (2014[17]) on avoidance rates should be used with a standard deviation of +/- 2. For species where there are no agreed avoidance rates, we recommend use of 98% as default. Where there are terrestrial estimates based on the species in question those rates should be used. Any deviations from this advice will require clear justification and evidence and be presented in conjunction with advised approaches.	The CRM assessment has been carried out following the NatureScot (2023b[16]) guidance note 7, using the appropriate avoidance rates and SDs provided within the guidance note. The CRM report and annexes (Volume 7B, Appendix 6-3: Offshore Ornithology Collision Risk Modelling Technical Report) provide the full methodology, input model parameters and full outputs from the assessment, as requested by NatureScot.
NatureScot	Presentation of outputs - Outputs from each model should be supplied in full as appendices with input parameters stored. There is not as yet a standard approach for sCRM output reports, but as a minimum, presentation of results should be accompanied by input values used. Where tables are used, column titles should be standardised as far as possible to allow comparisons to be made where this is appropriate.	The CRM report and annexes (Volume 7B, Appendix 6-3: Offshore Ornithology Collision Risk Modelling Technical Report) provide the full methodology, input model parameters and full outputs from the assessment, as requested by NatureScot.
NatureScot	Strategic collision risk - Potential collision risk to migratory species should be assessed qualitatively with reference to the survey results and the Marine Scotland commissioned strategic level report (Marine Scotland, 2014[30]). To note, Marine Scotland are also in the process of commissioning an updated strategic review of migratory routes via ScotMER. This update should be used if available within assessment timescales.	mCRM has been carried out following the NatureScot (2023b[16]) Guidance note 7. The updated strategic level report (Woodward *et al.*, 2023[19]) was used to carry out the assessment. The methodology, inputs and outputs have been presented in Volume 7B, Appendix 6-5: Migratory Collision Risk Modelling Technical Report.
NatureScot	Breeding season - The Marine Scotland apportioning tool (Butler *et al*. 2020[31]) should be used for guillemot,	The Applicant has agreed in consultation with NatureScot that the interim (2018[12]) guidance will be

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	razorbill and kittiwake (and shag, if required). For all other species that require detailed consideration in the assessment we advise use of our (2018) interim guidance.	used for apportioning due to the Butler *et al*. (2020[31]) tool being unavailable within the assessment timeframe.
NatureScot	Non-breeding season - The BDMPS Report (Furness, 2015[23]) should be used for species where the majority of birds are wintering elsewhere rather than in the northern North Sea. Further discussion will be needed to finalise the approach, with respect to birds who largely remain in the northern North Sea during the non-breeding season, but at present if non-breeding season assessment of displacement of guillemot is required, then we would wish to see the non-breeding season population defined in terms of the MMFR (Woodward *et al*. 2019[20]).	The Applicant has further discussed this matter during May 2023 consultation with NatureScot for which they provided the following advice: "*With respect to determining regional populations of guillemots in the non-breeding season. Regarding application of this approach, we advise that shortest (straight line) distance (rather than at-sea) as measured for closest points of proximity of the colony (including any marine extension) and development area boundary (rather than centres) should be used to determine which colonies may be within the relevant range for calculation of regional populations*". This methodology has therefore been followed in Table 6-9 and Table 6-10.
NatureScot	Population consequences (PVA) - In general the process detailed for PVA in section 10.8.3.16 is appropriate with the following exceptions and additions. We note and support the intention to use the NE PVA tool. We request that the modelling of impacts is undertaken over two set time periods; 25 years and 50 years due to increased uncertainty in interpreting outputs from model predictions further than 25 years ahead which necessitates a more cautious approach to their interpretation. No recovery period should be applied to either model run. Impacts should be applied to all ages in agreement with the age apportioning approach, and sabbatical rates of adult birds should be taken into account. The report	PVA has been carried out as requested by NatureScot, using the NE PVA tool and run for a range of years (25, 35 and 50 years). The full methodology and results are presented in Volume 7B, Appendix 6-4: Population Viability Analysis.

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	notes an intention to operate the model at a 40 year time span (the operational lifespan of the Proposed Development (Offshore), paragraph 10.8.3.16). This can be run in addition to the models run at 25 and 50 years.	
NatureScot	We advise the two-ratio metrics which are generally termed 'Counterfactual (ratio) of final population size' and 'Counterfactual (ratio) of population growth-rate' should be presented. The report intends to use density independent models as a more precautionary approach (section 10.8.3.17), which is considered suitable.	PVA has been carried out as requested by NatureScot, using 'Counterfactual (ratio) of final population size' and 'Counterfactual (ratio) of population growth-rate' as the metrics for result interpretation. PVA was run using density independent models. The full methodology and results are presented in Volume 7B, Appendix 6-4: Population Viability Analysis.
NatureScot	Initial population sizes inputted into PVAs for the biogeographic scale are intended to be taken from Furness (2015[23]). For productivity values Horswill and Robinson (2015[32]) are intended to be used as well as for survival rates for gannet, kittiwake, guillemot, razorbill, and puffin. The report proposes that survival rates for great blacked backed gull will be taken as for herring gull as presented in Horswill and Robinson (2015[32]), due to the age of the underlying data in the review. In general, we support the intention to use these data sources, with the following addition regarding great black-backed gull. Juvenile herring gull survival rate should be used for juvenile great black backed gull and then an 'average survival for juvenile and adult herring gull for immature great black-backed gull.	PVA has been carried out as requested by NatureScot, using the biogeographic population estimates presented in Furness (2015[23]). The demographic, productivity and survival rates used in the PVA are those presented in Horswill and Robinson (2015[32]). The full methodology and results are presented in Volume 7B, Appendix 6-4: Population Viability Analysis.
NatureScot	Cumulative impacts - We note and support the intention to use the Cumulative Effects Framework (CEF) tool. Prior to completing the cumulative	The Applicant has agreed in consultation that the CEF tool will not be used within the assessment of

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	assessment NatureScot and Marine Scotland should be consulted with the proposed list.	Proposed Development (Offshore) as the tool has not been released.
NatureScot	Breeding season - For the breeding season, the cumulative assessment should consider effects from projects within of the colony SPA under consideration, based on Woodward *et al*. (2019[20]) with species specific caveats (see Annex 1).	The Applicant has noted this request and can confirm that this was the approach taken as presented in the cumulative assessment section (see Section 6.8)
NatureScot	Non-breeding season - Cumulative assessment in the non-breeding season should include all relevant developments within the region defined for the species, either by BDMPS or other agreed approach.	The Applicant has noted this request and can confirm that this was the approach taken as presented in the cumulative assessment section (see Section 6.8)
NatureScot	Mitigation and monitoring - Where significant impact pathways have been identified, we advise that the full range of mitigation techniques and published guidance is considered and discussed in the EIA Report. In general, the embedded mitigation (detailed at 10.4.1.2) looks appropriate. However, we would advise that a wet storage plan is included within the embedded mitigation, and that operational maintenance activities are included within the vessel management plan as per above.	The assessment of potential impacts from wet storage have been discussed with MD-LOT, NatureScot and RSPB. It was concluded that consideration of wet storage would not be necessary within this assessment as this impact will be assessed through other marine licence applications for the Proposed Development (Offshore) as required.
NatureScot	Transboundary impacts - Further discussion will be required regarding transboundary / cross-border impacts. It is likely that impacts will occur to seabird populations that breed outside Scotland as well as to wintering water birds that originate outside the UK.	There are no non-UK seabird colonies within MMFR +1S.D. or other evidence to suggest connectivity (Wakefield *et al.,* 2017[33]; Woodward *et al.,* 2019[20]). Therefore, colonies outside of UK waters will not contribute to any transboundary effects in the breeding season. Given the larger spatial scale and the far-ranging behaviour of key receptors in the non-breeding

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		season, any potential transboundary effects would be in relation to much larger populations than those considered at the UK-scale. Therefore, any conclusions drawn from the existing cumulative impact assessment are considered highly unlikely to change.
NatureScot	Highly Pathogenic Avian Influenza (HPAI) - The Scoping Report makes no mention of the recent outbreak of HPAI. We acknowledge that HPAI is an ongoing mortality event and at this point it is challenging to quantify impacts on populations. However, a qualitative assessment of this proposal in light of HPAI should be presented in the EIA. NatureScot are developing advice on the HPAI impacts.	The Applicant has noted the request for a qualitative assessment of the impacts of HPAI and have included a statement on this in Section 6.4.5 as advised by NatureScot.
NatureScot	With the exception of those sites in closest proximity to the development, several sites for migratory species have been scoped out of the report based on the statement that "These nonbreeding features are unlikely to have non-breeding season connectivity with Caledonia due to their migratory path or proximity to the array". This does not provide clear justification for which species are within migratory pathways and this statement is not verified by the references provided (with a few exceptions).	The mCRM assessment was carried out using the updated strategic study of collision risk for birds on migration (Woodward *et al*., 2023[19]) to determine the species that have potential for overlap with the Proposed Development (Offshore). Full methodology is presented in Volume 7B, Appendix 6-5: Migratory Collision Risk Modelling Technical Report.
NatureScot	We would have like to see reference to bird migration pathways as presented in Bradbury *et al* (2017[34]). We recommend seeking an update on the ongoing migratory collision risk project from Marine Scotland. If this is published in time it should be used within the assessment.	The mCRM assessment was carried out using the updated strategic study of collision risk for birds on migration (Woodward *et al*., 2023[19]) to determine the species that have potential for overlap with the Proposed Development (Offshore). Full methodology is presented in mCRM Annex (Volume 7B, Appendix 6-5: Migratory Collision Risk Modelling Technical Report).

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NatureScot	Climate change - We recommend that climate sensitivity information is incorporated qualitatively within the assessment for key species (to be determined after LSE stage) where the information on their current population trend is included. This climate information can explicitly specify if the species is considered to be sensitive to climate change and what the latest population predications are, i.e. referencing MARPAMM or CEH modelling, Johnston *et al*., 2013[35], and Searle *et al*., 2022[36]. This can provide context for considering the projection of the population trend.	Climate change effects have been qualitatively considered within assessment of possible changes in population trends within Section 6.4.
NatureScot	In-combination impacts - Please see advice above on cumulative impacts.	This is noted by the Applicant.
NatureScot	[Refer to 'Annex 1: variations to standard approach to establishing connectivity' provided by NatureScot in consultation response (Appendix I)]	This is noted by the Applicant.
RSPB	RSPB recognise the needs to have flexibility in the design of developments and accept the Rochdale envelope approach as a way this can be dealt with through the consenting process. We do however encourage applicants to refine the parameters of their proposed development as far as possible. We welcome that a minimum blade clearance (at least 35 metres above Mean Sea Level) for Caledonia Offshore Wind Farm has already been specified.	This is noted by the Applicant.
RSPB	Scoping of impacts - Having reviewed Table 10.4 (EIA Scoping assessment for Offshore Ornithology) we are satisfied that the main impact pathways have been scoped in.	The Applicant welcomes the comments regarding the impacts scoped in/out of assessment. The assessment of potential impacts from wet storage have been discussed with MD-LOT, NatureScot and RSPB.

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	We do not however consider there is sufficient information to scope out displacement impacts from wet storage for floating wind turbine generators at therefore consider they should be included within the EIA. We also note that barrier effects during operation have been scoped out on the basis that is usually not possible to distinguish between displacement and barrier effects. This is correct but rather than scoping out barrier effects, we suggest it is made clear that they are scoped in alongside displacement effects.	The requirement for barrier effects to be scoped in has been noted. The impact pathway termed "distributional responses" has been included within the scoping table which covers both disturbance/displacement and barrier effects (Table 6-12). As requested, kittiwake have been considered within the distributional responses assessment.
RSPB	We consider it is premature to conclude there will be no significant transboundary effects on birds in the breeding season before data has been collected and analysed. We do however agree that due to the location of the Proposed Development (Offshore), the proportion of birds likely to be apportioned to transboundary designated seabird features during the breeding season are likely to be relatively low.	There are no non-UK seabird colonies within MMFR +1S.D. or other evidence to suggest connectivity (Wakefield *et al.,* 2017[33]; Woodward *et al.,* 2019[20]). Therefore, colonies outside of UK waters will not contribute to any transboundary effects in the breeding season. Given the larger spatial scale and the far-ranging behaviour of key receptors in the non-breeding season, any potential transboundary effects would be in relation to much larger populations than those considered at the UK-scale. Therefore, any conclusions drawn from the existing cumulative impact assessment are considered highly unlikely to change.
RSPB	We agree that transboundary impacts the non-breeding season should be addressed within the environmental impact assessment report.	This is noted by the Applicant.
RSPB	Important Ornithology Features - We agree that the species taken forward to the EIA should be identified through analysing the site-specific surveys and or	The applicant has assessed the results of site-specific surveys as well as historical observational data for context to determine important ornithological features

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	features of overlapping SPAs. We do not agree that at this stage Sooty shearwater, Manx shearwater, European storm petrel and Leach's storm petrel can be ruled out as Important Ornithological Features. While we agree that low numbers of these species have been recorded in historical surveys, it may be that these low number arise through biases inherent in the survey methods (such as timing of surveys and low visibility of birds on the water) rather than low numbers on site	as agreed with NatureScot and in line with latest guidance.
RSPB	RSPB encourage the adoption of a precautionary approach to the identification of relevant protected sites for seabirds with clear methodology on the exclusion of sites and species.	This is noted by the Applicant.
RSPB	Baseline data - Due to the location of the Proposed Development (Offshore) there is already a considerable amount of data sources that may be drawn from. We welcome the approach set out in the Scoping Report to supplement this by DAS data. We support this being undertaken for a period of 24 months covering the Array Area plus a 4 km buffer with flight lines approximately 2.6 km apart to result in approximately 15% coverage.	Details of the methodology carried out for DAS analysis can be found in Volume 7B, Appendix 6-1: Offshore Ornithology Baseline Characterisation Report and Volume 7B, Appendix 6-1, Annex 16: MRSea Modelling Report of key seabird species.
RSPB	We appreciate there are constraints on when DAS can be carried out (for example due to weather and daylight hours) but welcome surveys being carried out at different tidal states and different times of day to capture maximum variability in use of the site.	Details of the methodology carried out for DAS analysis can be found in Volume 7B, Appendix 6-1: Offshore Ornithology Baseline Characterisation Report and Volume 7B, Appendix 6-1, Annex 16: MRSea Modelling Report of key seabird species.
RSPB	We agree with the parameters that will be provided from the aerial surveys as set out in paragraph 10.8.1.3. As part of identifying the activities of the	Records of deceased birds are detailed in the baseline characterisation report (see Volume 7B, Appendix 6-1:

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	birds recorded, we would be grateful if any deceased birds could be also recorded. This is to help better understand the impacts of the highly pathogenic avian influenza (HPAI) outbreak.	Offshore Ornithology Baseline Characterisation Report).
RSPB	Data Analysis - For calculating density across the site, the RSPB consider Marine Renewables Strategic Environmental Assessment (MRSea) is a robust method if used correctly and transparently. The results of MRSea must be checked and validated and justification of decision making is crucial. Bootstrapped confidence intervals should be presented alongside model results.	As agreed in consultation, MRSea methodology has been used where possible (see Volume 7B, Appendix 6-1, Annex 16: MRSea Modelling Report of key seabird species). However, MRSea can only be used with sufficient count data and thus design-based estimates were use during months of low count data. Further information is provided in Volume 7B, Appendix 6-1: Offshore Ornithology Baseline Characterisation Report.
RSPB	Collision Risk Models - We agree with the use of the stochastic Band Collision Risk Model (sCRM) We recommend presentation of full model outputs from the Band model Option 2 (Basic) and Option 3 (Extended). For both these options, flight height distribution from Johnston *et al*., (2014b[15]) with corrigendum should be used.	The CRM assessment has been carried out following the NatureScot (2023b[16]) Guidance Note 7, presenting both deterministic and stochastic model outputs (see Volume 7B, Appendix 6-3: Offshore Ornithology Collision Risk Modelling Technical Report). The NatureScot (2023b[16]) guidance requests the use of Option 3 'extended' Band (2012[27]) model. However, the use of the Option 3 is no longer required, as highlighted within the Morven OWF Scoping Opinion (Marine Directorate, 2023[37]), which stated that the guidance will subsequently be updated in due course. The Applicant can confirm that flight height distributions from Johnston *et al.* (2014a) with corrigendum (Johnston *et al*., 2014b[15]) have been used within the CRM assessment. Flight speeds and associated SDs have been agreed in consultation with NatureScot and RSPB and have been used within the assessment (Table 6-4).

Consultee	Comment	Response
RSPB	The collision risk input parameters include a parameter known as the "Avoidance Rate". This is defined by Band (2012[27]) as the inverse of the ratio of the number of actual collisions to number of predicted collisions". As such, it is a catch all term for the inconsistency between predicted and actual mortalities. These inconsistences may result from variety of sources, including survey error and model mis-parameterisation as well as avoidance behaviour. Currently there only Avoidance Rates available for use with deterministic formulations of the Band model. RSPB agree with the avoidance rates recommended by the Statutory Nature Conservation Bodies (SNCBs, 2014[17]) with the exception of breeding gannets where a 98% avoidance rate is more appropriate. This is because the figures used for the calculation of avoidance rates advocated by the SNCBs are largely derived from the non-breeding season for gannet and there is evidence that the foraging movements and behaviour of gannets will vary in relation to stage of the breeding season and between the breeding and non-breeding season. In the absence of suitable avoidance rates to use with the full stochastic model, we agree the sCRM should be run deterministically. If avoidance rates become available, the model should be run stochastically.	The CRM assessment has been carried out following the NatureScot (2023b[16]) Guidance Note 7, presenting both deterministic and stochastic model outputs (see Volume 7B, Appendix 6-3: Offshore Ornithology Collision Risk Modelling Technical Report). The avoidance rates used in the assessment are presented within the NatureScot (2023b[16]) Guidance Note 7, published by Ozsanlev-Harris *et al*. (2023[38]).
RSPB	We also disagree with the omission of Sooty shearwater, Manx shearwater, European storm petrel and Leach's storm petrel as species with potential to be at risk of collision. Fundamental to the consideration of collision risk for these species is the extent to which nocturnally active seabirds, such as	The Applicant notes the request to include impacts of lighting. The impact pathway has been discussed further in consultation (Table 6-4) and included within the scoping table (Table 6-12).

Consultee	Comment	Response
	Manx shearwaters, may be attracted to the illuminations required for turbines, support vessels and the construction or expansion of ports. Such attraction will cause behaviour change, which could in turn increase collision risk, for example if birds fly higher when attracted to lights. As such, consideration of the potential of collision for these species should be included.	
RSPB	For migratory non-seabird species, species likely to migrate across the Array Area will be identified and will be assessed using the Marine Scotland commissioned strategic level report (Marine Scotland, 2014[30]).	Migratory CRM has been carried out following the NatureScot (2023b[16]) Guidance note 7. The updated strategic level report (Woodward *et al.*, 2023[19]) was used to carry out the assessment. The methodology, inputs and outputs have been presented in Volume 7B, Appendix 6-5: Migratory Collision Risk Modelling Technical Report.
RSPB	Disturbance and Displacement - It is not clear for which species it is proposed to use the SeabORD displacement assessment tool and for which is proposed to use the matrix approach. At this point it time, we consider premature to use the matrix approach without investigation of the SeabORD tool. As per the advice given to others developing windfarms at greater distances from the coast, where there is concern using GPS tracking data, RSPB support the use of SeabORD in its simplest form – i.e. based on distance decay. Like all models, SeabORD has its limitations, and it is up to the applicant to validate the results, and if necessary, revert to a different method. Justification of decision making is a crucial part of analysis.	The matrix approach has been adopted for all species as agreed with NatureScot. Following advice from MD-LOT regarding the use of SeabORD, The Applicant attempted to use this tool for Atlantic puffin, common guillemot, razorbill and black-legged kittiwake during the breeding season with the intention to provide the results as an additional note. However, the tool provided would not run and, after troubleshooting and consultation with MD-LOT, it was agreed that SeabORD outputs would not be required.

Consultee	Comment	Response
RSPB	The RSPB would also want to see displacement analysis for kittiwake.	As requested, kittiwake have been considered within the distributional responses assessment.
RSPB	In regard to suitable displacement and mortality rates, we are happy to discuss these with the applicant and Statutory Nature Conservation Bodies.	The Applicant welcomed the offer to discuss this further (undertaken during consultation).
RSPB	Population Viability Analysis - RSPB consider that it likely that population models will be required to establish whether or not there could be long-term impacts on population viability for impacted colonies. As per the results of work commissioned by JNCC, we agree with use of the two-ratio metrics generally termed ‘Counterfactual of population size’ (CPS) and ‘Counterfactual of population growth-rate’ (CPGR) are presented. The CPS is especially important to aid understanding of impacts for a non-specialist whereas the numbers given by the CPGR are less understandable beyond a population modelling context. Initial population sizes inputted into tall the PVAs for the biogeographical scale should be based on the latest published data from the Seabird Monitoring Programme (SMP) online database (BTO, 2024[39]) with non-breeding seabird populations derived from the zones determined by the BDMPS report (Furness, 2015[23])	PVA has been carried out as requested by RSPB, using ‘Counterfactual (ratio) of final population size’ and ‘Counterfactual (ratio) of population growth-rate’ as the metrics for result interpretation. PVA was run using density independent models. PVA has been carried out as requested using the biogeographic population estimates presented in Furness (2015[23]) and SMP (BTO, 2024[39]). The demographic, productivity and survival rates used in the PVA are those presented in Horswill and Robinson (2015[32]). The full methodology and results are presented in Volume 7B, Appendix 6-4: Population Viability Analysis.
RSPB	Cumulative Impacts - As per the EIA Regulations, the Environmental Statement will need to address the cumulation of impacts with other existing and/or approved works. In the approach to the cumulative assessment and identification of other built and/or	This is noted by the Applicant.

Consultee	Comment	Response
	approved projects, it is suggested (paragraph 4.3.1.6) that some projects may not be taken forward and built as currently described and, as such, there is a level of uncertainty over the level of impacts which may arise. It is therefore proposed that the phase of the project will be considered when drawing conclusions on cumulative effects and the certainty of those	
RSPB	RSPB agree that a project may not be constructed as per the worst case (Rochdale envelope) scenario. We do not however consider it is appropriate to make a case to 'use' the difference in predicted bird mortality from a worst-case scenario when development is consented and the predicted bird mortality from the as-built development.	This noted by the Applicant.
RSPB	Non-technical summary - It is necessary that the Environmental Statement will be complex and contain data, specialist models, and detailed analysis. Nevertheless, we welcome this being set out in a clearly logical way so the process, if not the details of the process, can be followed by the lay-person (and decision-maker) and easily scrutinised by technical experts. RSPB take a dim view of prejudicial use of language and selective reporting of results. There is already a huge amount of uncertainty inherent in the offshore wind assessment process and it is unhelpful to all parties for this made worse.	The Applicant has provided a non-technical summary as per EIA legislation.
RSPB	"It is a requirement of EIA legislation that the main findings must be set out in accessible, plain English, in a non-technical summary (NTS). This is so they can readily be disseminated to the general public, and easily understood by non-experts as well as decision-	The Applicant has provided a non-technical summary as per EIA legislation.

Consultee	Comment	Response
	makers. As such, alongside statements of significance, we consider the NTS ornithology section, should (as a minimum) contain the following information: ▪ An explanation of the 'worst case' scenario ▪ A table of 'worst case' annual mortality for relevant species using the methods set out in the screening opinion for the development in isolation ▪ A table of 'worst case' annual mortality for relevant species using the methods set out in the screening opinion for the development in combination with impacts arising from any existing or approved development ▪ Counterfactual of population size for impacted colonies (presented as a percentage) with explanation ▪ Counterfactual of population growth-rate for impacted colonies with explanation ▪ Measures taken to avoid and/or reduce the annual mortality to the levels presented. We would be grateful if these requirements for a non-technical summary could be specified in the scoping opinion."	
RSPB	We have reviewed the screening report (UKCAL1–ARP–GEN–ENV–RPT-00003, Rev 005, 30.09.2022). In generally, caution must be taken not to anticipate a conclusion of no adverse effect on site integrity by prematurely removing sites and features from initial assessment.	The Applicant notes the concern relating to removing sites and features from initial assessment and have followed NatureScot guidance and advice on sites/features scoped in/out of assessment.
RSPB	We disagree with the omission of Sooty shearwater, Manx shearwater, European storm petrel and Leach's storm petrel. While we agree that low numbers of	The Applicant notes the request to include impacts of lighting. The impact pathway has been discussed

Consultee	Comment	Response
	these species have been recorded in historical surveys, it may be that these low number arise through biases inherent in the survey methods (such as timing of surveys and low visibility of birds on the water) rather than low numbers on site. Furthermore, an additional consideration for these species is the extent to which nocturnally active seabirds, such as Manx shearwaters, may be attracted to the illuminations required for turbines, support vessels and the construction or expansion of ports. Such attraction will cause behaviour change, which could in turn increase collision risk, for example if birds fly higher when attracted to lights.	further in consultation (Table 6-4) and included within the scoping table (Table 6-12).
RSPB	Based on there being breeding seabird colonies with a foraging range that extends through the Proposed Development (Offshore) and an impact pathway for these species, we agree with the overall conclusion that it is not possible to rule out the potential risk of significant effects on a European site either alone or in-combination with other projects. As likely significant effects (LSE) cannot be ruled out we agree that an appropriate assessment must be undertaken by the competent authority before a consent could be granted.	There are no non-UK seabird colonies within MMFR +1S.D. or other evidence to suggest connectivity (Wakefield *et al.,* 2017[33]; Woodward *et al.,* 2019[20]). Therefore, colonies outside of UK waters will not contribute to any transboundary effects in the breeding season. Given the larger spatial scale and the far-ranging behaviour of key receptors in the non-breeding season, any potential transboundary effects would be in relation to much larger populations than those considered at the UK-scale. Therefore, any conclusions drawn from the existing cumulative impact assessment are considered highly unlikely to change.
THC	The Proposed Development (Offshore) is to occur within the Offshore Wind Sectoral Plan Option NE4. This is noted as 'subject to higher levels of ornithological constraint' due to foraging seabirds, some of which are likely to be designated features of sites within the THC area. The Scoping Report notes	The Applicant has noted the request to engage with THC regarding potential compensatory measures and will engage as appropriate regarding additional development for compensatory purposes.

Consultee	Comment	Response
	the potential for the HRA to conclude that an adverse effect on site integrity may occur. This could trigger a requirement for compensatory measures, potentially delivered within affected sites within the THC area. This could constitute development, noting the similar example in the East of England where kittiwake nesting towers were constructed. I would encourage the developer to engage early with the THC, if they believe it likely that they will have to undertake any additional development in support of any compensatory measures.	

Table 6-4: Stakeholder engagement activities.

Date	Stakeholder	Summary
25 May 2023	NatureScot and RSPB	Consultation meeting to provide a project update, introduce preliminary ornithological assessment work and discuss NatureScot's and RSPB's responses to the Offshore Scoping Report.
20 September 2023	MD-LOT	Quarterly consultation to discuss CIA cut-off date and justification, agreed to discuss the use of CEF at next NatureScot meeting advised still unable to access SeabORD for Ornithology Assessments.
13 November 2023	NatureScot and RSPB	Consultation meeting to provide a project update, including presentation of updated consenting strategy, discuss follow-up queries from previous consultation (May 2023) and outline proposed approaches to ornithological assessment for the Caledonia OWF.
13 December 2023	MD-LOT	Communications issued to MD-LOT to highlight significant challenges faced in accessing CEF.
13 March 2024	MD-LOT	CEF-LOT and NatureScot to provide interim guidance and are supportive of developer approach to agreed baseline. Highlighted issues with MatLab version of SeabORD tool which have also been flagged with NatureScot.
9 May 2024	NatureScot and RSPB	Consultation meeting to provide a project update, to discuss collision risk modelling (CRM) and distributional response assessment and potential options for compensation measures.
12 June 2024	MD-LOT	MD-LOT advised that West of Orkney numbers should not be used within the cumulative assessment. SeabORD query raised regarding use of tool.
1 July 2024	NatureScot and RSPB	Consultation meeting to discuss and present progress on assessments (SeabORD) and the identification of potential compensatory measures.
11 September 2024	MD-LOT	Feedback on the SeabORD approach. Advised that if the tool does not work then Caledonia is not required to submit this providing a matrix approach has been followed as an alternative.

6.4 Baseline Characterisation

6.4.1 Study Area

6.4.1.1 The Proposed Development (Offshore) is located in the Moray Firth in the North Sea. The northern limit of the site is approximately 22km off the coast of Wick, Highland and the southern limit of the site is approximately 38km off the coast of Banff, Aberdeenshire. The Array Area is approximately 423km^2 with water depths ranging from 40-88m relative to lowest astronomical tide (LAT), with a mean depth of 59m.

6.4.1.2 The Proposed Development (Offshore) will be the fourth commercial scale OWF within the Moray Firth and will be located directly to the east of the Moray East, Moray West, and Beatrice OWFs (with Caledonia OWF abutting the Moray East OWF). The proximity of these developments may have implications for the Caledonia OWF such as non-uniform distributions of species as a result of distributional responses from the existing OWFs. This may influence the pre-construction baseline data which has been considered as part of data analysis where necessary.

6.4.1.3 Whilst the Caledonia OWF is further offshore within the Moray Firth comparative to existing OWF developments, it still remains within foraging distance for SPA qualifying features along the Scottish coast, with the proximity to the Caithness coast likely requiring assessment. Potential impacts at the SPA level are discussed in the Report to Inform Appropriate Assessment (RIAA). The site maintains a similar distance to the coast as the other consented or constructed OWF developments nearby, ensuring that the transit corridor remains similar for birds returning to colonies.

6.4.1.4 The total Array Area footprint is approximately 423km^2, which comprises Caledonia North (with a footprint of approximately 218.5km^2), and Caledonia South (with a footprint of approximately 204.5km^2). The Offshore Export Cable Corridor (OECC) covers a total footprint of approximately 221.3km^2 and will contain export cabling for both Caledonia North and Caledonia South.

6.4.1.5 The following study areas have been used to inform this Offshore Ornithology chapter of the EIAR, with further details provided in the sections below:

- Offshore Ornithology regional study area;
- Offshore Ornithology study area; and
- Intertidal Ornithology study area.

6.4.1.6 See Figure 6-1 for location of study areas; note, the legend descriptors begin within the inset figure and expands, thus the dashed line for Offshore Ornithology Study Area relates to the dashed line within the inset and the Proposed Development Offshore Ornithology Regional Study Area is the dashed line within the main figure.

Offshore Ornithology Regional Study Area

6.4.1.7 The Offshore Ornithology regional study area was defined by the area within which potential impacts to breeding seabirds could occur and was defined separately based on the breeding and non-breeding seasons due to the differences in behaviour of seabirds during these two distinct periods.

6.4.1.8 During the breeding season, the Offshore Ornithology regional study area was defined using the published foraging ranges of breeding seabirds. Many seabirds have large foraging ranges which in some cases extend several hundred kilometres from their breeding colonies (Woodward *et al.,* 2019[20]). As such birds may overlap (i.e., have connectivity with) the Proposed Development (Offshore), even when the colonies they originate from are a significant distance away (Figure 6-1).

6.4.1.9 Published MMFR +1S.D. in Woodward *et al*. (2019[20]) were used to define the Offshore Ornithology regional study area and the potential Zone of Influence (ZoI) (Volume 7B, Appendix 6-1: Offshore Ornithology Baseline Characterisation Report). The ZoI of the Proposed Development (Offshore) is defined as gannet MMFR +-1SD (509.4km). Whilst other species have larger foraging ranges (e.g. Fulmar, Manx Shearwater), a larger zone of influence is not deemed necessary, as any impacts at such great distances from the project are considered to be immaterial. Of the key species considered in the ornithology assessment, gannet has the largest MMFR (315.2 km ± 194.2 km) (Woodward *et al.,* 2019[20]). As such, the Offshore Ornithology regional study area extends to 510 km (509.4 km) from the Proposed Development (Offshore) (Figure 6-1) as per NatureScot guidance (NatureScot, 2023a[10]). The larger foraging ranges recommended in Guidance note 3 (NatureScot, 2023c[40]) for three SPAs for gannet were not necessary as one (Grassholm SPA) remained out of scope and the remaining two SPAs (St Kilda SPA and Forth Islands SPA) are within the MMFR for gannet. SPA breeding colonies for other key species in the assessment will fall within the MMFR of gannet. Therefore, this approach is appropriate to define the maximum extent of the Offshore Ornithological regional study area during the breeding season.

6.4.1.10 Outside of the breeding season, seabirds are not constrained by colony location and, depending on individual species, range widely within UK waters and beyond. The ZoI for seabird species in the non-breeding season (where an assessment is deemed to be required) is based on Furness (2015[23]) which presents Biologically Defined Minimum Population Scales (BDMPS), with the exception of guillemot. For guillemot, the non-breeding season was based on the breeding population found within the MMFR +1S.D. of the Proposed Development (Offshore). This is in line with the approach outlined in the NatureScot Guidance Note 3 (NatureScot, 2023c[40]), based on recent geolocator studies presented in Buckingham *et al*. (2022[24]). Whilst guillemots do not disperse as widely as other species in the non-breeding period, they do migrate further than their MMFR +1SD, particularly in northern isles colonies (Buckingham *et al*., 2022[24]). Thus, tracking data and rose diagrams for the project are also reviewed to ensure all avenues of potential connectivity identification has been considered.

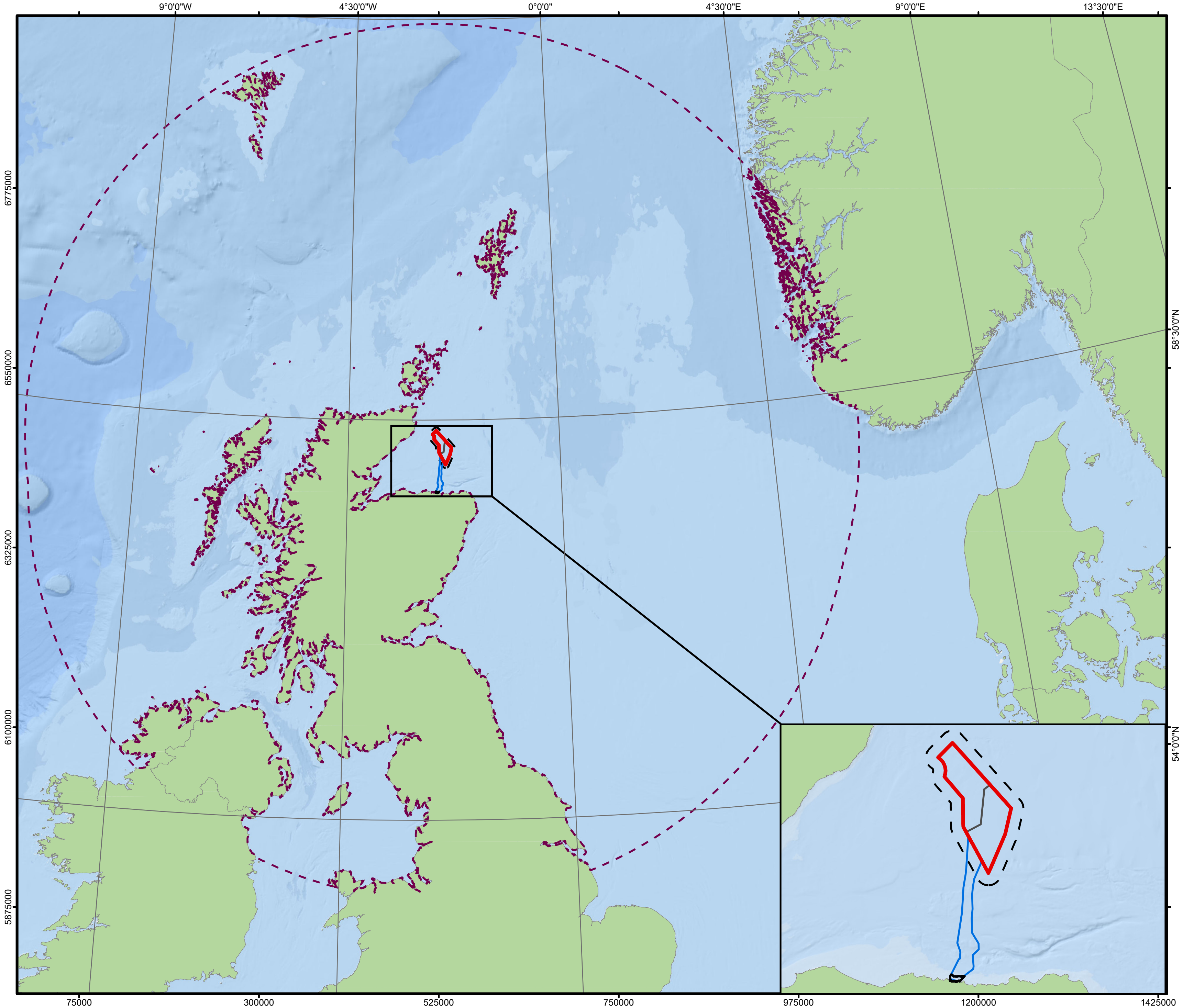
6.4.1.11 In the case of puffin, no assessment of impacts is required for the non-breeding season, as agreed in consultation with NatureScot, as this species leaves UK colonies and the areas of sea immediately adjacent by late August and disperse widely over vast areas (Furness, 2015[23]). However, an assessment has been completed for puffin in the non-breeding season as a precautionary measure.

Offshore Ornithology Study Area

6.4.1.12 The Offshore Ornithology study area encompasses the Caledonia OWF, plus a 4km buffer; the area covered by the baseline DAS (Figure 6-2). In assessing potential bird impacts, data from within this buffer zone have been utilized where relevant to provide context in relation to the Caledonia OWF Array Area.

Intertidal Ornithology Study Area

6.4.1.13 The Intertidal Ornithology study area for the assessment of effects on birds in the intertidal zone encompasses the intertidal area between Mean High Water Spring (MHWS) tides extending out to 1.5 km seaward from MHWS, covering the whole of the intertidal area (Figure 6-3). The proposed route of the OECC (plus 500m buffer) from the Offshore Ornithology Study Area to the proposed landfall location is also captured within the intertidal study area. Broader intertidal effects are considered within Volume 6, Chapter 5: Intertidal Assessment.



Caledonia OWF
Offshore Export Cable Corridor
North South Site Division
Offshore Ornithology Study Area
Intertidal Ornithology Study Area
Proposed Development Offshore Ornithology Regional Study Area

0 50 100 150 200 km

REV	DATE	DOC STATUS	ORIGIN	REVIEW	APP
01	19/09/2024	Approved	EV	BB	DH

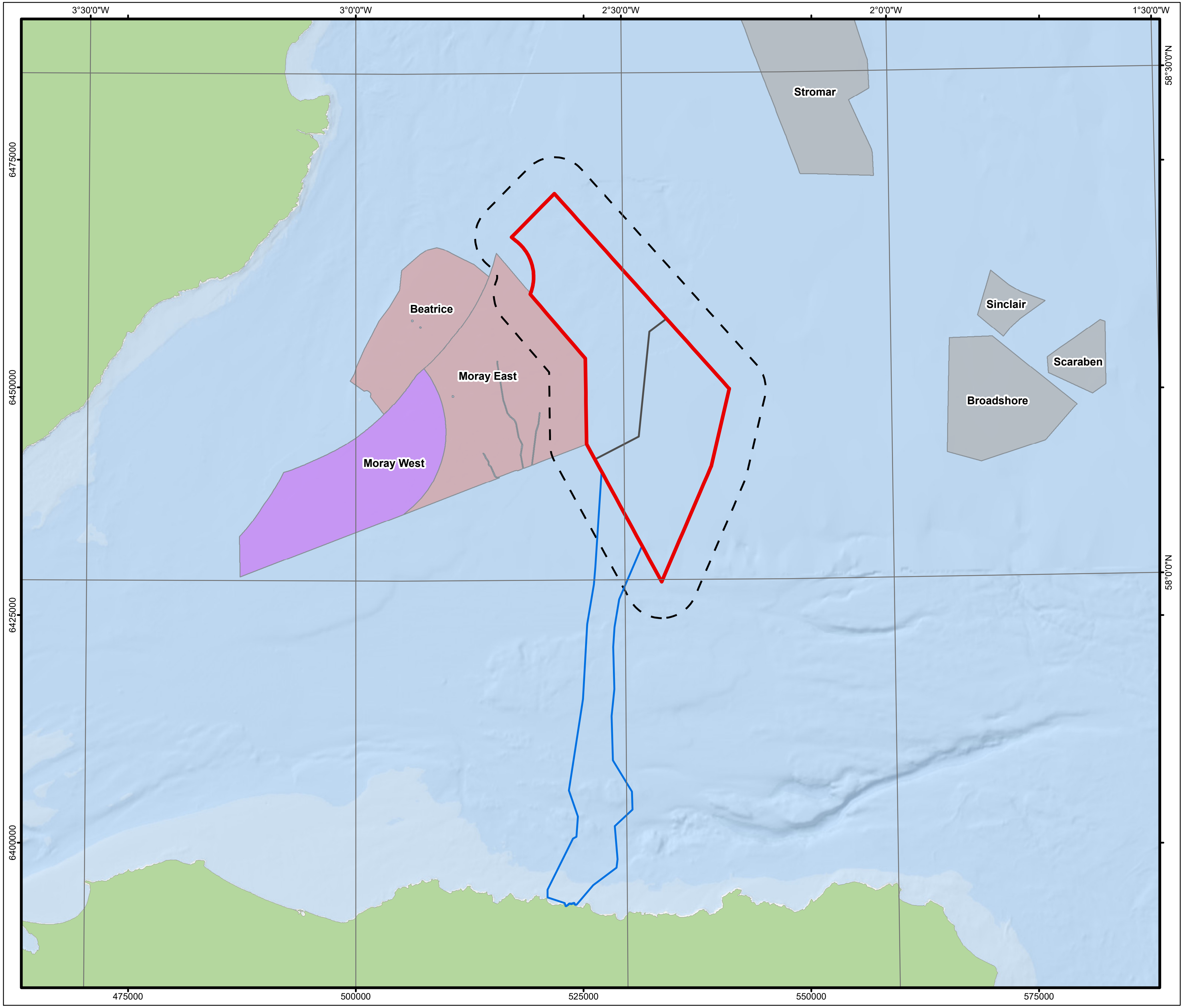
CALEDONIA Offshore Wind Farm
GoBe APEM Group

CONTRACTOR DRAWING NO	CONTRACTOR REV
UKCAL1_GO_WNF_ORN_MAP_00327	01

GEODETIC PARAMETERS
WGS 84 / UTM zone 30N (EPSG: 32630)

DRAWING TITLE
Figure 6-1: Offshore Ornithology Regional Study Area

STATUS	SCALE	
Approved	1:6,500,000	
DRAWING NUMBER	SHEET NO	REV
N/A	01 of 01	N/A



Caledonia OWF
Offshore Export Cable Corridor
North South Site Division
Aerial Survey Area
Operational Wind Farm
Wind Farm Under Construction
Wind Farm in Concept/Early Planning

0 5 10 15 20 km

REV	DATE	DOC STATUS	ORIGIN	REVIEW	APP
01	19/09/2024	Approved	EV	BB	DH

CALEDONIA Offshore Wind Farm
GoBe APEM Group

CONTRACTOR DRAWING NO
UKCAL1_GO_WNF_ORN_MAP_0032

CONTRACTOR REV
01

GEODETIC PARAMETERS
WGS 84 / UTM zone 30N (EPSG: 32630)

DRAWING TITLE

Figure 6-2: Offshore Ornithology Study Area

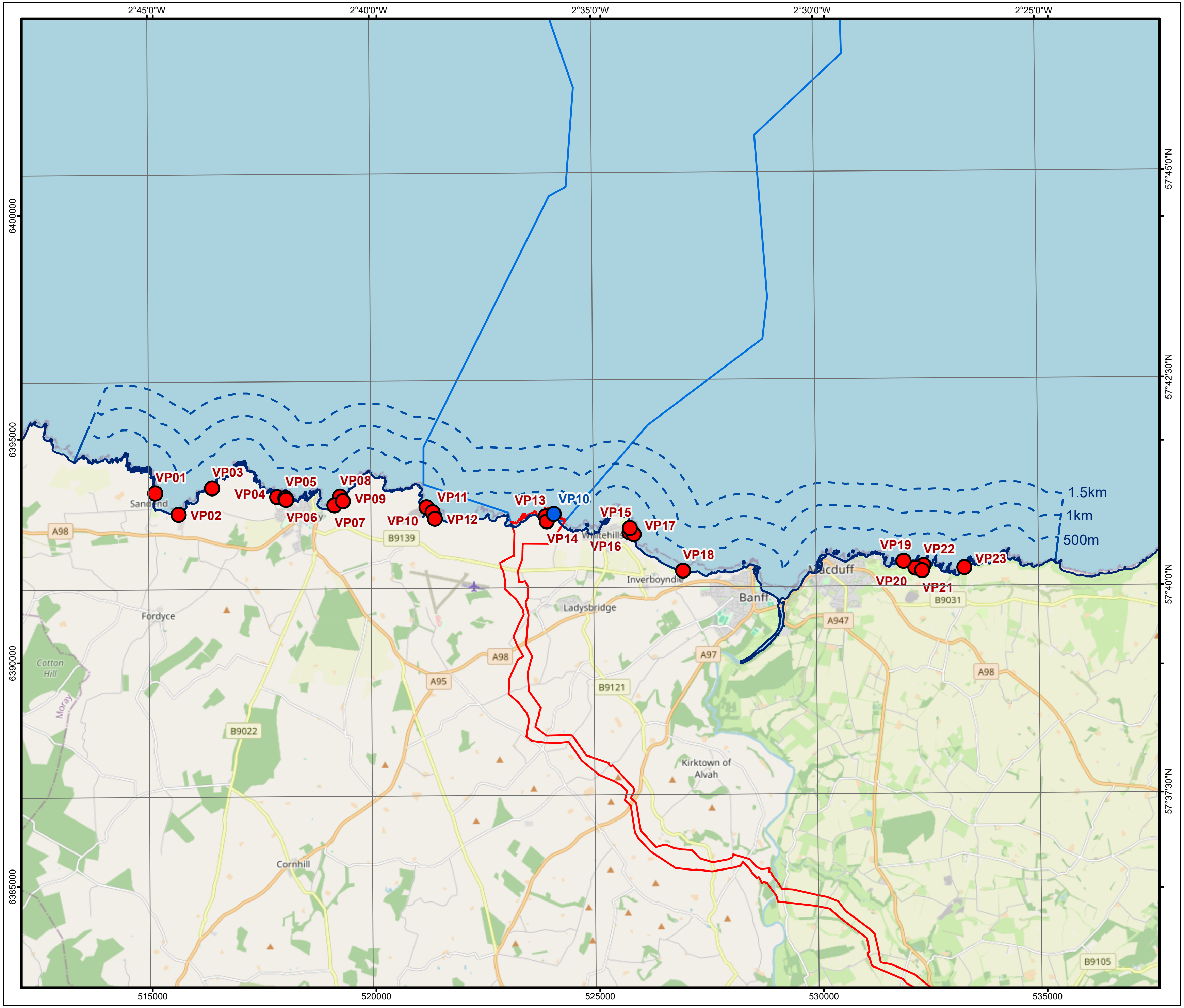
STATUS
Approved

SCALE
1:564,817

DRAWING NUMBER
N/A

SHEET NO
01 of 01

REV
N/A



Offshore Export Cable Corridor
Onshore Export Cable Corridor
Mean High Water Springs (MHWS)
1.5km Vantage Point Survey Area
Survey Vantage Point 2022/2023
Survey Vantage Point 2023/2024

Service Layer Credits: © OpenStreetMap (and) contributors, CC-BY-SA

0 1 2 3 4 km

REV	DATE	DOC STATUS	ORIGIN	REVIEW	APP
01	04/10/2024	Approved	EV	BB	DH

CALEDONIA Offshore Wind Farm
GoBe APEM Group

CONTRACTOR DRAWING NO: UKCAL1_GO_WNF_ORN_MAP_00482	CONTRACTOR REV: 01
GEODETIC PARAMETERS: WGS 84 / UTM zone 30N (EPSG: 32630)	
DRAWING TITLE: Figure 6-3: Intertidal Ornithology Study Area	
STATUS: Approved	SCALE: 1:115,000
DRAWING NUMBER: N/A	SHEET NO: 01 of 01 — REV: N/A

6.4.2 Data Sources

Desk Study

6.4.2.1 A detailed desktop review was carried out to establish the baseline of information available on the ornithological populations in the study area for the Proposed Development (Offshore) (see Volume 7B, Appendix 6-1: Offshore Ornithology Baseline Characterisation Report). The data sources that have been used to inform this Offshore Ornithology chapter of the EIAR are presented within Table 6-5.

6.4.2.2 The additional data sources (Table 6-5) were evaluated for their usefulness to the assessment based on several factors. These were: the relevance to the Proposed Development (Offshore) (i.e., the relative location of the data to the site footprint and the species included in the data sources); the quality of the data and purpose of collection (i.e., consideration of data collection survey approaches and potential biases and limitations to the data sources); and the age of the data. These data were used to provided context and to supplement the DAS completed within the Caledonia OWF between May 2021 and April 2023.

Table 6-5: Summary of key publicly available datasets for Offshore Ornithology.

Title	Author	Year
Existing OWF Data		
Moray East OWF Environmental Statement	Moray Offshore Renewables Limited	2011[41]
Beatrice OWF Environmental Statement	Beatrice OWF	2012[42]
Beatrice OWF Beatrice OWF Pre-Construction Aerial Survey Report	Beatrice OWF	2015 (May-August)[43]
Moray East OWF Pre-construction Aerial Survey Report 2018	Moray East	2018 (May-July)[44]
Moray West OWF EIAR -Chapter 10: Ornithology	Moray OWF (West) Limited	2018[45]
Beatrice OWF Post-construction Monitoring Reports (Year 1 and Year 2)	Beatrice OWF	April 2021; July 2023[46]
Publicly Available Datasets		
Designated Sites	NatureScot	Multiple

Title	Author	Year
Seabirds Count national colony census data	British Trust for Ornithology (BTO)	Multiple
Seabird Tracking Data	Multiple	Multiple
Beatrice O&G Field Decommissioning EIA	Repsol Sinopec Resources UK Limited	2018
Wetland Bird Survey Annual Report	British Trust for Ornithology (BTO)	Multiple
Literature		
Potential impacts of OWFs on birds	Multiple (e.g., Garthe and Hüppop (2004[47]); Drewitt and Langston (2006[48]); Stienen *et al*. (2007[49]); Speakman *et al*. (2009[50]); Langston (2010[51]); Band (2012[27]); Cook *et al*. (2012[52]); Furness and Wade (2012[53]); Wright *et al*. (2012[54]); Furness *et al*. (2013[55]); Johnston *et al*. (2014a; 2014b[15]); Cook *et al*. (2014[56]; 2018[57]); Dierschke *et al*. (2017[58]); Jarrett *et al*. (2018[59]); Leopold and Verdaat (2018[60]); Mendel *et al*. (2019[61]); Goodale and Milman (2020[62]); Peschko *et al*. (2020a[63]; 2020b[64]); MacArthur Green (2021[65]; 2023[66]); Garthe *et al*. (2023[67]); Tjørnløv *et al.* (2023[68]); Skov *et al*. (2018[69]); Vilela *et al.* (2021[70]); Vanermen *et al.* (2016[71]); Peschko *et al.* (2024[72]); and Wade *et al.* (2014[73])	Multiple
Bird distribution	Multiple (e.g., Stone *et al*. (1995[74]); Brown and Grice (2005[75]); Kober *et al*. (2010[76]); Bradbury *et al*. (2014[77]); HiDef Ltd. (2015[78]); Waggitt *et al*. (2019[21]); Cleasby *et al*. (2020[79]); Davies *et al*. (2021[80]); and Johnston *et al*. (2024[81]))	Multiple
Bird breeding ecology	Multiple (e.g., Cramp and Simmons (1977-94[82]); Del Hoyo *et al*. (1992-2011[83]); and Robinson (2005[84]))	Multiple
Bird population estimates and demographic rates	Multiple (e.g., Horswill and Robinson (2015[32]); Mitchell *et al*. (2004[85]); BirdLife International (2004[86]); Holling *et al*. (2011[87]); Musgrove *et al*. (2013[88]); Furness (2015[23]); Horswill *et al*. (2017[89]); Frost *et al*. (2019[90]); BTO (2024[39]); Burnell *et*	Multiple

Title	Author	Year
	al. (2023[91]); and Tremlett *et al*. (2024[92]))	
Bird migration and foraging movements	Multiple (e.g., Wernham *et al*. (2002[93]); Thaxter *et al.* (2012[94]); Wright *et al*. (2012[54]); Wakefield *et al*. (2013[95]; 2017[33]); Furness *et al*. (2018[96]); Woodward *et al*. (2019[20]); and Woodward *et al.* (2023[19]))	Multiple

Site-specific Surveys

6.4.2.3 To inform the Offshore Ornithology EIAR chapter, a programme of 24 DAS were undertaken monthly between May 2021 and April 2023 inclusive. The survey area included the Caledonia OWF plus a 4 km buffer, covering an area of approximatively 884 km^2. This was the standard survey area for all months.

6.4.2.4 A comprehensive baseline description of offshore ornithology and the data sources and survey methods used are presented in Volume 7B, Appendix 6-1: Offshore Ornithology Baseline Characterisation Report.

6.4.3 Baseline Description

6.4.3.1 The following sections provide a summary of the baseline environment for Offshore Ornithology. Full details of the analysis used to develop the Offshore Ornithology baseline can be found in the Volume 7B, Appendix 6-1: Offshore Ornithology Baseline Characterisation Report. This report includes information on survey design, methods, and the analysis techniques employed to characterize the baseline.

Offshore Ornithology

6.4.3.2 Species assessed for potential impacts are those recorded during DAS and considered to be at potential risk either due to their abundance, potential sensitivity to wind farm impacts or due to biological characteristics (e.g., commonly fly at rotor heights) that increase their susceptibility.

6.4.3.3 The following ornithological receptors were recorded within the Caledonia OWF during the 24 months of DAS:

- Pink-footed goose (*Anser brachyrhynchus*);
- Mallard (*Anas platyrhynchos*);
- Gannet (Morus bassanus)
- Kittiwake (*Rissa tridactyla*);
- Common gull (*Larus canus*);
- Great black-backed gull (*Larus marinus*);
- Herring gull (*Larus argentatus*);
- Lesser black-backed gull (*Larus fuscus*);
- Common tern (*Sterna hirundo*);
- Arctic tern (*Sterna paradisaea*);
- Great skua (*Stercorarius skua*);
- Arctic skua (*Stercorarius parasiticus*);
- Common guillemot (*Uria aalge*);
- Razorbill (*Alca torda*);
- Black guillemot (*Cepphus grylle*);
- Puffin (*Fratercula arctica*);
- Red-throated diver (*Gavia stellata*);
- Great northern diver (*Gavia immer*);
- Fulmar (*Fulmarus glacialis*);
- Sooty shearwater (*Ardenna grisea*); and
- Manx shearwater (*Puffinus puffinus*).

6.4.3.4 A total of 21 recorded bird species, including 19 seabird species, have been considered for assessment. Full justification is presented within the Offshore Scoping Report (Volume 7, Appendix 2), with an overview presented in Section 6.5. The conservation status of the species considered to be at risk of potential impacts is provided in Table 6-6. Abundances and distributions of all species observed are presented in Volume 7B, Appendix 6-1: Offshore Ornithology Baseline Characterisation Report, as well as Volume 7B, Appendix 6-1, Annex 16: MRSea Modelling Report of key seabird species.

Table 6-6: Summary of nature conservation status of seabird species considered at risk of potential impacts.

Species	Scientific Name	Conservation Status
Kittiwake	*Rissa tridactyla*	BoCCI Red listed Birds Directive Migratory Species
Common gull	*Larus canus*	BoCCI Amber listed Birds Directive Migratory Species
Great black-backed gull	*Larus marinus*	BoCCI Green listed Birds Directive Migratory Species
Herring gull	*Larus argentatus*	BoCCI Amber listed Birds Directive Migratory Species
Lesser black-backed gull	*Larus fuscus*	BoCCI Amber listed Birds Directive Migratory Species
Common tern	*Sterna hirundo*	BoCCI Amber listed Birds Directive Migratory Species Birds Directive Annex 1
Arctic tern	*Sterna paradisaea*	BoCCI Amber listed Birds Directive Migratory Species Birds Directive Annex 1
Great skua	*Stercorarius skua*	BoCCI Amber listed Birds Directive Migratory Species
Arctic skua	*Stercorarius parasiticus*	BoCCI Green listed Birds Directive Migratory Species
Common guillemot	*Uria aalge*	BoCCI Amber listed Birds Directive Migratory Species
Razorbill	*Alca torda*	BoCCI Red listed Birds Directive Migratory Species
Black guillemot	*Cepphus grylle*	BoCCI Amber listed Birds Directive Migratory Species
Puffin	*Fratercula arctica*	BoCCI Red listed Birds Directive Migratory Species
Red-throated diver	*Gavia stellata*	BoCCI Amber listed Birds Directive Migratory Species

Species	Scientific Name	Conservation Status
		Birds Directive Annex 1
Great northern diver	*Gavia immer*	BoCCI Amber listed Birds Directive Migratory Species Birds Directive Annex 1
Fulmar	*Fulmarus glacialis*	BoCCI Amber listed Birds Directive Migratory Species
Sooty shearwater	*Ardenna grisea*	BoCC Green listed Birds Directive Migratory Species
Manx shearwater	*Puffinus puffinus*	BoCCI Amber listed Birds Directive Migratory Species
Gannet	*Morus bassanus*	BoCCI Amber listed Birds Directive Migratory Species

6.4.3.5 Potential impacts have been assessed in relation to relevant biological seasons as agreed in consultation and as defined by NatureScot (2020[11]). Table 6-7 provides a summary of these seasons for the seabird species considered within the assessment.

Table 6-7: Defined seasons in the Scottish Marine Environment for seabird species (NatureScot, 2020[11]).

Species	Breeding Season	Non-breeding Season
Kittiwake	Mid-April to August	September to early April
Common gull	April to August	September to March
Great black-backed gull	April to August	September to early March
Herring gull	April to August	September to March
Lesser black-backed gull	Mid-March to August	-
Common tern	May to mid-September	-
Arctic tern	May to August	-
Great skua	Mid-April to mid-September	-
Arctic skua	May to August	-
Common guillemot	April to mid-August	Mid-August to March
Razorbill	April to mid-August	Mid-August to March
Black guillemot	April to August	September to March
Puffin	April to mid-August	Mid-August to March
Red-throated diver	May to mid-September	Mid-September to April
Great northern diver	-	October to mid-May
Fulmar	April to mid-September	Mid-September to March
Manx shearwater	April to mid-October	-
Gannet	Mid-March to September	October to early March
Note '-' identifies seasons during which species are not present in significant numbers within Scottish waters.		

6.4.3.6 As defined in NatureScot (2023a[10]) Guidance Note 6, the regional reference population for seabird species during the breeding season was calculated by summing the most recent colony counts from the SMP online database within MMFR +1S.D. of the Caledonia OWF where available Table 6-9, as defined in Woodward *et al*. (2019[20]) (Table 6-8). For the non-breeding period, the relevant BDMPS and associated population estimates were taken from Furness (2015[23]). Where there are multiple non-breeding season population estimates, the largest population estimate was used. Table 6-8 presents the

MMFR +1S.D. as per Woodward *et al*. (2019[20]) and Table 6-10 presents the breeding, non-breeding and biogeographic reference seabird populations. The application of the MMFR was discussed with NatureScot during May 2023 consultation as outlined in consultation Table 6-3.

6.4.3.7 As recently calculated and agreed as appropriate for Green Volt OWF (APEM, 2023[97]) The demographic rates for each species were derived from expected stable proportions in each age class for each species using the demographic rates presented in Horswill and Robinson (2015[32]). The age class survival rate was multiplied by the stage age proportion. The total for all ages were then summed to prove the weighted average survival rate. This was then converted into an average mortality rate (presented in Table 6-11).

6.4.3.8 Marine Renewables Strategic Environmental Assessment (MRSea) was used to estimate abundances of receptors for use in distributional response and collision risk assessments. However, MRSea cannot be used in the event of low count data. This meant that, for many species, a number of surveys could not be analysed using MRSea. Therefore, in months of low counts, design-based estimates were used as an alternative approach. The list below sets out the approach used for each species in scope for distributional response assessment (further details can be found in the relevant species sections):

- Guillemot: Model-based full year;
- Razorbill: Model-based breeding season; design-based non-breeding season;
- Puffin: Model-based breeding season; design-based non-breeding season;
- Kittiwake: Model-based breeding season; design-based non-breeding season; and
- Gannet: Design-based full year.

6.4.3.9 For collision risk assessments, design-based estimates were used for all species in scope. This is because the median was found to be a more representative measure of central tendency when presenting abundance and density estimates in the MRSea analysis. As such, the SD – a required input into sCRM – was not available for model-based estimates. Therefore, design-based estimates have been used for collision risk modelling to conform with NatureScot guidance for this assessment. This was agreed with NatureScot during consultation as confirmed via email on 07 August 2024 and as shown in Volume 7B, Appendix 6-6: Offshore Ornithology Consultation Agreement Log.

Table 6-8: MMFR + 1S.D. (where available) used for seabird species as per Woodward *et al*. (2019[20]).

Species	MMFR + 1SD
Kittiwake	156.1 ± 144.5 km
Common gull	50 km
Great black-backed gull	73 km
Herring gull	58.8 ± 26.8 km
Lesser black-backed gull	127 ± 109 km
Common tern	18.0 ± 8.9 km
Arctic tern	25.7 ± 14.8 km
Great skua	443.3 ± 487.9 km
Arctic skua	2.5 km
Common guillemot	73.2 ± 80.5 km (55.5 ± 39.7 km)*
Razorbill	88.7 ± 75.9 km (73.8 ± 48.4 km)*
Black guillemot	4.8 ± 4.3 km
Puffin	137.1 ± 128.3 km
Red-throated diver	9 km
Great northern diver	-
Fulmar	542.3 ± 657.9 km
Sooty shearwater	-
Manx shearwater	1,346.8 ± 1,018.7 km
Gannet	315.2 ± 194.2 km^

Note '-' identifies species not listed in Woodward *et al*. (2019[20]).

*Distances in brackets exclude data from Fair Isle where foraging range may have been unusually high as a result of reduced prey availability during the study year (Woodward *et al*., 2019[20]). These foraging ranges were used for sites south of the Pentland Firth for guillemot and razorbill as per the NatureScot Guidance Note 3 (NatureScot, 2023c[40]).

^ NatureScot Guidance Note 3 (NatureScot, 2023c[40]) recommends the use of extended ranges for three SPAs (Grassholm, St Kilda, and Forth Islands). However, Grassholm SPA remains out of scope despite the increased MMFR and St Kilda and Forth Islands SPAs are within the standard MMFR ± 1SD, thus the standard foraging range has been used.

Table 6-9: Calculation of regional reference breeding season population.

Species	Breeding Population at Colonies within MMFR + 1S.D. Foraging Range	Estimated Immatures per Breeding Adult in Population (Furness, 2015[23])	Estimated Juvenile, Immature and Non-breeding Individuals	Potential Total Regional Baseline Population During the Breeding Season
Kittiwake	264,269	0.88	232,557	496,826
Great black-backed gull	2,103	1.26	2,650	4,753
Herring gull	20,375	1.09	22,209	42,584
Great skua	8,561	1.42	12,157	20,718
Guillemot	751,423	0.74	556,053	1,307,476
Razorbill	135,131	0.75	101,348	236,479
Puffin	354,780	1.04	368,971	723,751
Gannet	508,571	0.81	411,943	920,514

Table 6-10: Breeding and non-breeding regional reference populations for seabird species.

Species	Breeding Season Reference Population (Individuals)	Non-breeding Season Reference Population* (Adult and Immature) (Furness, 2015[23])	Biogeographic Population (Furness, 2015[23])
Kittiwake	496,826	829,937 (autumn migration)	5,100,000
Great black-backed gull	4,753	91,399 (non-breeding)	235,000
Herring gull	42,584	466,511 (non-breeding)	1,098,000
Great skua	20,718	19,556 (autumn migration)	73,000
Guillemot	1,307,476	1,307,476 (non-breeding)	4,125,000
Razorbill	236,479	591,874 (autumn migration)	1,707,000
Puffin	723,751	231,957 (non-breeding)	11,840,000
Gannet	920,514	456,298 (autumn migration)	1,180,000
* Where there are multiple non-breeding season population estimates, the largest population estimate was used.			

Table 6-11: Demographic rates and population age ratio for each species.

Species	Parameter	Survival (Age Class)							Productivity (Chicks per Pair)	Average Mortality
		0-1	1-2	2-3	3-4	4-5	5-6	Adult		
Kittiwake	Demographic rate	0.790	0.854	0.854	0.854	-	-	0.854	0.690	0.156
	Population age ratio	0.153	0.121	0.103	0.088	-	-	0.535	-	-
Great black-backed gull	Demographic rate	0.798	0.834	0.834	0.834	0.834	-	0.885	1.111	0.160
	Population age ratio	0.177	0.141	0.115	0.094	0.076	-	0.397	-	-
Herring gull	Demographic rate	0.798	0.834	0.834	0.834	0.834	-	0.834	0.920	0.172
	Population age ratio	0.177	0.141	0.118	0.098	0.082	-	0.384	-	-
Guillemot	Demographic rate	0.560	0.792	0.917	0.917	0.939	0.939	0.939	0.672	0.138
	Population age ratio	0.160	0.090	0.017	0.065	0.061	0.570	0.496	-	-
Razorbill	Demographic rate	0.630	0.630	0.630	0.895	0.895	-	0.895	0.570	0.193
	Population age ratio	0.163	0.103	0.065	0.041	0.037	-	0.591	-	-

Species	Parameter	Survival (Age Class)							Productivity (Chicks per Pair)	Average Mortality
		0-1	1-2	2-3	3-4	4-5	5-6	Adult		
Puffin	Demographic rate	0.709	0.709	0.709	0.760	0.805	-	0.906	0.617	0.175
	Population age ratio	0.158	0.112	0.079	0.056	0.043	-	0.552	-	-
Great skua	Demographic rate	0.730	0.730	0.730	0.730	0.730	0.882	0.882	0.651	0.219
	Population age ratio	0.161	0.117	0.086	0.063	0.046	0.033	0.494	-	-
Gannet	Demographic rate	0.424	0.829	0.891	0.895	0.895	-	0.919	0.700	0.187
	Population age ratio	0.191	0.081	0.067	0.060	0.054	-	0.547	-	-

Intertidal Ornithology

6.4.3.10 Several bird species are likely to be reliant on the intertidal habitats in the vicinity of the cable landfall and the nearshore parts of the OECC.

6.4.3.11 The main source of data used to identify key receptors for the intertidal assessment was the intertidal vantage point surveys take across the landfall site. Intertidal surveys were undertaken between October to March in 2022 until 2024. Across the intertidal survey 23 bird species were recorded (see paragraph 6.7.1.10) within the intertidal zone with waders and phalacrocoracida being the most recorded species groups, while redshank was the most frequently sited bird. Behaviours of birds ranged during the survey with the majority of bird seen feeding within the intertidal zone.

6.4.3.12 The species recorded in the intertidal surveys were assessed for distributional response impacts associated with construction and decommissioning activities within the intertidal zone (see Section 6.7.1). Further information on the intertidal baseline is presented within Volume 5, Chapter 3: Terrestrial Ecology and Biodiversity.

6.4.4 Do Nothing Baseline

6.4.4.1 An assessment of the future baseline conditions assuming the Proposed Development (Offshore) does not go forward has been carried out and is described within this section.

6.4.4.2 The baseline environment will exhibit some degree of natural change over time due to naturally occurring processes and cycles, with or without the Proposed Development (Offshore) in place. Key anthropogenic pressures driving variation in seabird population sizes and distribution are considered to be climate change, prey availability, bycatch (entanglement in fishing gear), invasive alien species, and pollution (Dias *et al*., 2019[98]; Mitchell *et al*., 2020[99]; Royal Haskoning DHV, 2019[100]), with collision risk and distributional responses due to OWFs highlighted as emerging threats (Dias *et al*., 2019[98]; Mitchell *et al*., 2020[99]). However, the scale of impact of collision and distributional responses is considered minor in contrast to other pressures, especially with regard to emerging evidence on behavioural responses to OWFs outlined in Section 6.7. Therefore, the baseline characterisation of the Caledonia OWF and OECC described in Section 6.4.3 (and Volume 7B, Appendix 6-1: Offshore Ornithology Baseline Characterisation Report) represents a 'snapshot' of the present ornithological abundance and distribution within a gradual yet continuously changing environment. Any changes that may occur during the 35-year lifetime of the Proposed Development should be considered in the context of greater variability and sustained trends occurring on national and international scales within the marine environment.

6.4.4.3 Climate change is considered to be the greatest driver of seabird population change (IPCC, 2023[101]) with extreme weather events leading to reduced seabird breeding success and mortalities as a result of changes to prey availability and abundance (Daunt *et al*., 2017[102]; Daunt and Mitchell, 2013[103]; Jenouvrier, 2013[104]; Mitchell *et al*., 2020[99]; Morley *et al*., 2016[105]; Newell *et al*., 2015[106]). Interactions between prey availability and climate change have been widely reported (e.g., Lindegren *et al*., 2018[107]; MacDonald *et al*., 2018[108], 2015[109]; Régnier *et al*., 2019[110]; Sandvik *et al*., 2012[111], 2005[112]; Wright *et al*., 2018[113]), with climate change driving dealignment between fish spawning and bird breeding periods, leading to reductions in food available for chick rearing (Brander *et al*., 2016[114]), which in turn results in productivity impacts. As such, despite the recent UK wide closure of sandeel fisheries, the overall benefit may be difficult to quantify or will be limited if prey species are still affected by climate change shifts. According to Daunt *et al*. (2008[115]), the closure of the sandeel fishery off eastern Scotland in 2000 did benefit seabirds (kittiwake in particular) although the effectiveness of fisheries closures is likely to be impacted by environmental conditions pre- and post- closure. It should also be noted the impacts will vary spatially, for example prey recruitment in some areas may be less affected (ClimeFish, 2019[116]; Frederiksen *et al*., 2005[117]). However, impacts on prey recruitment are generally expected to increase in severity with increased incidences of warming and extreme weather predicted in climate models (Palmer *et al*., 2018[118]), and therefore it is likely that impacts on seabirds in relation to prey availability will similarly increase in both frequency and magnitude.

6.4.4.4 Additionally, the recent outbreak of HPAI across North Atlantic colonies has severely impacted seabird population sizes, breeding success and survival (Lean *et al*., 2022[119]; Lane *et al*., 2023[120]). Many UK species have shown a population decline of >10% compared to populations pre-HPAI outbreak (Tremlett *et al*., 2024[92]). The impacts of this outbreak are considered to be ongoing as the disease advances (Tremlett *et al*., 2024[92]). The frequency of disease outbreaks in the future is unknown (Mitchell *et al*., 2020[99]). Substantial declines of key seabird species population have been occurring for two decades in the UK and especially in the North Sea (Grandgeorge *et al*., 2008[121]; Burnell *et al*., 2023[91]; Mitchell *et al*., 2020[99]). Seabird populations are likely to continue their decline in future decades as they face ecological challenges from new and existing pressures (Mitchell *et al*. 2020[99]).

6.4.4.5 The Proposed Development (Offshore) would form part of a wider strategy to reduce greenhouse gas emissions via renewable energy solutions, with the aim of reducing climate change impacts. As with other renewable energy initiatives, suitable offshore wind sites are constrained by environmental and metocean conditions within the exclusive economic zone (EEZ) (including transport of energy onshore) (Weiss *et al*., 2018[122]). If the Proposed Development did not proceed, the associated benefits of reducing carbon emissions would be lost, potentially contributing to current downward trends in the breeding populations of vulnerable seabird species, such as kittiwakes. These birds are already considered at risk due to the impact of climate change on their prey distribution (RSPB, 2018[123]).

6.4.4.6 In summary, baseline conditions are not static, and most seabird populations are likely to experience some level of change over time, with or without the construction of the Proposed Development (Offshore).

6.4.5 Data Gaps and Limitations

6.4.5.1 The data sources used in this EIAR chapter are detailed in Table 6-5 with additional relevant information from Volume 7B, Appendix 6-1: Offshore Ornithology Baseline Characterisation Report. The desktop data used are the most up to date publicly available information which can be obtained from the applicable data sources as cited. It should be noted that the desktop data available have not been specifically collected to inform this EIA chapter and therefore the temporal scale, spatial scale, and methodological approaches might not be optimised for that purpose. Data availability for some sources may be several years old, and therefore may not fully reflect the changing environment.

6.4.5.2 The marine environment is highly variable, both spatially and temporally, and as such bird numbers may fluctuate greatly between months, seasons and between different years at any given location. However, site-specific baseline survey data to inform the assessments within this chapter were collected over a 24-month period to account for any interannual variation and to ensure robust representation of the Caledonia OWF and surrounding buffer area for the purpose of impact assessment.

Highly Pathogenic Avian Influenza

6.4.5.3 In relation to addressing impacts of Highly Pathogenic Avian Influenza ("HPAI"), the Applicant, in undertaking the EIA, has considered the impact of HPAI on colonies as detailed in the NatureScot and RSPB representations for other recent OWF Projects.

6.4.5.4 The first instance of the recent outbreak of the HPAI (H5NI strain) was recorded in the UK in April 2022 in great skuas (Falchieri *et al*., 2022[124]). In the UK, a total of 23 seabird species have tested positive for HPAI (Defra, 2023[125]). Across Scotland, 20,500 seabirds were reported dead within five months of 2022 (NatureScot, 2023c[40]). Gannet, great skua and guillemot were considered to have been the most impacted by HPAI in 2022, on account of the minimum loss, recovery rate and the number of positive cases (NatureScot, 2023c[40]).

6.4.5.5 The RSPB established a HPAI Seabird Surveys Project which provided a comparison of pre-HPAI colony counts from Burnell *et al*. (2023[91]) and post-HPAI counts, following surveys undertaken in summer 2023 (Tremlett *et al*., 2024[92]). Gannet AONs at UK breeding colonies surveyed in 2023 declined by

25% compared to pre-HPAI baseline, with changes at Scottish colonies (of which six were surveyed) ranging between declines of 3% (Fair Isle) to 37% (Hermaness, Saxa Vord and Valla Field). However, the declines at most sites are likely to be worse than indicated, owing to the previously increasing population and the length of time since the baseline counts were made.

6.4.5.6 Kittiwake AONs at the 21 UK colonies surveyed increased by 8% relative to the baseline counts (Tremlett *et al*., 2024[92]). Across the 19 Scottish breeding colonies surveyed, the average change in population between the baseline and 2023 counts was a 16% increase and a 21% increase in the Scottish breeding population overall, with most larger colonies recording population increases. However, trends were highly variable between colonies.

6.4.5.7 Guillemot counts at the national level remained relatively stable when compared with the pre-HPAI baseline, contrasting with a period of declining populations prior to the baseline count. Different trends were recorded by colony, with both increases (e.g. Cape Wrath, Fowlsheugh, North Caithness Cliffs and St Kilda) and decreases (e.g. Copinsay, Forth Islands, St. Abb's Head to Fast Castle) of up to around a third reported (Tremlett *et al*., 2024[92]).

6.4.5.8 The baseline DAS occurred between April 2021 and April 2023 and therefore the mean seasonal peaks in abundance occur for some species and seasons during the HPAI outbreak. Consideration of when the mean peak abundances are observed within a season and the timing of HPAI at colonies has been taken into account for gannet.

6.4.5.9 The gannet mean peak count calculated for the breeding season is derived from the June 2021 and June (4th) 2022 surveys. The first clinical symptoms of HPAI were observed in gannets on the Bass Rock on 4th June 2022 (Lane *et al*., 2023[120]) and short-term behavioural changes in gannet foraging distribution and distance travelled as a consequence of colony infection was recorded in tagged birds from the third week of June (Jeglinski *et al*., 2023[126]). Although the breeding season peak abundance between years is approximately two-fold higher in 2022 this is not unexpected considering the annual variations in peak counts which are often observed. Furthermore, when accounting for the size of the confidence intervals the breeding peak abundance between years is not significantly different (see Volume 7B, Appendix 6-1: Offshore Ornithology Baseline Characterisation Report). Therefore, the most appropriate population to assess impacts on the Bass Rock colony (Forth Islands SPA) would be prior to colony decline due to HPAIV. As the mean peak count over the Project area represents gannet abundance in relation to the colony population prior to the mass infection mortality event. The last count at Bass Rock was undertaken ten years ago in 2014 of 75,259 AOS. NatureScot guidance note 5 (NatureScot, 2023a[10]) advises that the most up to date counts are used. Although a drone survey of Bass Rock was undertaken in 2023 which estimated the population to be 51,844 AOS (Harris *et al*., 2023[12725]) this post HPAI outbreak colony population would not be appropriate for assessment. However, Wanless *et al*., (2023[128]) estimated that there would have been in the region of 81,000 AOS in 2021 prior to the outbreak of HPAI in 2022 and confirmed as a reliable estimate in Harris *et al*., (2023[127]).

6.4.5.10 Therefore, the Applicant would consider the Bass Rock gannet population estimate of 81,000 AOS to be the most appropriate and up-to-date to be used in assessments for Project as it represents the population associated with the derived mean peak abundance over the Project area during the breeding season.

6.4.5.11 The seasonal peak count for the non-breeding season occurred in October 2021 in year one and October 2022 in year two. The peak counts therefore occur prior to the outbreak of HPAI in year one and during the outbreak in year two. These peak counts differ significantly between years; 386 vs 58, a 6-7-fold difference. This may suggest that the year two peak count does not represent normal inter annual variation and is a reflection of population decline due to HPAI.

6.4.5.12 Therefore, the Applicant would not consider it appropriate to mean the yearly non-breeding peak counts as the year two counts are highly likely to be unrepresentative of normal inter annual variation and Project site usage. The peak count from the year one non- breeding season rather than an ambiguous mean peak from the two years would be a more robust estimate.

Wider Moray Firth Zone

6.4.5.13 As noted, site-specific DAS was flown between May 2021 and April 2023. During this time period it is important note any ongoing or future works for other OWF developments within the Moray Firth Zone. Construction of Moray East OWF commenced in 2019, with the last turbine installed in August 2021, meaning that construction activities for Moray East partially overlapped with baseline collection for the Proposed Development (Offshore). If construction works within Moray East resulted in distributional response effects, then there is potential that the abundance within the Proposed Development (Offshore) may have been inflated due to distributional responses. However, as detailed within the Volume 7B, Appendix 6-1, Annex 15: MRSea Method Statement, any potential influence from Moray East has been accounted for within MRSea modelling via Random forests additional analysis. Additionally, the construction of Moray West OWF did not commence until after all DAS surveys were collected, thus there is no potential for such works to influence baseline data collection.

6.5 EIA Approach and Methodology

6.5.1 Overview

6.5.1.1 This section outlines the methodology for assessing the likely significant effects on Offshore Ornithology from the construction, operation and decommissioning of the Proposed Development (Offshore).

6.5.2 Impacts Scoped into the Assessment

6.5.2.1 The Offshore Scoping Report (Volume 7, Appendix 2) was submitted to MD-LOT in September 2022. The Offshore Scoping Report set out the overall approach to assessment and allowed for the refinement of the Proposed Development (Offshore) over the course of the assessment. In accordance to recommendations from the Scoping Opinion (see Table 6-3 for comments and applicant responses) regarding the approach and impact pathways assessed for the Proposed Development (Offshore), the proposed scope of the assessment is set out in Table 6-12.

Table 6-12: Impacts scoped in for Offshore Ornithology.

Potential Impact	Phase	Nature of Impact
Distributional Responses (including Barrier Effects): Array Area	Construction Operation Decommissioning	Indirect
Distributional Responses: OECC and Landfall Site	Construction Decommissioning	Indirect
Distributional Responses: Vessel Transit (Moray Firth SPA)	Construction Operation Decommissioning	Indirect
Collision Risk	Operation	Direct
Indirect Impacts on Prey Species	Construction Operation Decommissioning	Indirect
Artificial Light	Operation	Direct

6.5.3 Impacts Scoped out of the Assessment

6.5.3.1 The impacts scoped out of the assessment during EIA scoping, and the justification for this, are listed in Table 6-13.

Table 6-13: Impacts scoped out for Offshore Ornithology.

Potential Impact	Justification
Indirect impacts through effects on prey species and habitats: Accidental pollution during construction	Chemical and oil inventories on vessels working during construction and decommissioning stages will be small in size. In the event of an accidental chemical or oil spill, hydrocarbons would rapidly be dispersed or diluted. In addition, all vessels working on the Proposed Development (Offshore) will be required to comply with strict environmental controls set out in the EMP and Marine Pollution Contingency Plan (MPCP) which will minimise the risk and set out provisions for responding to spills during construction and decommissioning. Due to the implementation of control measures and small quantities of hydrocarbons and chemicals it is proposed to scope this impact out of further consideration within the EIA.
Distributional responses from wet storage for floating WTG	The assessment of potential impacts from wet storage have been discussed with MD-LOT, NatureScot and RSPB. It was concluded that consideration of wet storage would not be necessary within this assessment as this impact will be assessed through other marine licence applications for the Proposed Development (Offshore), specifically Caledonia South, as required.
Collision risk from wet storage for floating WTG	The assessment of potential impacts from wet storage have been discussed with MD-LOT, NatureScot and RSPB. It was concluded that consideration of wet storage would not be necessary within this assessment as this impact will be assessed through other marine licences for the Proposed Development (Offshore), specifically Caledonia South, as required.
Operational distributional responses (OECC)	Given that potential impacts along the OECC would be highly localised and episodic (i.e., limited to any maintenance or repair of the export cables), it has been scoped out from further consideration within the EIA in relation to the OECC, with the focus of operation distributional responses from the Caledonia OWF only.
Artificial Light (Construction and decommissioning)	Given the potential impacts of artificial lighting during the construction and decommissioning phase would be localised and episodic (limited to vessel traffic and safety lighting in the array area during construction/decommissioning), it has been scoping out from further consideration within the EIA with the focus of artificial lighting during the operational phase within the Caledonia OWF only.

6.5.4 Assessment Methodology

6.5.4.1 The project-wide generic approach to assessment is set out in Volume 1, Chapter 7: EIA Methodology and follows the source pathway receptor approach. The assessment methodology for Offshore Ornithology for the EIAR is consistent with that provided in the Offshore Scoping Report (Volume 7, Appendix 2).

6.5.4.2 The criteria for determining the significance of effects is a two-stage process that involves defining the sensitivity of the receptors and the magnitude of the potential impacts. The following sections describe the criteria applied in this chapter to assign values to the sensitivity of the ornithology receptors and the magnitude of potential impacts.

Receptor Sensitivity

6.5.4.3 The sensitivity of ornithological receptors in the assessment have been classed as 'High', 'Medium', 'Low' or 'Negligible' and is determined from expert judgement (CIEEM, 2022[1]), based on the vulnerability (Table 6-14), conservation value (Table 6-15) and the confidence in sensitivity to impact pathways for each receptor. The overall sensitivity must be identified on a species-by-species basis, noting that any particular species with a high conservation value may not be sensitive to a specific effect and vice versa.

6.5.4.4 The vulnerability of ornithology receptors to potential OWF impacts have previously been reviewed (e.g., Furness and Wade, 2012[53]; Furness *et al*., 2013[55]; Bradbury *et al*., 2014[77]; Dierschke *et al.,* 2016[129]). Conclusions from these reviews have been used to inform definitions of sensitivity for ornithological receptors. Table 6-14 presents examples of different vulnerability levels for ornithological receptors.

Table 6-14: Example definitions of different vulnerability levels of ornithological receptors for two impact pathways.

Receptor Vulnerability	Definition
High	Bird species has very limited tolerance of sources of disturbance such as noise, light, vessel movements, offshore structures and human activity. Receptors have a very high vulnerability to collision impacts.
Medium	Bird species has limited tolerance of sources of disturbance such as noise, light, vessel movements, offshore structures and human activity. Receptors have a moderate vulnerability to collision impacts.
Low	Bird species has some tolerance of sources of disturbance such as noise, light, vessel movements, offshore structures and human activity. Receptors have a low vulnerability to collision impacts.
Negligible	Bird species is generally tolerant of sources of disturbance such as noise, light, vessel movements, offshore structures and human activity. Receptors have a very low vulnerability to collision impacts.

6.5.4.5 The population from which individuals are predicted to originate also contributes to the conservation value of ornithological receptors. Conservation value levels assigned to ornithological receptors reflects the current understanding of movements of the relevant species, with site-based protection (e.g. SPAs) generally limited to specific time-periods (e.g. the breeding season). Conservation value can therefore vary throughout the year, depending on the relative sizes of the number of individuals predicted to be at risk of impact and the population from which they are estimated to be drawn. The conservation value assigned to a species will correspond to the degree of connectivity predicted between the Proposed Development (Offshore), and protected populations. In Table 6-15 below, examples of the criteria for defining conservation value are presented, with values assigned to species likely to vary throughout the year.

Table 6-15: Example definitions of different conservation value levels for ornithological receptors.

Conservation Value	Definition
High	A species for which individuals at risk can be clearly connected to a particular SPA or is found in numbers of international importance within the Proposed Development (Offshore).
Medium	A species for which individuals at risk are probably drawn from particular SPA populations or found in numbers of national importance within the Proposed Development, although other colonies (both SPA and non-SPA) may also contribute to individuals observed in the offshore and intertidal ornithology study area.
Low	A species for which it is not possible to attribute designated sites and may be found in regionally or locally important numbers, or for which no sites are designated.
Negligible	Species that are widespread and common and which are not present in locally important (or greater) numbers, and which are of low conservation concern.

Impact Magnitude

6.5.4.6 Impacts on receptors are also judged based on their magnitude, referring to the anticipated scale of an impact. The scale of impact is determined on a quantitative basis where possible. The impact magnitude may relate, for example, to the area of habitat lost to the development footprint in the case of a habitat feature or predicted loss of individuals in the case of a population of a species of bird. Four levels are used to determine impact magnitude, detailed in Table 6-16.

6.5.4.7 Recovery time following the cessation of an activity is a metric commonly used to determine impact magnitude. However, it is often challenging to quantify recovery timescales and predictions can be highly uncertain. Where this has been possible, recovery has been considered as part of the impact magnitude assessment.

Table 6-16: Impact magnitude definitions for Offshore Ornithology.

Impact Magnitude	Definition
High	A change in the size or extent of distribution of the relevant biogeographic population or the population that is the interest feature of a specific protected site that is predicted to irreversibly alter the population in the short to long-term and to alter the long-term viability of the population and/or the integrity of the protected site. Recovery from that change predicted to be achieved in the long-term (i.e., more than five years) following cessation of the development activity.
Medium	A change in the size or extent of distribution of the relevant biogeographic population or the population that is the interest feature of a specific protected site that occurs in the short and long-term, but which is not predicted to alter the long-term viability of the population and/or the integrity of the protected site. Recovery from that change predicted to be achieved in the medium-term (i.e., no more than five years) following cessation of the development activity.
Low	A change in the size or extent of distribution of the relevant biogeographic population or the population that is the interest feature of a specific protected site that is sufficiently small-scale or of short duration to cause no long-term harm to the feature/ population. Recovery from that change predicted to be achieved in the short-term (i.e., no more than one year) following cessation of the development activity.
Negligible	Very slight change from the size or extent of distribution of the relevant biogeographic population or the population that is the interest feature of a specific protected site. Recovery from that change predicted to be rapid (i.e., no more than c. six months) following cessation of the development activity.

Impact Significance

6.5.4.8 The potential significance of the effect upon ornithological receptors is determined by considering both the sensitivity of the receptor and the magnitude of the impact. Table 6-17 below sets out a matrix to guide how impact magnitude and receptor sensitivity interact to facilitate a judgement of significance of effect.

Table 6-17: Relationship between impact magnitude and receptor sensitivity to use as a guide to assign significance of effect.

Significance of Effect		Sensitivity of Receptor			
		Negligible	Low	Medium	High
Impact Magnitude	Negligible	Negligible	Negligible	Negligible	Negligible
	Low	Negligible	Negligible	Minor	Minor
	Medium	Negligible	Minor	Moderate	Moderate
	High	Negligible	Minor	Moderate	Major

6.5.4.9 For the purposes of this assessment, any effect that is of major or moderate significance is considered to be 'significant' in EIA terms, as highlighted in grey in Table 6-17. Any effect that has a significance of minor or negligible is considered to be 'not significant' in EIA terms. A typical categorisation for effect significance is provided in Table 6-18. An assessment of the significance of potential effects is described in Sections 6.7 and 6.8.

Table 6-18: Categorisation for effect significance.

Expression	Definition	Significance
Major	Very large or large change in receptor condition, either adverse or beneficial, which are likely to be important considerations at a regional or district level because they contribute to achieving national, regional or local objectives, or could result in exceedance of statutory objectives and/or breaches of legislation.	Significant
Moderate	Intermediate change in receptor condition, which are likely to be important considerations at a local level.	Significant
Minor	Small change in receptor condition, which may be raised as local issues but are unlikely to be important in the decision-making process.	Not Significant
Negligible	No discernible change in receptor condition.	Not Significant

6.5.5 Embedded Mitigation

6.5.5.1 Where possible, mitigation measures will be embedded into the design of the Proposed Development (Offshore) applications, specifically Caledonia North and Caledonia South. These measures will be included with the objective to reduce the potential for impacts on the environment. Where embedded mitigation measures have been developed into the design with specific regard to Offshore Ornithology, these are described in Table 6-19. The impact assessment presented in Sections 6.7 to 6.10 take into account this embedded mitigation.

Table 6-19: Embedded mitigation.

Code	Embedded Mitigation Measure	Securing Mechanism
M-3	Development of and adherence to a Construction Method Statement (CMS). The CMS will confirm construction methods and the roles and responsibilities of parties engaged in construction. It will detail any construction-related mitigation measures.	To be secured as a condition of the Generation Asset and Transmission Asset Marine Licences for both Caledonia North and Caledonia South.
M-8	Development of and adherence to an Environmental Management Plan (EMP). The EMP will set out mitigation measures and procedures relevant to environmental management, including but not limited to the following topics: Chemical usage, invasive non-native marine species, dropped objects, pollution prevention and contingency planning, and waste management.	To be secured as a condition of the Generation Asset and Transmission Asset Marine Licences for both Caledonia North and Caledonia South.
M-11	Development of and adherence to a Piling Strategy (PS) (applicable where piling is undertaken). The PS will detail the method of pile installation and associated noise levels. It will describe any mitigation measures to be put in place (e.g., soft starts and ramp ups, use of Acoustic Deterrent Devices) during piling to manage the effects of underwater noise on sensitive receptors.	To be secured as a condition of the Generation Asset and Transmission Asset Marine Licences for both Caledonia North and Caledonia South.
M-12	Development of and adherence to a Project Environmental Monitoring Programme (PEMP). The PEMP will set out commitments to environmental monitoring in pre-, during and post-construction phases of the Proposed Development (Offshore).	To be secured as a condition of the Generation Asset and Transmission Asset Marine Licences for both Caledonia North and Caledonia South.
M-13	Development of and adherence to a Vessel Management Plan (VMP). The VMP will confirm the types and numbers of vessels that will be engaged on the Proposed Development (Offshore), and consider vessel coordination including indicative transit route planning.	To be secured as a condition of the Generation Asset and Transmission Asset Marine Licences for both Caledonia North and Caledonia South.
M-14	Development of and adherence to a Lighting and Marking Plan (LMP). The LMP will confirm compliance with legal requirements with regards to shipping, navigation and aviation marking and lighting.	To be secured as a condition of the Generation Asset and Transmission Asset Marine Licences for both Caledonia North and Caledonia South.

Code	Embedded Mitigation Measure	Securing Mechanism
M-15	Blade clearance of at least 35 m above Mean Sea Level (MSL) (minimum blade clearance of 35 m will be maintained for floating WTGs due to tidal movements).	To be secured as a condition of the Generation Asset Marine Licences for both Caledonia North and Caledonia South (note, floating WTGs are not included within the design envelope for Caledonia North).
M-106	Trenchless techniques (Horizontal Directional Drilling) will be used as installation methodology at landfall to avoid direct impacts to the intertidal area.	To be secured as a condition of the Transmission Asset Marine Licences for both Caledonia North and Caledonia South.

6.6 Key Parameters for Assessment

6.6.1.1 Volume 1, Chapter 3: Proposed Development Description (Offshore) details the parameters of the Proposed Development (Offshore) using the DE approach. This section identifies those parameters during construction, operation and decommissioning relevant to potential impacts on Offshore Ornithology.

6.6.1.2 Within the NatureScot (2023a[10]) Guidance, both a worst-case scenario and most-likely scenario are requested for the collision risk assessment. As collision risk is directly impacted by the WTG parameters (number and dimensions), collision risk (including migratory) is the only impact pathway that requires a MLS/WCS approach.

6.6.1.3 The worst-case assumptions with regard to Offshore Ornithology are summarised in Table 6-20. Due to external factors beyond the control of the Applicant, such as the constantly evolving WTG market conditions and technology advancements, it has not been possible for the applicant to define an MLS with confidence prior to undertaking the assessment. The assessment therefore focuses on CRMs calculated using the WCS only and is presented within this EIAR chapter. The results from all the proposed design scenarios are presented in Volume 7B, Appendix 6-3: Offshore Ornithology Collision Risk Modelling Technical Report and supporting Annexes.

Table 6-20: Worst case assessment scenario considered for each impact as part of the assessment of likely significant effects.

Potential Impact	Assessment Parameter	Explanation
Construction		
Impact 1: Distributional Responses: Caledonia OWF	**Construction/installation:** Caledonia OWF area of 423km^2, with potential distributional responses occurring out to a 2km buffer = 637km^2 **Vessel Activity:** - Foundation piling: 280 vessel movements - Substructure:560 vessel movements - WTG installation: 397 vessel movements - WTG commissioning: 793 vessel movements - Array Area cables installation and hook up: 1,450 vessel movements - Export Cables: 116 vessel movements - Total construction vessel movements: 3,992	The maximum estimated number of vessels associated with the construction of the Caledonia OWF.
Impact 2: Distributional Responses: Construction and associated vessel traffic within the Offshore Export Cable Corridor (OECC)	**Vessel Activity:** - 116 vessel movements over the construction phase.	The maximum estimated number of vessels associated with the construction of the OECC.
Impact 3: Distributional Responses: Vessel Transit (Moray Firth SPA)	**Vessel Activity:** - 3,876 vessel movements over the construction phase that pass through the Moray Firth SPA.	The construction ports and vessel routes have not been confirmed at the time of EIA. Thus, this assessment considers the worst case of all construction vessels may pass through the Moray Firth and presents the maximum estimated number of vessels to transit through the Moray Firth SPA.

Potential Impact	Assessment Parameter	Explanation
Impact 4: Indirect Effects: Habitat Loss/Displacement of Prey Species	See Worst Case Assessment Scenario for the Benthic and Intertidal Ecology assessment (Volume 2, Chapter 4: Benthic Subtidal and Intertidal Ecology, Impact 1-3) and for the Fish and Shellfish Ecology assessment (Volume 2, Chapter 5: Fish and Shellfish Ecology, impacts 1-5).	Indirect effects on birds could occur through changes to any of the species and habitats considered within the Benthic Subtidal and Intertidal Ecology or Fish and Shellfish Ecology assessments.
Operation and Maintenance		
Impact 5: Distributional Responses: Array Area	**Caledonia OWF:** ▪ Proposed Development (Offshore) area of 423km^2, with potential distributional responses occurring out to a 2km buffer = 637km^2 **WTGs:** ▪ 140 bottom-fixed WTGs **Vessel activity:** ▪ Vessels used during routine inspections, repairs and replacement of equipment, major component replacement, painting or other coatings, removal of marine growth, replacement of access ladders, and geophysical surveys.	As per the NatureScot Guidance Note 8 (NatureScot, 2023a[10]), species should be assessed within a wider zone which includes the impacts outside of the development footprint. For the key species of concern assessed for the Caledonia North Site this would be within 2km, with the exception of red-throated diver and sea ducks.
Impact 6: Distributional Responses: Vessel Transit (Moray Firth SPA)	**Vessel Activity:** ▪ Up to 938 vessel round trips movements per year over the operation phase that pass through the Moray Firth SPA.	The construction ports and vessel routes have not been confirmed at the time of EIA. Thus, this assessment considers the worst case of all construction vessels may pass through the Moray Firth and presents the maximum estimated number of vessels to transit through the Moray Firth SPA.

Potential Impact	Assessment Parameter	Explanation
Impact 7: Indirect Effects: Habitat Loss/Displacement of Prey Species	See Worst Case Assessment Scenario for the Benthic and Intertidal Ecology assessment (Volume 2, Chapter 4: Benthic Subtidal and Intertidal Ecology, impacts 4-10) and for the Fish and Shellfish Ecology assessment (Volume 2, Chapter 5: Fish and Shellfish Ecology, impacts 6-11).	Indirect effects on birds could occur through changes to any of the species and habitats considered within the Benthic Subtidal and Intertidal Ecology or Fish and Shellfish Ecology assessments.
Impact 8: Collision Risk	**Caledonia OWF:** Based on WTG deployment across the full Caledonia OWF (423km^2). **WTGs:** ▪ No. of WTGs: 140 bottom-fixed turbines; ▪ Rotor radius: 118m; and ▪ Minimum air gap: 35m relative to MLS (32.81m relative to HAT). ▪ All scenario details outlined in Volume 7B, Appendix 6-3: Offshore Ornithology Collision Risk Modelling Technical Report	This represents the greatest total swept area to be considered for collision risk. CRM shows that WTG scenario 1 has the largest theoretical collision impact risk for all species (see Volume 7B, Appendix 6-3: Offshore Ornithology Collision Risk Modelling Technical Report).
Impact 9: Artificial Light	To satisfy the requirements of the Civil Aviation Authority (CAA), maritime and coastguard agency (MCA) and Northern Lighthouse Board (NLB) appropriate operational marine and navigational lighting and marking will be agreed post consent and set out in a Lighting Management Plan (LMP). Recommendation O-117 or similar and during operations will take into account any new guidance from the Navigation and Offshore Renewable Energy Liaison (NOREL) group. These navigational aids will further maximise mariner awareness when in proximity to the Caledonia OWF as outlined in the Shipping and Navigation assessment (Volume 2, Chapter 9: Shipping and Navigation) Nocturnal receptors - Manx shearwater, sooty shearwater, European and Leach's storm petrel were assessed using the assessment criteria set out in section 6.5.4. As a WCS it is assumed that all species were of a medium sensitivity.	Qualitative assessment was used to determine the sensitivity, conservation value and magnitude to determine the overall significance of artificial lighting on sensitive receptors and impact was considered DAS data.

Potential Impact	Assessment Parameter	Explanation
Decommissioning		
Impact 10: Distributional Responses Caledonia OWF	The worst-case design scenario will be equal to (or less than) that of the construction phase. Refer to Impact 1	The maximum estimated number of vessels associated with the decommissioning of the Caledonia OWF.
Impact 11: Distributional Responses: associated vessel traffic within the OECC	The worst-case design scenario will be equal to (or less than) that of the construction phase. Refer to Impact 2.	The maximum estimated number of vessels associated with the decommissioning of the OECC.
Impact 12: Distributional Responses: Vessel Transit (Moray Firth SPA)	The worst-case design scenario will be equal to (or less than) that of the construction phase. Refer to Impact 3.	The maximum estimated number of vessels to transit through the Moray Firth SPA.
Impact 13: Indirect Effects: Habitat Loss/Displacement of Prey Species	See Worst Case Assessment Scenario for the Benthic and Intertidal Ecology assessment (Volume 2, Chapter 4: Benthic Subtidal and Intertidal Ecology, Impacts 11-14) and for the Fish and Shellfish Ecology assessment (Volume 2, Chapter 5: Fish and Shellfish Ecology, Impacts 12-15).	Indirect effects on birds could occur through changes to any of the species and habitats considered within the Benthic Subtidal and Intertidal Ecology or Fish and Shellfish Ecology assessments.

6.7 Potential Effects

6.7.1 Construction

6.7.1.1 This section presents the assessment of impacts arising from the construction phase of the Proposed Development (Offshore).

6.7.1.2 During these phases, the following effects have been screened in for potential impacts to ornithological features:

- Distributional responses (Impacts 1 to 3):
  - Impact 1: Construction and associated vessel traffic associated with the Array Area
  - Impact 2: Construction and associated vessel traffic within the Offshore Export Cable Corridor
  - Impact 3: Vessel transit routes (through the Moray Firth SPA).
- Impact 4: Indirect Effects - Habitat Loss/Displacement of Prey Species

Impact 1: Distributional Responses - Array Area

6.7.1.3 Seabirds could be disturbed during the construction phase of the Proposed Development (Offshore), namely the installation of foundations, towers, blades, export cables and other infrastructure, as well as the movement of vessels. This disturbance may result in distributional responses of birds from the Proposed Development (Offshore) area, driving a temporary habitat loss and reduce the area available to birds for foraging, loafing, and moulting.

6.7.1.4 The effect of distributional responses from construction are likely to be limited spatially and temporally, primarily affecting birds foraging within the construction area (consisting of the array area, OECC and intertidal zone), with the extent of effects depending on the activities taking place. The effects are also likely reversable in nature, with birds returning to the area following the end of construction phase.

6.7.1.5 It is assumed that the level of impact during the decommissioning phase for distributional responses within the array area would be similar to that of the construction phase and thus the conclusions above are expected to also be applicable to the decommissioning phase.

Impact 2: Distributional Responses - Construction and Associated Vessel Traffic within the Offshore Export Cable Corridor

6.7.1.6 The intertidal ornithology assessment area ranges across the intertidal OECC and landfall area to the low water mark of the landfall site, which the onshore ecology section begins and is subsequently assessed.

6.7.1.7 During construction of the Proposed Development (Offshore), distributional responses due to vessel activity, and construction work in the Offshore Export Cable Corridor may occur for some seabirds and wildfowl. The offshore export cables will make landfall at Stake Ness on the Aberdeenshire coast, located to the west of Whitehills. A full description of the construction of the Proposed Development is presented in Volume 1, Chapter 3: Proposed Development Description (Offshore). It is anticipated that the four offshore export cables will be pulled-in through a conduit prepared by Horizontal Directional Drilling (HDD). This trenchless technique avoids interaction with surface features and is used to install ducts through which cables can be pulled. HDD involves drilling through the ground from an onshore HDD site compound to a point offshore beyond the intertidal area, ideally with sufficient water depth for the cable laying vessel (CLV) to access. it is anticipated that the HDD punch-out location will be situated within the shallow subtidal area and the intertidal zone will be avoided (likely between 10m and 40m water depths).

6.7.1.8 Consequently, the main distributional response impact in the intertidal OECC will be from vessel disturbance at the HDD exit pits.

6.7.1.9 To assess the potential distributional responses during construction and decommissioning in the intertidal zone on bird populations, a 500 m buffer was applied to the intertidal OECC area and landfall site. To assess the connectivity of species observed within the intertidal vantage point surveys, a 15km and 20km buffer was added to the 500m buffer for wildfowl and geese, while MMFR + 1SD was added for seabirds.

6.7.1.10 A range of species were recorded in the intertidal surveys within the intertidal area of Stake Ness. The species found with the greatest peak counts were herring gull, oystercatcher and lapwing. The following 22 species observed in the intertidal area represented <1% of the Scottish population:

- Black-headed Gull (*Larus ridibundus*)
- Common Gull (*Larus canus*)
- Cormorant (*Phalacrocorax carbo*)
- Curlew (*Numenius arquata*)
- Dunlin (*Calidris alpina*)
- Eider (*Somateria mollissima*)
- Fulmar (*Fulmarus glacialis*)

- Goldeneye (*Bucephala clangula*)
- Great Black-backed Gull (*Larus marinus*)
- Guillemot (*Uria aalge*)
- Lapwing (*Vanellus vanellus*)
- Long-tailed Duck (*Clangula hyemalis*)
- Oystercatcher (*Haematopus ostralegus*)
- Peregrine (*Falco peregrinus*)
- Pink-footed Goose (*Anser brachyrhynchus*)
- Razorbill (*Alca torda*)
- Red-breasted Merganser (*Mergus serrator*)
- Redshank (*Tringa totanus*)
- Red-throated Diver (*Gavia stellata*)
- Ringed Plover (*Charadrius hiaticula*)
- Shag (*Phalacrocorax aristotelis*)
- Turnstone (*Arenaria interpres*)

6.7.1.11 Herring gull were observed with peak count of 1,110 individuals over the winter period (October to March) between 2022 and 2024. The individuals observed during the survey period accounted for 1.11% of the Scottish population (Burnell *et al*., 2023[91]). Herring gull are considered to have a low risk to distributional response impacts (Furness & Wade, 2012[53]; Furness *et al.*, 2013[55]; Bradbury *et al*., 2014[77]; SNCBs, Updated 2022[13]). As herring gull have a large foraging range (85.60km, MMFR + 1SD), the distributional response impacts occurring from the localised construction and decommissioning activity are considered to be low. Furthermore, gull species are generally found aggregating around vessels rather than being displaced by them and therefore it is unlikely that impact with occur as a result of vessel activity in proximity to the HDD exit pit.

Magnitude of Impact

6.7.1.12 The impact will only be focused onto one area of the intertidal zone at a time (localised) and the maximum duration of installation of OECC cables will be six months. Work under the HDD exit pit will be carried out over a short period of time, with only 24 hours required to complete excavation of the exit pit and transition zone the activity. Therefore, all activity within the intertidal zone will be temporally limited and reversible in nature.

6.7.1.13 Based upon the limited potential for impacts on intertidal ornithological receptors, with works undertaken being temporally and spatially limited, the magnitude of potential impact is expected to be **Negligible** for the Proposed Development (Offshore).

Sensitivity of intertidal ornithology receptors

6.7.1.14 The species listed above have the potential to be impacted by intertidal works, with varying levels of sensitivity to noise and/or visual disturbance. Although some species may be considered to have high sensitivity levels, the magnitude of impact is expected to remain low.

6.7.1.15 The sensitivity of offshore and intertidal receptors to potential disturbance and distributional response impacts is expected to vary across species ranging from low (gull species) to high (diver species) (Furness & Wade, 2012[53]; Furness *et al*., 2013[55]; Bradbury *et al*., 2014[77]). Conservation value is also variable, ranging from low (cormorant) to high (common gull, great black-backed gull, red-throated diver). Therefore, as precautionary measure the overall assessment uses high sensitivity.

Significance of Effect

6.7.1.16 Taking the precautionary **High** sensitivity of intertidal ornithological receptors and the **Negligible** magnitude of disturbance from vehicles and vessels during construction, the impact is considered to be **Negligible and Not Significant in EIA terms** following the matrix approach (Table 6-17).

6.7.1.17 It is assumed that the level of impact during the decommissioning phase for distributional responses due to OECC related traffic would be similar to that of the construction phase and thus the conclusions above are expected to also be applicable to the decommissioning phase.

Impact 3: Distributional responses - Vessel Transit Routes (through the Moray Firth SPA)

6.7.1.18 There is the potential for vessels to transit through the Moray Firth SPA, which is designated for red-throated diver (*Gavia stellata*). As this species is particularly vulnerable to disturbance from vessel traffic (Statutory Nature Conservation Body (SNCB), 2022[13]), the potential effects from these transit routes have also been considered.

6.7.1.19 There is evidence to suggest the susceptibility of seabirds to disturbance from OWF construction activities varies between species. Dierschke *et al*., (2016[129]) noted both avoidance and attraction to varying degrees to operational wind farms, depending upon the species in question. This observation has also been made by a number of other studies (Fliessbach *et al.,* 2019[130]; Furness *et al.,* 2013[55]; Furness and Wade, 2012[53]; Garthe and Hüppop[47], 2004; MMO, 2018[131]).

6.7.1.20 A screening exercise was undertaken to identify those species likely to be susceptible to distributional responses during the construction phase (Table 6-21).

Table 6-21: Scoping of seabird species recorded within the Caledonia OWF array area and 4km (with the exception of for divers and seaducks) buffer for risk of distributional responses during the construction phase.

Species	Sensitivity to Distributional Responses	Conservation Value	Frequency of Months Recorded in the Caledonia OWF/Baseline DAS Period	Peak Abundance in the Caledonia OWF plus a 2km Buffer/the Caledonia OWF plus 4km Buffer	Scoping Results (In or Out)
Kittiwake	Low	Medium	24 / 24	723 / 1,083	Out
Great black-backed gull	Low	Low	15 / 24	119 / 163	Out
Herring gull	Low	Low	15 / 24	14 / 29	Out
Lesser black-backed gull	Low	Low	2 / 24	4 / 6	Out
Common tern	Low	Low	1 / 24	3 / 3	Out
Arctic tern	Low	Low	2 / 24	7 / 9	Out
Great skua	Low	Low	5 / 24	6 / 10	Out
Guillemot	Medium	Medium	24 / 24	2,388 / 3,127	Out
Razorbill	Medium	Medium	23 / 24	401 / 514	Out
Puffin	Medium	Medium	17 / 24	462 / 562	Out
Red-throated diver	High	Low	1 / 24	1 / 1	In (within OECC)
Fulmar	Low	Medium	23 / 24	1,096 / 1,631	Out
Gannet	Low	Medium	24 / 24	225 / 258	Out
Note, sensitivity based on Bradbury *et al*. (2014[77]) and Dierschke *et al*. (2016[129]). Conservation value based on status presented in Table 6-6.					

6.7.1.21 The impacts of distributional responses during the construction phase of the Proposed Development (Offshore) are unlikely to equal those estimated during the operation and maintenance phase of the Proposed Development (Offshore).

6.7.1.22 Construction phase impacts are temporally and spatially limited. As such, any potential effect would be limited to construction areas and their surroundings, be short term, reversible, and the level of impact limited. For the project alone assessment, it was concluded that there is no material impact for in-scope species with respect to distributional responses during operational and maintenance phase of the Proposed Development (Offshore). Therefore, since the equivalent impacts during the construction phase are predicted to be of a considerably smaller duration, spatial scale and magnitude, as well as being fully reversible, the same conclusion can confidently be made for construction for all sites and receptors scoped in for assessment.

6.7.1.23 It is assumed that the level of impact during the decommissioning phase for distributional responses due to vessel transit routes would be similar to that of the construction phase and thus the conclusions above are expected to also be applicable to the decommissioning phase.

Impact 4: Indirect Effects - Habitat Loss/Displacement of Prey Species

6.7.1.24 During the construction and decommissioning phase of the Proposed Development (Offshore), potential impacts on prey species may indirectly affect ornithological features. Short-term habitat loss may occur due to the construction of turbine foundations and cable removal. Suspended sediments from these activities may result in fish and mobile invertebrates avoiding the area and may smother and hide immobile benthic prey. The resulting increase in turbidity of the water column may also make it harder for seabirds to see their prey. These impacts could therefore result in a reduction in prey available to foraging seabirds within the array area. Such potential effects on benthic invertebrates and fish have been assessed in Volume 2, Chapter 4: Benthic Subtidal and Intertidal Ecology and Volume 2, Chapter 5: Fish and Shellfish Ecology and the conclusions of those assessments inform this assessment of indirect effects on ornithology receptors.

6.7.1.25 The impacts of distributional responses during the construction phase of the Proposed Development (Offshore) are unlikely to equal those estimated during the operation and maintenance phase of the Proposed Development (Offshore) as these impacts are temporally and spatially limited. Thus, any potential effect would be limited to construction areas and their surroundings, and be short term, reversible, with a limited level of impact. It was concluded that there is no material impact for in-scope species with respect to indirect effects during operational and maintenance phase of the Proposed Development (Offshore) (see section 6.7.2.108 to 6.7.2.110). Therefore, since the equivalent impacts during the construction phase are predicted to be of a considerably smaller duration, spatial scale and magnitude, as well as being fully reversible, the same conclusion can confidently be made for construction for all sites and receptors scoped in for assessment.

6.7.1.26 It is assumed that the level of impact during the decommissioning phase for habitat loss/displacement of prey would be similar to that of the construction phase and thus the conclusions above are expected to also be applicable to the decommissioning phase.

6.7.2 Operation

Impact 5: Distributional Responses - Array Area

6.7.2.1 During the operational phase, the Proposed Development (Offshore) may directly disturb and displace vulnerable seabirds within and around the Array Area and may also cause barrier effects. A full assessment of distributional responses can be found in Volume 7B, Appendix 6-2: Offshore Ornithology Distributional Responses Technical Report.

6.7.2.2 Distributional responses may lead to temporary or permanent indirect habitat loss for sensitive seabirds, and, therefore, reduce the area available to forage, loaf and/or moult. Birds that do not intend to utilise the operational OWF but would have previously flown through it on the way to a feeding, resting or nesting area, and which either stop short or detour around it, are subject to barrier effects. Both impact pathways can cause reductions in either individual survival and/or breeding success.

6.7.2.3 While barrier effects are considered to represent a separate impact pathway to displacement, any impacts as a result of barrier effects are incorporated within the distributional response assessment as per the NatureScot Guidance Note 8 (NatureScot, 2023[10]). The distributional responses assessment presented here considers both flying and sitting birds, therefore any potential impacts on resident birds are already accounted for. By including sitting birds within the analysis, those potentially displaced from an area of sea they reside are assessed, meanwhile the inclusion of flying birds provides for an assessment of potential barrier effects to birds moving through the area of interest.

6.7.2.4 The susceptibility of seabirds to distributional responses from operational infrastructure associated with OWFs, such as WTGs and shipping activity related to maintenance activities, varies between species. As per Dierschke *et al*. (2016[129]) some species exhibit both distributional responses and avoidance to varying degrees while others were attracted to OWFs. Notably, guillemot, razorbill, puffin, and red-throated diver have all been shown to exhibit behavioural responses to OWFs and may be displaced as a consequence.

6.7.2.5 Gannet have shown high avoidance rates to OWFs in the breeding season (Peschko *et al*., 2021[132]). Post-construction monitoring of gannet at Beatrice OWF indicated that, although avoidance could not be determined, distributional responses was likely to be a greater potential risk than collision (MacArthur Green, 2023[66]). There are further studies that evidence strong avoidance behaviour in gannet to OWF in post-construction monitoring reports (Dierschke *et al*., 2016[129]; Leopold *et al*., 2013[133]; Vanermen *et al*., 2013[134]; 2016[71]; Skov *et al*., 2018[69]). Further information is provided in Volume 7B, Appendix 6-2, Annex 4: Review of Relevant Evidence.

6.7.2.6 Fulmars are considered to have a low vulnerability to distributional responses from operational OWFs (Furness & Wade, 2012[53]; Furness *et al*., 2013[55]; Bradbury *et al*., 2014[77]; SNCBs, Updated 2022[13]). However, the evidence around distributional response impacts on fulmar are not yet fully understood (Wade *et al*., 2016[135]). There is a lack of data surrounding fulmar avoidance behaviour to OWF, but there may be a strong avoidance response similar to gannet (Dierschke *et al*., 2016[129]). The reduced presence of fulmar within OWFs can be due to the lack of fishing vessels within the area as these species tend to benefit from discards (Neumann *et al*., 2013[136]; Braasch *et al*., 2015[137]). Studies conducted at BARD Offshore Wind Farm indicated some avoidance behaviour displayed by fulmar (Neumann *et al*., 2013[136]; Braasch *et al*., 2015[137]). Further information is provided in Volume 7B, Appendix 6-2, Annex 4: Review of Relevant Evidence.

6.7.2.7 Puffin are considered to have a moderate to low sensitivity to distributional responses whereas guillemot and razorbill have been assessed as moderate (Furness & Wade, 2012[53]; Furness *et al*., 2013[55]; Bradbury *et al*., 2014[77]; SNCBs, Updated 2022[13]). However, recent studies suggest a weak avoidance behaviour for auk species (Dierschke *et al.*, 2016[129]) with no significant distributional response effects recorded in numerous OWF monitoring studies (APEM, 2017[138]; APEM 2022[139]) and some evidence of positive distributional responses or habituation to the OWF over time (Leopold and Verdaat, 2018[60]; Degraer *et al*., 2021[140]; RoyalHaskoningDHV, 2013[141]; Mercker *et al.*, 2021[142]). Further, distributional responses within the Moray Firth has been low, with little to no avoidance behaviour recorded for razorbill and guillemot in the Moray East OWF and increases in abundance within the Beatrice OWF (immediately west of the Proposed Development (Offshore)) recorded during post-construction surveys comparative to pre-construction surveys. These findings are further supported by broader scale assessments as presented in MacArthur Green (2021[65], 2023[66]) and Trinder *et al.* (2024[143]). Therefore, current displacement rates of 60% are likely to result in an overestimate of impacts. Auk mortality as a result of distributional responses is also likely to be overestimated using current guidance values (3-5% during the breeding season, 1-3% in the non-breeding season). More recent studies have suggested mortality as a result of distributional responses is likely between 0.5%-1% (APEM, 2022[139]; Searle *et al.*, 2014[144]; 2018[145]; Van Kooten *et al.*, 2019[146]). Further information is provided in Volume 7B, Appendix 6-2, Annex 4: Review of Relevant Evidence.

6.7.2.8 Garthe and Hüppop (2004[47]) developed a scoring system for susceptibility to disturbance for a range of seabird species, which is used widely in OWF EIAs. Similarly, Furness and Wade (2012[53]) developed disturbance ratings for particular species based on Garthe and Hüppop (2004[47]), alongside scores for habitat flexibility and conservation importance in a Scottish context. These factors were used to define an index value that highlights the sensitivity of a species to distributional responses. Bradbury *et al*. (2014[77]) provided an update to the Furness and Wade (2012[53]) paper to consider seabirds in English waters.

6.7.2.9 A screening exercise was undertaken to identify those species likely to be susceptible to distributional responses and requiring further assessment (Table 6-22). Species were included based on their abundance in the proposed Array Area and the frequency with which they were recorded, highlighted by the 24 months of baseline data (Volume 7B, Appendix 6-1: Offshore Ornithology Baseline Characterisation Report), and on evidence regarding their sensitivity to displacement and barrier effects (e.g., Furness *et al*., 2013[55]; Bradbury *et al*., 2014[77]; Dierschke *et al*., 2016[129]; SNCB, 2022[13])).

6.7.2.10 The frequency and abundances used in the screening process was assessed quantitively through the baseline DAS data. Frequency of species in the array area plus a 2km buffer was determined by the presence of species within the baseline DAS period. The peak abundance was used to describe the peak number of all birds (sitting and in flight) within the Caledonia OWF array area and a 2km buffer relative to the peak abundance in Caledonia OWF, and a 4km buffer in the baseline DAS (see Volume 7B, Appendix 6-1: Offshore Ornithology Baseline Characterisation Report).

Table 6-22: Scoping of seabird species recorded within the Caledonia OWF and 4km buffer for risk of distributional responses during the O&M phase.

Species	Sensitivity to Distributional Responses	Conservation Value	Frequency of Months Recorded within the Array Area plus a 2km Buffer/ Baseline DAS Period	Peak Abundance in the Array Area plus a 2km Buffer/Array Area plus 4km Buffer (Individuals)	Scoping Results (in or out)
Kittiwake	Low	Medium	24/24	723/1,083	In
Great black-backed gull	Low	Low	15/24	119/163	Out
Herring gull	Low	Low	15/24	14/29	Out
Lesser black-backed gull	Low	Low	2/24	4/6	Out
Common tern	Low	Low	1/24	3/3	Out
Arctic tern	Low	Low	2/24	7/9	Out
Great skua	Low	Low	5/24	6/10	Out
Guillemot	Medium	Medium	24/24	2,388/3,127	In
Razorbill	Medium	Medium	23/24	401/514	In
Puffin	Medium	Medium	17/24	462/562	In
Red-throated diver	High	Low	1/24	1/1	In
Fulmar	Low	Medium	23/24	1,096/1,631	In (Barrier effects)
Gannet	Medium	Medium	24/24	225/258	In
Note, sensitivity based on Bradbury *et al.* (2014[77]) and Dierschke *et al.* (2016[129]).					

6.7.2.12 Based upon the findings presented in the literature reviewed on this subject (Table 6-5), guillemot, razorbill, puffin and gannet have been identified to be potentially sensitive to distributional responses by OWFs during the operational phase. These species were identified in the Offshore Scoping Report (Volume 7, Appendix 2) for inclusion in quantitative assessments of operational phase distributional responses, and as such have been screened in for further assessment (Table 6-22).

6.7.2.13 Kittiwake have also been screened in for assessment of distributional responses despite being considered to have 'low' sensitivity to distributional responses (Bradbury *et al*., 2014[77]; Dierschke *et al*., 2016[129]), upon request by NatureScot and RSPB during their representation (25 May 2023). Whist this species is screened onto this impact pathway, there is no evidence from OWFs, in UK waters, identified to support kittiwake distributional responses from OWFs (see Volume 7B, Appendix 6-2, Annex 4: Review of Relevant Evidence).

6.7.2.14 Fulmar were also identified in the Offshore Scoping Report (Volume 7, Appendix 2) for inclusion in quantitative assessments of operational phase distributional responses on a precautionary basis due to the species' presence within the surveys. This species is considered to have a low sensitivity to distributional responses as per Bradbury *et al*. (2014[77]), and based on this, along with consultation responses from NatureScot and RSPB, has not been included in quantitative assessments of operational phase distributional responses. It should be noted it was requested, by NatureScot and RSPB during their representation (09 May 2024), that this species be included in a qualitative assessment specifically with regard to potential barrier effects.

6.7.2.15 Table 6-23 presents the displacement and mortality rates used for the Guidance Approach and the Applicant Approach for guillemot, razorbill, puffin, kittiwake and gannet for distributional responses during the operation phase of the proposed Caledonia OWF. The displacement and mortality rates for the Applicant Approach were selected following a review of evidence, which is presented in Volume 7B, Appendix 6-2, Annex 4: Review of Relevant Evidence.

Table 6-23: Displacement and mortality rates used for the NatureScot Guidance Approach and the Applicant Approach, for the assessment during the operational phase of the Caledonia OWF.

Species	Displacement Rate	Mortality Rate – Breeding Season	Mortality Rate – Non-breeding Season
Guidance Approach			
Guillemot, Razorbill and Puffin	60%	3% and 5%	1% and 3%
Kittiwake	30%	1% and 3%	1% and 3%
Gannet	70%	1% and 3%	1% and 3%
Applicant Approach			
Guillemot and Razorbill	50%	1%	1%
Puffin	50%	1%	1%
Kittiwake	Not Assessed	Not Assessed	Not Assessed
Gannet	70%	1%	1%

Kittiwake

Magnitude of Impact

6.7.2.16 The impact assessment is based on the NatureScot Guidance Approach of a displacement rate of 30% and a mortality rate of up to 3% for operational phase distributional responses as detailed in Table 6-23. Presentation of distributional response impacts following the NatureScot Guidance Approach for the operational phase is provided in Table 6-24 by season.

6.7.2.17 An Applicant Approach has not been included for kittiwake as The Applicant remains of the view that kittiwake do not require assessment for distributional response. This position is based on a review of the available evidence. Further details regarding the exclusion of an Applicant Approach for the kittiwake distributional response assessment are provided in Volume 7B, Appendix 6-2, Annex 4: Review of Relevant Evidence.

6.7.2.18 The average "all ages" survival rate was calculated using the average mortality rate (0.156), which itself was calculated using age-specific demographic rates and age class proportions from Horswill and Robinson (2015[32]) (Table 6-11). An "all ages" survival rate was derived by subtracting the "all ages" mortality from 1. The potential magnitude of impact was estimated by calculating the change in average annual "all ages" survival rate (presented as a decrease in percentage point change) within each defined season with respect to the relevant regional populations.

Table 6-24: Seasonal distributional response estimates of kittiwake for the Caledonia OWF during the operational phase, as per the Guidance Approach.

Defined Season	Mean Seasonal Peak Abundance	Regional Baseline Populations and Baseline Mortality Rates (Individuals Per Annum)		Estimated Number of Mortalities (Individuals Per Annum) (Displacement Rate; Mortality Rate)		Change in Average Survival Rate (% Point Change) (Displacement Rate; Mortality Rate)	
		Population (Individuals)	Baseline Mortality	30%; 1%	30%; 3%	30%; 1%	30%; 3%
NatureScot Seasons							
Breeding season (Mid-April to August)	2,039	496,826	77,505	6.12	18.35	0.001	0.004
Non-breeding season (September to early-April)	483	829,937	129,470	1.45	4.35	<0.001	0.001
Note, model-based abundance estimates used to calculate breeding season mean peak; design-based abundance estimates used to calculate non-breeding season mean peak.							

Table 6-25: Annual distributional response estimates of kittiwake for the Caledonia OWF during the operational phase, as per the Guidance Approach.

Defined Season	Mean Seasonal Peak Abundance	Regional Baseline Populations and Baseline Mortality Rates (Individuals Per Annum)		Estimated Number of Mortalities (Individuals Per Annum)	Change in Average Survival Rate (% Point Change)
		Population (Individuals)	Baseline Mortality		
Guidance Approach					
Annual total (regional/BDMPS)	2,522	829,937	129,470	7.57 – 22.70	0.001 - 0.003
Annual total (biogeographic)	2,522	5,100,000	795,600	7.57- 22.70	<0.001
Note, as per the Guidance Approach displacement rate is 30% and mortality rates are: 1% and 3%, as such annual totals have been presented as a range (30% displacement and 1% to 3% mortality).					

Breeding Season

6.7.2.19 During the breeding season, the mean peak abundance for kittiwake was 2,039 individuals within the Caledonia OWF (plus 2 km buffer). Assuming a 30% displacement rate and a mortality rate of up to 3%, this would result in a maximum of less than 19 (6.12 – 18.35) kittiwake being subject to mortality per annum. The breeding season regional population is estimated to be 496,826 individuals (Table 6-24). Based on the average survival rate of 84.4%, the predicted annual baseline mortality for this population is 77,505 (77,504.8) individuals. The addition of less than 19 predicted additional mortalities per annum due to distributional responses during the operational phase would result in a less than one (0.001 – 0.004) percentage point survival rate change to this population.

6.7.2.20 This level of impact is considered to be of **Negligible** magnitude, as it would not materially impact the existing mortality rate and would be undetectable in the context of natural variation.

Non-breeding Season

6.7.2.21 During the non-breeding season, the mean peak abundance for kittiwake was 483 individuals within the Caledonia OWF (plus a 2 km buffer). Assuming a 30% displacement rate and a mortality rate of up to 3%, this would result in under five (1.45 – 4.35) kittiwake being subject to mortality per annum. The non-breeding season regional population is estimated to be 829,937 individuals (Table 6-24). Based on the average survival rate of 84.4%, the predicted annual baseline mortality for this population is 129,470 (129,470.2) individuals. The addition of less than five predicted additional mortalities per annum due to distributional responses during the operational phase would result in a less than one (<0.001 – 0.001) percentage point survival rate change to this population.

6.7.2.22 This level of impact is considered to be of **Negligible** magnitude, as it would not materially impact the existing mortality rate and would be undetectable in the context of natural variation.

Annual Total

6.7.2.23 The annual total of kittiwake subject to mortality as a result of distributional responses during the operation phase is estimated to be under 23 (7.57 – 22.70) individuals. Using the largest BDMPS population of 829,937 individuals, with an average survival rate of 84.4%, the predicted annual baseline mortality for this population is 129,470 (129,470.2) individuals. The addition of less than 23 predicted additional mortalities per annum due to distributional responses during the operational phase would result in less than one (0.001 – 0.003) percentage point survival rate change (Table 6-25). When considering the annual potential level of impact at the biogeographic scale (5,100,000 individuals), the predicted annual baseline mortality is 795,600 individuals. The addition of less than 23 predicted additional mortalities per annum due to distributional responses during the operational phase would result in a less than one (<0.001) survival rate percentage point change (Table 6-25).

6.7.2.24 This level of impact is considered to be of **Negligible** magnitude during the annual period, as it would not materially impact the existing mortality rate and would be undetectable in the context of natural variation.

Sensitivity of Receptor

6.7.2.25 Based upon the findings presented in the literature reviewed (Table 6-5), kittiwake sensitivity to distributional responses during the operation phase is considered to be **Low**. The conservation value of the species is medium (Table 6-22).

Significance of Effect

6.7.2.26 Taking the low sensitivity of kittiwake (Table 6-22) to this impact pathway and the negligible magnitude of impact, the overall effect of distributional responses during operation is considered to be **Negligible and Not Significant in EIA terms** following the matrix approach (Table 6-17).

Guillemot

Magnitude of Impact

6.7.2.27 The impact assessment for guillemot is based on the Applicant Approach of a displacement rate of 50% and a 1% mortality rate for operational phase distributional responses (Table 6-26). As detailed in Table 6-23, NatureScot advise that distributional response assessment for guillemot should be based on a displacement rate of 60% and a mortality rate of up to 5% depending on the season being assessed. Presentation of the predicted distributional response impacts following the NatureScot Guidance Approach is provided in Table 6-27.

6.7.2.28 For further details regarding the differences between the Guidance Approach and the Applicant Approach for the distributional responses assessment, along with justification for the use of the latter, refer to Volume 7B, Appendix 6-2, Annex 4: Review of Relevant Evidence.

6.7.2.29 The average "all ages" survival rates was calculated using the average mortality rate (0.138), which itself was calculated using age-specific demographic rates and age class proportions from Horswill and Robinson (2015) (Table 6-11). An "all ages" survival rate was derived by subtracting the "all ages" mortality from 1. The potential magnitude of impact was estimated by calculating the change in average "all ages" survival rate (presented as a decrease in percentage point change) within each defined season with respect to the relevant regional populations.

Table 6-26: Seasonal distributional response estimates of guillemot for the Caledonia OWF during the operational phase, as per the Applicant Approach.

Defined Season	Mean Seasonal Peak Abundance	Regional Baseline Populations and Baseline Mortality Rates (Individuals Per Annum)		Estimated Number of Mortalities (Individuals Per Annum) (Displacement Rate; Mortality Rate)	Change in Survival Rate (% Point Change) (Displacement Rate; Mortality Rate)
		Population (Individuals)	Baseline Mortality	50%; 1%	50%; 1%
NatureScot Seasons					
Breeding season (April to mid-August)	16,092	1,307,476	180,432	80.46	0.006
Non-breeding season (Late-August to March)	6,710	1,307,476	180,432	33.55	0.003
Note: Model-based abundance estimates used to calculate breeding and non-breeding season mean peak.					

Table 6-27: Seasonal distributional response estimates of guillemot for the Caledonia OWF during the operational phase, as per the Guidance Approach. Bold text represents percentage point change >0.02.

Defined Season	Mean Seasonal Peak Abundance	Regional Baseline Populations and Baseline Mortality Rates (Individuals Per Annum)		Estimated Number of Mortalities (Individuals Per Annum) (Displacement Rate; Mortality Rate)			Change in Average Survival Rate (% Point Change) (Displacement Rate; Mortality Rate)		
		Population (Individuals)	Baseline Mortality	60%; 1%	60%; 3%	60%; 5%	60%; 1%	60%; 3%	60%; 5%
NatureScot Seasons									
Breeding season (April to mid-August)	16,092	1,307,476	180,432	-	289.65	482.75	-	**0.022**	**0.037**
Non-breeding season (Late-August to March)	6,710	1,307,476	180,432	40.26	120.78	-	0.003	0.009	-
Note: '-' indicates mortality rate not assessed during that season as per the NatureScot Guidance Approach. The Guidance Approach displacement rate is 60% and mortality rates are as follows: 3% and 5% (breeding season) and 1% and 3% (non-breeding season). Model-based abundance estimates used to calculate breeding and non-breeding season mean peak.									

Table 6-28: Annual distributional response estimates of guillemot for the Caledonia OWF during the operational phase, as per the Guidance Approach and Applicant Approach. Bold text represents percentage point change >0.02.

Defined Season	Mean Seasonal Peak	Regional Baseline Populations and Baseline Mortality Rates (Individuals Per Annum)		Estimated Number of Mortalities (Individuals Per Annum)	Change in Average Adult Survival Rate (% Point Change)
		Population (Individuals)	Baseline Mortality		
Guidance Approach					
Annual total (regional/BDMPS)	22,802	1,307,476	180,432	329.91 – 603.53	**0.025 - 0.046**
Annual total (biogeographic)	22,802	4,125,000	569,250	329.91 – 603.53	0.008 - 0.015
Applicant Approach					
Annual total (regional/BDMPS)	22,802	1,307,476	180,432	114.01	0.009
Annual total (biogeographic)	22,802	4,125,000	569,250	114.01	0.003
Note as per the Guidance Approach displacement rate is 60% and mortality rates are as follows: 3% and 5% (breeding season) and 1% and 3% (non-breeding season) as such annual totals have been presented as a range (30% displacement and 1% to 5% mortality).					

Breeding Season

6.7.2.30 During the breeding season, the mean peak abundance for guillemot was 16,092 individuals within the Caledonia OWF (plus 2 km buffer). Assuming a 50% displacement rate and 1% mortality rate, this would result in 81 (80.46) guillemot being subject to mortality per annum. The breeding season regional population is estimated to be 1,307,476 individuals (Table 6-26). Based on the average survival rate of 86.2%, the predicted annual baseline mortality for this population is 180,432 (180,431.7) individuals. The addition of 81 predicted additional mortalities per annum due to distributional responses during the operational phase would result in a 0.006 percentage point survival rate change to this population.

6.7.2.31 This level of impact is considered to be of **Negligible** magnitude, as it would not materially impact the existing mortality rate and would be undetectable in the context of natural variation.

Non-breeding Season

6.7.2.32 During the non-breeding season, the mean peak abundance for guillemot was 6,710 individuals within the Caledonia OWF (plus 2 km buffer). Assuming a 50% displacement rate and 1% mortality rate, this would result in 34 (33.55) guillemot being subject to mortality per annum. The non-breeding season regional population is estimated to be 1,307,476 individuals (Table 6-26). Based on the average survival rate of 86.2%, the predicted annual baseline mortality for this population is 180,432 individuals. The addition of 34 predicted additional mortalities per annum due to distributional responses during the operational phase would result in a 0.003 percentage point survival rate change within this population.

6.7.2.33 This level of impact is considered to be of **Negligible** magnitude, as it would not materially impact the existing mortality rate and would be undetectable in the context of natural variation.

Annual Total

6.7.2.34 The annual total of guillemot subject to mortality as a result of distributional responses during the operational phase is estimated to be 114 (114.01) individuals. Using the BDMPS population of 1,307,476 with an average survival rate of 86.2%, the predicted annual baseline mortality of this population is 180,432 individuals. The addition of 114 predicted additional mortalities per annum due to distributional responses during the operational phase would result in a change to the survival rate of 0.009 percentage point change within this population (Table 6-28). When considering the annual potential level of impact at the biogeographic scale (4,125,000 individuals), the predicted annual baseline mortality for this population is 569,250 (569,250.0) individuals. The addition of 114 predicted additional mortalities per annum due to distributional responses during the operational phase would result in a change to the survival rate of 0.003 percentage point change within this population (Table 6-28).

6.7.2.35 This level of impact is considered to be of **Negligible** magnitude, as it would not materially impact the existing mortality rate and would be undetectable in the context of natural variation. The level of impact when considering the guidance approach is predicted to be higher although would still be considered of negligible magnitude (Table 6-28).

6.7.2.36 Only when considering the Guidance Approach is there a decrease in adult annual survival rate of >0.02% within the BDMPS population (Table 6-27) Therefore, as per with NatureScot (2023[10]) guidance, PVA has been undertaken on a precautionary basis. The full methodology and results are presented in Volume 7B, Appendix 6-4: Population Viability Analysis.

Population Viability Analysis

6.7.2.37 PVA was undertaken using predicted operational phase mortalities calculated using the Guidance Approach displacement and mortality rates for the breeding season and annually, with the BDMPS population (1,307,476 individuals) used as the reference population. The Guidance Approach displacement rate is 60% and mortality rates are 3% and 5% for the breeding season (Table 6-27). As the non-breeding season survival rate did not decrease by more than 0.02% under any scenario, PVA was not completed for this season.

6.7.2.38 The counterfactual of growth rate (CGR) and counterfactual of population size (CPS) have been presented for all Guidance Approach displacement and mortality rate scenarios for the breeding season and annually to estimate the potential changes in annual growth rate and population size during the operational lifespan of 35 years (Table 6-29). As requested by NatureScot, the PVA results are presented for 25 years, 35 years (operational life) and 50 years, with impact scenarios compared to a baseline (unimpacted) scenario which are provided within Volume 7B, Appendix 6-4: Population Viability Analysis.

Breeding Season

6.7.2.39 The estimated mortality for guillemot during the breeding season due to operational phase distributional responses is under Guidance Approach scenarios is between 290 and 483 individuals when assessed against the BDMPS population size. The population growth rate is predicted to decrease between 0.02% and 0.04% for the lower and upper predicted breeding mortality predictions respectively, which after 35 years would result in a reduction in population size by 0.89% and 1.49% when compared to the baseline unimpacted population (Table 6-29).

6.7.2.40 The estimated annual mortality for guillemot due to operational phase distributional responses is under Guidance Approach scenarios is between 330 and 604 individuals when assessed against the BDMPS population size. The population growth rate is predicted to decrease between 0.03% and 0.05% for the lower and upper predicted annual mortality predictions respectively, which after 35 years would result in a reduction in population size by 1.01% and 1.85% when compared to the baseline unimpacted population (Table 6-29).

6.7.2.41 A full description of the methodology and results are presented in Volume 7B, Appendix 6-4: Population Viability Analysis.

Table 6-29: PVA results for predicted impacts on guillemot for the Caledonia OWF during the operational phase, using the BDMPS population as a reference population.

Scenario	Impact on Adult Survival	Median CGR (SD)	Median CPS (SD)	Difference in CGR	Difference in CPS
Baseline (unimpacted)	-	1.000	1.000	-	-
Breeding Season 60%, 3% (BDMPS)	0.022	1.000 ± <0.001	0.991 ± 0.002	0.02%	0.89%
Breeding Season 60%, 5% (BDMPS)	0.037	1.000 ± <0.001	0.985 ± 0.002	0.04%	1.49%
Annual 60%, 1%; 60%, 3% (BDMPS)	0.025	1.000 ± <0.001	0.990 ± 0.002	0.03%	1.01%
Annual 60%, 3%; 60%, 5% (BDMPS)	0.046	0.999 ± <0.001	0.986 ± 0.002	0.05%	1.85%

6.7.2.42 An impact of this magnitude as estimated by PVA is unlikely to have a significant effect on the BDMPS population given the minimal impact on growth rate and population size. The predicted impact would likely be indistinguishable from natural population fluctuations variations which may be driven by other factors such as changes in prey availability, avian influenza outbreaks, or wrecks, leading to a low overall magnitude of impact.

Sensitivity of Receptor

6.7.2.43 Based upon the findings presented in the literature reviewed on this subject (Table 6-5), guillemot sensitivity to distributional responses during the operation phase is considered to be **Medium**. The conservation value of the species is **Medium** (Table 6-22).

Significance of Effect

6.7.2.44 Taking the medium sensitivity of guillemot (Table 6-22) and the negligible magnitude of impact, the overall effect of distributional responses during operation is considered to be **Negligible and Not Significant in EIA terms** following the matrix approach (Table 6-17).

Razorbill

Magnitude of Impact

6.7.2.45 The impact assessment for razorbill is based on the Applicant Approach of a displacement rate of 50% and a 1% mortality rate for operational phase distributional responses (Table 6-30). As detailed in Table 6-23, NatureScot advise that distributional response assessment for razorbill should be based on a displacement rate of 60% and a mortality rate of up to 5% depending on the season being assessed. Presentation of the predicted distributional response impacts following the NatureScot Guidance Approach for the operational phase is provided in Table 6-31.

6.7.2.46 For further details regarding the differences between the Guidance Approach and the Applicant Approach for the distributional responses assessment, along with justification for the use of the latter, refer to Volume 7B, Appendix 6-2, Annex 4: Review of Relevant Evidence.

6.7.2.47 The average "all ages" survival rates were calculated using the average mortality rate (0.193), which itself was calculated using age-specific demographic rates and age class proportions from Horswill and Robinson (2015[32]) (Table 6-11). An "all ages" survival rate was derived by subtracting the "all ages" mortality from 1. The potential magnitude of impact was estimated by calculating the change in average annual "all ages" survival (presented as a decrease in percentage point change) within each defined season with respect to the relevant regional populations.

Table 6-30: Seasonal distributional response estimates of razorbill for the Caledonia OWF during the operational phase, as per the Applicant Approach.

Defined Season	Mean Seasonal Peak Abundance	Regional Baseline Populations and Baseline Mortality Rates (Individuals Per Annum)		Estimated Number Mortalities (Individuals Per Annum) (Displacement Rate; Mortality Rate)	Change in Average Survival Rate (% Point Change) (Displacement Rate; Mortality Rate)
		Population (Individuals)	Baseline Mortality	50%; 1%	50%; 1%
NatureScot Seasons					
Breeding season (April to mid-August)	1,762	236,479	45,641	8.81	0.004
Non-breeding season (Late-August to March)	1,930	591,874	114,232	9.65	0.002
Note: Model-based abundance estimates used to calculate breeding season mean peak; design-based estimates used to calculate non-breeding season mean peak.					

Table 6-31: Seasonal distributional response estimates of razorbill for the Caledonia OWF during the operational phase, as per the Guidance Approach. Bold text represents percentage point change >0.02.

Defined Season	Mean Seasonal Peak Abundance	Regional Baseline Populations and Baseline Mortality Rates (Individuals per Annum)		Estimated Number of Mortalities (Individuals per Annum) (Displacement Rate; Mortality Rate)			Change in Average Survival Rate (% Point Change) (Displacement Rate; Mortality Rate)		
		Populations (Individuals)	Baseline Mortality	60%; 1%	60%; 3%	60%; 5%	60%; 1%	60%; 3%	60%; 5%
NatureScot Seasons									
Breeding season (April to mid-August)	1,762	236,479	45,641	-	31.71	52.86	-	0.013	**0.022**
Non-breeding season (Late-August to March)	1,930	591,874	114,232	11.58	34.74	-	-	0.002	0.006

Note, '-' indicates mortality rate not assessed during that season as per the NatureScot Guidance Approach. The Guidance Approach displacement rate is 60% and mortality rates are as follows: 3% and 5% (breeding season) and 1% and 3% (non-breeding season).

Model-based estimates used to calculate breeding season peak; design-based estimates used to calculate non-breeding season peak.

Table 6-32: Annual distributional response estimates of razorbill for the Caledonia OWF during the operational phase, as per the Guidance Approach and Applicant Approach.

Defined Season	Mean Seasonal Peak	Regional Baseline Populations and Baseline Mortality Rates (Individuals Per Annum)		Estimated Number of Mortalities (Individuals Per Annum)	Change in Average Survival Rate (% Point Change)
		Population (Individuals)	Baseline Mortality		
Guidance Approach					
Annual total (regional/BDMPS)	3,692	591,874	114,232	43.29 – 87.60	0.007 - 0.015
Annual total (biogeographic)	3,692	1,707,000	329,451	43.29 – 87.60	0.003 - 0.005
Applicant Approach					
Annual total (regional/BDMPS)	3,692	591,874	114,232	18.46	0.003
Annual total (biogeographic)	3,692	1,707,000	329,451	18.46	0.001
Note, as per the Guidance Approach displacement rate is 60% and mortality rates are as follows: 3% and 5% (breeding season) and 1% and 3% (non-breeding season) as such annual totals have been presented as a range (30% displacement and 1% to 5% mortality).					

Breeding Season

6.7.2.48 During the breeding season, the mean peak abundance for razorbill was 1,762 individuals within the Caledonia OWF (plus 2 km buffer). Assuming a 50% displacement rate and 1% mortality rate, this would result in nine (8.81) razorbill being subject to mortality annually. The breeding season regional population is estimated to be 236,479 individuals (Table 6-30). Based on the average "all ages" survival rate of 80.7%, the predicted annual baseline mortality for this population is 45,641 (45,640.5) individuals. The addition of nine predicted additional mortalities per annum due to distributional responses during the operational phase would result in a 0.004 survival rate percentage point change within this population.

6.7.2.49 This level of impact is considered to be of **Negligible** magnitude, as it would not materially impact the existing mortality rate and would be undetectable in the context of natural variation.

6.7.2.50 However, when considering the displacement and higher mortality rate recommended by the Guidance Approach (5%), there is a decrease in survival rate within the BDMPS population of >0.02% (Table 6-31) for the breeding season. Therefore, as per with NatureScot (2023[10]) guidance, PVA has been undertaken on a precautionary basis.

Non-breeding Season

6.7.2.51 During the non-breeding season, the mean peak abundance for razorbill is 1,930 individuals within the Caledonia OWF (plus 2 km buffer). Assuming a 50% displacement rate and 1% mortality rate, this would result in 10 (9.65) razorbill being subject to mortality per annum. The non-breeding season regional population is estimated to be 591,874 individuals (Table 6-30). Based on the average "all ages" survival rate of 80.7%, the predicted annual baseline mortality for this population is 114,232 (114,231.7) individuals. The addition of 10 predicted additional mortalities per annum to this population due to distributional responses would result in a 0.002 percentage point survival rate change.

6.7.2.52 This level of impact is considered to be of **Negligible** magnitude, as it would not materially impact the existing mortality rate and would be undetectable in the context of natural variation.

Annual Total

6.7.2.53 The annual total of razorbill potentially subject to mortality as a result of distributional responses in the operational phase is estimated to be 18 (18.46) individuals. Using the largest BDMPS population of 591,874 with an average "all ages" survival rate of 80.7%, the predicted annual baseline mortality of the background population is 114,232 (114,231.7). The addition of 18 predicted additional mortalities per annum due to distributional responses during the operational phase would result in a 0.003 percentage point survival rate change to this population (Table 6-32). When considering the annual potential level of impact at the biogeographic scale (1,707,000 individuals), the predicted annual baseline mortality is 329,451 (329,451.0) individuals. The addition of 18 predicted additional mortalities per annum due to distributional responses during the operational phase would result in a 0.001 percentage point survival rate change to this population (Table 6-32).

6.7.2.54 Additionally, the Guidance Approach also predicts a low percentage point survival rate change of 0.007 and 0.015 for mortality rates of 3% and 5% respectively, further demonstrating the negligible magnitude of the impact when considering more precautionary scenarios (Table 6-32).

6.7.2.55 This level of impact is of **Negligible** magnitude to the population, as it would not materially impact the existing mortality rate and would be undetectable in the context of natural variation.

Population Viability Analysis

6.7.2.56 PVA was undertaken using predicted operational phase mortalities calculated using the Guidance Approach displacement and mortality rate for the breeding season, with the BDMPS breeding population (591,874 individuals) used as the reference population. The Guidance Approach displacement rate is 60% for the breeding season, and mortality rates are 3% and 5% (presented in Table 6-31), although only a 5% mortality has been assessed given that this was the only scenario in which survival rate decreased by more than 0.02%.

6.7.2.57 The counterfactual of growth rate (CGR) and counterfactual of population size (CPS) have been presented to estimate the potential changes in annual growth rate and population size during the operational lifespan of 35 years (Table 6-33). As requested by NatureScot, the PVA results are presented for 25 years, 35 years (operational life) and 50 years, with impact scenarios compared to a baseline (unimpacted) scenario which is presented within Volume 7B, Appendix 6-4: Population Viability Analysis.

6.7.2.58 The estimated breeding season mortality for razorbill due to operational phase distributional responses when applying a 5% mortality rate is 53 individuals. The population growth rate is predicted to reduce by 0.03%, which after 35 years would result in a reduction in population size by 0.68% when compared to the baseline unimpacted population (Table 6-33).

6.7.2.59 A full description of the methodology and results are presented in Volume 7B, Appendix 6-4: Population Viability Analysis.

Table 6-33: PVA results for predicted impacts on razorbill for the Caledonia OWF during the operational phase, using the BDMPS population as a reference population.

Scenario	Annual Mortality (Individuals)	Impact on Adult Survival	Median CGR (SD)	Median CPS (SD)	Difference in CGR (%)	Difference in CPS (%)
Baseline (unimpacted)			1.000	1.000	-	-
Breeding Season 60%, 5% (BDMPS)	52.86	0.022	0.999 ± <0.001	0.993 ± 0.017	0.03	0.68

6.7.2.60 An impact of this magnitude as estimated by PVA is unlikely to have a significant effect on the BDMPS population given the minimal impact on growth rate and population size. The predicted impact would likely be indistinguishable from natural population fluctuations variations which may be driven by other factors such as changes in prey availability, avian influenza outbreaks, or wrecks, leading to a low overall magnitude of impact.

Sensitivity of Receptor

6.7.2.61 Based upon the findings presented in the literature reviewed on this subject (Table 6-5), razorbill sensitivity to distributional responses during the operation phase is considered to be **Medium**. The conservation value of the species is **Medium** (Table 6-22).

Significance of Effect

6.7.2.62 Taking the medium sensitivity of razorbill (Table 6-22) and the negligible magnitude of impact, the overall effect of distributional responses during operation is considered to be **Negligible and Not Significant in EIA terms** following the matrix approach (Table 6-17).

Puffin

Magnitude of Impact

6.7.2.63 The impact assessment is based on the Applicant Approach of a displacement rate of 50% and a 1% mortality rate for operational phase distributional responses (Table 6-34). As detailed in Table 6-23, NatureScot advise that distributional response assessment for puffin should be based on a displacement rate of 60% and a mortality rate of up to 5% depending on the season being assessed. Presentation of distributional response impacts following the NatureScot Guidance Approach for the operational phase is provided in both Table 6-34 and Table 6-35.

6.7.2.64 For further details regarding the differences between the Guidance Approach and the Applicant Approach for the distributional responses assessment, along with justification for the use of the latter, refer to Volume 7B, Appendix 6-2, Annex 4: Review of Relevant Evidence.

6.7.2.65 The Applicant has decided to include the Year 1 August count in the non-breeding season rather than during the breeding season. This is due to the Year 1 August abundance from the baseline DAS being considered to reflect migration rather than individuals present in the breeding season. The mean seasonal peaks for puffin have also been presented with the August count included in the breeding season as per the Guidance Approach, further details are provided in Volume 7B, Appendix 6-2: Offshore Ornithology Distributional Responses Technical Report. This enables comparison of how the inclusion of the Year 1 August abundance within the breeding season alters the mean peaks, and therefore the predicted operational phase distributional response impacts, for both the breeding and non-breeding seasons.

6.7.2.66 The average "all ages" survival rates were calculated using the average mortality rate (0.175), which itself was calculated using age-specific demographic rates and age class proportions from Horswill and Robinson (2015[32]) (Table 6-11). An "all ages" survival rate was derived by subtracting the "all ages" mortality from 1. The potential magnitude of impact was estimated by calculating the change in average survival rate (presented as a decrease in percentage point change) within each defined season with respect to the relevant regional populations.

Table 6-34: Seasonal distributional response estimates of puffin for the Caledonia OWF during the operational phase, as per the Applicant Approach of including Year 1 August count in the non-breeding season. Both Applicant and Guidance Approach values presented for this approach. Bold text represents percentage point change >0.02.

Defined Season	Mean Seasonal Peak Abundance	Regional Baseline Populations and Baseline Mortality Rates (Individuals Per Annum)		Estimated Number of Mortalities (Individuals Per Annum) (Displacement Rate; Mortality Rate)				Change in Average Survival Rate (% Point Change) (Displacement Rate; Mortality Rate)			
		Population (Individuals)	Baseline Mortality	50%; 1%	60; 1%	60; 3%	60; 5%	50%; 1%	60; 1%	60; 3%	60; 5%
NatureScot Seasons											
Breeding season (April to mid-August)	698	723,751	126,657	3.49	-	12.57	20.94	<0.001	-	0.002	0.003
Non-breeding season (Late-August to March)	3,005	231,957	40,593	15.02	18.03	54.08	-	0.006	0.008	**0.023**	-
Note, as per the Applicant Approach, the Year 1 August count (3,583 individuals) has been included in the non-breeding season rather than during the breeding season. Further details are provided in Volume 7B, Appendix 6-2: Offshore Ornithology Distributional Responses Technical Report. Model-based abundance estimates used to calculate breeding season mean peak; design-based abundance estimates used to calculate non-breeding season mean peak.											

Table 6-35: Seasonal distributional response estimates of puffin for the Caledonia OWF during the operational phase, as per the Guidance Approach of including Year 1 August count in the breeding season. Both Applicant and Guidance Approach values presented for this approach.

Defined Season	Mean Seasonal Peak Abundance	Regional Baseline Populations and Baseline Mortality Rates (Individuals Per Annum)		Estimated Number of Mortalities (Individuals Per Annum) (Displacement Rate; Mortality Rate)				Change in Average Survival Rate (% Point Change) (Displacement Rate; Mortality Rate)			
		Population (Individuals)	Baseline Mortality	50%; 1%	60; 1%	60%; 3%	60%; 5%	50%; 1%	60; 1%	60%; 3%	60%; 5%
NatureScot Seasons											
Breeding season (April to mid-August)	2,061	723,751	126,657	10.30	-	37.09	61.82	0.001	-	0.005	0.009
Non-breeding season (Late-August to March)	1,336	231,957	40,593	6.68	8.02	24.05	-	0.003	0.003	0.010	-
Note, '-' indicates mortality rate not assessed during that season as per the NatureScot Guidance Approach. The Guidance Approach displacement rate is 60% and mortality rates are as follows: 3% and 5% (breeding season) and 1% and 3% (non-breeding season). As per the Guidance Approach the Year 1 August count (3,583 individuals) has been included in the breeding season rather than during the non- breeding season. Further details are provided in Volume 7B, Appendix 6-2: Offshore Ornithology Distributional Responses Technical Report. Model-based abundance estimates used to calculate breeding season peak; design-based abundance estimates used to calculate non-breeding season peak.											

Table 6-36: Annual distributional response estimates of puffin for the Caledonia OWF during the operational phase, as per the Guidance Approach and Applicant Approach.

Defined Season	Mean Seasonal Peak	Regional Baseline Populations and Baseline Mortality Rates (Individuals Per Annum)		Estimated Number of Mortalities (Individuals Per Annum)	Change in Average Survival Rate (% Point Change)
		Population (Individuals)	Baseline Mortality		
Guidance Approach					
Annual total (regional/BDMPS)	3,397	723,751	126,657	45.11 – 85.87	0.006 - 0.012
Annual total (biogeographic)	3,397	11,840,000	2,072,000	45.11 – 85.87	<0.001 - 0.001
Applicant Approach					
Annual total (regional/BDMPS)	3,703	723,751	126,657	18.51	0.003
Annual total (biogeographic)	3,703	11,840,000	2,072,000	18.51	<0.001
Note, as per the Guidance Approach displacement rate is 60% and mortality rates are as follows: 3% and 5% (breeding season) and 1% and 3% (non-breeding season) as such annual totals have been presented as a range (30% displacement and 1% to 5% mortality) Note: as per the Applicant Approach the Year 1 August count (3,583 individuals) has been in the non-breeding season rather than during the breeding season, and as per the Guidance Approach the Year 1 August count has been included in the breeding season rather than the non-breeding season. Further details are provided in Volume 7B, Appendix 6-2: Offshore Ornithology Distributional Responses Technical Report.					

Breeding Season

6.7.2.67 As per the Applicant Approach, the Year 1 August count (3,005 individuals) has been included in the non-breeding season rather than during the breeding season, due to the Year 1 August abundance being considered to reflect migration rather than individuals present in the breeding season.

6.7.2.68 As such, during the breeding season, the mean peak abundance for puffin is 698 individuals within the Caledonia OWF (plus 2 km buffer) (Table 6-34). Assuming a 50% displacement rate and 1% mortality rate, this would result in three (3.49) puffin being subject to mortality annually. The breeding season regional population is estimated to be 723,751 individuals (Table 6-34). Based on the average survival rate of 82.5%, the predicted annual baseline mortality for this population is 126,657 (126,656.5) individuals. The addition of three predicted additional mortalities per annum to this population due to distributional responses during the operational phase would result in a <0.001 percentage point change to the survival rate.

6.7.2.69 This level of impact is considered to be of **Negligible** magnitude, as it would not materially impact the existing mortality rate and would be undetectable in the context of natural variation.

Non-breeding Season

6.7.2.70 The Applicant is of the position that assessment for the non-breeding season for puffin is not necessary given the wide dispersal of this species post-breeding. However, an assessment has been completed as a precautionary measure using the Applicant Approach to ensure consistency between breeding and non-breeding assessment.

6.7.2.71 During the non-breeding season, the mean peak abundance for puffin is 3,005 individuals within the Caledonia OWF (plus 2 km buffer) (Table 6-34). Assuming a 50% displacement rate and 1% mortality rate, this would result in 15 (15.02) puffin being subject to mortality annually. The non-breeding season regional population is estimated to be 231,957 individuals (Table 6-34). Based on the average survival rate of 82.5%, the predicted annual baseline mortality for this population is 40,593 (40,592.5) individuals. The addition of 15 predicted additional mortalities per annum to this population due to distributional responses during the operational phase would result in a 0.006 percentage point change to the survival rate.

6.7.2.72 When considering the increased displacement and mortality rates as set out in the Guidance Approach, predicted mortalities naturally increase to between 18 and 54 birds per annum. This equates to a percentage point change to the survival rate between 0.008 and 0.023 (Table 6-34).

6.7.2.73 Overall, this level of impact is considered to be of **Negligible** magnitude, as it would not materially impact the existing mortality rate and would be undetectable in the context of natural variation. However, as the survival rate for puffin when applying a 3% mortality rate (and 60% displacement rate) is above the recommended threshold as set by NatureScot (0.02), PVA has been completed as a precautionary measure.

Annual Total

6.7.2.74 The annual total of puffin subject to mortality as a result of distributional responses is estimated to be 19 (18.51) individuals. Using the largest BDMPS population of 723,751 individuals with an average survival rate of 82.5%, the predicted annual baseline mortality is 126,657 individuals. The addition of 19 predicted additional mortalities per annum due to distributional responses during the operational phase would result in a 0.003 percentage point survival rate change (Table 6-36). When considering the annual potential level of impact at the biogeographic scale (11,840,000 individuals), the predicted annual baseline mortality of this population is 2,072,000 (2,072,000.0) individuals. The addition of 19 predicted additional mortalities per annum due to distributional responses during the operation phase would result in a <0.001 percentage point survival rate change (Table 6-36).

6.7.2.75 This level of impact is considered to be of **Negligible** magnitude, as it would not materially impact the existing mortality rate and would be undetectable in the context of natural variation.

6.7.2.76 When considering the more precautionary measure of increasing displacement and mortality rates as per the Guidance Approach (60% displacement, 3-5% mortality, between 45 and 86 additional mortalities are predicted. This equates to a 0.006-0.012 percent point change in survival rate comparative to the BDMPS population and thus still considered to be of negligible magnitude.

Population Viability Analysis

6.7.2.77 PVA was undertaken using predicted operational phase mortalities calculated using the Guidance Approach displacement and mortality guidance approach rates for the non-breeding season, with the non-breeding BDMPS population (231,957 individuals) used as the reference population. The Guidance Approach displacement rate is 60% for the non-breeding season, and mortality rates are 1% and 3% (presented in Table 6-34 and Table 6-35), although only the 5% mortality was assessed via PVA as this was the only scenario in which the survival rate decreased by more than 0.02%.

6.7.2.78 The counterfactual of growth rate (CGR) and counterfactual of population size (CPS) have been presented for all Guidance Approach displacement and mortality rate scenarios to estimate the potential changes in annual growth rate and population size during the operational lifespan of 35 years (Table 6-37). As requested by NatureScot, the PVA results are presented for 25 years, 35 years (operational life) and 50 years, with impact scenarios compared to a baseline (unimpacted) scenario which is presented within Volume 7B, Appendix 6-4: Population Viability Analysis.

6.7.2.79 The estimated non-breeding season mortality for puffin due to operational phase distributional responses when applying a 3% mortality rate is 54 individuals. The population growth rate is predicted to reduce by 0.03%, which after 35 years would result in a reduction in population size by 0.69% when compared to the baseline unimpacted population (Table 6-37).

6.7.2.80 A full description of the methodology and results are presented in Volume 7B, Appendix 6-4: Population Viability Analysis.

Table 6-37: PVA results for predicted impacts on puffin for the Caledonia OWF during the operational phase, using the BDMPS population as a reference population.

Scenario	Annual Mortality (Individuals)	Impact on Adult Survival	Median CGR (SD)	Median CPS (SD)	Difference in CGR (%)	Difference in CPS (%)
Baseline (unimpacted)			1.000	1.000	-	-
Non-breeding 60%, 3%; (BDMPS)	54.08	0.023	0.999 ± <0.001	0.993 ±0.013	0.03	0.69

6.7.2.81 An impact of this magnitude as estimated by PVA is **unlikely** to have a significant effect on the BDMPS population given the minimal impact on growth rate and population size. The predicted impact would likely be indistinguishable from natural population fluctuations variations which may be driven by other factors such as changes in prey availability, avian influenza outbreaks, or wrecks, leading to a low overall magnitude of impact.

Sensitivity of Receptor

6.7.2.82 Based upon the findings in the literature review (Table 6-5), puffin sensitivity to distributional responses during the operation phase is considered to be **Medium**. The conservation value of the species is also **Medium** (Table 6-22).

Significance of Effect

6.7.2.83 Taking the medium sensitivity of puffin (Table 6-22) and the negligible magnitude of impact, the overall effect of distributional responses during operation is considered to be **Negligible and Not Significant in EIA terms** following the matrix approach (Table 6-17).

Gannet

Magnitude of Impact

6.7.2.84 The impact assessment for is gannet based on the Applicant Approach of a displacement rate of 70% and a 1% mortality rate for operational phase distributional responses (Table 6-38). As detailed in Table 6-23, NatureScot advise that distributional response assessment for gannet should be based on a displacement rate of 70% and a mortality rate of up to 3% depending on the season being assessed. Presentation of distributional response impacts following the NatureScot Guidance Approach for the operational phase is provided in Table 6-39.

6.7.2.85 For further details regarding the differences between the Guidance Approach and the Applicant Approach for the distributional responses assessment, along with justification for the use of the latter, refer to Volume 7B, Appendix 6-2, Annex 4: Review of Relevant Evidence.

6.7.2.86 The average "all ages" survival rates were calculated using the average mortality rate (0.187), with itself was calculated using age-specific demographic rates and age class proportions from Horswill and Robinson (2015[32]) (Table 6-11). An "all ages" survival rate was derived by subtracting the "all ages" mortality from 1. The potential magnitude of impact was estimated by calculating the change in average "all ages" survival rate (presented as a decrease in percentage point change) within each defined season with respect to the relevant regional populations.

Table 6-38: Seasonal distributional response estimates of gannet for the Caledonia OWF during the operational phase, as per the Applicant Approach.

Defined Season	Mean Seasonal Peak Abundance	Regional Baseline Populations and Baseline Mortality Rates (Individuals Per Annum)		Estimated Number Mortalities (Individuals Per Annum) (Displacement Rate; Mortality Rate)	Change in Average Survival Rate (% Point Change) (Displacement Rate; Mortality Rate)
		Population (Individuals)	Baseline Mortality	70%; 1%	70%; 1%
NatureScot Seasons					
Breeding season (Mid-March to September)	909	920,514	172,136	6.36	0.001
Non-breeding season (October to early-March)	315	456,298	85,328	2.21	<0.001
Note, design-based estimates used to calculate breeding and non-breeding season peaks.					

Table 6-39: Seasonal distributional response estimates of gannet for the Caledonia OWF during the operational phase, as per the Guidance Approach.

Defined Season	Mean Seasonal Peak Abundance	Regional Baseline Populations and Baseline Mortality Rates (Individuals Per Annum)		Estimated Number of Mortalities (Individuals Per Annum) (Displacement Rate; Mortality Rate)		Change in Average Survival Rate (% Point Change) (Displacement Rate; Mortality Rate)	
		Population (Individuals)	Baseline Mortality	70%; 1%	70%; 3%	70%; 1%	70%; 3%
NatureScot Seasons							
Breeding season (Mid-March to September)	909	920,514	172,136	6.36	19.08	0.001	0.002
Non-breeding season (October to early-March)	315	456,298	85,328	2.21	6.62	<0.001	0.001
Note, design-based estimates used to calculate breeding and non-breeding season peaks.							

Table 6-40: Annual distributional response estimates of gannet for the Caledonia OWF during the operational phase, as per the Guidance Approach and Applicant Approach.

Defined Season	Mean Seasonal Peak	Regional Baseline Populations and Baseline Mortality Rates (Individuals Per Annum)		Estimated Number of Mortalities (Individuals Per Annum)	Change in Average Survival Rate (% Point Change)
		Population (Individuals)	Baseline Mortality		
Guidance Approach					
Annual total (regional/BDMPS)	1,252	920,514	172,136	8.56 - 25.69	0.001 – 0.003
Annual total (biogeographic)	1,252	1,180,000	220,660	8.56 - 25.69	0.001 – 0.002
Applicant Approach					
Annual total (regional/BDMPS)	1,252	920,514	172,136	8.56	0.001
Annual total (biogeographic)	1,252	1,180,000	220,660	8.56	0.001
Note, as per the Guidance Approach displacement rate is 30% and mortality rates are: 1% and 3%, as such annual totals have been presented as a range (30% displacement and 1% to 3% mortality).					

Breeding Season

6.7.2.87 During the breeding season, the mean peak abundance for gannet was 909 individuals within the Caledonia OWF (plus 2 km buffer). Assuming a 70% displacement rate and 1% mortality rate, this would result in six (6.36) gannet being subject to mortality per annum. The breeding season regional population is estimated to be 920,514 individuals (Table 6-38). Based on the average survival rate of 81.3%, the predicted annual baseline mortality for this population is 172,136 (172,136.0) individuals. The addition of six predicted additional mortalities per annum to this total due to distributional responses during the operational phase would result in a 0.001 percentage point survival rate change within this population.

6.7.2.88 This level of impact is considered to be of **Negligible** magnitude, as it would not materially impact the existing mortality rate and would be undetectable in the context of natural variation.

Non-breeding Season

6.7.2.89 During the non-breeding season, the mean peak abundance for gannet is 315 individuals within the Caledonia OWF (plus 2 km buffer). Assuming a 70% displacement rate and 1% mortality rate, this would result in two (2.21) gannet being subject to mortality per annum. The non-breeding season regional population is estimated to be 456,298 individuals (Table 6-38). Based on the average survival rate of 81.3%, the predicted annual baseline mortality for this population is 85,328 (85,327.7) individuals. The addition of two predicted additional mortalities per annum to this population due distributional responses during the operation phase would result in a <0.001 percentage point survival rate change.

6.7.2.90 This level of impact is considered to be of **Negligible** magnitude, as it would not materially impact the existing mortality rate and would be undetectable in the context of natural variation.

Annual Total

6.7.2.91 The annual total of gannet subject to mortality as a result of distributional responses during the operational phase is estimated to be nine (8.56) individuals. Using the largest BDMPS population of 920,514 with an average survival rate of 81.3%, the predicted annual baseline mortality within this population is 172,136. (172,136.0) individuals. The addition of nine predicted additional mortalities per annum due to distributional responses during the operation phase would result in a 0.001 percentage point survival rate change within this population (Table 6-40). When considering the annual potential level of impact at the biogeographic scale (1,180,000 individuals), the predicted annual baseline mortality across all seasons is 220,660 (220,660.0) individuals. The addition of nine predicted additional mortalities per annum due to operational phase distributional responses would result in a 0.001 percentage point survival rate change (Table 6-40).

6.7.2.92 This level of impact is considered to be of **Negligible** magnitude, as it would not materially impact the existing mortality rate and would be undetectable in the context of natural variation.

6.7.2.93 When considering the more precautionary measure of increasing the mortality rate to 3% as per the Guidance Approach, 26 additional mortalities are predicted (Table 6-40). This equates to a 0.003 percent point change in survival rate comparative to the BDMPS population and thus still considered to be of negligible magnitude.

Sensitivity of Receptor

6.7.2.94 Based upon the findings in the literature review, gannet sensitivity to distributional responses during the operation phase is considered to be **Medium**. The conservation value of the species is also **Medium** (Table 6-22).

Significance of Effect

6.7.2.95 Taking the **Low** sensitivity of gannet (Table 6-22) and the negligible magnitude of impact, the overall effect of distributional responses during operation is considered to be **Negligible and Not Significant in EIA terms** following the matrix approach (Table 6-17).

Barrier Effects: Fulmar

6.7.2.96 When an OWF is in the operational phase, the presence of WTGs has the potential to create a barrier to movement of birds in flight. This could potentially alter the flight routes to foraging sites for birds and therefore increase the energetic expenditure associated with these movements. The overall impact may result in a reduced rate in breeding success or survival for birds affected. Barrier effects of OWFs can affect those species which may forage regularly in the array area or further than the Caledonia OWF. As requested through consultation with key stakeholders (Table 6-3), fulmar has been qualitatively assessed for barrier effects associated with the Proposed Development (Offshore).

6.7.2.97 Fulmar are generalist feeders, taking a wide range of prey as well as scavenging for fish offal at fishing vessels (Camphuysen and Garthe, 1997[147]). Naturally, their diet consists of fish (*Ammodytidae*, *Clupeidae*, *Gadidae*), squid, and crustaceans (Ojowski *et al*., 2001[148]). They are a central place forager in the breeding season with predominant breeding sites at St Kilda and Foula (Hamer *et al*., 1997[149]), though breeding birds are widely distributed along UK coastlines. Due to their diet consisting of prey from both intertidal areas and pelagic waters, fulmar are not thought be restricted to specific areas and forage extensively (Hamer *et al.*, 1997[149]). Fulmar undertake large foraging trips during the breeding season, with a MMFR + SD of 1,182km (Woodward *et al*., 2019[20]). For example, Fulmar from Enyhallow, Orkney, travelled as far as the Charlie-Gibbs Fracture Zone in the Mid-Atlantic Ridge in the breeding season (Edwards *et al*., 2013[150]). During the non-breeding season, birds feed within the pelagic zone around shelf edges (Lack, 1986[151]; Stone *et al*., 1995[74]). Operational OWFs have the potential to influence the foraging distance and energy expenditure from breeding site to feeding grounds (Masden *et al*., 2010[152]).

6.7.2.98 Fulmar are considered to have a very low sensitivity to distributional responses as well as exhibiting weak avoidance behaviour to OWF (Bradbury *et al*., 2014[77]; Dierschke *et al*., 2016[129]; Furness *et al*., 2013[55]). However, there is a lack of evidence for fulmar presence within OWFs which could suggest that fulmar undertake avoidance behaviour (Dierschke *et al*., 2016[129]). The reduced presence of fulmar within OWFs could also be due to the lack of fishing vessels within the area, as they tend to benefit from discards. This was considered within work conducted at the BARD OWF, located within German waters, where avoidance of the OWF by fulmar was observed (Neumann *et al*., 2013[136]; Braasch *et al*., 2015[137]). A review of post-construction monitoring of OWFs in the North and Baltic Seas by Lamb *et al*. (2024[153]) found that the magnitude for distributional responses was large for fulmar relative to other species when such an impact was detected, but there was a low chance of detecting significant effects relative to other species due to few studies reporting fulmar presence, and those that did often reported the species at low densities.

6.7.2.99 Overall, it appears that fulmar may avoid certain wind farm developments. However, due to the large MMFR + SD that fulmar is known to have, it is considered that OWF avoidance is unlikely to add substantially to the energetic costs of foraging individuals during the breeding season. Furthermore, their generalist diet suggests that in the event of exclusion from an OWF occurring, they are likely to be able to utilise a range of food sources beyond the boundaries of OWFs should this be required. It is inferred based on these considerations that, the magnitude of impact from potential barrier effects during the operational phase of the Proposed Development (Offshore) for fulmar is **Negligible**.

Sensitivity of Receptor

6.7.2.100 Based upon the findings in the literature review (Table 6-5), fulmar sensitivity to distributional responses during the operation phase is considered to be **Low**. The conservation value of the species is **Medium** (Table 6-22).

Significance of Effect

6.7.2.101 Taking the low sensitivity of fulmar (Table 6-22) and the negligible magnitude of impact, the overall effect of distributional responses during operation is considered to be **Negligible and Not Significant in EIA terms** based on qualitative assessment of current literature.

Impact 6: Distributional Responses - Vessel Transit

6.7.2.102 The Applicant recognises NatureScot's request to assess potential distributional response effects on the red-throated diver qualifying feature of the Moray Firth SPA due to O&M vessel traffic. Since this concerns qualifying features of the Moray Firth SPA (specifically red-throated diver, which is anticipated to be the most sensitive ornithology receptor anticipated to be present with respect to O&M vessel traffic distributional responses), a detailed assessment has been presented within the RIAA (Application Document 13: Caledonia North Report to Inform Appropriate Assessment and Application Document 14: Caledonia South Report to Inform Appropriate Assessment).

6.7.2.103 Whilst some offshore ornithology receptors are known to be sensitive to disturbance by vessel traffic, no evidence has been identified to suggest that such disturbance (which will occur in a spatially restricted transit corridor between the O&M base and the Array Area) could regularly result in mortality of adult birds. Birds that are disturbed by O&M vessel traffic will relocate following disturbance to alternative locations.

6.7.2.104 Whilst the O&M strategy is yet to be finalised, irrespective of the O&M base selected, for all transits (including those through the Moray Firth SPA), the use of established vessel routes will be prioritised. Therefore, it is likely that disturbance effects due to Caledonia OWF O&M vessel traffic will frequently be occurring within habitat which is already disturbed by other vessels. O&M traffic will follow best practice procedures and will adhere to a Vessel Management Plan (M-13), which will further minimise the risk of distributional responses of offshore ornithology receptors.

6.7.2.105 The sensitivity of offshore ornithology receptors to disturbance by vessel traffic varies from **Negligible** to **High**, as does their conservation value.

6.7.2.106 The magnitude of the impact resulting from this impact pathway is considered to be **Negligible**.

6.7.2.107 It is concluded that the impact significance on offshore ornithology receptors due to operational phase O&M vessel traffic is **Negligible and Not Significant in EIA terms**.

Impact 7: Indirect Effects - Habitat Loss/Displacement of Prey Species

6.7.2.108 During the operational phase of the Proposed Development (Offshore), potential impacts on prey species may indirectly affect ornithological features. Long-term habitat loss will occur throughout the lifetime of the Proposed Development (Offshore) due to the presence of turbine foundations, scour protection and cable protection. Additionally, suspended sediments from maintenance activity may result in fish and mobile invertebrates avoiding the area and may smother and hide immobile benthic prey. The resulting increase in turbidity of the water column may also make it harder for seabirds to see their prey. These impacts could therefore result in a reduction in prey available to foraging seabirds within the array area. Such potential effects on benthic invertebrates and fish have been assessed in Volume 2, Chapter 4: Benthic Subtidal and Intertial Ecology and Volume 2, Chapter 5: Fish and Shellfish Ecology and the conclusions of those assessments inform this assessment of indirect effects on ornithology receptors.

6.7.2.109 With regard to habitat loss, Volume 2, Chapter 5: Fish and Shellfish Ecology discusses the potential impacts upon fish relevant to ornithology as prey species for the Proposed Development (Offshore). For species such as herring, sprat and sandeel, which are the main prey items of many seabird species, potential impacts during operation are considered to be **Minor, and Not Significant in EIA terms** (see Volume 2, Chapter 5: Fish and Shellfish Ecology). With a minor adverse impact on fish that are important prey species for birds, it is concluded that the indirect impact significance on seabirds occurring in or around the Proposed Development (Offshore) during the operational phase is similarly a **Minor adverse impact**.

6.7.2.110 Therefore, the overall effect of indirect impacts on prey during operation is considered to be **Minor and Not Significant in EIA terms**.

Impact 8: Collision Risk

6.7.2.111 During the operational phase of an OWF, there is a risk that birds flying through the Array Area could collide with the rotor blades of operational WTGs. The potential risk of collision of a given species with WTG blades increases where there are increased levels of flight activity. This can be associated with important foraging areas for seabirds where food supply is concentrated or there is a high passage rate of birds (potentially due to daily commuting from nesting and feeding areas or passing through on seasonal migrations). Therefore, CRM is used to estimate the collision risk posed by the OWF.

6.7.2.112 In addition to the species assessed for collision risk in the array area using sCRM (which is informed in part by baseline DAS results), there is also potential collision risk to migratory species which may pass through the array area during migration periods. These species may not have been detected by the baseline DAS and therefore a separate CRM process is undertaken for these species. The assessment methods and results are presented in Section 6.7.2.227 to 6.7.2.236.

6.7.2.113 The seabird species that have been scoped in for collision risk assessment have been identified as being potentially sensitive to collision with OWFs due to published information (based largely on expert opinion) considering traits such as flight manoeuvrability, proportion of time in flight, and proportion of birds expected to occur at rotor swept heights (e.g., Garthe and Hüppop, 2004[47]; Furness and Wade, 2012[53]; Bradbury *et al.,* 2014[77]; Johnston *et al.,* 2014a[14]; 2014b[15]). The species are presented within Table 6-41 along with a quantitative assessment of their peak abundance and frequency of detection during the baseline DAS. Further explanation of the scoping process for species recorded in low abundances is given in Paragraph 6.7.2.115.

6.7.2.114 The frequency and abundances used in the screening process was assessed quantitively through the baseline DAS data. Frequency of species in flight within the array area alone was determined by the presence of species within the baseline DAS. The peak abundance was used to describe the peak number of birds in flight within the Caledonia OWF array area alone, relative to the peak abundance in Caledonia OWF and a 4km buffer in the baseline DAS (see Volume 7B, Appendix 6-1: Offshore Ornithology Baseline Characterisation Report).

6.7.2.115 The Offshore Scoping Report (Volume 7, Appendix 2) scoped lesser black-backed gull (*Larus fuscus*), Arctic skua (*Stercocarius parasiticus*) and terns (common (*Sterna hirundo*) and Arctic (*Sterna paradisaea*)) into the assessment for collision risk. Due to the low numbers recorded within the baseline DAS, these species have been scoped out of the CRM assessment (raw count and density estimates presented in Volume 7B, Appendix 6-3: Offshore Ornithology Collision Risk Modelling Technical Report).

6.7.2.116 The 24 baseline DAS recorded two flying lesser black-backed gulls and two flying Arctic skua within the Array Area. Tern numbers were notably low, with ten terns recorded in the months of May and August, with a maximum of four birds per species/species group (common tern, Arctic tern, and "commic” tern) observed at the end and beginning of the migration seasons. It is therefore concluded that there is no potential for a material effect to occur on these species based on the low number recorded.

Table 6-41: Scoping of seabird species recorded within the Caledonia OWF array area and 4km buffer for risk of collision during the O&M phase. Sensitivity based on Bradbury *et al*. (2014[77]) and Dierschke *et al*. (2016[129]).

Species	Sensitivity to Collision	Conservation Value	Frequency of Months Recorded in the Array Area/ Baseline DAS Period	Peak Abundance of Birds in Flight in the Array Area/ Array Area plus 4km	Scoping Results (in or out)
Kittiwake	Medium	Medium	24 / 24	312 / 540	In
Great black-backed gull	High	Low	11 / 24	15 / 25	In
Herring gull	High	Low	9 / 24	3 / 20	In
Lesser black-backed gull	High	Low	1 / 24	2 / 2	Out
Common tern	Low	Low	1 / 24	3 / 3	Out
Arctic tern	Low	Low	0 / 24	0 / 9	Out
Great skua	Medium	Low	5 / 24	4 / 6	In
Guillemot	Low	Medium	21 / 24	160 / 296	Out
Razorbill	Low	Medium	10 / 24	6 / 12	Out
Puffin	Low	Medium	5 / 24	3 / 5	Out
Red-throated diver	Low	Low	1 / 24	1 / 1	Out
Fulmar	Low	Medium	23 / 24	230 / 440	Out
Gannet	Medium	Medium	22 / 24	89 / 101	In

6.7.2.117 CRM was undertaken using the web-browser version of the Marine Science Scotland Stochastic Collision Risk Model Shiny Application ("sCRM App"; Caneco, 2022[154]), as recommended by NatureScot (2023a[10]). The sCRM App was run stochastically and deterministically using the 'basic' Band (2012[27]) model Option 2, using the Johnston *et al*. (2014a[14]; 2014b[15]) generic flight height distribution dataset as recommended by NatureScot (2023a[10]). The basic CRM assumes flight height distribution is uniform across the rotor swept height. The NatureScot (2023a[10]) guidance requests the use of Option 3 'extended' Band (2012[27]) model. However, the use of the Option 3 is no longer required, as highlighted within the Morven OWF Scoping Opinion (Marine Directorate, 2023[37]), which stated that the guidance will subsequently be updated in due course (Volume 7B, Appendix 6-3: Offshore Ornithology Collision Risk Modelling Technical Report).

6.7.2.118 It is worth nothing that, whilst Johnston *et al.* (2014a[14], 2014b[15]) flight height distribution has been used within the CRM assessment on a precautionary basis, recent research by the BTO (Johnston *et al.*, 2024[81]) into kittiwake flight height distribution showed that the distribution results were lower than the distribution data used within CRM assessment (Johnston *et al.,* 2014a[14], 2014b[15]). The study also noted that results indicated that the kittiwake commuting flight was higher than foraging/searching flight (Johnston *et al.,* 2024[81]). From this data, the commuting behaviour median flight height was estimated at 8.1m (mean 12.6m) and the median flight height for foraging/searching behaviour was 5m (mean 7.6m) (Johnston *et al.*, 2024[81]).

6.7.2.119 Monthly mean density estimates (design-based) of birds in flight within the array areas (i.e. Caledonia, Caledonia North and Caledonia South), and their associated SD, were determined using the 24 months of DAS data. Densities were provided for Caledonia North, Caledonia South and the Caledonia OWF to assess all potential scenarios in line with the two Section 36 consent applications. Birds not identified to species level have been apportioned appropriately (Volume 7B, Appendix 6-1: Offshore Ornithology Baseline Characterisation Report) and are included in the mean density estimates presented in the CRM report (Volume 7B, Appendix 6-3: Offshore Ornithology Collision Risk Modelling Technical Report).

6.7.2.120 The predicted mortalities from CRM have been presented as WCS for Caledonia OWF within this EIAR. The WCS has been defined using the largest number of the smallest turbines considered within the DE for the Proposed Development (Offshore). The Caledonia OWF WCS is based on the maximum number of turbines (fixed) that could be constructed, rather than an addition of Caledonia North and Caledonia South. For more information on the DE, refer to Volume 1, Chapter 3: Proposed Development Description (Offshore) and Volume 1, Chapter 5: Proposed Development Phasing.

6.7.2.121 Gannet was assessed for both distributional responses (Volume 7B, Appendix 6-2: Offshore Ornithology Distributional Responses Technical Report) and collision risk (Volume 7B, Appendix 6-3: Offshore Ornithology Collision Risk Modelling Technical Report). The suggestion within NatureScot Guidance (2023a[10]) is to use an additive approach (i.e., total predicted annual mortality = total predicted collision mortality + total predicted distributional responses mortality), although NatureScot advice has since been updated (see Section 2.8.2 in Volume 7B, Appendix 6-3: Offshore Ornithology Collision Risk Modelling Technical Report). This approach does not consider that birds that have been displaced from the OWF are not at risk from collision. Such an approach will therefore lead to the overestimation of the combined impact of collision and distributional responses.

6.7.2.122 To avoid this overestimation, macro-avoidance rate has been applied to densities used within the CRM, by adding a "correction" step (Pavat *et al.*, 2023[155]).

6.7.2.123 As agreed in consultation, a macro-avoidance rate of 70% has been applied to gannet densities during the non-breeding season (October – early-March). During the breeding season (mid-March – September), the monthly in-flight densities have not been adjusted for macro-avoidance. As March is both within the breeding and non-breeding season, the predicted impacts have been split between both defined seasons. The March breeding season predicted mortalities were not adjusted for macro-avoidance, but the predicted mortalities associated within the non-breeding season have been adjusted accordingly. This approach has been presented as the Guidance Approach (Table 6-42).

6.7.2.124 The Applicant Approach has also been presented, with the macro-avoidance rate of 70% applied to the predicted mortalities in all months (Table 6-42).

Model Parameters

6.7.2.125 The physical and biological parameters used in the CRM assessment follow the NatureScot (2023b[16]) guidance, including e.g. body length and wingspan (NatureScot Guidance note 7 (2023b[16]); Volume 7B, Appendix 6-3: Offshore Ornithology Collision Risk Modelling Technical Report). The deterministic Nocturnal Activity Factor (NAF) rates used within the CRM assessment are based on the NatureScot (2023b[16]) guidance. For gull species, the stochastic NAF was determined based on the central value of the recommended deterministic NAF, with the range (0.25 to 0.50) being captured within the 95% confidence intervals (CIs). These values were presented in consultation with NatureScot in May 2023.

6.7.2.126 The most recent published avoidance rates (NatureScot, 2023b[16]) based on Ozsanlev-Harris *et al*. (2023[38]), were used for CRM. Further detail is provided in Volume 7B, Appendix 6-3: Offshore Ornithology Collision Risk Modelling Technical Report. The JNCC guidance (2024b[156]) was not used in the assessment as it was released after values had been agreed in consultation with NatureScot and after assessment had been completed.

Precautionary Nature of CRM

6.7.2.127 The species parameters used within the CRM assessment (see 6.7.2.125 and 6.7.2.126) are based on the NatureScot Guidance note 7 (2023b[16]). To aid with the interpretation of model outputs, it is important to recognise the precautionary nature of these parameters.

Avoidance Rates

6.7.2.128 Considering avoidance rates, the Offshore Renewables Joint Industry Programme (ORJIP) funded study around Thanet OWF, which recorded over 12,000 bird movements across 220 survey days between July 2014 and April 2016, found that only six birds (all gull species) were reported to have collided with WTGs during this two-year period (Skov *et al*., 2018[69]). Avoidance rates for seabird species calculated from this dataset were considerably higher than the NatureScot recommended avoidance rates used in the assessment. Whilst they are from a single site study, this highlights the likely high levels of precaution applied to collision risk estimates by the assessment.

6.7.2.129 APEM Ltd's study on gannet during the migratory period (APEM, 2014[157]) found that all gannets avoided WTGs within the study area, indicating a potential 100% avoidance rate. Even if a 100% avoidance rate is not used, a rate of 99.5% for the autumn migration was recommended as suitable precaution. This suggests that the currently applied avoidance rates may overestimate collision risk.

6.7.2.130 Additionally, a study carried out at the Aberdeen Offshore Windfarm Limited (AOWFL, 2023[158]) at the European Offshore Wind Development Centre (EOWDC), found that collision rates of birds are likely to be lower than predicted by the NatureScot-recommended avoidance rates. A radar/camera system similar to that employed by Skov *et al*. (2018[69]) collected data between April and October 2020, and April and October 2021. During both data collection periods, no collisions or narrow escapes were recorded in over 10,000 bird videos. It should also be noted that this dataset was not included in the calculations of the latest NatureScot-recommended avoidance rates. Whilst this is a single site study, this highlights the likely high levels of precaution applied to collision risk estimates by the assessment.

Flight Speeds

6.7.2.131 Flight speeds were reviewed by Royal HaskoningDHV (2020[159]) and undertaken at Norfolk Boreas OWF. This review suggested that the current flight speed used for kittiwake (13.1m/s) is an overestimation of the value observed and thus considered to be more realistic (10.8m/s). Included in the Skov *et al*. (2018[69]) study was an even lower estimate of mean kittiwake flight speed of 8.7m/s. The study also suggested lower flight speeds for gannet and large gull species than recommended by the current NatureScot guidance, although flight speeds from the latter are used by the assessment. The flight speed used within the CRM assessment can directly impact the predicted potential mortality and the predicted mortalities could be lowered using these less precautionary rates.

6.7.2.132 Overall, these findings suggest that the collision risk modelling input parameters for this assessment (and other developments) incorporate a high degree of precaution, which should be noted when interpreting the results of the assessment. It is also worth noting that Bill Bands original guidance on CRM recommends best evidence parameters be used over precautionary estimates due to the sensitivity of the model.

Results

6.7.2.133 The monthly and annual predicted collision mortalities for all assessed species in the worst-case scenario (WCS) are presented in Table 6-42.

6.7.2.134 Annual estimated collision mortalities from the Caledonia OWF have been calculated using the design-based mean densities of flying birds recorded on baseline DAS.

6.7.2.135 A complete range of collision estimates for the Caledonia OWF and the different design scenarios are presented in Volume 7B, Appendix 6-3, Annex 1: Offshore Ornithology Collision Risk Modelling (Caledonia OWF).

Table 6-42: Estimated monthly collisions for collision risk species in Caledonia OWF for the WCS (WTG 1) using the Marine Science Scotland Stochastic Collision Risk Model Shiny Application ("sCRM App"; Caneco *et al.*, 2022[154]).

Species	CI	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Kittiwake	Mean	0.44	0.67	0.59	6.11	8.47	21.95	14.86	6.94	1.53	1.73	3.25	0.48	67.01
	2.5%	0.10	0.11	0.16	1.45	3.32	5.61	4.41	3.71	0.64	0.67	1.09	0.13	21.40
	97.5%	0.92	1.38	1.12	12.52	14.61	43.10	28.16	10.97	2.66	3.06	5.85	0.94	125.28
Great Black-backed gull	Mean	3.99	2.39	0	0	0	0	0	0	1.61	1.11	4.65	1.24	14.98
	2.5%	1.11	0.30	0	0	0	0	0	0	0.15	0.11	0.98	0.23	2.87
	97.5%	8.28	5.32	0	0	0	0	0	0	3.87	2.66	9.84	2.84	32.81
Herring gull	Mean	0.30	0.30	0	0	0	0	0	0	0.36	0.33	0.79	1.04	3.12
	2.5%	0.01	0.02	0	0	0	0	0	0	0.02	0.02	0.08	0.07	0.23
	97.5%	0.82	0.79	0	0	0	0	0	0	0.92	0.81	1.90	2.72	7.95
Great skua	Mean	0	0	0	0	0.02	0.02	0.02	0.08	0	0	0	0	0.15
	2.5%	0	0	0	0	0	0	0	0.01	0	0	0	0	0.02
	97.5%	0	0	0	0	0.05	0.05	0.05	0.17	0	0	0	0	0.33
Gannet – Guidance Approach	Mean	0.02	0.02	0.06	0.48	0.11	6.81	1.27	1.24	2.41	0.50	0.09	0.03	13.02
	2.5%	0	0	0	0.03	0.01	0.79	0.23	0.24	0.44	0.09	0.02	0	1.85
	97.5%	0.06	0.06	0.20	1.46	0.36	19.42	3.29	3.04	6.37	1.24	0.26	0.12	35.89

Species	CI	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Gannet – Applicant Approach	Mean	0.02	0.02	0.03	0.14	0.03	2.04	0.38	0.37	0.72	0.50	0.09	0.03	4.38
	2.5%	0	0	0	0.01	0	0.24	0.07	0.07	0.13	0.09	0.02	0	0.63
	97.5%	0.06	0.06	0.09	0.44	0.11	5.83	0.99	0.91	1.91	1.24	0.26	0.12	12.02

Kittiwake

Magnitude of Impact

6.7.2.136 The monthly predicted number of collisions for kittiwake is presented in Table 6-42. The predicted number of collisions per defined season for kittiwake are presented in Table 6-43, and predicted annual collisions relative to relevant background populations are presented in Table 6-44. Predicted mortalities are presented for the NatureScot breeding season and non-breeding season based on the worst-case design scenario (WTG 1).

6.7.2.137 The average "all ages" survival rate was calculated using the average mortality rate (0.156), which itself was calculated using age-specific demographic rates and age class proportions from Horswill and Robinson (2015[32]) (Table 6-11). An "all ages" survival rate was derived by subtracting the "all ages" mortality from 1.

6.7.2.138 The potential magnitude of impact was estimated by calculating the change in average annual "all ages" survival rate (presented as a decrease in percentage point change) within each defined season with respect to the relevant regional populations.

Table 6-43: Predicted kittiwake seasonal collision impacts for the Caledonia OWF.

Defined Season	Predicted Collisions (Mean and 95% CIs)	Regional Baseline Population (Individuals)	Baseline Annual Mortality	Change in average survival (% point change)
Breeding Season (Mid-April – August)	55.27 (17.78 – 103.10)	496,826	77,505	0.011
Non-breeding Season (Mid-Aug – Mar)	11.74 (3.61-22.18)	829,937	129,470	0.001

Table 6-44: Predicted kittiwake annual collision impacts for the Caledonia OWF and predicted change to annual mortality rate of relevant background populations based on mean collision rate.

Defined Season	Predicted Collisions (Mean and 95% CIs)	Regional Baseline Population (Individuals)	Baseline Annual Mortality	Change in Average Survival (% Point Change)
Annual total (regional/BDMPS)	67.01 (21.40 – 125.28)	829,937	129,470	0.008
Annual total (biogeographic)		5,100,000	795,600	0.001

Breeding Season

6.7.2.139 During the breeding season, 55 (55.27) kittiwake are predicted to be subject to collision mortality. The breeding season regional population size is estimated to be 496,826 individuals (Table 6-43). Based on the average survival rate of 84.4%, the predicted annual baseline mortality for this population is 77,505 individuals per annum. The addition of 55 predicted additional mortalities per annum to this population due to collision would result in a 0.011 survival rate percentage point change.

6.7.2.140 This level of impact is considered to be of **Negligible** magnitude, as it would not materially impact the existing mortality rate and would be undetectable in the context of natural variation.

Non-Breeding Season

6.7.2.141 During the non-breeding season, 12 (11.74) kittiwake are predicted to be subject to collision mortality per annum. The non-breeding season regional population size is estimated to be 829,937 individuals (Table 6-43). Based on the average survival rate of 84.4%, the predicted annual baseline mortality for the non-breeding season population is 129,470 individuals. The addition of 12 predicted additional mortalities per annum to this population due to collision would result in a 0.001 survival rate percentage point change.

6.7.2.142 This level of impact is considered to be of **Negligible** magnitude, as it would not materially impact the existing mortality rate and would be undetectable in the context of natural variation.

Annual total

6.7.2.143 The annual total of kittiwake subject to mortality due to collision is estimated to be 67 (67.01) individuals per annum. Using the largest BDMPS population of 829,937 (Table 6-44) with an average survival rate of 84.4%, the predicted annual baseline mortality of this population is 129,470. The addition of 67 predicted additional mortalities per annum due to collision would result in a 0.008 survival rate percentage point change for this population. When considering the annual potential level of impact at the biogeographic scale (5,100,000 individuals), the predicted annual baseline mortality across all seasons is 795,600.0 individuals. The addition of 67 predicted additional mortalities per annum due to collision would result in a of 0.001 survival rate percentage point change for this population.

6.7.2.144 This level of impact is considered to be of **Negligible** magnitude, as it would not materially impact the existing mortality rate and would be undetectable in the context of natural variation.

Sensitivity of Receptor

6.7.2.145 Based upon the findings presented in the literature review (Table 6-5), kittiwake sensitivity to collision risk during the operational phase is considered to be **Medium**. The conservation value of the species is **Medium** (Table 6-41).

Significance of Effect

6.7.2.146 Taking the **Medium** sensitivity of kittiwake (Table 6-41) and the negligible magnitude of impact predicted by the sCRM, the overall significance of effect of collision during operation is considered to be **Negligible and Not Significant in EIA terms** following the matrix approach (Table 6-17).

Great Black-backed Gull

Magnitude of Impact

6.7.2.147 The monthly predicted number of great black-backed gull collisions is presented in Table 6-42. The predicted number of collisions per defined season for great black-backed gull are presented in Table 6-45, and predicted annual collisions relative to relevant background populations is presented in Table 6-46. Predicted mortalities are presented for the NatureScot breeding season and non-breeding season based on the worst-case design scenario (WTG 1).

6.7.2.148 The average "all ages" survival rate was calculated using the average mortality rate (0.160), which itself was calculated using age-specific demographic rates and age class proportions from Horswill and Robinson (2015[32]) (Table 6-11). An "all ages" survival rate was derived by subtracting the "all ages" mortality from 1

6.7.2.149 The potential magnitude of impact was estimated by calculating the change in average annual "all ages" survival rate (presented as a decrease in percentage point change) within each defined season with respect to the relevant regional populations.

Table 6-45: Predicted great black-backed gull seasonal collision impacts for the Caledonia OWF.

Defined Season	Predicted Collisions (Mean and 95% CIs)	Regional Baseline Population (Individuals)	Baseline Annual Mortality	Change in Average Survival (% Point Change)
Breeding (April-August)	0 (0 - 0)	4,753	760	<0.001
Non-breeding (September-March)	14.98 (2.87 - 32.81)	91,399	14,624	0.016

Table 6-46: Predicted great black-backed gull annual collision impacts for the Caledonia OWF and predicted change to annual mortality rate of relevant background populations based on mean collision rate.

Defined Season	Predicted Collisions (Mean and 95% CIs)	Regional Baseline Population (Individuals)	Baseline Annual Mortality	Change in Average Survival (% Point Change)
Annual total (regional/BDMPS)	14.98 (2.87 - 32.81)	91,399	14,624	0.016
Annual total (biogeographic)		235,000	37,600	0.006

Breeding Season

6.7.2.150 During the breeding season, 0 great black-backed gull are predicted to be subject to collision mortality. The breeding season regional population size is estimated to be 7,753 individuals (Table 6-45). Based on the average survival rate of 84.0%, the predicted annual baseline mortality this population is 760 individuals per annum. The addition of 0 predicted additional mortalities per annum to this population due to collision would result in a <0.001 survival rate percentage point change.

6.7.2.151 This level of impact (i.e. zero) is considered to be of **Negligible** magnitude.

Non-Breeding Season

6.7.2.152 During the non-breeding season, 15 (14.98) great black-backed gull are predicted to be subject to collision mortality per annum. Based on the average survival rate of 84.0%, the predicted annual baseline mortality for the non-breeding season population is 14,624 individuals (Table 6-45). The addition of 15 predicted additional mortalities per annum to this population due to collision would result in a 0.016 survival rate percentage point change.

6.7.2.153 This level of impact is considered to be of **Negligible** magnitude, as it would not materially impact the existing mortality rate and would be undetectable in the context of natural variation.

Annual total

6.7.2.154 The annual total of great black-backed gull predicted to be subject to mortality due to collision is estimated to be 15 (14.98) individuals. Using the largest BDMPS population of 91,399 (Table 6-46) with an average survival rate of 84.0%, the predicted annual baseline mortality of this population is 14,624. The addition of 15 predicted additional mortalities per annum due to collision would result in a 0.016 survival rate percentage point change for this population. When considering the annual potential level of impact at the biogeographic scale (235,000 individuals), the predicted annual baseline mortality across all seasons is 37,600 individuals. The addition of 15 predicted additional mortalities per annum due to collision would result in a 0.006 survival rate percentage point change for this population.

6.7.2.155 This level of impact is considered to be of **Negligible** magnitude, as it would not materially impact the existing mortality rate and would be undetectable in the context of natural variation.

Sensitivity of Receptor

6.7.2.156 Based upon the findings presented in the literature review (Table 6-5), great black-backed gull sensitivity to collision risk during the operation phase is considered to be **High**. The conservation value of the species is **Low**.

Significance of Effect

6.7.2.157 Taking the high sensitivity of great black-backed gull (Table 6-41) and the negligible magnitude of impact, the overall effect of collision during operation is considered to be **Negligible and Not Significant in EIA terms** following the matrix approach (Table 6-17).

Herring gull

Magnitude of Impact

6.7.2.158 The monthly number of predicted collisions for herring gull is presented in Table 6-42. The predicted number of collisions per defined season for herring gull are presented in Table 6-47, and predicted annual collisions relative to relevant background populations are presented in Table 6-48. Predicted mortalities are presented for the NatureScot breeding season and non-breeding season based on the worst-case design scenario (WTG 1).

6.7.2.159 The average "all ages" survival rate was calculated using the average mortality rate (0.172), which itself was calculated using age-specific demographic rates and age class proportions from Horswill and Robinson (2015[32]). An "all ages" survival rate was derived by subtracting the "all ages" mortality from 1.

6.7.2.160 The potential magnitude of impact was estimated by calculating the change in average annual "all ages" survival rate (presented as a decrease in percentage point change) within each defined season with respect to the relevant regional populations.

Table 6-47: Predicted herring gull seasonal collision impacts for the Caledonia OWF.

Defined Season	Predicted Collisions (Mean and 95% CIs)	Regional Baseline Population (Individuals)	Baseline Annual Mortality	Change in Average Survival (% Point Change)
Breeding (April-August)	0 (0 - 0)	42,584	7,324	<0.001
Non-breeding (September-March)	3.12 (0.23 – 7.95)	466,511	80,240	0.001

Table 6-48: Predicted herring gull annual collision impacts for the Caledonia OWF and predicted change to annual mortality rate of relevant background populations based on mean collision rate.

Defined Season	Predicted Collisions (Mean and 95% CIs)	Regional Baseline Population (Individuals)	Baseline Annual Mortality	Change in Average Survival (% Point Change)
Annual total (regional/BDMPS)	3.12 (0.23 – 7.95)	466,511	80,240	0.001
Annual total (biogeographic)	3.12 (0.23 – 7.95)	1,098,000	188,856	<0.001

Breeding Season

6.7.2.161 During the breeding season, 0 herring gull are predicted to be subject to collision mortality. The breeding season regional population size is estimated to be 42,584 individuals (Table 6-47). Based on the average survival rate of 82.8%, the predicted annual baseline mortality for this population is 7,3424 individuals per annum. The addition of 0 predicted additional mortalities per annum during the breeding season due to collision would result in a <0.001 survival rate percentage point change.

6.7.2.162 This level of impact (i.e., zero) is considered to be of **Negligible** magnitude.

Non-Breeding Season

6.7.2.163 During the non-breeding season, three (3.12) herring gull are predicted to be subject to collision mortality per annum. Based on the average survival rate of 82.8%, the predicted annual baseline mortality for the non-breeding population is 80,240 individuals (Table 6-47). The addition of three predicted additional mortalities per annum to this population due to collision would result in a 0.001 survival rate percentage point change.

6.7.2.164 This level of impact is considered to be of **Negligible** magnitude, as it would not materially impact the existing mortality rate and would be undetectable in the context of natural variation.

Annual Total

6.7.2.165 The annual total of herring gull subject to mortality due to collision is estimated to be three (3.12) individuals per annum. Using the largest BDMPS population of 466,511 (Table 6-48) with an average survival rate of 82.8%, the predicted annual baseline mortality of this population is 80,240. The addition of three predicted additional mortalities per annum due to collision would result in a 0.001 survival rate percentage point change for this population. When considering the annual potential level of impact at the biogeographic scale (1,098,000 individuals), the predicted annual baseline mortality across all seasons is 188,856 individuals. The addition of three predicted additional mortalities per annum due to collision would result in a <0.001 survival rate percentage point change to this population.

6.7.2.166 This level of impact is considered to be of **Negligible** magnitude, as it would not materially impact the existing mortality rate and would be undetectable in the context of natural variation.

Sensitivity of Receptor

6.7.2.167 Based upon the findings presented in the literature reviewed on this subject (Table 6-5), herring gull sensitivity to collision risk during the operational phase is considered to be **High**. The conservation value of the species is low (Table 6-41).

Significance of Effect

6.7.2.168 Taking the high sensitivity of herring gull (Table 6-41) and the negligible magnitude of impact, the overall effect of collision during operation is considered to be **Negligible and Not Significant in EIA terms** following the matrix approach (Table 6-17).

Great Skua

Magnitude of Impact

6.7.2.169 The monthly predicted number of great skua collisions presented in Table 6-42. The predicted number of collisions per defined season for great skua are presented in Table 6-49, and predicted annual collisions relative to relevant background populations are presented in Table 6-50. Predicted mortalities are presented for the NatureScot breeding season and non-breeding season based on the worst-case design scenario (WTG 1).

6.7.2.170 The average "all ages" survival rate was calculated using the average mortality rate (0.219), which itself was calculated using age-specific demographic rates and age class proportions from Horswill and Robinson (2015[32]) (Table 6-11). An "all ages" survival rate was derived by subtracting the "all ages" mortality from 1. The potential magnitude of impact was estimated by calculating the change in average annual "all ages" survival rate (presented as a decrease in percentage point change) within each defined season with respect to the relevant regional populations.

Table 6-49: Predicted great skua seasonal collision impacts for the Caledonia OWF.

Defined Season	Predicted Collisions (Mean and 95% CIs)	Regional Population Size (Individuals)	Baseline Mortality	Change in Average Survival (% Point Change)
Breeding (mid April - mid September)	0.15 (0.02 – 0.33)	20,718	4,542	0.001
Non-breeding Season	0 (0 – 0)	19,556	4,287	<0.001

Table 6-50: Predicted great skua annual collision impacts for the Caledonia OWF and predicted change to annual mortality rate of relevant background populations based on mean collision rate.

Defined Season	Predicted Collisions (Mean and 95% CIs)	Regional Baseline Population (Individuals)	Baseline Mortality	Change in Average Survival (% Point Change)
Annual total (regional/BDMPS)	0.15 (0.02 – 0.33)	20,718	4,542	0.001
Annual total (biogeographic)		73,000	16,003	<0.001

Breeding Season

6.7.2.171 During the breeding season, 0 (0.15) great skua are predicted to be subject to collision mortality. The breeding season regional population size is estimated to be 20,718 individuals (Table 6-49). Based on the average survival rate of 78.1%, the predicted annual baseline mortality for this population is 4,542 individuals. The addition of 0.15 predicted additional mortalities per annum to this population due to collision would result in a 0.001 survival rate percentage point change.

6.7.2.172 This level of impact is considered to be of **Negligible** magnitude, as it would not materially impact the existing mortality rate and would be undetectable in the context of natural variation.

Non-Breeding Season

6.7.2.173 During the non-breeding season, 0 great skua are predicted to be subject to collision mortality per annum. Based on the average survival rate of 78.1%, the predicted annual baseline mortality for the non-breeding season population is 4,287 individuals. The addition of 0 predicted additional mortalities per annum to this population due to collision would result in a <0.001 survival rate percentage point change.

6.7.2.174 This level of impact (i.e. zero) is considered to be of **Negligible** magnitude.

Annual Total

6.7.2.175 The annual total of great skua subject to mortality due to collision is predicted to be 0 (0.15) individuals per annum. Using the largest BDMPS population of 20,718 (Table 6-50) with an average survival rate of 78.1%, the predicted annual baseline mortality of this population is 4,542. The addition of 0 predicted additional mortalities per annum due to collision would result in a 0.001 survival rate percentage point change for this population. When considering the annual potential level of impact at the biogeographic scale (73,000 individuals), the predicted annual baseline mortality across all seasons is 16,003 individuals. The addition of 0 predicted additional mortalities per annum due to collision would result in a of <0.001 survival rate percentage point change for this population.

6.7.2.176 This level of impact is considered to be of **Negligible** magnitude, as it would not materially impact the existing mortality rate and would be undetectable in the context of natural variation.

Sensitivity of Receptor

6.7.2.177 Based upon the findings presented in the literature reviewed on this subject (Table 6-5), great skua sensitivity to collision risk during the operational phase is considered to be **Medium**. The conservation value of the species is **Low** (Table 6-41).

Significance of Effect

6.7.2.178 Taking the medium sensitivity of great skua (Table 6-41) and the negligible magnitude of impact, the overall effect of collision during operation is considered to be **Negligible and Not Significant in EIA terms** following the matrix approach (Table 6-17).

Gannet - Guidance Approach

Magnitude of Impact

6.7.2.179 The monthly predicted number of collisions for gannet is presented in Table 6-42. The estimated number of collisions per defined season for gannet are presented in Table 6-51, and predicted annual collisions relative to relevant background populations are presented in Table 6-52. Predicted mortalities are presented for the NatureScot breeding season and non-breeding season based on the worst-case design scenario (WTG 1).

6.7.2.180 The average "all ages" survival rate was calculated using the average mortality rate (0.187), which itself was calculated using age-specific demographic rates and age class proportions from Horswill and Robinson (2015[32]) (Table 6-11). An "all ages" survival rate was derived by subtracting the "all ages" mortality from 1.

6.7.2.181 The potential magnitude of impact was estimated by calculating the change in average annual "all ages" survival rate (presented as a decrease in percentage point change) within each defined season with respect to the relevant regional populations.

Table 6-51: Predicted gannet seasonal collision impacts using the Guidance Approach for the Caledonia OWF.

Defined Season	Predicted Collisions (Mean and 95% CIs)	Regional Population Size (Individuals)	Baseline Mortality	Change in Average Survival (% Point Change)
Breeding (mid April-mid September)	12.35 (1.73 – 34.10)	920,514	172,136	0.001
Non-breeding Season	0.67 (0.11 – 1.79)	456,298	85,328	<0.001

Table 6-52: Predicted gannet annual collision impacts using the Guidance Approach for the Caledonia OWF and predicted change to annual mortality rate of relevant background populations based on mean collision rate.

<table>
<tr><th>Defined Season</th><th>Predicted Collisions (Mean and 95% CIs)</th><th>Regional Baseline Population (Individuals)</th><th>Baseline Mortality</th><th>Change in Average Survival (% Point Change)</th></tr>
<tr><td>Annual total (regional/BDMPS)</td><td rowspan="2">13.02
(1.85 – 35.89)</td><td>920,514</td><td>172,136</td><td>0.001</td></tr>
<tr><td>Annual total (biogeographic)</td><td>1,180,000</td><td>220,660</td><td>0.001</td></tr>
</table>

Breeding Season

6.7.2.182 During the breeding season, 12 (12.35) gannet are predicted to be subject to collision mortality. The breeding season regional population size is estimated to be 920,514 individuals (Table 6-51). Based on the average survival rate of 81.3%, the predicted annual baseline mortality for this population is 172,136 individuals. The addition of 12 predicted additional mortalities per annum to this population due to collision would result in a 0.001 survival rate percentage point change.

6.7.2.183 This level of impact is considered to be of **Negligible** magnitude, as it would not materially impact the existing mortality rate and would be undetectable in the context of natural variation.

Non-Breeding Season

6.7.2.184 During the non-breeding season, less than one (0.67) gannet are predicted to be subject to collision mortality per annum. Based on the average survival rate of 81.3%, the predicted annual baseline mortality for the non-breeding season population is 85,328 individuals. The addition of less than one predicted additional mortalities per annum to this population due to collision would result in a <0.001 survival rate percentage point change.

6.7.2.185 This level of impact is considered to be of **Negligible** magnitude, as it would not materially impact the existing mortality rate and would be undetectable in the context of natural variation.

Annual Total

6.7.2.186 The annual total of gannet subject to mortality due to collision is estimated to be 13 individuals per annum. Using the largest BDMPS population of 920,514 (Table 6-52) with an average survival rate of 81.3%, the predicted annual baseline mortality of this population is 172,136. The addition of 13 predicted additional mortalities per annum due to collision would result in a 0.001 survival rate percentage point change for this population. When considering the annual potential level of impact at the biogeographic scale (1,180,000 individuals), the predicted annual baseline mortality across all seasons for that population is 220,660 individuals. The addition of 13 predicted additional mortalities per annum due to collision would result in a 0.001 survival rate percentage point change for this population.

6.7.2.187 This level of impact is considered to be of **Negligible** magnitude, as it would not materially impact the existing mortality rate and would be undetectable in the context of natural variation.

Sensitivity of Receptor

6.7.2.188 Based upon the findings presented in the literature review (Table 6-5), gannet sensitivity to collision risk during the operational phase is considered to be **Medium**. The conservation value of the species is **Medium** (Table 6-41).

Significance of Effect

6.7.2.189 Taking the **Medium** sensitivity of gannet (Table 6-41) and the negligible magnitude of impact, the overall effect of collision during operation is considered to be **Negligible and Not Significant in EIA terms** following the matrix approach (Table 6-17).

Gannet - Applicant Approach

Magnitude of Impact

6.7.2.190 The monthly predicted number of collisions for gannet is presented in Table 6-42. The estimated number of collisions per defined season for gannet are presented in Table 6-53, and predicted annual collisions relative to relevant background populations are presented in Table 6-54. Predicted mortalities are presented for the NatureScot breeding season and non-breeding season based on the worst-case design scenario (WTG 1).

6.7.2.191 The average "all ages" survival rate was calculated using the average mortality rate (0.187), which itself was calculated using age-specific demographic rates and age class proportions from Horswill and Robinson (2015[32]) (Table 6-11). An "all ages" survival rate was derived by subtracting the "all ages" mortality from 1.

Table 6-53:Predicted gannet seasonal collision impacts using the Applicant Approach for the Caledonia OWF.

Defined Season	Predicted Collisions (Mean and 95% CIs)	Regional Population Size (Individuals)	Baseline Mortality	Change in Average Survival (% Point Change)
Breeding Season (mid-March- September)	3.70 (0.52 – 10.23)	920,514	172,136	<0.001
Non-breeding Season (Oct - Mid-Mar)	0.67 (0.11 – 1.79)	456,298	85,328	<0.001

Table 6-54: Predicted gannet annual collision impacts using the Applicant Approach for the Caledonia OWF and predicted change to annual mortality rate of relevant background populations based on mean collision rate.

Defined Season	Predicted Collisions (Mean and 95% CIs)	Regional Baseline Population (Individuals)	Baseline Mortality	Change in Average Survival (% Point Change)
Annual total (regional/BDMPS)	4.38 (0.63 – 12.02)	920,514	172,136	<0.001
Annual total (biogeographic)		1,180,000	220,660	<0.001

Breeding Season

6.7.2.192 During the breeding season, four (3.70) gannet are predicted to be subject to collision mortality. The breeding season regional population size is estimated to be 920,514 individuals (Table 6-53). Based on the average survival rate of 81.3%, the predicted annual baseline mortality for this population is 172,136 individuals. The addition of four predicted additional mortalities per annum to this population due to collision would result in a change to the survival rate of <0.001 percentage point change.

6.7.2.193 This level of impact is considered to be of **Negligible** magnitude, as it would not materially impact the existing mortality rate and would be undetectable in the context of natural variation.

Non-Breeding Season

6.7.2.194 During the non-breeding season, less than one (0.67) gannet is predicted to be subject to collision mortality per annum. Based on the average survival rate of 81.3%, the predicted annual baseline mortality for the non-breeding season population is 85,328 individuals. The addition of less than one predicted additional mortality per annum to this population due to collision would result in a change to the survival rate of <0.001 percentage point change.

6.7.2.195 This level of impact is considered to be of **Negligible** magnitude, as it would not materially impact the existing mortality rate and would be undetectable in the context of natural variation.

Annual Total

6.7.2.196 The annual total of gannet predicted to be subject to mortality due to collision is estimated to be four (4.38) individuals per annum. Using the largest BDMPS population of 920,514 (Table 6-54) with an average survival rate of 81.3%, the predicted annual baseline mortality of this population is 172,136. The addition of four predicted additional mortalities per annum due to collision would result in a change to the survival rate of <0.001 percentage point change for this population. When considering the annual potential level of impact at the biogeographic scale (1,180,000 individuals), the predicted annual baseline mortality across all seasons is 220,660 individuals. The addition of four predicted additional mortalities per annum due to collision would result in a change to the survival rate of <0.001 percentage point change to this population.

6.7.2.197 This level of impact is considered to be of **Negligible** magnitude, as it would not materially impact the existing mortality rate and would be undetectable in the context of natural variation.

Sensitivity of Receptor

6.7.2.198 Based upon the findings presented in the literature review (Table 6-5), gannet sensitivity to collision risk during the operational phase is considered to be **Medium**. The conservation value of the species is **Medium** (Table 6-41).

Significance of Effect

6.7.2.199 Taking the medium sensitivity of gannet (Table 6-41) and the negligible magnitude of impact, the overall effect of collision during operation is considered to be **Negligible and Not Significant in EIA terms** following the matrix approach (Table 6-17).

Combined Impacts: Distributional Responses and Collision Risk

6.7.2.200 Gannet and kittiwake have been assessed for both distributional responses and collision risk during the operational phase of the Caledonia OWF. Previous sections have concluded negligible predicted magnitudes of impact with respect to operational phase distributional effects or collision risk acting alone; however, the combined impact of both collision risk and distributional responses may be greater than either one acting alone. Further consideration of both impacts acting together is therefore provided below.

6.7.2.201 Assessing these two potential impacts together will amount to double counting of impacts, as birds that are subject to distributional responses would not be subject to potential collision risk as they are already assumed to have not entered the Caledonia OWF. Similarly, birds estimated to be subject to collision risk mortality would not be able to be subjected to mortality as a result of distributional responses as well.

Kittiwake

Magnitude of Impact

6.7.2.202 The predicted level of mortality due to combined operational phase distributional responses and collision per defined season for kittiwake is presented in Table 6-55. The predicted annual mortality due to combined operational phase distributional responses and collision relative to relevant background populations using both approaches is presented in Table 6-56.

6.7.2.203 The combined assessment for kittiwake was completed using the Guidance Approach as The Applicant has assessed the distributional response risk for kittiwake as low and thus not requiring assessment. Thus, assessment has used the displacement rates of 30% for all seasons and a range of 1% - 3% mortality rate as set out in the Guidance Approach.

6.7.2.204 The "all ages" average survival rate was calculated using the average mortality rate (0.156), which itself was calculated using age-specific demographic rates and age class proportions from Horswill and Robinson (2015[32]) (Table 6-11). An "all ages" survival rate was derived by subtracting the "all ages" mortality from 1. The potential magnitude of impact was estimated by calculating the change in average survival rate (presented as a decrease in percentage point change) within each defined season with respect to the relevant regional populations.

Table 6-55: Seasonal combined distributional response estimates and collision impacts of kittiwake for the Caledonia OWF during the operational phase, as per the Guidance Approach.

Defined Season	Regional Baseline Populations and Baseline Mortality Rates (Individuals Per Annum)		Estimated Number of Mortalities from Combined CRM (Mean) and Distributional Responses Per Annum		Change in Average Survival Rate (% Point Change) (Displacement Rate; Mortality Rate)	
	Population (Individuals)	Baseline Mortality	30% Disp; 1% Mort	30% Disp; 3% Mort	30% Disp; 1% Mort	30% Disp; 3% Mort
NatureScot Seasons						
Breeding season (Mid-April to August)	496,826	77,505	61.39 (6.12 due to distributional responses (Table 6-24), 55.27 due to collision (Table 6-43))	73.62 (18.35 due to distributional responses (Table 6-24), 55.27 due to collision (Table 6-43))	0.012	0.015
Non-breeding season (September to early-April)	829,937	129,470	13.19 (1.45 due to distributional responses (Table 6-24), 11.74 due to collision (Table 6-43))	16.09 (4.35 due to distributional responses (Table 6-24), 11.74 due to collision (Table 6-43))	0.002	0.002

Table 6-56: Annual combined distributional response estimates and collision impacts of kittiwake for the Caledonia OWF during the operational phase, as per the Guidance Approach.

Defined Season	Regional Baseline Populations and Baseline Mortality Rates (Individuals Per Annum)		Estimated Number of Mortalities from Combined CRM (Mean) and Distributional Responses Per Annum	Change in Average Survival Rate (% Point Change)
	Population (Individuals)	Baseline Mortality		
Annual total (regional/BDMPS)	829,937	129,470	74.57 – 89.70	0.009 – 0.011
Annual total (biogeographic)	5,100,000	795,600	74.57 – 89.70	0.001 – 0.002
Note, as per the Guidance Approach displacement rate is 30% and mortality rates are: 1% and 3%, as such annual totals have been presented as a range (30% displacement and 1% to 3% mortality)				

Breeding Season

6.7.2.205 As presented in Table 6-55, the combined potential mortality of kittiwake as a result of operational phase distributional responses and collision combined is 61 (61.39) individuals during the breeding season. The breeding season regional population is estimated to be 496,826 individuals (Table 6-55). Based on the average survival rate of 84.4%, the predicted annual baseline mortality for this population is 77,505 individuals. The addition of 61 predicted additional mortalities per annum due to distributional responses and collision combined would result in a 0.015 survival rate percentage point change for this population.

6.7.2.206 This level of impact is considered to be of **Negligible** magnitude, as it would not materially impact the existing mortality rate and would be undetectable in the context of natural variation.

Non-breeding Season

6.7.2.207 As presented in Table 6-55, the combined potential mortality of kittiwake as a result of operational phase distributional responses and collision combined is 13 (13.19) individuals during the non-breeding season. The non-breeding season regional population is estimated to be 829,937 individuals (Table 6-55). Based on the average survival rate of 81.3%, the predicted annual baseline mortality for this population is 129,470 individuals. The addition of 13 predicted additional mortalities per annum during the non-breeding season due to operational phase distributional responses and collision combined would result in a 0.002 survival rate percentage point change this population.

6.7.2.208 This level of impact is considered to be of **Negligible** magnitude, as it would not materially impact the existing mortality rate and would be undetectable in the context of natural variation.

Annual Total

6.7.2.209 As presented in Table 6-56, the combined potential mortality of kittiwake as a result of distributional responses and collision is 75 (74.57) individuals. Using the largest BDMPS population of 829,937 with an average survival rate of 81.3%, the predicted annual baseline mortality for this population is 129,470 individuals. The addition of 75 predicted additional mortalities per annum due to operational phase distributional responses and collision would result in a 0.009 survival rate percentage point change. When considering the annual potential level of impact at the biogeographic scale (5,100,000 individuals), the predicted annual baseline mortality of this population is 795,600 individuals. The addition of 75 predicted additional mortalities per annum due to operational phase distributional responses and collision combined would result in a 0.002 survival rate percentage point change for this population.

6.7.2.210 This level of impact is considered to be of **Negligible** magnitude, as it would not materially impact the existing mortality rate and would be undetectable in the context of natural variation.

Sensitivity of Receptor

6.7.2.211 Based upon the findings presented in the literature reviewed on this subject (Table 6-5), kittiwake sensitivity to distributional responses during the operation phase is considered to be **Medium**. The conservation value of the species is medium (Table 6-22 and Table 6-41).

Significance of Effect

6.7.2.212 Taking the medium sensitivity of kittiwake (Table 6-22 and Table 6-41) and the negligible magnitude of impact, the overall combined effect of collision and distributional responses during operation is considered to be **Negligible and Not Significant in EIA terms** following the matrix approach (Table 6-17).

Gannet

Magnitude of Impact

6.7.2.213 The predicted level of mortality due to combined operational phase distributional responses and collision per defined season for gannet is presented in Table 6-57 (Applicant Approach) and Table 6-58 (Guidance Approach). The predicted annual mortality due to combined operational phase distributional responses and collision relative to relevant background populations using both approaches is presented in Table 6-59.

6.7.2.214 The average "all ages" survival rates was calculated using the average mortality rate (0.187), which itself was calculated using age-specific demographic rates and age class proportions from Horswill and Robinson (2015[32]) (Table 6-11). An "all ages" survival rate was derived by subtracting the "all ages" mortality from 1. The potential magnitude of impact was estimated by calculating the change in average survival rate (presented as a decrease in percentage point change) within each defined season with respect to the relevant regional populations.

6.7.2.215 Gannet has been assessed using both the Applicant and Guidance Approach. For the Guidance Approach, macro avoidance has been applied for the non-breeding season only for collision assessment and a displacement rate of 70% has been applied with a 1% mortality rate in the non-breeding season and a 3% mortality rate in the breeding season. The Applicant Approach applies macro-avoidance year-round for collision and applies a 1% mortality rate for distributional responses across all seasons.

Table 6-57: Seasonal combined distributional response estimates and collision impacts of gannet for the Caledonia OWF during the operational phase, as per the Applicant Approach.

Defined Season	Regional Baseline Populations and Baseline Mortality Rates (Individuals Per Annum)		Estimated Number of Mortalities from Combined CRM (Mean) and Distributional Responses Per Annum	Change in Average Survival Rate (% Point Change) (Displacement Rate; Mortality Rate)
	Population (Individuals)	Baseline Mortality	70% Disp; 1% Mort	70% Disp; 1% Mort
NatureScot Seasons				
Breeding season (Mid-April to August)	920,514	172,136	10.06 (6.36 due to distributional responses (Table 6-38), 3.70 due to collision (Table 6-53))	0.001
Non-breeding season (September to early-April)	456,298	85,328	2.88 (2.21 due to distributional responses (Table 6-38), 0.67 due to collision (Table 6-53))	0.001

Table 6-58: Seasonal combined distributional response estimates and collision impacts of gannet for the Caledonia OWF during the operational phase, as per the Guidance Approach.

Defined Season	Regional Baseline Populations and Baseline Mortality Rates (Individuals Per Annum)		Estimated Number of Mortalities from Combined CRM (Mean) and Distributional Responses Per Annum		Change in Average Survival Rate (% Point Change) (Displacement Rate; Mortality Rate)	
	Population (Individuals)	Baseline Mortality	70% Disp; 1% Mort	70% Disp; 3% Mort	70% Disp; 1% Mort	70% Disp; 3% Mort
NatureScot Seasons						
Breeding season (Mid-March to September)	920,514	172,136	18.71 (6.36 due to distributional responses (Table 6-39), 12.35 due to collision (Table 6-51))	31.43 (19.08 due to distributional responses (Table 6-39), 12.35 due to collision (Table 6-51))	0.002	0.003
Non-breeding season (October to early-March)	456,298	85,328	2.88 (2.21 due to distributional responses (Table 6-39), 0.67 due to collision (Table 6-51))	7.29 (6.62 due to distributional responses (Table 6-39), 0.67 due to collision (Table 6-51))	0.001	0.002

Table 6-59: Annual combined distributional response estimates and collision impacts of gannet for the Caledonia OWF during the operational phase, as per the Guidance Approach and Applicant Approach.

Defined Season	Regional Baseline Populations and Baseline Mortality Rates (Individuals Per Annum)		Estimated Number of Mortalities from Combined CRM (Mean) and Distributional Responses Per Annum	Change in Average Survival Rate (% Point Change)
	Population (Individuals)	Baseline Mortality		
Guidance Approach				
Annual total (regional/BDMPS)	920,514	172,136	21.58 – 38.71	0.002 – 0.004
Annual total (biogeographic)	1,180,000	220,660	21.58 – 38.71	0.002 – 0.003
Applicant Approach				
Annual total (regional/BDMPS)	920,514	172,136	12.94	0.001
Annual total (biogeographic)	1,180,000	220,660	12.94	0.001
Note, as per the Guidance Approach displacement rate is 70% and mortality rates are: 1% and 3%, as such annual totals have been presented as a range (70% displacement and 1% to 3% mortality).				

Breeding Season

6.7.2.216 As presented in Table 6-57, the combined potential mortality of gannet as a result of operational phase distributional responses and collision combined is 10 (10.06) individuals during the breeding season. The breeding season regional population is estimated to be 920,514 individuals (Table 6-57). Based on the average survival rate of 81.3%, the predicted annual baseline mortality for this population is 172,136 individuals. The addition of 10 predicted additional mortalities per annum due to distributional responses and collision combined would result in a 0.001 survival rate percentage point change for this population.

6.7.2.217 When considering the Guidance Approach, the number of predicted annual mortalities increases to 31, which equates to a 0.003 survival rate percentage point change.

6.7.2.218 This level of impact is considered to be of **Negligible** magnitude, as it would not materially impact the existing mortality rate and would be undetectable in the context of natural variation.

Non-breeding Season

6.7.2.219 As presented in Table 6-57, the combined potential mortality of gannet as a result of operational phase distributional responses and collision combined is three (2.88) individuals during the non-breeding season. The non-breeding season regional population is estimated to be 456,298 individuals (Table 6-57). Based on the average survival rate of 81.3%, the predicted annual baseline mortality for this population is 85,328 individuals per annum. The addition of three predicted additional mortalities per annum during the non-breeding season due to operational phase distributional responses and collision combined would result in a 0.001 survival rate percentage point change for this population.

6.7.2.220 When considering the Guidance Approach, the number of predicted annual mortalities increases to 7 (7.29), which equates to a 0.002 survival rate percentage point change.

6.7.2.221 This level of impact is considered to be of **Negligible** magnitude, as it would not materially impact the existing mortality rate and would be undetectable in the context of natural variation.

Annual Total

6.7.2.222 As presented in Table 6-59, the combined potential mortality of gannet as a result of distributional responses and collision is 13 (12.94) individuals per annum. Using the largest BDMPS population of 920,514 with an average survival rate of 81.3%, the predicted annual baseline mortality for this population is 172,136 individuals. The addition of 13 predicted additional mortalities per annum due to operational phase distributional responses and collision would result in a 0.001 survival rate percentage point change. When considering the annual potential level of impact at the biogeographic scale (1,180,000 individuals), the predicted annual baseline mortality of this population is 220,660 individuals. The addition of 13 predicted additional mortalities per annum due to operational phase distributional responses and collision combined would result in a 0.001 survival rate percentage point change for this population.

6.7.2.223 When considering the Guidance Approach, the number of predicted annual mortalities increases to 39 (38.71), which equates to a 0.004 survival rate percentage point change.

6.7.2.224 This level of impact is considered to be of **Negligible** magnitude, as it would not materially impact the existing mortality rate and would be undetectable in the context of natural variation.

Sensitivity of Receptor

6.7.2.225 Based upon the findings presented in the literature review (Table 6-5) gannet sensitivity to distributional responses and collision during the operation phase is considered to be **Medium**. The conservation value of the species is medium (Table 6-22 and Table 6-41).

Significance of Effect

6.7.2.226 Taking the low/medium sensitivity of gannet (Table 6-22 and Table 6-41) and the negligible magnitude of impact, the overall combined effect of collision and distributional responses during operation is considered to be **Negligible and Not Significant in EIA terms** following the matrix approach (Table 6-17).

Migratory Collision Risk

6.7.2.227 In addition to the species assessed for collision risk in the array area using the sCRM, there is also potential collision risk to migratory species which may pass through the array area during migration periods. These species may not have been detected by the baseline DAS and therefore a separate CRM process is undertaken for these species.

6.7.2.228 Migratory collision risk modelling (mCRM) has been carried out for the Caledonia OWF to estimate the potential risk of collision to migratory birds within the array area. The predicted mortalities are presented as a worst-case scenario (WCS). For mCRM, the WCS was calculated as WTG 1, which is the scenario that includes largest number of smallest fixed turbines. A full description is presented in Volume 7B, Appendix 6-5: Migratory Collision Risk Modelling Technical Report.

6.7.2.229 As requested within the NatureScot (2023b[16]) guidance, mCRM was assessed using the mCRM Application. This application is a stochastic adaptation of the Band (2012[27]) migration collision risk worksheet, accessible through the user-friendly 'Shiny Application' interface available in standard web browsers or within the R statistical software (R Core Team, 2021[160]).

6.7.2.230 The full scoping process is described within Volume 7B, Appendix 6-5: Migratory Collision Risk Modelling Technical Report. The species population estimates and proportion of birds at risk of collision from the Caledonia OWF (for all scenarios) were calculated within the tool separately for each WTG scenario (presented in Table 6-60). Species that were equal to and greater than 1% of the UK non-breeding population at collision risk from Caledonia OWF were scoped into the mCRM assessment (Table 6-60).

6.7.2.231 The percent of birds at risk of collision as presented in Table 6-60 is determined as the proportion of each species present within the Caledonia OWF relative to the UK population. For example, the UK population of Bar-tailed godwit is estimated as 680,000 individuals, of which ~1.9% (12,941) is estimated to pass through the Caledonia OWF.

Table 6-60: The population estimates passing through the Caledonia OWF (WCS – WTG 1) and the proportion of birds at risk of collision.

Species	Population Estimate - Individuals (SD)	% at Collision Risk	Scoped In/Out
Bar-tailed godwit	12,941 (2,263)	1.90	In
Bean goose	24 (4)	2.50	In
Bittern	-	0.00	Out
Black-tailed godwit	-	0.00	Out
Black-throated diver	28 (4)	2.30	In
Canadian light-bellied brent goose	-	0.00	Out
Common scoter	1,868 (334)	1.40	In
Corncrake	264 (45)	1.60	In
Curlew	2,636 (415)	1.90	In
Dotterel	11 (2)	2.80	In
Dunlin	32,542 (5,162)	1.60	In
Eider	1,953 (275)	1.80	In
Golden plover	53,388 (8,521)	1.60	In
Goldeneye	687 (124)	1.80	In
Goosander	606 (75)	3.50	In
Great crested Grebe	-	0.00	Out
Great northern diver	183 (31)	1.70	In

Species	Population Estimate - Individuals (SD)	% at Collision Risk	Scoped In/Out
Greenshank	116 (18)	1.60	In
Grey plover	2,020 (320)	1.60	In
Hen harrier	37 (6)	1.70	In
Icelandic greylag goose	169 (75)	0.20	Out
Knot	5,212 (899)	1.40	In
Lapwing	59,276 (11,379)	1.50	In
Long-tailed duck	269 (34)	2.10	In
Mallard	18,058 (2,844)	2.20	In
Marsh harrier	53 (8)	2.00	In
Merlin	46 (14)	0.60	Out
Nightjar	85 (20)	1.10	In
Osprey	16 (3)	2.40	In
Oystercatcher	6,170 (1,022)	1.70	In
Pink-footed goose	893 (427)	0.20	Out
Pintail	339 (62)	1.60	In
Purple sandpiper	459 (71)	1.90	In
Red-breasted merganser	300 (50)	1.90	In
Redshank	5,484 (1,004)	1.30	In
Red-throated diver	727 (100)	2.10	In
Ringed plover	4,093 (738)	1.40	In
Ruff	532 (94)	1.70	In
Sanderling	3,412 (633)	1.70	In
Scaup	81 (18)	1.10	In
Shelduck	932 (162)	1.50	In
Short-eared owl	256 (45)	1.70	In

Species	Population Estimate - Individuals (SD)	% at Collision Risk	Scoped In/Out
Shoveler	247 (54)	1.10	In
Slavonian grebe	18 (4)	1.70	In
Snipe	93,133 (15,778)	1.50	In
Spotted crake	1 (-)	3.80	In
Svalbard barnacle goose	1,868 (220)	4.30	In
Svalbard light-bellied brent goose	334 (39)	3.30	In
Teal	739 (365)	0.20	Out
Tufted duck	2,427 (470)	1.60	In
Turnstone	6,089 (977)	1.80	In
Velvet scoter	59 (11)	1.70	In
Whimbrel	74 (15)	1.60	In
White-tailed eagle	2 (1)	1.30	In
Whooper swan	1,054 (133)	2.60	In
Wigeon	7,839 (1,421)	1.60	In
Wood sandpiper	1 (-)	1.90	In

6.7.2.232 The estimated annual total collisions from Caledonia OWF WTG 1 are presented in Table 6-61. The UK non-breeding population estimates were based on those presented within Woodward *et al*. (2023[19]). Some species do not have population estimates due to lack of data and therefore cannot be assessed. For most migratory species considered, the level of predicted impact is less than a single individual per annum (Table 6-61). Such a low level of effect can be confidently concluded as of negligible magnitude.

6.7.2.233 For species where the impact was predicted to be greater than a single individual per annum, this equated to at most 0.002% of the UK non-breeding population being impacted. Such level of effects would almost certainly be indistinguishable from natural fluctuations in the population and is therefore migratory collision risk is concluded as a negligible magnitude of effect for all species considered.

Table 6-61: Estimated collisions based on non-breeding populations of bird species assessed for mCRM WCS (WTG 1).

Species	UK Non-breeding Population Estimate (Individuals)	Avoidance Rate	Annual Total Collision	Collision Estimate as % of UK Non-Breeding Population
Bar-tailed godwit	53,500	99.90	0.450	0.001
Bean goose	230	99.90	0.002	0.001
Black-throated diver	430	99.50	0.002	<0.001
Common scoter	135,000	98.50	0.984	0.001
Corncrake	0	99.50	0.045	-
Curlew	125,000	99.90	0.107	<0.001
Dotterel	0	99.90	0	-
Dunlin	350,000	99.90	1.008	<0.001
Eider	81,000	98.50	0.297	<0.001
Golden plover	410,000	99.90	1.780	<0.001
Goldeneye	21,000	98.50	0.369	0.002
Goosander	14,500	98.50	0.346	0.002
Great northern diver	4,400	99.50	0.010	<0.001
Greenshank	920	99.90	0.004	<0.001
Grey plover	33,500	99.90	0.067	<0.001
Hen harrier	Unknown	99.50	0.008	-
Knot	265,000	99.90	0.160	<0.001
Lapwing	635,000	99.90	2.167	<0.001
Long-tailed duck	13,500	98.50	0.142	0.001
Mallard	675,000	98.50	16.441	0.002
Marsh harrier	Unknown	99.50	0.006	-
Nightjar	Unknown	99.50	0.016	-
Osprey	-	99.50	0.002	-
Oystercatcher	305,000	99.90	0.245	<0.001

Species	UK Non-breeding Population Estimate (Individuals)	Avoidance Rate	Annual Total Collision	Collision Estimate as % of UK Non-Breeding Population
Pintail	20,000	98.50	0.188	0.001
Purple sandpiper	9,900	99.90	0.014	<0.001
Red-breasted merganser	11,000	98.50	0.162	0.001
Redshank	100,000	99.90	0.186	<0.001
Red-throated diver	21,500	99.50	0.036	<0.001
Ringed plover	42,500	99.90	0.128	<0.001
Ruff	920	99.90	0.018	0.002
Sanderling	20,500	99.90	0.102	<0.001
Scaup	6,400	98.50	0.043	0.001
Shelduck	51,000	98.50	0.422	0.001
Short-eared owl	Unknown	99.50	0.054	-
Shoveler	19,500	98.50	0.200	0.001
Slavonian grebe	995	99.50	0.002	<0.001
Snipe	1,100,000	99.90	4.561	<0.001
Spotted crake	-	99.50	0.000	-
Svalbard barnacle goose	43,500	99.90	0.077	<0.001
Svalbard light-bellied brent goose	Unknown	99.90	0.007	-
Tufted duck	140,000	98.50	1.256	0.001
Turnstone	43,000	99.90	0.222	0.001
Velvet scoter	3,350	98.50	0.033	0.001
Whimbrel	41	99.90	0.002	0.005
White-tailed eagle	Unknown	98.70	0.002	-
Whooper swan	25,800	98.80	0.396	0.002
Wigeon	450,000	98.50	4.337	0.001
Wood sandpiper	0	99.90	0	-

Sensitivity of Migratory Species

6.7.2.234 There is a significant lack of empirical data on the sensitivity of migratory species to collision with WTGs in comparison to seabirds. However, sensitivity to collisions is considered to be generally low, with most migration periods occurring on a broad front (i.e., birds flying across a wide area as opposed to channelling through a narrow area), above rotor height, and occurring twice per year, reducing the probability of collision relative to breeding seabirds, which may encounter OWFs multiple times across a single breeding season. As a precautionary approach, the sensitivity of all migratory birds scoped into mCRM is judged to be **Medium**.

Magnitude of Impact

6.7.2.235 The level of impact is considered to be of **Negligible** magnitude due to the small number of estimated collisions predicted for all species scoped into the mCRM (Table 6-61).

Significance of Effect

6.7.2.236 Taking the **Medium** sensitivity of all migratory species (Table 6-22) and the negligible magnitude of impact, the overall effect of collision during operation for migratory species is considered to be **Negligible and Not Significant in EIA terms** following the matrix approach (Table 6-17).

Impact 9: Artificial Light

6.7.2.237 As requested in consultation by MD-LOT, NatureScot and RSPB (Table 6-3), the Applicant has considered the potential impact of artificial lighting on nocturnal ornithological receptors. The species scoped into the assessment are Manx shearwater, sooty shearwater, European and Leach's storm petrel.

6.7.2.238 During the 24-month baseline DAS, there were 60 Manx shearwater and 3 sooty shearwater recorded within the Caledonia OWF. There were no records of either Leach's or European storm petrel within the Caledonia OWF. Surveys were undertaken during daylight hours, and it is acknowledged that this limits the abilities of the baseline DAS to effectively characterise the use of the Caledonia OWF by nocturnal species. DAS surveys were undertaken using a ground sampling distance (GSD) of 1.5cm which leads to higher resolution imagery and subsequent increased detectability of cryptic species such as storm petrel species, in contrast to standard global best practice of only 2cm GSD. This means that the baseline DAS would have been able to reliably detect and identify any storm petrel species captured within the survey imagery.

6.7.2.239 Although storm petrels are active at night, tagging data of European storm petrels from Mousa SPA (the closest SPA to the Proposed Development (Offshore)) suggested the species tended to forage within the daylight and return to the colony during the hours of darkness (Bolton, 2021[161]). Furthermore, storm petrels have been recorded to forage close to colonies in the intertidal zone during the night (Albores-Barajas *et al.*, 2011[162]; Thomas *et al.*, 2006[163]; D'Elbee and Hemery, 1998[164]), while longer foraging trips occurred in daylight during the breeding season (Albores-Barajas *et al.*, 2011[164]).

6.7.2.240 The distance of the nearest storm petrel and shearwater colonies, the consideration their foraging ranges (Bolton, 2021[161]; Woodward *et al.*, 2019[20]) and at-sea distribution based on a multiyear tagging study at Mousa (Bolton, 2021[161]), and predicted densities around the area (<0.1 birds/km^2 for both petrel species) from Waggitt *et al.* (2019[21]) suggest minimal overlap during the breeding season between the at-sea distribution of shearwater and petrel species and the Proposed Development (Offshore) (Figure 6-4).

6.7.2.241 This conclusion is bolstered by the ebird relative density range maps (Fink *et al.*, 2022[165]; Figure 6-5). These sources suggest very low occurrence of both European storm and Leach's storm petrel over the Proposed Development (Offshore) and only on passage, which would be in agreement with the lack of records within site specific DAS. It is important to note that, although DAS surveys are limited in terms of the length of time surveyed and spatial extent of surveys, no instances of storm petrel were recorded, indicating along with the additional sources presented that the Caledonia OWF is not an area of importance for these species.

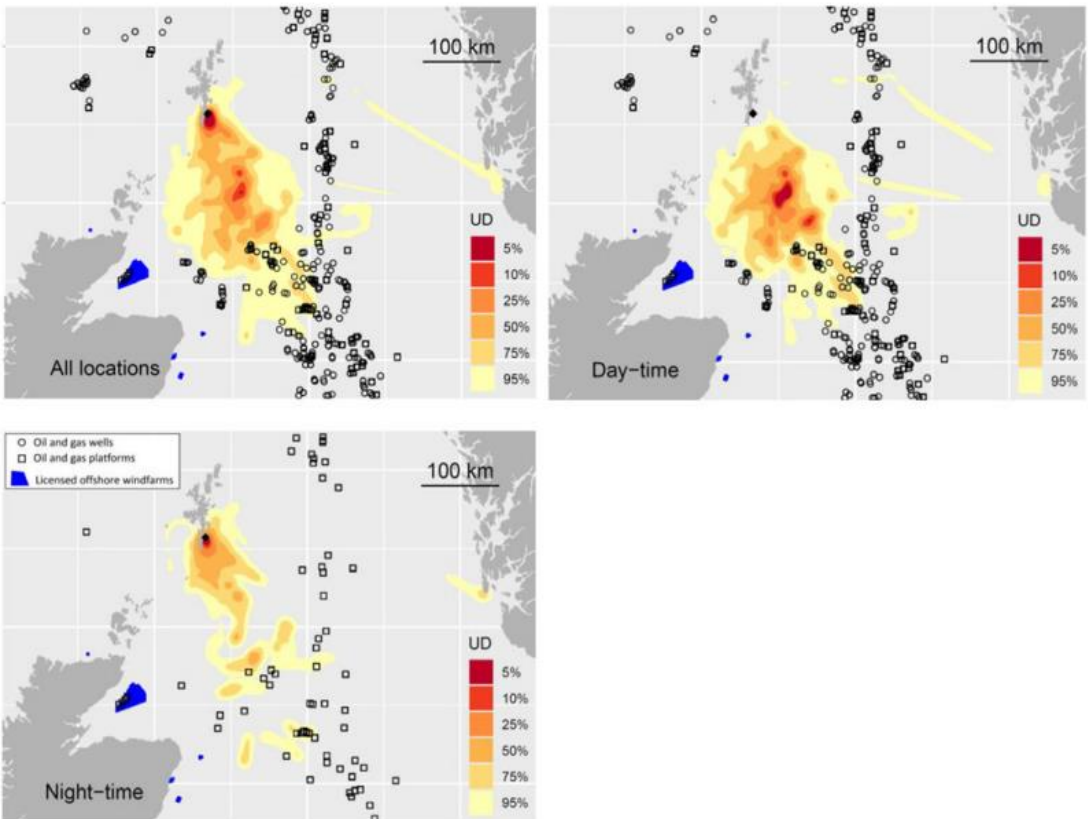


Figure 6-4: Distribution of storm petrels during the 24-hour cycle, during the daylight and during the hours of darkness. Breeding colony is located by black diamond, active oil and gas wells are indicated by circles and platforms by squares (Bolton, 2021[161]).

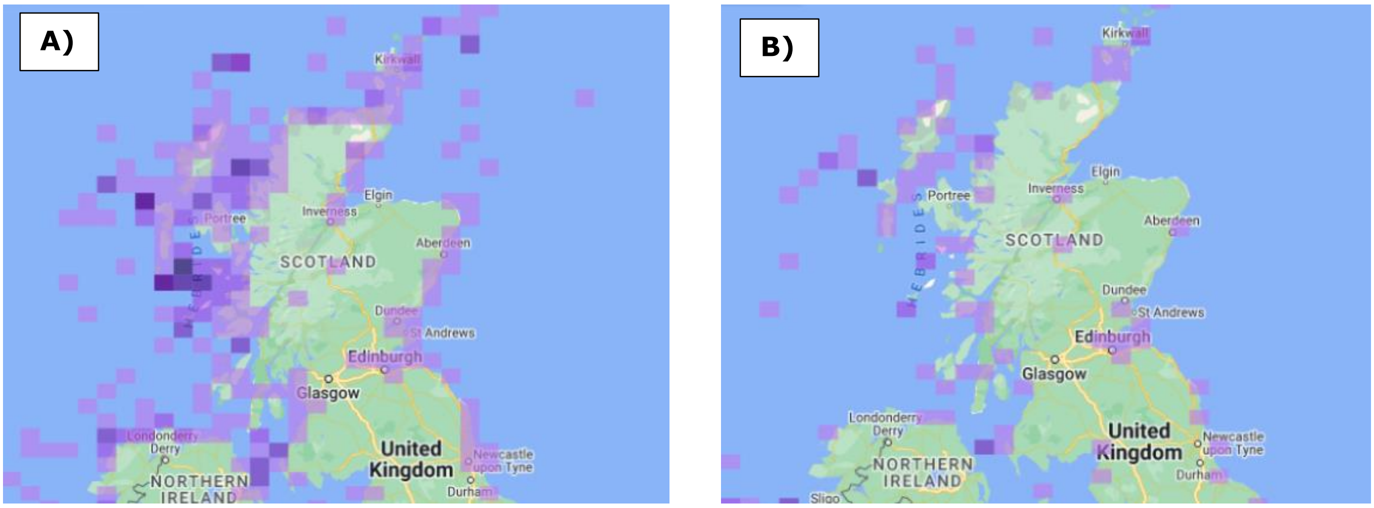


Figure 6-5: ebird relative density range maps (Fink *et al.*, 2022[165]): A - European storm petrel; and B - Leach's storm petrel.

6.7.2.242 The presence of illuminated structures has the potential to impact birds in the offshore environment, acting both as a deterrent to some species and an attractant to others. When deterred, this drives a change in flight directions and acts in line with effects resulting from distributional responses. An attractant effect in an OWF context may increase the likelihood of bird collisions, and could result in distributional response-level impacts due to alterations in flight path.

6.7.2.243 Some bird species might be attracted to or deterred by artificially lit structures in offshore environments, such as oil and gas platforms, during nighttime or poor weather with low visibility. These impacts can be positive, offering extended feeding periods, shelter, resting places, or navigation aids for migrating birds. However, they can also be negative, causing migratory course changes, increased energy expenditure, or distributional responses during nocturnal foraging. Predicting behavioural changes due to artificial lighting also requires considering factors such as species, age, and season.

6.7.2.244 Most offshore evidence on lighting effects comes from studies on oil and gas platforms (reviewed in Ronconi *et al.,* 2015[166]). However, WTGs are not as extensively or intensively lit compared to oil and gas platforms, which may also include extremely intense lighting from gas flares. Therefore, any benefits related to increased foraging opportunities or negative disorientation effects during darkness are unlikely to be as significant at WTGs. Additionally, any benefits of lighting from OWFs may be outweighed by the increased risk of collision with the rotating blades of WTGs for species that fly at the rotor-swept height. The effect of disorientation is primarily recorded in poor visibility conditions (such as nights with rain and fog) due to the increase refraction of light by the moisture droplets and the subsequent usage of stronger intensity illumination (Hill *et al*., 2014[167]). Furthermore, the degree at which nocturnal seabirds are at risk to illuminated structures may depend on the frequency and duration of poor visibility conditions which potentially varies between seasons and geographical location.

6.7.2.245 Despite documentation of nocturnal foraging in parts of west Ireland (Kane *et al,* 2020[168]), Manx shearwater tagging studies in the Celtic Sea have shown that birds almost exclusively forage during daylight hours, since this corresponds to the diurnal diel movements of clupeids, their primary prey source (Shoji *et al*., 2016[169]; Dean, 2012[170]). Similarly, European storm petrels breeding at Mousa SPA tended to forage pelagically within daylight hours and return to the colony during the hours of darkness, with return trips from foraging areas typically commencing in the early afternoon (Bolton, 2021[161]). The distribution of nocturnal foraging trips to Mousa indicated that there is a reduced potential likelihood of night time flight within the Proposed Development (Offshore) relative to during the day (Bolton, 2021[161]) (Figure 6-4). In the Bay of Biscay and Mediterranean, storm petrels have been recorded foraging close to breeding colonies in the intertidal zone during the night (Albores-Barajas *et al*., 2011[162]; D'Elbee and Hemery, 1998[164]), while longer foraging trips occurred in daylight during the breeding season (Albores-Barajas *et al*., 2011[162]).

6.7.2.246 Literature regarding artificial lighting-induced collision and distributional response risk of petrels and shearwater to OWFs and other structures in Scotland was reviewed in Deakin *et al*. (2022[171]). A key conclusion from this review was that there is a lack of evidence to judge the existence and strength of light attraction in Manx shearwater, European storm petrel and Leach's petrel. However, it was found that recently fledged juveniles exhibited disorientation in low visibility conditions compared to adults, which is potentially due to their sensitive sight (Deakin *et al*., 2022[171]). Studies on the attraction of fledglings to artificial light is restricted to birds on maiden flights (Brown *et al*., 2023[172]), thus temporally limiting the potential for such an effect to occur.

6.7.2.247 The potential impact on nocturnal species at an operational OWF is likely to be minimal compared to studies which are based on offshore oil and gas platforms and onshore illumination. The Proposed Development (Offshore) will be illuminated in accordance with aviation and navigational lighting requirements which are set to ensure safe navigation for shipping and aviation receptors as described in Volume 2, Chapter 9: Shipping and Navigation and Volume 2, Chapter 12: Seascape, Landscape and Visual Impact Assessment. The requirements ensure that navigational lighting of WTGs consists of a flashing red light at medium intensity. Manx shearwater are less responsive to red light compared to high intensity light (Syposz *et al*., 2021[173]). This is also evident at Bardsey lighthouse on the Welsh coast, which significantly reduced the number of Manx shearwater collisions through changing to a red flashing light (Deakin *et al*., 2022[171]).

6.7.2.248 There is also potential for impacts on nocturnal migratory birds if large numbers pass through an OWF site simultaneously, which could lead to disorientation or collisions. However, there is insufficient evidence from current literature or existing UK OWFs to suggest that mass collision events occur due to aviation and navigation lighting at OWF sites. Studies by Welcker *et al.* (2017[174]) and Kerlinger *et al.* (2010[175]) found that nocturnal migrants do not have a higher risk of collision with wind energy facilities than diurnally active species, nor do mortality rates increase at OWFs with lighting compared to those without. Additionally, research has shown that birds adjust their nocturnal flight paths to avoid collisions with WTGs, typically flying down the centre of corridors and further away from the structures (Dirksen *et al.,* 2000[176]; Desholm and Kahlert, 2005[177]).

6.7.2.249 On account of the information provided above, the magnitude of impact due to the presence of artificial light sources during the operational phase is considered to be **Negligible**. Although Manx shearwater and storm petrel species are known to be active at night, the vulnerability of these species remain low to **Medium** based on the evidence described above. Based on the worst-case sensitivity of medium and the negligible magnitude of impact, the overall effect of artificial light during operation is considered to be **Negligible and Not Significant in EIA terms** following the matrix approach (Table 6-17).

6.7.3 Decommissioning

Impact 10: Distributional Responses - Array Area

6.7.3.1 See Impact 1: Distributional responses – Array Area in Section 6.7.1 (6.7.1.3 to 6.7.1.5).

Impact 11: Distributional Responses - Construction and associated vessel traffic within the Offshore Export Cable Corridor

6.7.3.2 See Impact 2: Distributional Responses - Construction and associated vessel traffic within the Offshore Export Cable Corridor in Section 6.7.1 (6.7.1.15 to 6.7.1.17).

Impact 12: Distributional Responses - Vessel transit routes (through the Moray Firth SPA).

6.7.3.3 See Impact 3: Distributional Responses – Vessel transit routes (through the Moray Firth SPA) in Section 6.7.1 (6.7.1.18 to 6.7.1.23).

Impact 13: Indirect Effects - Habitat Loss/Displacement of Prey Species

6.7.3.4 See Impact 4: Indirect Effects – Habitat Loss/Displacement of Prey Species in Section 6.7.1 (6.7.1.24 to 6.7.1.26).

6.8 Cumulative Effects

6.8.1 Overview

6.8.1.1 The Cumulative Impact Assessment (CIA) assesses the impacts associated with the Proposed Development (Offshore) together with the impacts of other relevant plans, projects and activities. Cumulative effects are therefore the combined effect of the Proposed Development (Offshore) with the predicted effects from a number of different projects, on the same receptor or resource. The overall method followed for identifying and assessing potential cumulative effects in relation to the offshore environment (including offshore ornithology) is set out in Volume 7A, Appendix 7-1: Cumulative Impact Assessment Methodology, including details of relevant consultation and agreements on approaches.

6.8.1.2 Based on the Planning Inspectorate's Advice Note Seventeen (PINS, 2019[8]) and elements of the RenewableUK cumulative impact assessment guidelines (RenewableUK, 2013[178]), reasonably foreseeable plans and projects that may act cumulatively with the Proposed Development (Offshore) have been identified through a long list screening exercise based on the Proposed Development's ZOI. For offshore ornithology, the ZOI has been defined as the area within each individual receptors foraging range (MMFR +1SD; Woodward *et al.*, 2019[20]) from the Proposed Development for the breeding season, and the receptors defined BDMPS region within Furness (2015[23]) for the non-breeding season (Table 6-8). The exceptions to this rule are guillemot and herring gull where a regional approach is considered for the non-breeding season. For guillemot, this is based on NatureScot (2023a[10]) guidance note 6. For herring gull, a regional approach has been considered based on advice provided to the Northeast and East Regional group, on the assumption that Scottish herring gulls remain largely sedentary, thus limiting potential cumulative effects to more northern projects within the UK North Sea waters (RoyalHaskoningDHV, 2024[179]) (Table 6-62).

Table 6-62: Relevant non-breeding BDMPS regions for key species considered within the EIA report for cumulative assessment.

Species	BDMPS Region
Kittiwake	UK North Sea
Great black-backed gull	UK North Sea
Herring gull	Regional Population
Great skua	UK North Sea and Channel
Guillemot	Regional Population (as per NatureScot (2023a[10]) guidance)
Razorbill	UK North Sea and Channel
Puffin	UK North Sea and Channel
Gannet	UK North Sea and Channel

6.8.1.3 It is pertinent to recognise that some developments, especially those that have been 'proposed' or identified development plans, may not be taken forward or built out in full as detailed in worst case scenario conditions. Therefore, it is appropriate to build in consideration of certainty with regard to potential impacts that may arise from these proposals. For example, projects under construction are likely to contribute to cumulative impacts but proposals not yet approved are less likely to contribute to these effects as these projects may not proceed to development. With this in mind, all plans and projects within the cumulative long-list have been allocated into a tiering system to reflect their current development stage, based on the definitions within Table 6-63.

Table 6-63: Description of tiers of other developments considered for CIA.

Tier	Description
1	Operational Under construction, or will become operational following baseline characterisation. Permitted application(s), but not yet implemented. Submitted application(s), but not yet determined. For these plans, projects or activities detailed project information is available in the public domain
2	Projects where a scoping report has been submitted and there is sufficient detail within the scoping report to support CIA. For these plans, projects or activities some detailed or high level project information is available in the public domain).
3	Projects where a scoping report has not been submitted. Projects identified in the relevant Development Plan (and emerging Development Plans – with appropriate weight being given as they move closer to adoption) recognising that there will be limited or only high level information available on the relevant proposals. Projects identified in other plans and programmes (as appropriate) such as other ScotWind developments, which set the framework for future development consents/approvals, where such development is reasonably likely to come forward.
4	Projects identified in other plans and programmes where such development is proposed but assessment cannot be progressed as there is limited or no information available in the public domain.

6.8.1.4 Refinement of the long list of planned and operational projects was undertaken, resulting in a finalised short-list of plans and projects for inclusion as presented in Table 6-64. Plans and projects were screened out for further consideration for potential cumulative effects on offshore ornithology based on the following justifications:

- There is no conceptual effect-receptor pathway between the projects;
- The is no physical effect-receptor overlap between projects;
- There is no temporal overlap between projects;
- There is low confidence/no data available.

Table 6-64: Projects considered within the offshore ornithology CIA.

Project	Tier	Project Status	Included in CIA	Rationale
Aberdeen	1	Operational	Yes	Within ZoI, data available
Arven	3	Concept/Early planning	No	No data
Aspen	3	Concept/Early planning	No	No data
Ayre	2	Concept/Early planning	No	No data
Beatrice	1	Operational	Yes	Within ZoI, data available
Beech	3	Concept/Early planning	No	No data
Bellrock	3	Concept/Early planning	No	No data
Berwick Bank	1	Concept/Early planning	Yes	Within ZoI, data available
Blyth Demo	1	Operational	Yes	Within ZoI, data available
Bowdun	2	Concept/Early planning	No	No data
Broadshore	2	Concept/Early planning	No	No data
Buchan	2	Concept/Early planning	No	No data
Campion	3	Concept/Early planning	No	No data
Cedar	3	Concept/Early planning	No	No data
Cenos	2	Concept/Early planning	No	No data
Culzean	1	Consented	Yes	Within ZoI, data available
Dudgeon Extension Project (DEP)	1	Consented	Yes	Within ZoI, data available
Dogger Bank A	1	Under Construction	Yes	Within ZoI, data available
Dogger Bank B	1	Under Construction	Yes	Within ZoI, data available
Dogger Bank C	1	Under Construction	Yes	Within ZoI, data available
Dogger Bank South	1	Concept/ Early Planning	Yes	Within ZoI, data available

Project	Tier	Project Status	Included in CIA	Rationale
Dudgeon	1	Operational	Yes	Within ZoI, data available
East Anglia ONE	1	Operational	Yes	Within ZoI, data available
East Anglia ONE North	1	Consented	Yes	Within ZoI, data available
East Anglia TWO	1	Consented	Yes	Within ZoI, data available
East Anglia THREE	1	Consented	Yes	Within ZoI, data available
Five Estuaries	1	Concept/Early planning	Yes	Within ZoI, data available
Flora	3	Concept/Early planning	No	No data
Forthwind	1	Consented	Yes	Within ZoI, data available
Galloper	1	Operational	Yes	Within ZoI, data available
Greater Gabbard	1	Operational	Yes	Within ZoI, data available
Green Volt	1	Consented	Yes	Within ZoI, data available
Gunfleet Sands	1	Operational	Yes	Within ZoI, data available
Haybredey	3	Concept/Early planning	No	No data
Hornsea Project One	1	Operational	Yes	Within ZoI, data available
Hornsea Project Two	1	Operational	Yes	Within ZoI, data available
Hornsea Project Three	1	Consented	Yes	Within ZoI, data available
Hornsea Project Four	1	Consented	Yes	Within ZoI, data available
Humber Gateway	1	Operational	Yes	Within ZoI, data available
Hywind	1	Operational	Yes	Within ZoI, data available

Project	Tier	Project Status	Included in CIA	Rationale
Inch Cape	1	Under Construction	Yes	Within ZoI, data available
Kentish Flats and Extension	1	Operational	Yes	Within ZoI, data available
Kincardine	1	Operational	Yes	Within ZoI, data available
Lincs, Lynn & Inner Dowsing	1	Operational	Yes	Within ZoI, data available
London Array	1	Operational	Yes	Within ZoI, data available
Marram	2	Concept/Early planning	No	No data
Methil	1	Operational	Yes	Within ZoI, data available
Moray East	1	Operational	Yes	Within ZoI, data available
Moray West	1	Under Construction	Yes	Within ZoI, data available
Morven	2	Concept/Early planning	No	No data
Muir Mhor	2	Concept/Early planning	No	No data
Neart Na Gaoithe	1	Under Construction	Yes	Within ZoI, data available
Norfolk Boreas	1	Consented	Yes	Within ZoI, data available
Norfolk Vanguard	1	Consented	Yes	Within ZoI, data available
North falls (PEIR)	2	Concept/Early planning	Yes	Within ZoI, data available
Ossian	1	Concept/Early planning	Yes	Within ZoI, data available
Outer Dowsing	1	Concept/Early planning	Yes	Within ZoI, data available
Pentland Floating OWF (PFOWF)	1	Consented	Yes	Within ZoI, data available
Race Bank	1	Operational	Yes	Within ZoI, data available

Project	Tier	Project Status	Included in CIA	Rationale
Rampion	1	Operational	Yes	Within ZoI, data available
Rampion 2	1	Concept/Early planning	Yes	Within ZoI, data available
Salamander	1	Concept/Early planning	Yes	Within ZoI, data available
Scroby Sands	1	Operational	Yes	Within ZoI, data available
Seagreen Alpha and Bravo	1	Operational	Yes	Within ZoI, data available
Sheringham Shoal Extension Project (SEP)	1	Consented	Yes	Within ZoI, data available
Scaraben	2	Concept/Early planning	No	No data
Sheringham Shoal	1	Operational	Yes	Within ZoI, data available
Sinclair	2	Concept/Early planning	No	No data
Spiorad na Mara	3	Concept/Early planning	No	No data
Stoura	3	Concept/Early planning	No	No data
Stromar	2	Concept/early planning	No	No data
Talisk	3	Concept/Early planning	No	No data
Teeside	1	Operational	Yes	Within ZoI, data available
Thanet	1	Operational	Yes	Within ZoI, data available
Triton Knoll	1	Operational	Yes	Within ZoI, data available
West of Orkney[ii]	1	Concept/Early planning	Yes	Within ZoI, data available
Westermost Rough	1	Operational	Yes	Within ZoI, data available

[ii] These numbers for West of Orkney are subject to change, but have been included to support this assessment on a precautionary basis.

Cumulative Effect Pathways

6.8.1.5 Some impacts assessed for the project alone have not been considered as part of the cumulative assessment. This is because:

- The predicted impacts are highly localized (i.e., occur within the project boundary only);
- Management measures proposed will be in place for other projects, reducing the risk of the impact occurring;
- Impacts do not overlap temporally, and;
- The potential significance of the impact in terms of the project alone has been assessed as negligible and therefore considered not to contribute in any material way to an existing potential cumulative impact.

6.8.1.6 The impact pathways excluded for these reasons are:

- Distributional responses of ornithological receptors during the construction and decommissioning phase of the Proposed Development (Offshore) due to potential impacts for the project alone being **Negligible** and spatially and temporally restricted; and
- Indirect impacts for all phases of the Proposed Development (Offshore) as these will be spatially limited and expected to be **Negligible** at a project alone level.

6.8.1.7 The impacts that are therefore considered for cumulative assessment are:

- Distributional responses of kittiwake, guillemot, razorbill, puffin and gannet during the operational and maintenance phase of the Proposed Development (Offshore) cumulatively with other planned, in-construction and operational developments screened in (see Table 6-65);
- Collision risk to kittiwake, herring gull, great black-backed gull and gannet during the operational and maintenance phase of the Proposed Development (offshore) cumulatively with other planned, in-construction, and operational developments screened in (see Table 6-65); and
- Distributional responses and collision combined for kittiwake and gannet during the operational and maintenance phase of the Proposed Development (offshore) cumulatively with other planned, in-construction, and operational developments screened in (see Table 6-65).

6.8.1.8 For each of the cumulative effect pathways considered, the cumulative worst-case scenario has been selected for assessment, as described in Table 6-65.

6.8.1.9 It has been assumed that all projects are developed to the full extent of the proposed design for the purposes of the cumulative assessment. This approach is precautionary given that not all projects may gain consent, may reduce the proposed design prior to consent, or may not fully develop within the proposed area.

6.8.1.10 Furthermore, original assessments from other developments have been used for this assessment which are likely overestimating effects based on post construction monitoring studies. For example, post construction surveys at Beatrice OWF has indicated that no distributional responses of any species has occurred but original predictions of impact have been included in the CIA. Further information can be found in Volume 7B, Appendix 6-2, Annex 4: Review of Relevant Evidence.

6.8.1.11 As with the project alone assessment, the Proposed Development (Offshore) has been assessed within the CIA using the worst-case scenario as defined in the DE. Therefore, should any other design within the DE envelope be taken forward to the final project design, greater adverse effects are not expected to arise.

6.8.1.12 For all cumulative impact assessments, three scenarios have been considered:

- All projects – this is considered the worst case scenario in which all in-scope projects (where data is available) are included in cumulative assessment along with Caledonia OWF. This includes projects that are operational, in construction, consented, planned and those that are operational but are likely to be decommissioned before or during the life span of the Proposed Development (Offshore). This scenario assumes that all projects will be built out as planned in project proposals.
- All projects excluding Berwick Bank – this scenario includes all in-scope projects (where data is available) excluding Berwick Bank in cumulative assessment along with the Caledonia OWF. This scenario is being presented at the request of stakeholders given the current uncertainty regarding consent for this project.
- All consented projects plus Caledonia OWF – this scenario includes projects that have been consented only in cumulative assessment along with the Caledonia OWF. Thus, this scenario does not account for projects that may not go ahead or may reduce in scope prior to consent.

6.8.1.13 The CIA is limited by the data available in which to complete the assessment. Some older developments which may have the potential to have a cumulative impact on ornithological receptors do not have comparable datasets on which to base an assessment or did not address potential effects in a quantitative manner. Furthermore, some more recent developments have not yet released data into the public domain. Therefore, the CIA has been carried out with the fullest data available, acknowledging that further cumulative effects may occur from both existing and planned developments.

6.8.1.14 In the absence of the Cumulative Effects Framework (CEF) tool being available, the most appropriate dataset to inform cumulative assessments was identified as the In-combination and Cumulative Totals for Seabird Species of Key Importance to Northeast and East Scotwind Projects (RoyalHaskoningDHV, 2024[179]). Since publication of this dataset, a number of planned projects have either submitted applications (Culzean, Salamander and Ossian) or have published updated impact predictions (for example Five Estuaries and Outer Dowsing). These updated values have been incorporated within assessments, with specific details of updates provided in further detail in the assessment sections below.

Table 6-65: Potential cumulative impacts.

Impact	Potential for Cumulative Impact	Scenario	Rationale
Operation – distributional responses	Yes	WCS for the Proposed Development (Offshore) and the cumulative full development of all screened in tier 1 projects (where appropriate). No Tier 2, 3 or 4 projects identified as quantitative data is currently unavailable.	This represents the maximum potential for interactive effects of other developments within he relevant ZoI. The ZoI was defined as the region in which seabirds associated with the project are likely to come from or move to other areas within the ZoI as well as interact with other developments within the region.
Operation – collision risk	Yes	WCS for the Proposed Development (Offshore) and the cumulative full development of all screened in tier 1 projects (where appropriate). No Tier 2, 3 or 4 projects identified as quantitative data is currently unavailable.	This represents the maximum potential for interactive effects of other developments within he relevant ZoI. The ZoI was defined as the region in which seabirds associated with the project are likely to come from or move to other areas within the ZoI as well as interact with other developments within the region.
Operation – distributional responses and collision risk combined	Yes	WCS for the Proposed Development (Offshore) and the cumulative full development of all screened in tier 1 projects (where appropriate). No Tier 2, 3 or 4 projects identified as quantitative data is currently unavailable.	This represents the maximum potential for interactive effects of other developments within he relevant ZoI. The ZoI was defined as the region in which seabirds associated with the project are likely to come from or move to other areas within the ZoI as well as interact with other developments within the region.

6.8.2 Cumulative Distributional Responses: Operational Phase

6.8.2.1 There is potential for cumulative distributional response effects during the operation and maintenance phase of the Proposed Development (Offshore) along with other developments (Table 6-64). Therefore, an assessment to determine this impact has been completed for species at risk of distributional response effects cumulatively (see Table 6-22).

Kittiwake

Magnitude of Impact

6.8.2.2 The seasonal abundance estimates for kittiwake associated with projects scoped into the CIA are presented in Table 6-66. The predicted abundance for planned and operational projects included within Table 6-66, are primarily based on the Northeast and East Scotwind Projects Cumulative totals dataset (RoyalHaskoningDHV, 2024[179]), with the addition of abundance totals for Ossian (NIRAS & RPS, 2024[180]) and Salamander (ERM, 2024[181]) derived from their respective EIAs. Culzean was not included within Table 6-66 due to lack of available data, though to note given the apparently relatively small size of Culzean, it is considered unlikely that such a project would materially contribute to any cumulative assessment as concluded within its respective EIA (Xodus Group, 2024[182]).

6.8.2.3 Due to differences in assessment methodologies between OWFs in English and Scottish waters, all projects in English waters have been excluded from cumulative assessment of kittiwake distributional response effects. This approach has been agreed on other Scottish OWF projects.

6.8.2.4 Displacement and mortality rates were applied in the assessment of 30% for both the breeding and non-breeding seasons and a mortality rate of 1% and 3% for all seasons as per the Guidance Approach (as detailed in Table 6-23). Presentation of distributional responses impacts following the NatureScot Guidance Approach for the operational phase of the Proposed Development (Offshore) is provided in Table 6-67.

6.8.2.5 An Applicant Approach has not been included for kittiwake as The Applicant remains of the view that kittiwake do not require assessment for distributional response. This position is based on a review of the available evidence. Further details regarding the exclusion of an Applicant Approach for the kittiwake distributional response assessment are provided in Volume 7B, Appendix 6-2, Annex 4: Review of Relevant Evidence.

Table 6-66 : Kittiwake cumulative season and total abundance estimates.

Development	Predicted Abundance (individuals)		
	Breeding Season	Non-breeding Season	Total
Aberdeen	663	37	700
Beatrice	1,430	2,224	3,654
Berwick Bank	21,141	24,956	46,097
Blyth Demo	-	1,480	1,480
Green Volt	183	149	332
Hywind	112	-	112
Inch Cape	3,866	2,138	6,004
Kincardine	229	-	229
Methil	184	-	184
Moray East	1,963	-	1,963
Moray West	6,902	2,544	9,446
Neart na Gaoithe	2,164	2,155	4,319
Ossian	3,183	581	3,764
PFOWF	546	118	664
Salamander	3,718	220	3,938
Seagreen Alpha & Bravo	3,235	2,286	5,521
West of Orkney	1,113	1,217	2,330
Caledonia OWF	**2,039**	**483**	**2,522**
All Projects (Inc. Berwick Bank)	**52,671**	**40,588**	**93,259**
All Projects (Excl. Berwick Bank)	**31,530**	**15,632**	**47,162**
Consented (plus Caledonia OWF)	**23,516**	**13,614**	**37,130**
Note, cells values of '–' denotes where data is either unavailable for a season, no impact is considered for a season or no connectivity is concluded for the breeding season.			

Table 6-67: Seasonal and annual distributional response estimates of kittiwake for the Caledonia OWF and other projects during the operational phase, as per the Guidance Approach. Bold text represents percentage point change >0.02.

Defined Season	Estimated Number of Mortalities (Individuals Per Annum) (Displacement Rate; Mortality Rate)		Change in Average Survival Rate (% Point Change) (Displacement Rate; Mortality Rate)	
	30%; 1%	30%; 3%	30%; 1%	30%; 3%
All Projects				
Breeding season (Mid-April to August)	158.01	474.04	**0.032**	**0.095**
Non-breeding season (September to early-April)	121.76	365.29	0.015	**0.044**
Annual total	279.78	839.33	**0.034**	**0.101**
All Projects Excluding Berwick Bank				
Breeding season (Mid-April to August)	94.59	283.77	0.019	**0.057**
Non-breeding season (September to early-April)	46.90	140.69	0.006	0.017
Annual total	141.49	424.46	0.017	**0.051**
All Consented Projects plus Caledonia OWF				
Breeding season (Mid-April to August)	70.55	211.64	0.014	**0.043**
Non-breeding season (September to early-April)	40.84	122.53	0.005	0.015
Annual total	111.39	334.17	0.013	**0.040**

Breeding Season

6.8.2.6 During the breeding season, the cumulative abundance (all projects) for kittiwake is 52,671 individuals (Table 6-66). Assuming a 30% displacement rate and 1% mortality rate, this would result in 158 (158.01) kittiwake being subject to mortality per annum. The breeding season regional population is estimated to be 496,826 individuals (Table 6-67). Based on the average survival rate of 84.4%, the predicted annual baseline mortality for this population is 77,505 (77,504.8) individuals. The addition of 158 predicted additional mortalities per annum due to distributional responses during the operational phase would result in a 0.032 percentage point survival rate change to this population.

6.8.2.7 The removal of Berwick Bank from the assessment reduces the predicted mortality to 95 (94.59) birds per annum. Mortalities reduce further to 71 (70.55) per annum when only consented projects plus Caledonia OWF are considered. This equates to a 0.019 and 0.014 percentage point survival rate change within this population respectively (Table 6-67).

6.8.2.8 When considering the more precautionary mortality rate of 3%, the percentage point survival rate change increases to 0.095, 0.057, and 0.043 for all projects, all projects excluding Berwick Bank, and consented projects only plus Caledonia OWF respectively (Table 6-67). As the percentage point survival rate change exceeds the recommended threshold of 0.02, PVA has been undertaken as per NatureScot (2023a[10]) guidance to further consider such a level of predicted effect.

Non-breeding Season

6.8.2.9 During the non-breeding season, the cumulative abundance for kittiwake is 40,588 individuals (Table 6-66). Assuming a 30% displacement rate and 1% mortality rate, this would result in 122 (121.76) kittiwakes being subject to mortality per annum when accounting for all projects (Table 6-67). The non-breeding season regional population is estimated to be 829,937 individuals. Based on the average survival rate of 84.4%, the predicted annual baseline mortality for this population is 129,470 individuals. The addition of 122 predicted additional mortalities per annum due to distributional responses during the operational phase would result in a 0.015 percentage point survival rate change within this population when accounting for all potential projects in the region.

6.8.2.10 The removal of Berwick Bank from the assessment reduces the predicted mortality to 47 (46.90) birds per annum. Mortalities reduce further to 41 (40.84) per annum when only consented projects are considered (Table 6-67). This equates to a 0.006 and 0.005 percentage point survival rate change within this population respectively.

6.8.2.11 When considering the more precautionary mortality rate of 3%, the percentage point survival rate change increases to 0.044, 0.017, and 0.015 for all projects, all projects excluding Berwick Bank, and consented projects only plus Caledonia OWF respectively (Table 6-67). As the percentage point survival rate change exceeds the recommended threshold of 0.02, PVA has been undertaken as per NatureScot (2023a[10]) guidance to further consider such a level of predicted effect.

Annual Total

6.8.2.12 The annual total of kittiwake subject to mortality as a result of cumulative distributional responses is estimated to be 280 (279.78) individuals, when considering a displacement rate of 30% and a mortality rate of 1%. Using the largest BDMPS population of 829,937 with an average survival rate of 84.4%, the predicted annual baseline mortality of this population is 129,470 individuals (Table 6-67). The addition of 280 predicted additional mortalities per annum due to cumulative distributional responses during the operational phase would result in a change to the survival rate of 0.034 percentage point change within this population. When considering the annual potential level of impact at the biogeographic scale (5,100,000 individuals), the predicted annual baseline mortality for this population is 765,600 individuals. The addition of 291 predicted additional mortalities per annum due to cumulative distributional responses during the operational phase would result in a change to the survival rate of 0.006 percentage point change.

6.8.2.13 The removal of Berwick Bank from the assessment reduces predicted mortality to 141 (141.49) birds per annum. Mortalities reduce further to 111 (111.39) per annum when only consented projects are considered. This equates to a 0.051 and 0.040 percentage point survival rate change within this population respectively (Table 6-67).

6.8.2.14 When considering a more precautionary mortality rate of 3%, estimated mortalities total 839 individuals per annum under the all projects scenario, resulting in a survival rate percentage point change of 0.101 per annum (Table 6-67).

6.8.2.15 As the adult annual survival rate is predicted to decrease by more than 0.02% for some of the scenarios annually, and as per NatureScot (2023a[10]) guidance, PVA has been undertaken for the annual population as presented below. The full methodology and results are presented in Volume 7B, Appendix 6-4: Population Viability Analysis.

Population Viability Analysis

6.8.2.16 PVA was undertaken using predicted cumulative operational phase mortalities calculated in Table 6-67, with the BDMPS population of 829,937 individuals used as the reference population for annual and non-breeding analysis, and the breeding population of 496,826 individuals for breeding season analysis.

6.8.2.17 The counterfactual of growth rate (CGR) and counterfactual of final population size (CPS) have been presented for all scenarios to estimate the potential changes in annual growth rate and population size after the operational lifespan of 35 years (Table 6-68). As requested by NatureScot, PVA results are also presented for 25 years and 50 years, with cumulative impact scenarios compared to a baseline (unimpacted) scenario within Volume 7B, Appendix 6-4: Population Viability Analysis.

Breeding Season

6.8.2.18 For the breeding season, as presented in Table 6-68, PVA was completed for annual mortality rates that exceeded the 0.02% threshold, this included:

- All projects scenario for mortality rates of 1% and 3%;
- All projects excluding Berwick Bank for a mortality rate of 3% only; and
- Consented Only projects plus Caledonia OWF for a mortality rate of 3% only.

6.8.2.19 For the all projects scenario, the population growth rate is predicted to decline by between 0.04 and 0.11% compared to the no impact baseline, which after 35 years would result in a reduction in population size of 1.36 to 3.98% compared to the no impact baseline population (Table 6-68).

6.8.2.20 When considering all projects excluding Berwick Bank, the population growth rate is predicted to decline by 0.07% annually compared to the no impact baseline, which after 35 years would result in a reduction in population size of 2.40% compared to the no impact baseline population (Table 6-68).

6.8.2.21 When considering consented projects only plus Caledonia OWF, the population growth rate is predicted to decline by 0.05% annually compared to the no impact baseline, which after 35 years would result in a reduction in population size of 1.81% compared to the no impact baseline population (Table 6-68).

Non-breeding Season

6.8.2.22 For the non-breeding season, predicted mortality only increased above the 0.02% threshold for the all projects scenario when considering a mortality rate of 3%. Thus, PVA was ran for this scenario only.

6.8.2.23 For the all projects scenario, the population growth rate is predicted to decline by 0.05% annually compared to the no impact baseline, which after 35 years would result in a reduction in population size of 1.86% compared to the no impact baseline population (Table 6-68).

Annual Total

6.8.2.24 As presented in Table 6-68, PVA was completed for annual mortality rates that exceeded the 0.02% threshold, this included:

- All projects scenario for mortality rates of 1% and 3%;
- All projects excluding Berwick Bank for a mortality rate of 3% only; and

- Consented Only projects plus Caledonia OWF for a mortality rate of 3% only.

6.8.2.25 For the all projects scenario, the population growth rate is predicted to decline by between 0.04% and 0.12% annually compared to the no impact baseline, which after 35 years would result in a reduction in population size of 1.44 to 4.22% compared to the no impact baseline population (Table 6-68).

6.8.2.26 When considering all projects excluding Berwick Bank, the population growth rate is predicted to decline by 0.06% annually compared to the no impact baseline, which after 35 years would result in a reduction in population size of 2.16% compared to the no impact baseline population (Table 6-68).

6.8.2.27 When considering consented projects only plus Caledonia OWF, the population growth rate is predicted to decline by 0.05% annually compared to the no impact baseline, which after 35 years would result in a reduction in population size of 1.69% compared to the no impact baseline population (Table 6-68).

Table 6-68: PVA results for kittiwake cumulative impacts during the operational phase, using the BDMPS population as a reference population.

Season	Scenario	Annual Mortality (Individuals)	Impact on Adult Survival	Median CGR (SD)	Median CPS (SD)	Difference in CGR (%)	Difference in CPS (%)
Baseline (unimpacted)		-	-	1.00	1.00	-	-
All projects							
Breeding	30%, 1%	158.01	0.032	1.000± <0.001	0.986 ±0.006	0.04%	1.36%
	30%, 3%	474.04	0.095	0.999± <0.001	0.960 ±0.006	0.11%	3.98%
Non-breeding	30%, 3%	365.29	0.044	0.999± <0.001	0.981 ±0.005	0.05%	1.86%
Annual	30%, 1%	279.78	0.034	1.000± <0.001	0.986 ±0.005	0.04%	1.44%
	30%, 3%	839.33	0.101	0.999± <0.001	0.958 ±0.004	0.12%	4.22%
All projects excluding Berwick Bank							
Breeding	30%, 3%	283.77	0.057	0.999± <0.001	0.976 ±0.006	0.07%	2.40%
Annual	30%, 3%	424.46	0.051	0.999 ± <0.001	0.978 ±0.004	0.06%	2.16%
Consented Projects Only (plus Caledonia OWF)							
Breeding	30%, 3%	211.64	0.043	0.999± <0.001	0.982 ±0.006	0.05%	1.81%
Annual	30%, 3%	334.17	0.040	1.000± <0.001	0.983 ±0.005	0.05%	1.69%

6.8.2.28 The PVA outputs set out above across all seasons and annually demonstrate a minimal change to the population annual growth rate (max reduction 0.12%) and final population size after 35 years (max reduction 4.22%), in contrast to baseline conditions. Such a level of predicted effect would almost certainly be indistinguishable from natural fluctuations in population size, which may be driven by other factors outside of the influence of the Proposed Development (Offshore) cumulatively with other plans and projects (such as changes in prey availability, avian influenza outbreaks or adverse weather). Therefore, such a level of predicted effect is concluded to be of **Low** overall magnitude of impact.

Sensitivity of Receptor

6.8.2.29 Based upon the findings presented in the literature reviewed on this subject (Table 6-5), kittiwake sensitivity to cumulative distributional responses during the operation phase is considered to be **Low**. The conservation value of the species is **Medium** (Table 6-22).

Significance of Effect

6.8.2.30 Given the **Low** sensitivity of kittiwake (Table 6-22) and the **Low** magnitude of impact when considering the PVA outputs for all seasons and annually, the overall effect of distributional responses during operation cumulatively is considered to be **Negligible and Not Significant in EIA terms** following the matrix approach (Table 6-17).

6.8.2.31 It is worth noting the small contribution from the Proposed Development (Offshore) of 2.7% to the annual cumulative total when considering all projects. Further, given the evidence presented in Volume 7B, Appendix 6-2, Annex 4: Review of Relevant Evidence, suggesting that kittiwake show little avoidance behaviour in the presence of OWF, further reinforces the **Negligible** conclusion.

Guillemot

Magnitude of Impact

6.8.2.32 The seasonal abundance estimates for guillemot associated with projects scoped into the CIA are presented in Table 6-69. The predicted abundance for planned and operational projects included within Table 6-69, are primarily based on the Northeast and East Scotwind Projects Cumulative totals dataset for project's within the regionally defined ZOI, with the addition of abundance totals for Salamander (ERM, 2024[181]) derived from their respective EIAs. Culzean was not included within Table 6-69 due to lack of available data, though to note given the size of Culzean it is unlikely such a project would materially contribute to any cumulative assessment as concluded within it's respective EIAs (Xodus Group, 2024[182]).

6.8.2.33 The cumulative impact assessment is focussed on the Applicant Approach of a displacement rate of 50% and a 1% mortality rate for operational phase distributional responses (Table 6-23). As detailed in Table 6-23, NatureScot advise that distributional response assessment for guillemot should be based on a displacement rate of 60% and a mortality rate of up to 5% depending on the season being assessed, therefore such levels of predicted effect are also provided.

6.8.2.34 As the Berwick Bank OWF is out of Proposed Development ZoI for guillemot, this project has not been included.

6.8.2.35 For further details regarding the differences between the Guidance Approach and the Applicant Approach for the distributional responses assessment, along with justification for the use of the latter, refer to Volume 7B, Appendix 6-2, Annex 4: Review of Relevant Evidence.

Table 6-69: Guillemot cumulative season and total abundance estimates.

Development	Predicted Abundance (individuals)		
	Breeding Season	Non-breeding Season	Total
Aberdeen	547	225	772
Beatrice	13,610	2,755	16,365
Green Volt	4,429	16,105	20,534
Hywind	249	2,136	2,385
Moray East	9,820	547	10,367
Moray West	24,426	38,174	62,600
PFOWF	1,146	651	1,797
Salamander	3,616	11,779	15,395
West of Orkney	7,973	4,393	12,366
Caledonia OWF	**16,092**	**6,710**	**22,802**
All Projects	**81,908**	**83,475**	**165,383**
Consented (plus Caledonia OWF)	**70,319**	**67,303**	**137,622**

Table 6-70: Seasonal and annual distributional response estimates of guillemot for the Caledonia OWF and other projects during the operational phase, as per the Applicant and Guidance Approach. Bold text represents percentage point change >0.02.

Defined Season	Estimated Number of Mortalities (Individuals Per Annum) (Displacement Rate; Mortality Rate)			Change in Average Survival Rate (% Point Change) (Displacement Rate; Mortality Rate)		
	50%; 1%	60%; 3%* 60%; 1%**	60%; 5%* 60%; 3%**	50%; 1%	60%; 3%* 60%; 1%**	60%; 5%* 60%; 3%**
All Projects						
Breeding season	409.54	1,474.34	2,457.23	**0.031**	**0.113**	**0.188**
Non-breeding season	417.37	500.85	1,502.55	**0.032**	**0.038**	**0.115**
Annual total	826.91	1,975.19	3,959.78	**0.063**	**0.151**	**0.303**
All Consented Projects (plus Caledonia OWF)						
Breeding season	351.59	1,265.74	2,109.56	**0.027**	**0.097**	**0.161**
Non-breeding season	336.51	403.82	1,211.45	**0.026**	**0.031**	**0.093**
Annual total	688.11	1,669.56	3,321.02	**0.053**	**0.128**	**0.254**
* Displacement rate of 60% and mortality rate of 3 -5% considered for the breeding season ** Displacement rate of 60% and mortality rate of 1 -3% considered for the non-breeding season.						

Breeding Season

6.8.2.36 During the breeding season, the cumulative abundance is 81,908 individuals (Table 6-69). Under the WCS (all projects) and assuming a 50% displacement rate and 1% mortality rate, this would result in 410 (409.54) guillemot being subject to mortality per annum. The breeding season regional population is estimated to be 1,307,476 individuals. Based on the average survival rate of 86.2%, the predicted annual baseline mortality for this population is 180,432 (180,431.7) individuals. The addition of 410 predicted additional mortalities per annum due to distributional responses during the operational phase would result in a 0.031 percentage point survival rate change to this population (Table 6-70). As the percentage point survival rate change exceeds the recommended threshold of 0.02, PVA has been undertaken as per NatureScot (2023a[10]) guidance to further consider such a level of predicted effect.

6.8.2.37 When considering consented projects only plus Caledonia OWF, guillemot mortalities reduce to 352 (351.59) individuals per annum which equates to a 0.027 percentage point survival rate change to the population (Table 6-70). As the percentage point survival rate change exceeds the recommended threshold of 0.02, PVA has been undertaken as per NatureScot (2023a[10]) guidance to further consider such a level of predicted effect.

6.8.2.38 The more precautionary displacement and mortality rates as recommended by NatureScot (Table 6-23) results in a mortality prediction of 1,266 (1,265.74) – 2,110 (2,109.56) guillemots when considering all consented projects plus Caledonia OWF and 1,474 (1,474.34) – 2,457 (2,457.23) when considering all projects (Table 6-70). For all scenarios the increase in the percentage point change in survival is beyond the 0.02 threshold as recommended by NatureScot. Therefore, PVA has been undertaken as per NatureScot (2023a[10]) guidance to further consider such a level of predicted effect.

Non-breeding Season

6.8.2.39 During the non-breeding season, the cumulative abundance is 83,475 individuals (Table 6-69). Under the WCS (all projects), and assuming a 50% displacement rate and 1% mortality rate, this would result in 417 (417.37) guillemots being subject to mortality per annum. The non-breeding season regional population is estimated to be 1,307,476 individuals. Based on the average survival rate of 86.2%, the predicted annual baseline mortality for this population is 180,432 (180,431.7) individuals. The addition of 417 predicted additional mortalities per annum due to distributional responses during the operational phase would result in a 0.032 percentage point survival rate change within this population when accounting for all potential projects in the region (Table 6-70). As the percentage point survival rate change exceeds the recommended threshold of 0.02, PVA has been undertaken as per NatureScot (2023a[10]) guidance to further consider such a level of predicted effect.

6.8.2.40 When considering consented projects only plus Caledonia OWF, guillemot mortalities reduce to 337 (336.51) individuals per annum which equates to a

0.026 percentage point survival rate change to the population (Table 6-70). As the percentage point survival rate change exceeds the recommended threshold of 0.02, PVA has been undertaken as per NatureScot (2023a[10]) guidance to further consider such a level of predicted effect.

6.8.2.41 The more precautionary displacement and mortality rates as recommended by NatureScot (Table 6-23) results in a mortality prediction of 404 (403.82) – 1,212 (1,211.45) guillemots when considering all consented projects plus Caledonia OWF and 501 (500.85) – 1,503 (1,502.55) when considering all projects (Table 6-70). For all scenarios the increase in the percentage point change in survival is beyond the 0.02 threshold as recommended by NatureScot. Therefore, PVA has been undertaken as per NatureScot (2023a[10]) guidance to further consider such a level of predicted effect.

Annual Total

6.8.2.42 The annual total of guillemot subject to mortality as a result of cumulative distributional responses within the region is estimated to be 827 (826.91) individuals under the WCS (all projects). Using the largest BDMPS population of 1,307,476 with an average survival rate of 86.2%, the predicted annual baseline mortality of this population is 180,432 individuals. The addition of 827 predicted additional mortalities per annum due to cumulative distributional responses during the operational phase would result in a change to the survival rate of 0.063 percentage point change within this population (Table 6-70). When considering the annual potential level of impact at the biogeographic scale (4,125,000 individuals), the predicted annual baseline mortality for this population is 569,250 individuals. The addition of 827 predicted additional mortalities per annum due to cumulative distributional responses during the operational phase would result in a change to the survival rate of > 0.02 percentage point change.

6.8.2.43 When considering consented projects only plus Caledonia OWF, the annual predicted mortality for guillemot reduces to 688 (688.11) individuals per annum, which equates to a change in the survival rate of 0.053 percent point change. At a biogeographic scale, this percentage point change reduces to 0.017 (Table 6-70).

6.8.2.44 The more precautionary displacement and mortality rates as recommended by NatureScot (Table 6-23) results in a mortality prediction of 1,670 (1,669.56) – 3,321 (3,321.02) guillemots when considering all consented projects plus Caledonia OWF and 1,975 (1,975.19) – 3,960 (3,959.78) when considering all projects (Table 6-70). For all scenarios the increase in the percentage point change in survival is beyond the 0.02 threshold as recommended by NatureScot. Therefore, PVA has been undertaken as per NatureScot (2023a[10]) guidance to further consider such a level of predicted effect.

Population Viability Analysis

6.8.2.45 PVA was undertaken using predicted cumulative operational phase mortalities calculated in Table 6-71 for both the Applicant and Guidance approach, with the BDMPS population of 1,307,476 individuals used as the reference population for all seasons.

6.8.2.46 The counterfactual of growth rate (CGR) and counterfactual of population size (CPS) have been presented for all scenarios to estimate the potential changes in annual growth rate and population size after the operational lifespan of 35 years (Table 6-71). As requested by NatureScot, PVA results are also presented for 25 years and 50 years, with cumulative impact scenarios compared to a baseline (unimpacted) scenario within Volume 7B, Appendix 6-4: Population Viability Analysis.

Breeding Season

6.8.2.47 During the breeding season, as presented in Table 6-71 PVA analysis was completed for all impact predictions.

6.8.2.48 For all projects when considering the Applicant Approach, the population growth rate is predicted to decline by 0.03% annually compared to the no impact baseline, which after 35 years would result in a reduction in population size of 1.25% compared to the no impact baseline population (Table 6-71).

6.8.2.49 For all consented projects only plus Caledonia OWF when considering the Applicant Approach, the population growth rate is predicted to decline by 0.03% annually compared to the no impact baseline, which after 35 years would result in a reduction in population size of 1.10% compared to the no impact baseline population (Table 6-71).

6.8.2.50 For the Guidance approach, the growth rate is predicted to decline by between 0.13 and 0.21% annually when considering all projects and between 0.11 and 0.18% annually for consented projects only plus Caledonia OWF. After 35 years, this equates to a reduction in population size of 4.49 – 7.35% and 3.86 – 6.32% for all projects and consented projects only plus Caledonia OWF, respectively.

Non-breeding Season

6.8.2.51 During the non-breeding season, as presented in Table 6-71 PVA analysis was completed for all impact predictions.

6.8.2.52 For all projects when considering the Applicant Approach, the population growth rate is predicted to decline by 0.04% annually compared to the no impact baseline, which after 35 years would result in a reduction in population size of 1.29% compared to the no impact baseline population (Table 6-71).

6.8.2.53 For all consented projects only plus Caledonia OWF when considering the Applicant Approach, the population growth rate is predicted to decline by 0.03% annually compared to the no impact baseline, which after 35 years would result in a reduction in population size of 1.05% compared to the no impact baseline population (Table 6-71).

6.8.2.54 For the Guidance approach, the growth rate is predicted to decline by between 0.04 and 0.13% annually when considering all projects and between 0.03 and 0.10% annually for consented projects only plus Caledonia OWF. After 35 years, this equates to a reduction in population size of 1.53 – 4.56% and 1.25 – 3.70% for all projects and consented projects only plus Caledonia OWF, respectively.

Annual Total

6.8.2.55 For all projects when considering the Applicant Approach, the population growth rate is predicted to decline by 0.07% annually compared to the no impact baseline, which after 35 years would result in a reduction in population size of 2.52% compared to the no impact baseline population (Table 6-71).

6.8.2.56 For all consented projects only plus Caledonia OWF when considering the Applicant Approach, the population growth rate is predicted to decline by 0.06% annually compared to the no impact baseline, which after 35 years would result in a reduction in population size of 2.13% compared to the no impact baseline population (Table 6-71).

6.8.2.57 For the Guidance approach, the growth rate is predicted to decline by between 0.17 and 0.34% annually when considering all projects and between 0.14 and 0.29% annually for consented projects only plus Caledonia OWF. After 35 years, this equates to a reduction in population size of 5.95 – 11.58% and 5.06 – 9.80% for all projects and consented projects only plus Caledonia OWF, respectively.

Table 6-71: PVA results for guillemot cumulative impacts during the operational phase, using the BDMPS population as a reference population.

Season	Scenario	Annual Mortality (Individuals)	Impact on Adult Survival	Median CGR (SD)	Median CPS (SD)	Difference in CGR	Difference in CPS
Baseline (unimpacted)		-	-	1.00	1.00	-	-
All Projects							
Breeding	50%, 1%	409.54	0.031	1.000 ±<0.001	0.987 ±0.002	0.03%	1.25%
	60%, 3%	1474.34	0.113	0.999 ±<0.001	0.955 ±0.002	0.13%	4.49%
	60%, 5%	2,457.23	0.188	0.998 ±<0.001	0.927 ±0.002	0.21%	7.35%
Non-breeding	50%, 1%	417.37	0.032	1.000 ±<0.001	0.987 ±0.002	0.04%	1.29%
	60%, 1%	500.85	0.038	1.000 ±<0.001	0.985 ±0.002	0.04%	1.53%
	60%, 3%	1,502.55	0.15	0.999 ±<0.001	0.954 ±0.002	0.13%	4.56%
Annual	50%, 1%	826.91	0.063	0.999 ±<0.001	0.975 ±0.002	0.07%	2.52%
	60%, 3%; 60%, 1%	1975.19	0.151	0.998 ±<0.001	0.941 ±0.002	0.17%	5.95%
	60%, 5%; 60%, 3%	3,959.78	0.303	0.997 ±<0.001	0.884 ±0.002	0.34%	11.58%
Consented Projects Only (plus Caledonia OWF)							
Breeding	50%, 1%	351.59	0.027	1.000 ±<0.001	0.989 ±0.002	0.03%	1.10%
	60%, 3%	1,265.74	0.097	0.999 ±<0.001	0.961 ±0.002	0.11%	3.86%
	60%, 5%	2,109.56	0161	0.998 ±<0.001	0.937 ±0.002	0.18%	6.32%

Season	Scenario	Annual Mortality (Individuals)	Impact on Adult Survival	Median CGR (SD)	Median CPS (SD)	Difference in CGR	Difference in CPS
Non-breeding	50%, 1%	336.51	0.026	1.000 ±<0.001	0.989 ±0.002	0.03%	1.05%
	60%, 1%	403.82	0.031	1.000 ±<0.001	0.987 ±0.002	0.03%	1.25%
	60%, 3%	1,211.45	0.093	0.999 ±<0.001	0.963 ±0.002	0.10%	3.70%
Annual	50%, 1%	688.11	0.053	0.999 ±<0.001	0.979 ±0.002	0.06%	2.13%
	60%, 3%; 60%, 1%	1,669.56	0.128	0.998 ±<0.001	0.949 ±0.002	0.14%	5.06%
	60%, 5%; 60%, 3%	3,321.02	0.254	0.997 ±<0.001	0.902 ±0.002	0.29%	9.80%

6.8.2.58 The predicted population level consequences for all scenarios in Table 6-71 for the Applicant Approach demonstrates a minimal change to the population annual growth rate (max reduction 0.07%) and final population size after 35 years (max reduction 2.52%), in contrast to baseline conditions. Such a level of predicted effect would almost certainly be indistinguishable from natural fluctuations in population size, which may be driven by other factors outside of the influence of the Proposed Development (Offshore) cumulatively with other plans and projects (such as changes in prey availability or avian influenza outbreaks). Therefore, such a level of predicted effect is concluded to be of **Low** overall magnitude.

6.8.2.59 When considering the Guidance approach predicted population level consequences for all scenarios in Table 6-71, it is important to consider the population trend of Scottish guillemots as summarised in Figure 6-6. Overall, the long-term trend (1986 – 2019) of the population is relatively stable with minor fluctuations in the population trend. During the early 2000's a decline is noted within the guillemot population which is due to low productivity between 2003 to 2007, which coincided with a decline in sandeel abundance (Burnell *et al.*, 2023[91]). From early 2010 onwards, the population has appeared to stabilise with the population increasing positively up until 2019. In the last five the years the overall population for guillemots in Scotland is uncertain, though to note the species was known to be impacted by HPAI at some UK colonies (RSPB, 2024[183]). However, in Scotland the overall impact of HPAI is unclear given the large differences between baseline counts (2015 –

2021) and 2023 counts recorded for Scottish North Sea colonies which varied by +47% to -56%.

6.8.2.60 The overall population trend of guillemots in Scotland can be classified as stable. Therefore, even when considering the most precautionary level of effect from all projects, which predicted a reduction in growth rate of 0.34% per annum, the population is considered resilient enough to withstand such a reduction in growth rate. This conclusion is reinforced when considering the information summarised within Section 6.4.4, as the key driver of guillemot population change relates to climate change effects.

6.8.2.61 It is important to note that the likelihood of every single project included within the cumulative assessment leading to a displacement rate of 60% and subsequent mortality rate of 3 -5% in Scotland is considered unlikely in light of the evidence presented within Volume 7B, Appendix 6-2, Annex 4: Review of Relevant Evidence, when considering the high variability in auk displacement rates observed and no level of significant consequential mortality evidenced due to the presence of OWF developments in the North Sea.

6.8.2.62 In consideration of the above evidence, when considering the Guidance approach the magnitude of effect is concluded to be of **Low - Medium** overall magnitude.

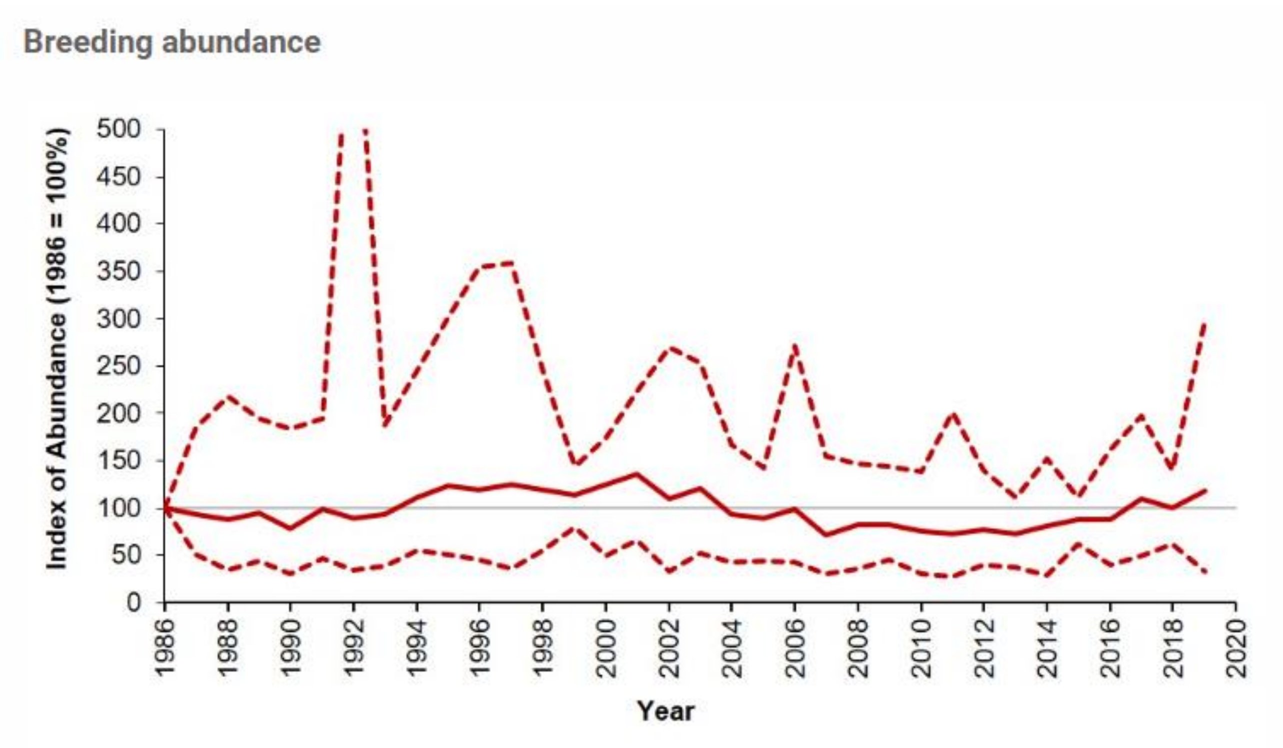


Figure 6-6: Trend in abundance index (solid line) of guillemots in Scotland from 1986–2019 based on SMP data. Figure derived from JNCC (2024[184]).

Sensitivity of Receptor

6.8.2.63 Based upon the findings presented in the literature reviewed on this subject (Table 6-5), guillemot sensitivity to cumulative distributional responses during the operation phase is considered to be **Medium**. The conservation value of the species is **Medium** (Table 6-22).

Significance of Effect

6.8.2.64 When considering the medium sensitivity of guillemot (Table 6-22) and the low magnitude of impact for the Applicant approach, the overall effect of distributional responses during operation is considered to be **Minor and Not Significant in EIA terms following the matrix approach** (Table 6-17).

6.8.2.65 When considering the Guidance approach, the overall effect of distributional responses during operation is considered to be minor to moderate at most. Though as noted the upper range of mortality is considered unlikely in light of the evidence presented in Volume 7B, Appendix 6-2, Annex 4: Review of Relevant Evidence, and the uncertainty that not all projects include cumulatively may not be taken forward or built out in full as per their worst-case scenario conditions assessed.

Puffin

Magnitude of Impact

6.8.2.66 The seasonal abundance estimates for puffin associated with projects scoped into the CIA are presented in Table 6-72. The predicted abundance for planned and operational projects included within Table 6-72, are primarily based on the Northeast and East Scotwind Projects Cumulative totals dataset, with the addition of abundance totals for Ossian (NIRAS & RPS, 2024[180]) and Salamander (ERM, 2024[181]) derived from their respective EIARs. Culzean was not included within Table 6-72 due to lack of available data, though to note given the size of Culzean it is unlikely such a project would materially contribute to any cumulative assessment as concluded within it’s respective EIAR (Xodus Group, 2024[182]).

6.8.2.67 The cumulative impact assessment is focussed on the Applicant Approach of a displacement rate of 50% and a 1% mortality rate for operational phase distributional responses. NatureScot advise that distributional response assessment for puffin should be based on a displacement rate of 60% and a mortality rate of up to 5% depending on the season being assessed, therefore such level of predicted effect are also provided. Presentation of distributional response impacts following the NatureScot Guidance Approach for the operational phase is provided in Table 6-73.

6.8.2.68 The Applicant has decided to include the Year 1 August count in the non-breeding season rather than during the breeding season. This is due to the Year 1 August abundance from the baseline DAS being considered to reflect migration rather than individuals present in the breeding season. The mean seasonal peaks for puffin have also been presented with the August count included in the breeding season as per the Guidance Approach, further details are provided in Volume 7B, Appendix 6-2: Offshore Ornithology Distributional Responses Technical Report. This enables comparison of how the inclusion of the Year 1 August abundance within the breeding season alters the mean peaks, and therefore the predicted operational phase distributional response impacts, for both the breeding and non-breeding seasons.

6.8.2.69 For further details regarding the differences between the Guidance Approach and the Applicant Approach for the distributional responses assessment, along with justification for the use of the latter, refer to Volume 7B, Appendix 6-2, Annex 4: Review of Relevant Evidence.

Table 6-72: Puffin cumulative season and total abundance estimates.

Development	Predicted Abundance (individuals)		
	Breeding Season	Non-breeding Season	Total
Aberdeen	42	82	124
Beatrice	2,858	2,435	5,293
Berwick Bank	4,513	8,892	13,405
Blyth Demonstration Site	-	123	123
DEP	-	46	46
Dogger Bank A	-	295	295
Dogger Bank B	-	743	743
Dogger Bank C	-	273	273
Dogger Bank South (PEIR)	-	786	786
Dudgeon	-	3	3
East Anglia One	-	32	32
East Anglia Three	-	307	307
Galloper	-	1	1
Greater Gabbard	-	1	1
Green Volt	250	41	291
Hornsea Project Four	-	442	442
Hornsea Project One	-	1,257	1,257

Development	Predicted Abundance (individuals)		
	Breeding Season	Non-breeding Season	Total
Hornsea Project Three	-	67	67
Hornsea Project Two	-	2,039	2,039
Humber Gateway	-	10	10
Hywind 2 Demonstration	119	85	204
Inch Cape	2,956	2,688	5,644
Kentish Flats Extension	-	6	6
Kincardine	19	-	19
Lincs, Lynn and Inner Dowsing	-	6	6
London Array	-	1	1
Methil	8	-	8
Moray East	2,795	656	3,451
Moray West	1,115	3,966	5,081
Neart na Gaoithe	2,562	2,103	4,665
Norfolk Boreas	-	23	23
Norfolk Vanguard	-	112	112
North Falls (PEIR)	-	7	7
Ossian	1,928	-	1,928
Outer Dowsing	-	645	645
PFOWF	6,521	6	6,527
Race Bank	-	10	10
Salamander	357	-	357
Seagreen Alpha	2,572	1,526	4,098
Seagreen Bravo	3,582	3,863	7,445
SEP	-	18	18

Development	Predicted Abundance (individuals)		
	Breeding Season	Non-breeding Season	Total
Sheringham Shoal	-	26	26
Sofia	-	329	329
Teesside	-	18	18
Triton Knoll	-	71	71
West of Orkney	5,272	2,136	7,408
Westermost Rough	-	35	35
Caledonia OWF (Applicant Approach)	**698**	**3,005**	**3,703**
Caledonia OWF (Guidance Approach)	**2,061**	**1,336**	**3,397**
All Projects (Applicant Approach)	**38,167**	**39,216**	**77,383**
All Projects (Guidance Approach)	**39,530**	**37,547**	**77,077**
All Projects Excl. Berwick Bank (Applicant Approach)	**33,654**	**30,324**	**63,978**
All Projects Excl. Berwick Bank (Guidance Approach)	**35,017**	**28,655**	**63,672**
Consented (plus Caledonia OWF Applicant Approach)	**26,097**	**26,750**	**52,847**
Consented (plus Caledonia OWF Guidance Approach)	**27,460**	**25,081**	**52,541**
Note: cells values of – denotes where data is either unavailable for a season, no impact is considered for a season or no connectivity is concluded for the breeding season.			

Table 6-73: Seasonal and annual cumulative distributional response estimates of puffin for the Caledonia OWF and other projects during the operational phase, as per the Applicant and Guidance Approach. Bold text represents percentage point change >0.02.

Defined Season	Estimated Number of Mortalities (Individuals Per Annum) (Displacement Rate; Mortality Rate)			Change in Average Survival Rate (% Point Change) (Displacement Rate; Mortality Rate)		
	50%; 1%	60%; 3%* 60%; 1%**	60%; 5%* 60%; 3%**	50%; 1%	60%; 3%* 60%; 1%**	60%; 5%* 60%; 3%**
All Projects (Applicant Approach)						
Breeding season	190.84	687.01	1,145.01	**0.026**	**0.095**	**0.158**
Non-breeding season	196.08	235.29	705.88	**0.085**	**0.101**	**0.304**
Annual total	386.91	922.30	1,850.89	**0.053**	**0.127**	**0.256**
All Projects Excluding Berwick Bank (Applicant Approach)						
Breeding season	168.27	605.77	1,009.62	**0.023**	**0.084**	**0.139**
Non-breeding season	151.62	181.94	545.82	**0.065**	**0.078**	**0.235**
Annual total	319.89	787.71	1,555.44	**0.044**	**0.109**	**0.215**
All Consented Projects plus Caledonia OWF (Applicant Approach)						
Breeding season	130.49	469.75	782.91	0.018	**0.065**	**0.108**
Non-breeding season	133.75	160.50	481.49	**0.058**	**0.069**	**0.208**
Annual total	264.23	630.24	1,264.40	**0.037**	**0.087**	**0.175**
All Projects (Guidance Approach)						
Breeding season	197.65	711.54	1,185.89	**0.027**	**0.098**	**0.164**

Defined Season	Estimated Number of Mortalities (Individuals Per Annum) (Displacement Rate; Mortality Rate)			Change in Average Survival Rate (% Point Change) (Displacement Rate; Mortality Rate)		
	50%; 1%	60%; 3%* 60%; 1%**	60%; 5%* 60%; 3%**	50%; 1%	60%; 3%* 60%; 1%**	60%; 5%* 60%; 3%**
Non-breeding season	187.74	225.28	675.85	**0.081**	**0.097**	**0.291**
Annual total	385.38	936.82	1,861.74	**0.053**	**0.129**	**0.257**
All Projects Excluding Berwick Bank (Guidance Approach)						
Breeding season	175.08	630.30	1,050.50	**0.024**	**0.087**	**0.145**
Non-breeding season	143.28	171.93	515.79	**0.062**	**0.074**	**0.222**
Annual total	318.36	802.23	1,566.29	**0.044**	**0.111**	**0.216**
All Consented Projects plus Caledonia OWF (Guidance Approach)						
Breeding season	137.30	494.28	823.79	0.019	**0.068**	**0.114**
Non-breeding season	125.41	150.49	451.46	**0.054**	**0.065**	**0.195**
Annual total	262.70	644.76	1,275.25	**0.036**	**0.089**	**0.176**

* Displacement rate of 60% and mortality rate of 3 -5% considered for the breeding season.

** Displacement rate of 60% and mortality rate of 1 -3% considered for the non-breeding season.

Breeding Season

6.8.2.70 During the breeding season, the cumulative abundance for puffin is 38,167 individuals (Table 6-72) when considering the Applicant approach. Assuming a 50% displacement rate and 1% mortality rate, this would result in 191 (190.84) puffin being subject to mortality per annum. The breeding season regional population is estimated to be 723,751 individuals. Based on the average survival rate of 82.5%, the predicted annual baseline mortality for this population is 126,657 (126,656.5) individuals. The addition of 191 predicted additional mortalities per annum due to distributional responses during the operational phase would result in a 0.026 percentage point survival rate change to this population. As the percentage point survival rate change exceeds the recommended threshold of 0.02, PVA has been undertaken as per NatureScot (2023a[10]) guidance to further consider such a level of predicted effect.

6.8.2.71 When considering all projects excluding Berwick Bank and consented projects only plus Caledonia OWF, puffin mortalities reduce to 168 (168.27) and 130 (130.49) individuals per annum respectively which equates to a 0.023 and 0.018 percentage point survival rate change to the population (Table 6-73). As the percentage point survival rate change exceeds the recommended threshold of 0.02, PVA has been undertaken as per NatureScot (2023a[10]) guidance to further consider such a level of predicted effect.

6.8.2.72 The more precautionary displacement and mortality rates as recommended by NatureScot (Table 6-23) results in a higher level of mortality (Table 6-73), with an increase in the percentage point change in survival beyond the 0.02 threshold as recommended by NatureScot. Therefore, PVA has been undertaken as per NatureScot (2023a[10]) guidance to further consider such a level of predicted effect.

6.8.2.73 The Guidance Approach in which the first year August count was included in the breeding season resulted in a slightly higher mortality (197.65) and thus a slightly higher change in the survival rate (0.027). As per the Applicant Approach, mortality increased with increasing mortality rate and reduced when considering other scenarios (all projects excluding Berwick Bank, consented projects only plus Caledonia OWF) (Table 6-73). Whilst mortality levels and subsequent survival rate change were not highly variable between the two approaches, as the survival rate change exceeded the 0.02 threshold, PVA was completed for both approaches to consider the level of predicted effect.

Non-breeding Season

6.8.2.74 During the non-breeding season, the cumulative abundance for puffin is 39,216 individuals for all projects considered (Table 6-72). Assuming a 50% displacement rate and 1% mortality rate, this would result in 196 (196.08) puffin being subject to mortality per annum when accounting for all projects. The non-breeding season regional population is estimated to be 231,957 individuals. Based on the average survival rate of 82.5%, the predicted annual baseline mortality for this population is 40,593 (40,592.5) individuals. The addition of 196 predicted additional mortalities per annum due to distributional responses during the operational phase would result in a 0.085 percentage point survival rate change within this population when accounting for all potential projects in the region. As the percentage point survival rate change exceeds the recommended threshold of 0.02, PVA has been undertaken as per NatureScot (2023a[10]) guidance to further consider such a level of predicted effect.

6.8.2.75 When considering all projects excluding Berwick Bank and consented projects only plus Caledonia OWF, puffin mortalities reduce to 152 (151.62) and 134 (133.75) individuals per annum respectively which equates to a 0.078 and 0.058 percentage point survival rate change to the population (Table 6-73). As the percentage point survival rate change exceeds the recommended threshold of 0.02, PVA has been undertaken as per NatureScot (2023a[10]) guidance to further consider such a level of predicted effect.

6.8.2.76 The more precautionary displacement and mortality rates as recommended by NatureScot (Table 6-23) results in a higher level of mortality (Table 6-73), with an increase in the percentage point change in survival beyond the 0.02 threshold as recommended by NatureScot. Therefore, PVA has been undertaken as per NatureScot (2023a[10]) guidance to further consider such a level of predicted effect.

6.8.2.77 The Guidance Approach in which the first year August count was not included in the non-breeding season resulted in a slightly lower mortality (187.74) and thus a slightly lower change in the survival rate (0.081). As per the Applicant Approach, mortality increased with increasing mortality rate and reduced when considering other scenarios (all projects excluding Berwick Bank, consented projects only plus Caledonia OWF) (Table 6-73). Whilst mortality levels and subsequent survival rate change were not highly variable between the two approaches, as the survival rate change exceeded the 0.02 threshold, PVA was completed for both approaches to consider the level of predicted effect.

Annual Total

6.8.2.78 The annual total of puffin subject to mortality as a result of cumulative distributional responses within the region is estimated to be 387 (386.91) individuals. Using the BDMPS population of 723,751 with an average survival rate of 82.5%, the predicted annual baseline mortality of this population is 126,657 (126,656.5) individuals. The addition of 387 predicted additional mortalities per annum due to cumulative distributional responses during the operational phase would result in a change to the survival rate of 0.053 percentage point change within this population. When considering the annual potential level of impact at the biogeographic scale (11,840,000 individuals), the predicted annual baseline mortality for this population is 2,072,000 individuals. The addition of 387 predicted additional mortalities per annum due to cumulative distributional responses during the operational phase would result in a change to the survival rate of 0.003 percentage point change.

6.8.2.79 When considering all projects excluding Berwick Bank and consented projects only plus Caledonia OWF, puffin mortalities reduce to 320 (319.89) and 264 (264.23) individuals per annum respectively which equates to a 0.044 and 0.037 percentage point survival rate change to the population (Table 6-73).

6.8.2.80 The more precautionary displacement and mortality rates as recommended by NatureScot (Table 6-23) results in a higher level of mortality (Table 6-73), with an increase in the percentage point change in survival beyond the 0.02 threshold as recommended by NatureScot.

6.8.2.81 The Guidance Approach (in which the first year August count was included in the breeding season) resulted in a similar annual mortality to the Applicant seasonal approach (AA: 386.91; GA: 385.38) and thus the same change in the survival rate (AA:0.053; GA: 0.053). As per the Applicant Approach, mortality increased with increasing mortality rate and reduced when considering other scenarios (all projects excluding Berwick Bank, consented projects only plus Caledonia OWF) (Table 6-73). Whilst mortality levels and subsequent survival rate change very similar between the two approaches, as the survival rate change exceeded the 0.02 threshold, PVA was completed for both approaches to consider the level of predicted effect.

6.8.2.82 As the percentage point survival rate change exceeds the recommended threshold of 0.02 for some scenarios annually, PVA has been undertaken as per NatureScot (2023a[10]) guidance to further consider such a level of predicted effect. The full methodology and results are presented in Volume 7B, Appendix 6-4: Population Viability Analysis.

Population Viability Analysis

6.8.2.83 PVA was undertaken using predicted cumulative operational phase mortalities calculated in Table 6-73 for both the Applicant and Guidance Approach, with the breeding population of 723,751 individuals used as the reference for annual and breeding season analysis and the non-breeding BDMPS population size of 231,957 for the non-breeding assessment.

6.8.2.84 The counterfactual of growth rate (CGR) and counterfactual of population size (CPS) have been presented for scenarios to estimate the potential changes in annual growth rate and population size during the operational lifespan of 35 years (Table 6-74). As requested by NatureScot, the PVA results are also presented for 25 years and 50 years, with cumulative impact scenarios compared to a baseline (unimpacted) scenario within Volume 7B, Appendix 6-4: Population Viability Analysis.

Breeding Season

6.8.2.85 For the breeding season, as presented in Table 6-74 and Table 6-75 PVA was completed for annual mortality rates that exceeded the 0.02% threshold, this included:

- All projects scenario (Applicant and Guidance seasonal approach) when considering a displacement rate of 50% and a mortality rate of 1%;
- All projects scenario (Applicant and Guidance seasonal approach) when considering a displacement rate of 60% and a mortality rate of 1 - 3%;
- All projects excluding Berwick Bank (Applicant and Guidance seasonal approach) when considering a displacement rate of 50% and a mortality rate of 1%;
- All projects excluding Berwick Bank (Applicant and Guidance seasonal approach) when considering a displacement rate of 60% and a mortality rate of 1 - 3%;
- Consented projects only plus Caledonia OWF (Applicant and Guidance seasonal approach) when considering a displacement rate of 60% and a mortality rate of 1 - 3%;

Applicant Seasonal Approach

6.8.2.86 For the all projects scenario when considering a displacement rate of 50% and a mortality rate of 1%, the population growth rate is predicted to decline by 0.03% annually, which after 35 years would result in a reduction in population size of 1.09% compared to the baseline unimpacted population (Table 6-74).

6.8.2.87 For the all projects excluding Berwick Bank scenario, when considering a displacement rate of 50% and a mortality rate of 1%, the population growth rate is predicted to decline by 0.03% annually, which after 35 years would result in a reduction in population size of 0.97% when compared to the baseline unimpacted population (Table 6-74).

6.8.2.88 When Considering a Displacement rate of 60% and mortality rate of 1 -3% for all scenarios, the growth rate is predicted to decline by between 0.11 - 0.19% when considering all projects, 0.10 - 0.16% for all projects excluding Berwick Bank and 0.08 - 0.13% for consented projects only plus Caledonia OWF annually. After 35 years, this equates to a reduction in population size of 3.97 – 6.50%, 3.49 – 5.73%, and 2.73 – 4.48% for all projects, all projects excluding Berwick Bank and consented projects only plus Caledonia OWF, respectively.

Guidance Seasonal Approach

6.8.2.89 For the all projects scenario when considering a displacement rate of 50% and a mortality rate of 1%, the population growth rate is predicted to decline by 0.03% annually, which after 35 years would result in a reduction in population size of 1.09% compared to the baseline unimpacted population (Table 6-74).

6.8.2.90 For the all projects excluding Berwick Bank scenario, when considering a displacement rate of 50% and a mortality rate of 1%, the population growth rate is predicted to decline by 0.03% annually, which after 35 years would result in a reduction in population size of 0.97% when compared to the baseline unimpacted population (Table 6-74).

6.8.2.91 When Considering a Displacement rate of 60% and mortality rate of 1 -3% for all scenarios, the growth rate is predicted to decline by between 0.10 – 0.19 for all projects, 0.10 - 0.17% for all projects excluding Berwick Bank and 0.08 - 0.13% for consented projects only plus Caledonia OWF annually. After 35 years, this equates to a reduction in population size by 4.08 – 6.74%, 3.63 – 5.98% and 2.85 – 4.74% for all projects, all projects excluding Berwick Bank and consented projects only plus Caledonia OWF respectively.

Non-breeding Season

6.8.2.92 PVA was undertaken for all scenarios using the Guidance Approach and Applicant Approaches for the non-breeding season.

Applicant Seasonal Approach

6.8.2.93 For the all projects scenario when considering a displacement rate of 50% and a mortality rate of 1%, the population growth rate is predicted to decline by 0.10% annually, which after 35 years would result in a reduction in population size of 3.56% compared to the baseline unimpacted population (Table 6-74).

6.8.2.94 For the all projects excluding Berwick Bank scenario, when considering a displacement rate of 50% and a mortality rate of 1%, the population growth rate is predicted to decline by 0.08% annually, which after 35 years would result in a reduction in population size of 2.72% when compared to the baseline unimpacted population (Table 6-74).

6.8.2.95 For the consented projects only plus Caledonia OWF scenario, when considering a displacement rate of 50% and a mortality rate of 1%, the population growth rate is predicted to decline by 0.07% annually, which after 35 years would result in a reduction in population size of 2.46% when compared to the baseline unimpacted population (Table 6-74).

6.8.2.96 When considering a Displacement rate of 60% and mortality rate of 1 -3% for all scenarios, the growth rate is predicted to decline by between 0.12 – 0.36%, 0.09 - 0.28% for all projects excluding Berwick Bank and 0.08 - 0.25% for consented projects only plus Caledonia OWF annually. After 35 years, this equates to a reduction in population size by 4.22 – 12.18%, 3.26 – 9.57%, and 2.93 – 8.49% for all projects, all projects excluding Berwick Bank and consented projects only plus Caledonia OWF, respectively.

Guidance Seasonal Approach

6.8.2.97 For the all projects scenario when considering a displacement rate of 50% and a mortality rate of 1%, the population growth rate is predicted to decline by 0.10% annually, which after 35 years would result in a reduction in population size of 3.56% when compared to the baseline unimpacted population (Table 6-74).

6.8.2.98 For the all projects excluding Berwick Bank scenario, when considering a displacement rate of 50% and a mortality rate of 1%, the population growth rate is predicted to decline by 0.08% annually, which after 35 years would result in a reduction in population size of 2.72% when compared to the baseline unimpacted population (Table 6-74).

6.8.2.99 For the consented projects only plus Caledonia OWF scenario, when considering a displacement rate of 50% and a mortality rate of 1%, the population growth rate is predicted to decline by 0.07% annually, which after 35 years would result in a reduction in population size of 2.46% when compared to the baseline unimpacted population (Table 6-74).

6.8.2.100 When Considering a Displacement rate of 60% and mortality rate of 1 -3% for all scenarios, the growth rate is predicted to decline by between 0.12 - 0.36% for all projects, 0.09 - 0.28% for all projects excluding Berwick Bank and 0.08 - 0.25% for consented projects only plus Caledonia OWF annually. After 35 years, this equates to a reduction in population size by 4.22 – 12.18%, 3.26 – 9.57%, and 2.93 – 8.49% for all projects, all projects excluding Berwick Bank and consented projects only plus Caledonia OWF, respectively.

Annual Total

Applicant Seasonal Approach

6.8.2.101 For the all projects scenario when considering a displacement rate of 50% and a mortality rate of 1%, the population growth rate is predicted to decline by 0.06% annually, which after 35 years would result in a reduction in population size of 2.21% when compared to the baseline unimpacted population (Table 6-74).

6.8.2.102 For the all projects excluding Berwick Bank scenario, when considering a displacement rate of 50% and a mortality rate of 1%, the population growth rate is predicted to decline by 0.05% annually, which after 35 years would result in a reduction in population size of 1.84% when compared to the baseline unimpacted population (Table 6-74).

6.8.2.103 For the consented projects only plus Caledonia OWF scenario, when considering a displacement rate of 50% and a mortality rate of 1%, the population growth rate is predicted to decline by 0.04% annually, which after 35 years would result in a reduction in population size of 1.54% when compared to the baseline unimpacted population (Table 6-74).

6.8.2.104 When Considering a Displacement rate of 60% and mortality rate of 1 -3% for all scenarios, the growth rate is predicted to decline by between 0.15 - 0.30% when considering all projects, 0.13 - 0.25% for all projects excluding Berwick Bank and 0.10 - 0.21% for consented projects only plus Caledonia OWF annually (Table 6-74). After 35 years, this equates to a reduction in population size by 5.27 – 10.32%, 4.52 – 8.74%, and 3.62 – 7.17% for all projects, all projects excluding Berwick Bank and consented projects only plus Caledonia OWF respectively (Table 6-74).

Guidance Seasonal Approach

6.8.2.105 For the all projects scenario when considering a displacement rate of 50% and a mortality rate of 1%, the population growth rate is predicted to decline by 0.06% annually, which after 35 years would result in a reduction in population size of 2.21% when compared to the baseline unimpacted population (Table 6-74).

6.8.2.106 For the all projects excluding Berwick Bank scenario, when considering a displacement rate of 50% and a mortality rate of 1%, the population growth rate is predicted to decline by 0.05% annually, which after 35 years would result in a reduction in population size of 1.83% when compared to the baseline unimpacted population (Table 6-74).

6.8.2.107 For the consented projects only plus Caledonia OWF scenario, when considering a displacement rate of 50% and a mortality rate of 1%, the population growth rate is predicted to decline by 0.04% annually, which after 35 years would result in a reduction in population size of 1.52% when compared to the baseline unimpacted population (Table 6-74).

6.8.2.108 When considering a displacement rate of 60% and mortality rate of 1 -3% for all scenarios, the growth rate is predicted to decline by between 0.15 - 0.30% when considering all projects, 0.13 - 0.25% for all projects excluding Berwick Bank and 0.10 - 0.21% for consented projects only plus Caledonia OWF annually (Table 6-74). After 35 years, this equates to a reduction in population size by 5.34 – 10.35%, 4.61 – 8.78%, and 3.72 – 7.22% for all projects, all projects excluding Berwick Bank and consented projects only respectively (Table 6-74).

Table 6-74: PVA results for cumulative distributional response impacts for puffin for the Caledonia OWF and other projects during the operational phase for the Applicant Approach, using the BDMPS population as a reference population.

Season	Scenario (Disp Rate, Mort Rate)	Annual Mortality (Individuals)	Impact on Adult Survival	Median CGR (SD)	Median CPS (SD)	Difference in CGR	Difference in CPS
Baseline (unimpacted)		-	-	1.00	1.00	-	-
All Projects							
Breeding	50%, 1%	190.84	0.026	1.000 ±<0.001	0.989 ±0.007	0.03%	1.09%
	60%, 3%	687.01	0.095	0.999 ±<0.001	0.960 ±0.007	0.11%	3.97%
	60%, 5%	1,145.01	0.158	0.998 ±<0.001	0.935 ±0.007	0.19%	6.50%
Non-breeding	50%, 1%	196.08	0.085	0.999 ±<0.001	0.964 ±0.012	0.10%	3.56%
	60%, 1%	235.29	0.101	0.999 ±<0.001	0.958 ±0.012	0.12%	4.22%
	60%, 3%	705.88	0.304	0.996 ±<0.001	0.878 ±0.012	0.36%	12.18%
Annual	50%, 1%	386.91	0.053	0.999 ±<0.001	0.978 ±0.007	0.06%	2.21%
	60%, 3%; 60%, 1%	922.30	0.127	0.998 ±<0.001	0.947 ±0.007	0.15%	5.27%
	60%, 5%; 60%, 3%	1,850.89	0.256	0.997 ±<0.001	0.897 ±0.007	0.30%	10.32%
All projects excluding Berwick Bank							
Breeding	50%, 1%	168.27	0.023	1.000 ±<0.001	0.990 ±0.007	0.03%	0.97%
	60%, 3%	605.77	0.084	0.999 ±<0.001	0.965 ±0.007	0.10%	3.49%
	60%, 5%	1,009.62	0.139	0.998 ±<0.001	0.943 ±0.007	0.10%	5.73%
Non-breeding	50%, 1%	151.62	0.065	0.999 ±<0.001	0.973 ±0.013	0.08%	2.72%
	60%, 1%	181.94	0.078	0.999 ±<0.001	0.967 ±0.012	0.09%	3.26%
	60%, 3%	545.82	0.235	0.997 ±<0.001	0.904 ±0.012	0.28%	9.57%

Season	Scenario (Disp Rate, Mort Rate)	Annual Mortality (Individuals)	Impact on Adult Survival	Median CGR (SD)	Median CPS (SD)	Difference in CGR	Difference in CPS
Annual	50%, 1%	319.89	0.044	0.999 ±<0.001	0.982 0.007	0.05%	1.84%
	60%, 3%; 60%, 1%	787.71	0.109	0.999 ±<0.001	0.955 0.007	0.13%	4.52%
	60%, 5%; 60%, 3%	1,555.44	0.215	0.997 ±<0.001	0.913 0.007	0.25%	8.74%
Consented Projects Only (plus Caledonia OWF)							
Breeding	60%, 3%	469.75	0.065	0.999 ±<0.001	0.973 ±0.007	0.08%	2.73%
	60%, 5%	782.91	0.108	0.999 ±<0.001	0.955 ±0.007	0.13%	4.48%
Non-breeding	50%, 1%	133.75	0.058	0.999 ±<0.001	0.975 ±0.013	0.07%	2.46%
	60%, 1%	160.50	0.069	0.999 ±<0.001	0.971 ±0.012	0.08%	2.93%
	60%, 3%	481.49	0.208	0.998 ±<0.001	0.915 ±0.012	0.25%	8.49%
Annual	50%, 1%	264.23	0.037	1.000 ±<0.001	0.985 ±0.007	0.04%	1.54%
	60%, 3%; 60%, 1%	630.24	0.087	0.999 ±<0.001	0.964 ±0.007	0.10%	3.62%
	60%, 5%; 60%, 3%	1,264.40	0.175	0.998 ±<0.001	0.928 ±0.007	0.21%	7.17%

Table 6-75: PVA results for cumulative distributional response impacts for puffin for the Caledonia OWF and other projects during the operational phase for the Guidance Approach, using the BDMPS population as a reference population.

Season	Scenario (Disp Rate, Mort Rate)	Annual Mortality (Individuals)	Impact on Adult Survival	Median CGR (SD)	Median CPS (SD)	Difference in CGR	Difference in CPS
Baseline (unimpacted)		-	-	1.00	1.00	-	-
All Projects							
Breeding	50%, 1%	197.65	0.027	1.000 ±<0.001	0.989 ±0.007	0.03%	1.14
	60%, 3%	711.54	0.098	0.999 ±<0.001	0.959 ±0.007	0.12%	4.08
	60%, 5%	1,185.89	0.164	0.998 ±<0.001	0.932 ±0.007	0.19%	6.74%
Non-breeding	50%, 1%	187.74	0.081	0.999 ±<0.001	0.966 ±0.012	0.10%	3.38%
	60%, 1%	225.28	0.097	0.999 ±<0.001	0.959 ±0.012	0.11%	4.07%
	60%, 3%	675.85	0.291	0.997 ±<0.001	0.883 ±0.012	0.34%	11.66%
Annual	50%, 1%	385.38	0.053	0.999 ±<0.001	0.978 ±0.007	0.06%	2.21%
	60%, 3%; 60%, 1%	936.82	0.129	0.998 ±<0.001	0.947 ±0.007	0.15%	5.34%
	60%, 5%; 60%, 3%	1,861.74	0.257	0.997 ±<0.001	0.896 ±0.007	0.30%	10.35%
All projects excluding Berwick Bank							
Breeding	50%, 1%	175.08	0.024	1.000 ±<0.001	0.990 ±0.007	0.03%	1.02%
	60%, 3%	630.30	0.087	0.999 ±<0.001	0.964 ±0.007	0.10%	3.63%
	60%, 5%	1,050.50	0.145	0.998 ±<0.001	0.940 ±0.007	0.17%	5.98%
Non-breeding	50%, 1%	143.28	0.062	0.999 ±<0.001	0.974 ±0.012	0.07%	2.60%
	60%, 1%	171.93	0.074	0.999 ±<0.001	0.969 ±0.013	0.09%	3.07%
	60%, 3%	515.79	0.222	0.997 ±<0.001	0.910 ±0.012	0.26%	9.04%

Season	Scenario (Disp Rate, Mort Rate)	Annual Mortality (Individuals)	Impact on Adult Survival	Median CGR (SD)	Median CPS (SD)	Difference in CGR	Difference in CPS
Annual	50%, 1%	318.36	0.044	0.999 ±<0.001	0.982 0.007	0.05%	1.83%
	60%, 3%; 60%, 1%	802.23	0.111	0.999 ±<0.001	0.954 0.007	0.13%	4.61%
	60%, 5%; 60%, 3%	1,566.29	0.216	0.997 ±<0.001	0.912 0.007	0.26%	8.78%
Consented Projects Only (plus Caledonia OWF)							
Breeding	60%, 3%	494.28	0.068	0.0999 ±<0.001	0.971 ±0.007	0.08%	2.85%
	60%, 5%	823.79	0.114	0.999 ±<0.001	0.953 ±0.007	0.13%	4.74%
Non-breeding	50%, 1%	125.41	0.054	0.999 ±<0.001	0.977 ±0.013	0.06%	2.28%
	60%, 1%	150.49	0.065	0.999 ±<0.001	0.973 ±0.013	0.08%	2.74%
	60%, 3%	451.46	0.195	0.998 ±<0.001	0.920 ±0.012	0.23%	7.98%
Annual	50%, 1%	262.70	0.036	1.000 ±<0.001	0.985 ±0.007	0.04%	1.52%
	60%, 3%; 60%, 1%	644.76	0.089	0.999 ±<0.001	0.963 ±0.007	0.10%	3.72%
	60%, 5%; 60%, 3%	1,275.25	0.176	0.998 ±<0.001	0.928 ±0.007	0.21%	7.22%

6.8.2.109 The Applicant Approach (when considering a displacement rate of 50% and a mortality rate of 1%) predicted population level consequences for all scenarios in Table 6-74 demonstrate a minimal change to the population annual growth rate (max reduction 0.06%) and final population size after 35 years (max reduction 2.21%), in contrast to baseline conditions. Such a level of predicted effect would almost certainly be indistinguishable from natural fluctuations in population size, which may be driven by other factors outside of the influence of the Proposed Development (Offshore) cumulatively with other plans and projects (such as changes in prey availability or avian influenza outbreaks). Therefore, such a level of predicted effect is concluded to be of **Low** overall magnitude.

6.8.2.110 When considering the Guidance approach (displacement rate of 60% and a mortality rate of 1-3%) predicted a maximum reduction in the growth rate annually of 0.15 – 0.30%. comparative analysis of such a reduction in growth rate in contrast to the known population growth trends is logistically difficult due to the different methodology employed historically and high uncertainty regarding count accuracy (Burnell *et al.*, 2023[91]). However, the likelihood of such a predicted maximum effect is considered low, especially during the non-breeding season. Post-breeding, puffins quickly disperse from Scottish Colonies predominantly out of the North Sea to wintering grounds (Furness, 2015[23]). Therefore, the potential for all projects considered cumulatively to result in a 60% displacement rate and 3% consequential mortality during the non-breeding is considered highly unlikely given the limited potential for connectivity during the non-breeding season. When taking this into account, such a level of predicted effect is concluded to be of **Low** overall magnitude.

Sensitivity of Receptor

6.8.2.111 Based upon the findings presented in the literature reviewed on this subject (Table 6-22), puffin sensitivity to cumulative distributional responses during the operation phase is considered to be **Medium**. The conservation value of the species is **Medium** (Table 6-22).

Significance of Effect

6.8.2.112 When considering the medium sensitivity of puffin (Table 6-22), the low magnitude of impact, and the relative impact of the Proposed development (Offshore), the overall effect of distributional responses during operation is considered to be **Minor and Not Significant in EIA terms** following the matrix approach (Table 6-17).

Razorbill

Magnitude of Impact

6.8.2.113 The seasonal abundance estimates for razorbill associated with projects scoped into the CIA are presented in Table 6-76. The predicted abundance for planned and operational projects included within Table 6-76, are primarily based on the Northeast and East Scotwind Projects Cumulative totals dataset, with the addition / update of abundance totals for Five Estuaries (GoBe, 2024a[185]) Ossian (NIRAS & RPS, 2024[180]) and Salamander (ERM, 2024[181]) derived from their respective EIArs. Culzean was not included within Table 6-76 due to lack of available data, though to note given the size of Culzean it is unlikely such a project would materially contribute to any cumulative assessment as concluded within it’s respective EIAr (Xodus Group, 2024[182]).

6.8.2.114 The cumulative impact assessment is focussed on the Applicant Approach of a displacement rate of 50% and a 1% mortality rate for operational phase. NatureScot advise that distributional responses assessment for razorbill should be based on a displacement rate of 60% and a mortality rate of up to 5% depending on the season being assessed, therefore such level of predicted effect are also provided.

6.8.2.115 For further details regarding the differences between the Guidance Approach and the Applicant Approach for the distributional responses assessment, along with justification for the use of the latter, refer to Volume 7B, Appendix 6-2, Annex 4: Review of Relevant Evidence.

Table 6-76: Razorbill cumulative season and total abundance estimates.

Development	Predicted Abundance (individuals)		
	Breeding Season	Non-breeding Season	Total
Aberdeen (EOWDC)	-	97	97
Beatrice	873	2,221	3,094
Berwick Bank	-	17,728	17,728
Blyth Demonstration Project	-	243	243
DEP	-	1,589	1,589
Dogger Bank A2	-	7,453	7,453
Dogger Bank B2	-	9,359	9,359
Dogger Bank C3	-	3,188	3,188
Dogger Bank South (PEIR)	-	13,983	13,983
Dudgeon	-	1,437	1,437
East Anglia ONE	-	517	517
East Anglia ONE North	-	346	346
East Anglia THREE	-	4,145	4,145
East Anglia TWO	-	410	410
Five Estuaries	-	2,407	2,407
Galloper	-	543	543
Greater Gabbard	-	471	471
Green Volt	457	56	513
Gunfleet Sands	-	30	30
Hornsea Project Four	-	5,215	5,215
Hornsea Project One	-	8,133	8,133
Hornsea Project Three	-	7,774	7,774

Development	Predicted Abundance (individuals)		
	Breeding Season	Non-breeding Season	Total
Hornsea Project Two	-	6,609	6,609
Humber Gateway	-	53	53
Hywind	30	729	759
Inch Cape	-	3,521	3,521
Kincardine	22	-	22
Lincs & LID	-	90	90
London Array	-	54	54
Methil	4	-	4
Moray East	2,423	1,301	3,724
Moray West	2,808	7,313	10,121
Neart na Gaoithe	-	6,000	6,000
Norfolk Boreas	-	1,673	1,673
Norfolk Vanguard	-	2,629	2,629
North Falls (PEIR)	-	2,565	2,565
Ossian	-	1,493	1,493
Outer Dowsing	-	5,537	5,537
PFOWF	134	17	151
Race Bank	-	112	112
Rampion	-	4,637	4,637
Rampion 2	-	7,522	7,522
Salamander	334	484	818
Seagreen Alpha	-	1,103	1,103
Seagreen Bravo	3,698	1,272	4,970
SEP	-	4,906	4,906
Sheringham Shoal	-	1,584	1,584

Development	Predicted Abundance (individuals)		
	Breeding Season	Non-breeding Season	Total
Sofia	-	4,971	4,971
Teesside	-	83	83
Thanet	-	35	35
Triton Knoll	-	1,226	1,226
West of Orkney	141	167	308
Westermost Rough	-	364	364
Caledonia OWF	**1,762**	**1,930**	**3,692**
All Projects Incl. Berwick Bank	**12,686**	**157,325**	**170,011**
All Projects Excl. Berwick Bank	**12,686**	**139,597**	**152,283**
Consented (plus Caledonia OWF)	**12,211**	**105,439**	**117,650**
Note, cells values of '–' denotes where data is either unavailable for a season, no impact is considered for a season or no connectivity is concluded for the breeding season.			

Table 6-77: Seasonal and annual distributional response estimates of razorbill for the Caledonia OWF and other projects during the operational phase, as per the Applicant and Guidance Approach. Bold text represents percentage point change >0.02.

Defined Season	Estimated Number of Mortalities (Individuals Per Annum) (Displacement Rate; Mortality Rate)			Change in Average Survival Rate (% Point Change) (Displacement Rate; Mortality Rate)		
	50%; 1%	60%; 3%* 60%; 1%**	60%; 5%* 60%; 3%**	50%; 1%	60%; 3%* 60%; 1%**	60%; 5%* 60%; 3%**
All Projects Including Berwick Bank						
Breeding season	63.43	228.35	380.58	**0.027**	**0.097**	**0.161**
Non-breeding season	786.62	943.95	2,831.85	**0.133**	**0.159**	**0.478**
Annual total	850.05	1,172.29	3,212.42	**0.144**	**0.198**	**0.543**
All Projects Excluding Berwick Bank						
Breeding season	63.43	228.35	380.58	**0.027**	**0.097**	**0.161**
Non-breeding season	697.98	837.58	2,512.74	**0.118**	**0.142**	**0.425**
Annual total	761.41	1,065.93	2,893.32	**0.129**	**0.180**	**0.489**
All Consented Projects plus Caledonia OWF						
Breeding season	61.05	219.80	366.33	**0.026**	**0.093**	**0.155**
Non-breeding season	527.20	632.63	1,897.90	**0.089**	**0.107**	**0.321**
Annual total	588.25	852.43	2,264.23	**0.099**	**0.144**	**0.383**
* Displacement rate of 60% and mortality rate of 3 -5% considered for the breeding season. ** Displacement rate of 60% and mortality rate of 1 -3% considered for the non-breeding season.						

Breeding Season

6.8.2.116 During the breeding season, the cumulative abundance for razorbill is 12,686 individuals (Table 6-76). Assuming a 50% displacement rate and 1% mortality rate, this would result in 63 (63.43) razorbill being subject to mortality per annum. The breeding season regional population is estimated to be 236,479 individuals. Based on the average survival rate of 80.7%, the predicted annual baseline mortality for this population is 45,641 (45,640.5) individuals. The addition of 63 predicted additional mortalities per annum due to distributional responses during the operational phase would result in a 0.027 percentage point survival rate change to this population. As the percentage point survival rate change exceeds the recommended threshold of 0.02, PVA has been undertaken as per NatureScot (2023a[10]) guidance to further consider such a level of predicted effect.

6.8.2.117 When considering all projects excluding Berwick Bank, mortality rates remain the same due this project being out of foraging range during the breeding season. For consented projects only plus Caledonia OWF, razorbill mortalities reduce to 61 (61.05) which equates to a 0.026 percentage point survival rate change to the population (Table 6-77). As the percentage point survival rate change exceeds the recommended threshold of 0.02, PVA has been undertaken as per NatureScot (2023a[10]) guidance to further consider such a level of predicted effect.

6.8.2.118 The more precautionary displacement and mortality rates as recommended by NatureScot (Table 6-23) results in a mortality prediction of 220 (219.80) – 366 (366.33) razorbills when considering all consented projects plus Caledonia OWF to 228 (228.35) – 381 (380.58) when considering all projects (Table 6-77). For all scenarios the increase in the percentage point change in survival is beyond the 0.02 threshold as recommended by NatureScot. Therefore, PVA has been undertaken as per NatureScot (2023a[10]) guidance to further consider such a level of predicted effect.

Non-breeding Season

6.8.2.119 During the non-breeding season, the cumulative abundance for razorbill is 157,325 individuals for all projects considered (Table 6-76). Assuming a 50% displacement rate and 1% mortality rate, this would result in 787 (786.62) razorbill being subject to mortality per annum when accounting for all projects. The non-breeding season regional population is estimated to be 591,874 individuals. Based on the average survival rate of 80.7%, the predicted annual baseline mortality for this population is 114,232 (114,231.7) individuals. The addition of 787 predicted additional mortalities per annum due to distributional responses during the operational phase would result in a 0.133 percentage point survival rate change within this population when accounting for all potential projects in the region. As the percentage point survival rate change exceeds the recommended threshold of 0.02, PVA has been undertaken as per NatureScot (2023a[10]) guidance to further consider such a level of predicted effect.

6.8.2.120 When considering all projects excluding Berwick Bank and consented projects only plus Caledonia OWF, razorbill mortalities reduce to 698 (697.98) and 527 (527.20) individuals per annum respectively which equates to a 0.118 and 0.089 percentage point survival rate change to the population (Table 6-77). As the percentage point survival rate change exceeds the recommended threshold of 0.02, PVA has been undertaken as per NatureScot (2023a[10]) guidance to further consider such a level of predicted effect.

6.8.2.121 The more precautionary displacement and mortality rates as recommended by NatureScot (Table 6-23) results in a mortality prediction of 633 (632.63) – 1,898 (1,897.90) razorbills when considering all consented projects plus Caledonia OWF to 944 (943.95) – 2,832 (2,831.85) when considering all projects (Table 6-77). For all scenarios the increase in the percentage point change in survival is beyond the 0.02 threshold as recommended by NatureScot. Therefore, PVA has been undertaken as per NatureScot (2023a[10]) guidance to further consider such a level of predicted effect.

Annual Total

6.8.2.122 The annual total of razorbill subject to mortality as a result of cumulative distributional responses within the region is estimated to be 850 (850.05) individuals. Using the largest BDMPS population of 591,874 with an average survival rate of 80.7%, the predicted annual baseline mortality of this population is 114,232 individuals. The addition of 850 predicted additional mortalities per annum due to cumulative distributional responses during the operational phase would result in a change to the survival rate of 0.144 percentage point change within this population. When considering the annual potential level of impact at the biogeographic scale (1,707,000 individuals), the predicted annual baseline mortality for this population is 329,451 individuals. The addition of 850 predicted additional mortalities per annum due to cumulative distributional responses during the operational phase would result in a change to the survival rate of 0.05 percentage point change.

6.8.2.123 When considering all projects excluding Berwick Bank and consented projects only plus Caledonia OWF, razorbill mortalities reduce to 761 (761.41) and 588 (588.25) individuals per annum respectively which equates to a 0.129 and 0.099 percentage point survival rate change to the population (Table 6-77).

6.8.2.124 The more precautionary displacement and mortality rates as recommended by NatureScot (Table 6-23) results in a mortality prediction of 852 (852.43) – 2,264 (2,264.23) razorbills when considering all consented projects plus Caledonia OWF to 1,172 (1,172.29) – 3,212 (3,212.42) when considering all projects (Table 6-77). For all scenarios the increase in the percentage point change in survival is beyond the 0.02 threshold as recommended by NatureScot. Therefore, PVA has been undertaken as per NatureScot (2023a[10]) guidance to further consider such a level of predicted effect.

6.8.2.125 As the percentage point survival rate change exceeds the recommended threshold of 0.02 for all scenarios annually, PVA has been undertaken as per NatureScot (2023a[10]) guidance to further consider such a level of predicted effect. The full methodology and results are presented in Volume 7B, Appendix 6-4: Population Viability Analysis.

Population Viability Analysis

6.8.2.126 PVA was undertaken using predicted cumulative operational phase mortalities calculated in Table 6-77 for both the Applicant and Guidance Approach, with the BDMPS population of 591,874 individuals used as the reference population for annual and non-breeding season analysis, and the breeding population size of 236,479 individuals for breeding season analysis.

6.8.2.127 The counterfactual of growth rate (CGR) and counterfactual of population size (CPS) have been presented for all scenarios to estimate the potential changes in annual growth rate and population size during the operational lifespan of 35 years (Table 6-78). As requested by NatureScot, the PVA results are presented for 25 years and 50 years, with cumulative impact scenarios compared to a baseline (unimpacted) scenario within Volume 7B, Appendix 6-4: Population Viability Analysis.

Breeding Season

6.8.2.128 During the breeding season, as presented in Table 6-78 PVA analysis was completed for all impact predictions in (Table 6-78).

6.8.2.129 For all projects when considering the Applicant approach, the population growth rate is predicted to decline by 0.03% annually compared to the no impact baseline, which after 35 years would result in a reduction in population size of 1.13% compared to the no impact baseline population (Table 6-78). As Berwick Bank is out of foraging range for razorbill in the breeding season, the impact for the all projects excluding Berwick Bank scenario is the same during the breeding season.

6.8.2.130 For all consented projects only plus Caledonia OWF when considering the Applicant Approach, the population growth rate is predicted to decline by 0.03% annually compared to the no impact baseline, which after 35 years would result in a reduction in population size of 1.09% compared to the no impact baseline population (Table 6-78).

6.8.2.131 For the Guidance approach, the growth rate is predicted to decline by between 0.12 and 0.19% annually when considering all projects (including and excluding Berwick Bank) and between 0.11 and 0.19% annually for consented projects only plus Caledonia OWF. After 35 years, this equates to a reduction in population size of 4.09 – 6.73% and 3.93% - 6.48% for all projects (including and excluding Berwick Bank) and consented projects only plus Caledonia OWF, respectively.

Non-breeding Season

6.8.2.132 During the non-breeding season, as presented in Table 6-78 PVA analysis was completed for all impact predictions in Table 6-77.

6.8.2.133 For all projects when considering the Applicant Approach, the population growth rate is predicted to decline by 0.16% annually compared to the no impact baseline, which after 35 years would result in a reduction in population size of 5.57% compared to the no impact baseline population (Table 6-78).

6.8.2.134 When considering the Applicant approach for all projects excluding Berwick Bank, the population growth rate is predicted to decline by 0.14% annually compared to the no impact baseline, which after 35 years would result in a reduction in population size of 4.95% compared to the no impact baseline population (Table 6-78).

6.8.2.135 For all consented projects only plus Caledonia OWF when considering the Applicant Approach, the population growth rate is predicted to decline by 0.11% annually compared to the no impact baseline, which after 35 years would result in a reduction in population size of 3.76% compared to the no impact baseline population (Table 6-78).

For the Guidance approach, the growth rate is predicted to decline by between 0.19 and 0.57% when considering all projects, between 0.17 and 0.51% for all projects excluding Berwick Bank and between 0.13 and 0.38% for consented projects only plus Caledonia OWF annually. After 35 years, this equates to a reduction in population size of 6.63 – 18.67%, 5.96 – 16.77%, and 4.52 – 12.96% for all projects, all projects excluding Berwick Bank and consented projects only respectively.

Annual Total

6.8.2.136 For all projects when considering the Applicant Approach, the population growth rate is predicted to decline by 0.17% annually compared to the no impact baseline, which after 35 years would result in a reduction in population size of 6.02% compared to the no impact baseline population (Table 6-78).

6.8.2.137 When considering the Applicant approach for all projects excluding Berwick Bank, the population growth rate is predicted to decline by 0.16 annually compared to the no impact baseline, which after 35 years would result in a reduction in population size of 5.44% compared to the no impact baseline population (Table 6-78).

6.8.2.138 For all consented projects only plus Caledonia OWF when considering the Applicant Approach, the population growth rate is predicted to decline by 0.12% annually compared to the no impact baseline, which after 35 years would result in a reduction in population size of 4.18% compared to the no impact baseline population (Table 6-78).

6.8.2.139 For the Guidance approach, the growth rate is predicted to decline by between 0.24 and 0.65% when considering all projects, between 0.22 and 0.59% for all projects excluding Berwick Bank and 0.17 and 0.46% for consented projects only plus Caledonia OWF annually. After 35 years, this equates to a reduction in population size of 8.20 – 20.93%, 7.48 – 19.08%, and 6.02 – 15.24% for all projects, all projects excluding Berwick Bank and consented projects only plus Caledonia OWF, respectively.

Table 6-78: PVA results for razorbill cumulative impacts during the operational phase, using the BDMPS population as a reference population.

Season	Scenario	Annual Mortality (Individuals)	Impact on Adult Survival	Median CGR (SD)	Median CPS (SD)	Difference in CGR (%)	Difference in CPS (%)
Baseline (unimpacted)		-	-	1.00	1.00	0	0
All Projects Including Berwick Bank							
Breeding	50%, 1%	63.43	0.027	1.000 ±<0.001	0.989 ±0.017	0.03	1.13
	60%, 3%	228.35	0.097	0.999 ±<0.001	0.959 ±0.016	0.12	4.09
	60%, 5%	380.58	0.161	0.998 ±<0.001	0.933 ±0.016	0.19	6.73
Non-breeding	50%, 1%	786.62	0.133	0.998 ±<0.001	0.944 ±0.010	0.16	5.57
	60%, 1%	943.95	0.159	0.998 ±<0.001	0.934 ±0.010	0.19	6.63
	60%, 3%	2,831.85	0.478	0.994 ±<0.001	0.813 ±0.009	0.57	18.67
Annual	50%, 1%	850.05	0.144	0.998 ±<0.001	0.940 ±0.010	0.17	6.02
	60%, 3%; 60%, 1%	1,172.29	0.198	0.998 ±<0.001	0.918 ±0.010	0.24	8.20
	60%, 5%; 60%, 3%	3,212.42	0.543	0.993 ±<0.001	0.791 ±0.009	0.65	20.93
All Projects Excluding Berwick Bank							
Breeding	50%, 1%	63.43	0.027	1.000 ±<0.001	0.9889 ±0.017	0.03	1.13
	60%, 3%	228.35	0.097	0.999 ±<0.001	0.959 ±0.016	0.12	4.09

Season	Scenario	Annual Mortality (Individuals)	Impact on Adult Survival	Median CGR (SD)	Median CPS (SD)	Difference in CGR (%)	Difference in CPS (%)
	60%, 5%	380.58	0.161	0.998 ±<0.001	0.933 ±0.016	0.19	6.73
Non-breeding	50%, 1%	697.98	0.118	0.999 ±<0.001	0.951 ±0.010	0.14	4.95
	60%, 1%	837.58	0.142	0.998 ±<0.001	0.940 ±0.010	0.17	5.96
	60%, 3%	2,512.74	0.425	0.995 ±<0.001	0.832 ±0.009	0.51	16.77
Annual	50%, 1%	761.41	0.129	0.998 ±<0.001	0.946 ±0.010	0.16	5.44
	60%, 3%; 60%, 1%	1,065.93	0.180	0.998 ±<0.001	0.925 ±0.010	0.22	7.48
	60%, 5%; 60%, 3%	2,893.32	0.489	0.994 ±<0.001	0.809 ±0.010	0.59	19.08
Consented Projects Only (plus Caledonia OWF)							
Breeding	50%, 1%	61.05	0.026	1.000 ±<0.001	0.989 ±0.017	0.03	1.09
	60%, 3%	219.80	0.093	0.999 ±<0.001	0.961 ±0.016	0.11	3.93
	60%, 5%	366.33	0.155	0.998 ±<0.001	0.935 ±0.016	0.19	6.48
Non-breeding	50%, 1%	527.20	0.089	0.999 ±<0.001	0.962 ±0.010	0.11	3.76
	60%, 1%	632.63	0.107	0.999 ±<0.001	0.955 ±0.010	0.13	4.52
	60%, 3%	1,897.90	0.321	0.996 ±<0.001	0.870 ±0.0010	0.38	12.96
Annual	50%, 1%	588.25	0.099	0.999 ±<0.001	0.958 ±0.010	0.12	4.18
	60%, 3%; 60%, 1%	852.43	0.144	0.998 ±<0.001	0.940 ±0.010	0.17	6.02
	60%, 5%; 60%, 3%	2,264.23	0.383	0.995 ±<0.001	0.848 0.010	0.46	15.24

6.8.2.140 The Applicant Approach predicted population level consequences for all scenarios demonstrate a minimal change to the population annual growth rate (max reduction 0.17%) and final population size after 35 years (max reduction 6.02%), in contrast to baseline conditions. Such a level of predicted effect would almost certainly be indistinguishable from natural fluctuations in population size, which may be driven by other factors outside of the influence of the Proposed Development (Offshore) cumulatively with other plans and projects (such as changes in prey availability or avian influenza outbreaks). Therefore, such a level of predicted effect is concluded to be of low overall magnitude.

6.8.2.141 When considering the Guidance approach predicted population level consequences for all scenarios, it is important to consider the population trend of Scottish guillemots as summarised in Figure 6-7. Overall, the long term trend (1986 – 2019) of the population is relatively stable with minor fluctuations in population trend. In Autumn of 2007, a mass wreck event was reported in Skagerrak and wider Europe, which ring recoveries suggested was made up of a significant proportion of Scottish razorbills (Heubeck *et al.*, 2011[186]). The cause of the mass wreck event is believed to be due to adverse weather conditions and food shortage (Heubeck *et al.*, 2011[186]). From early 2010 onwards the population has appeared to stabilise with the population increasing positively up until 2017, where a decline in the growth is noted. In the last five the years the overall population for razorbills in Scotland is uncertain, though to note low mortality was reported across UK razorbill colonies in 2023, suggesting limited effect from HPAI (RSPB, 2024[183]).

6.8.2.142 The overall population trend of guillemots in Scotland can be classified as stable, therefore even when considering the most precautionary level of effect from all projects, which predicted a reduction in growth rate of 0.65% per annum, the population is considered resilient enough to withstand such a reduction in growth rate. This conclusion is reinforced when considering the information summarised within Section 6.4.4, as the key driver of razorbill population change relates to climate change effects.

6.8.2.143 It is important to note however, The likelihood of every single project included within the cumulative assessment leading to a displacement rate of 60% and subsequent mortality rate of 3 -5% in Scotland is considered unlikely in light of the evidence presented within Volume 7B, Appendix 6-2, Annex 4: Review of Relevant Evidence, when considering the high variability in auk displacement rates observed and no level of significant consequential mortality evidenced due to the presence of OWF developments in the North Sea.

6.8.2.144 In consideration of the above evidence, when considering the Guidance approach the magnitude of effect is concluded to be of **Low - Medium overall magnitude**.

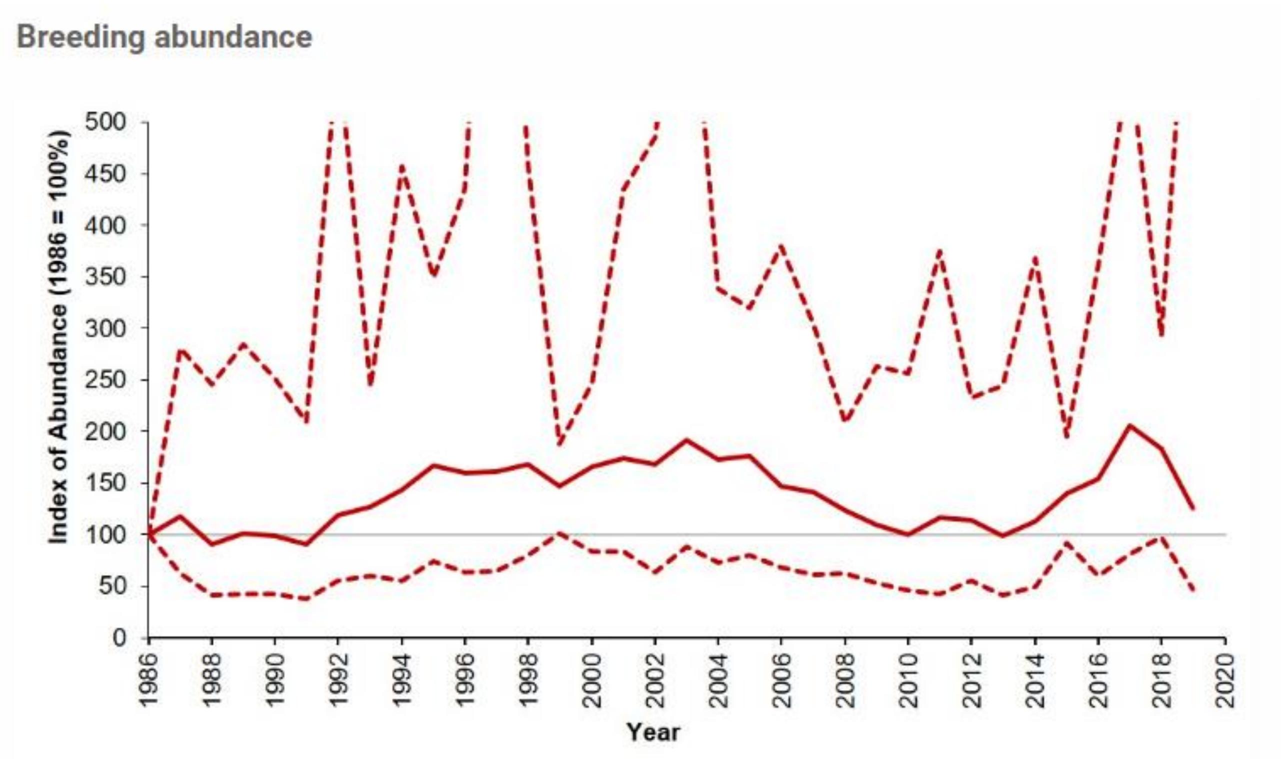


Figure 6-7: Trend in abundance index (solid line) of razorbills in Scotland from 1986–2019 based on SMP data. Figure derived from JNCC (2024[184]).

Sensitivity of Receptor

6.8.2.145 Based upon the findings presented in the literature reviewed on this subject (Table 6-22), razorbill sensitivity to cumulative distributional responses during the operation phase is considered to be **Medium**. The conservation value of the species is **Medium** (Table 6-22).

Significance of Effect

6.8.2.146 When considering the medium sensitivity of razorbill (Table 6-22) and the low magnitude of impact, particularly given the cumulative contribution from the Proposed Development (Offshore) is ~2%, the overall effect of distributional responses during operation is considered to be **Minor and Not Significant in EIA terms** following the matrix approach (Table 6-17).

6.8.2.147 When considering the Guidance approach, the overall effect of distributional responses during operation is considered to be minor at most, in light of the evidence presented in Volume 7B, Appendix 6-2, Annex 4: Review of Relevant Evidence, and the Proposed Developments (Offshore) minimal contribution to any annual cumulative effect (~2%).

Gannet

Magnitude of Impact

6.8.2.148 The seasonal abundance estimates for gannet associated with projects scoped into the CIA are presented in Table 6-79. The predicted abundance for planned and operational projects included within Table 6-79 are primarily based on the Northeast and East Scotwind Projects Cumulative totals dataset, with the addition/update of abundance totals for Dogger Bank South (Royal Haskoning DHV (2024[179])) Ossian (NIRAS and RPS, 2024[180]) and Salamander (ERM, 2024[181]) derived from their respective EIArs. Culzean was not included within Table 6-79 due to lack of available data, though to note given the size of Culzean it is unlikely such a project would materially contribute to any cumulative assessment as concluded within the respective EIAR (Xodus Group, 2024[182]).

6.8.2.149 The cumulative impact assessment is focussed on the Applicant Approach of a displacement rate of 70% and a 1% mortality rate for operational phase distributional responses. NatureScot advise that distributional response assessment for guillemot should be based on a displacement rate of 70% and a mortality rate of up to 3%, therefore such level of predicted effect is also provided.

6.8.2.150 For further details regarding the differences between the Guidance Approach and the Applicant Approach for the distributional responses assessment, along with justification for the use of the latter, refer to Volume 7B, Appendix 6-2, Annex 4: Review of Relevant Evidence.

Table 6-79: Gannet cumulative season and total abundance estimates.

Development	Predicted Abundance (individuals)		
	Breeding Season	Non-breeding Season	Total
Aberdeen	35	5	40
Beatrice	151	-	151
Berwick Bank	4,735	1,769	6,504
Dogger Bank A + B	1,155	2,442	3,597
Dogger Bank C + Sofia	2,250	1,351	3,601
Dogger Bank South (PEIR)	1,335	1,708	3,043
Dudgeon	-	36	36
East Anglia One	-	3,714	3,714
East Anglia ONE North	-	512	512
East Anglia THREE	-	1,793	1,793
East Anglia TWO	-	1,083	1,083
Five Estuaries	-	707	707
Galloper	-	1,183	1,183
Greater Gabbard	-	174	174
Green Volt	198	102	300
Gunfleet Sands	-	21	21
Hornsea FOUR	976	1,191	2,167
Hornsea Project ONE	-	944	944
Hornsea Project THREE	-	1,508	1,508
Hornsea Project TWO	457	1,264	1,721
Hywind	10	4	14
Inch Cape	2,398	915	3,313
Kentish Flats Ext	-	13	13
Kincardine	120	-	120
Methil	23	-	23

Development	Predicted Abundance (individuals)		
	Breeding Season	Non-breeding Season	Total
Moray East	564	319	883
Moray West	2,827	583	3,410
Neart na Gaoithe	1,987	833	2,820
Norfolk Boreas	-	2,249	2,249
Norfolk Vanguard	-	2,890	2,890
North Falls (PEIR)	-	453	453
Ossian	1,383	775	2,158
Outer Dowsing	-	496	496
PFOWF	166	24	190
Race Bank	-	61	61
Rampion	-	590	590
Rampion 2	-	225	225
Salamander	442	363	805
SeaGreen (Alpha & Bravo)	2,956	664	3,620
SEP & DEP	-	695	695
Sheringham Shoal	-	33	33
Triton Knoll	-	39	39
West of Orkney	1,226	1,171	2,397
Caledonia OWF	**909**	**315**	**1,224**
All Projects Incl. Berwick Bank	**26,302**	**35,217**	**61,519**
All Projects Excl. Berwick Bank	**21,567**	**33,448**	**55,015**
Consented (plus Caledonia OWF)	**17,182**	**27,550**	**44,732**
Note, cells values of '–' denotes where data is either unavailable for a season, no impact is considered for a season or no connectivity is concluded for the breeding season.			

Table 6-80: OWF and other projects during the operational phase, as per the Applicant and Guidance Approach. Bold text represents percentage point change >0.02.

Defined Season	Estimated Number of Mortalities (Individuals per Annum) (Displacement Rate; Mortality Rate)		Change in Average Survival Rate (% Point Change) (Displacement Rate; Mortality Rate)	
	70%; 1%	70%; 3%	70%; 1%	70%; 3%
All Projects				
Breeding season	184.12	552.35	0.020	**0.060**
Non-breeding season	246.52	739.55	**0.054**	**0.162**
Annual total	430.63	1,291.90	**0.047**	**0.140**
All Projects Excluding Berwick Bank				
Breeding season	150.97	452.92	**0.016**	**0.049**
Non-breeding season	234.13	702.40	**0.051**	**0.154**
Annual total	385.11	1,155.32	**0.042**	**0.126**
All Consented Projects plus Caledonia OWF				
Breeding season	120.27	360.81	0.013	**0.039**
Non-breeding season	192.85	578.55	**0.042**	**0.127**
Annual total	313.12	939.36	**0.034**	**0.102**

Breeding Season

6.8.2.151 During the breeding season, the cumulative abundance for gannet is 26,302 individuals for all projects (Table 6-79). Assuming a 70% displacement rate and 1% mortality rate, would result in 184 (184.12) gannets being subject to mortality per annum. The breeding season regional population is estimated to be 920,514 individuals. Based on the average survival rate of 81.3%, the predicted annual baseline mortality for this population is 172,136 (172,136.0) individuals. The addition of 184 predicted additional mortalities per annum due to distributional responses during the operational phase would result in a 0.020 percentage point survival rate change to this population. As the percentage point survival rate change exceeds the recommended threshold of 0.02, PVA has been undertaken as per NatureScot (2023a[10]) guidance to further consider such a level of predicted effect.

6.8.2.152 When considering all projects excluding Berwick Bank and consented projects only plus Caledonia OWF, gannet mortalities reduce to 151 (150.97) and 120 (120.27) individuals per annum respectively. This equates to a 0.016 and 0.013 percentage point survival rate change to the population (Table 6-80).

6.8.2.153 When considering the more precautionary mortality rate of 3% as recommended by NatureScot (Table 6-23), the percentage point survival rate change increases to 0.060, 0.049, and 0.093 for all projects, all projects excluding Berwick Bank, and consented projects only plus Caledonia OWF, respectively. As the percentage point survival rate change exceeds the recommended threshold of 0.02, PVA has been undertaken as per NatureScot (2023a[10]) guidance to further consider such a level of predicted effect.

Non-breeding Season

6.8.2.154 During the non-breeding season, the cumulative abundance for gannet is 35,217 individuals for all projects considered (Table 6-79). Assuming a 70% displacement rate and 1% mortality rate, this would result in 247 (246.52) gannets being subject to mortality per annum when accounting for all projects. The non-breeding season regional population is estimated to be 456,298 individuals. Based on the average survival rate of 81.3%, the predicted annual baseline mortality for this population is 85,328 (85,327.7) individuals. The addition of 547 predicted additional mortalities per annum due to distributional responses during the operational phase would result in a 0.054 percentage point survival rate change within this population when accounting for all potential projects in the region. As the percentage point survival rate change exceeds the recommended threshold of 0.02, PVA has been undertaken as per NatureScot (2023a[10]) guidance to further consider such a level of predicted effect.

6.8.2.155 When considering all projects excluding Berwick Bank and consented projects only plus Caledonia OWF, gannet mortalities reduce to 234 (234.13) and 193 (192.85) individuals per annum respectively which equates to a 0.051 and 0.042 percentage point survival rate change to the population (Table 6-80).

6.8.2.156 When considering the more precautionary mortality rate of 3% as recommended by NatureScot (Table 6-23), the percentage point survival rate change increases to 0.162, 0.154, and 0.0.127 for all projects, all projects excluding Berwick Bank, and consented projects only plus Caledonia OWF, respectively. As the percentage point survival rate change exceeds the recommended threshold of 0.02, PVA has been undertaken as per NatureScot (2023a[10]) guidance to further consider such a level of predicted effect.

Annual Total

6.8.2.157 The annual total of gannet subject to mortality as a result of cumulative distributional responses within the region is estimated to be 431 (430.63) individuals. Using the BDMPS population of 920,514 with an average survival rate of 81.3%, the predicted annual baseline mortality of this population is 172,136 individuals. The addition of 431 predicted additional mortalities per annum due to cumulative distributional responses during the operational phase would result in a change to the survival rate of 0.047 percentage point change within this population. When considering the annual potential level of impact at the biogeographic scale (1,180,000 individuals), the predicted annual baseline mortality for this population is 220,660 individuals. The addition of 431 predicted additional mortalities per annum due to cumulative distributional responses during the operational phase would result in a change to the survival rate of 0.037 percentage point change.

6.8.2.158 When considering all projects excluding Berwick Bank and consented projects only plus Caledonia OWF, gannet mortalities reduce to 385 (385.11) and 313 (313.12) individuals per annum respectively which equates to a 0.042 and 0.034 percentage point survival rate change to the population (Table 6-80).

6.8.2.159 When considering the more precautionary mortality rate of 3% as recommended by NatureScot (Table 6-23), the percentage point survival rate change increases to 0.140, 0.126, and 0.102 for all projects, all projects excluding Berwick Bank, and consented projects only plus Caledonia OWF, respectively.

6.8.2.160 As the percentage point survival rate change exceeds the recommended threshold of 0.02 for all scenarios annually, PVA has been undertaken as per NatureScot (2023a[10]) guidance to further consider such a level of predicted effect. The full methodology and results are presented in Volume 7B, Appendix 6-4: Population Viability Analysis.

Population Viability Analysis

6.8.2.161 PVA was undertaken using predicted cumulative operational phase mortalities calculated in Table 6-81 for both the Applicant and Guidance Approach, with the breeding population size of 920,514 individuals used as the reference population for annual and breeding season analysis, and the largest non-breeding BDMPS population size of 456,298 for the non-breeding season analysis. The Applicant Approach displacement rate is 70% for both the breeding and non-breeding seasons, and mortality rates are 1%. As a precautionary measure, the Guidance Approach rates of 70% displacement and morality rates of 1% and 3% in all seasons were also assessed.

6.8.2.162 The counterfactual of growth rate (CGR) and counterfactual of population size (CPS) have been presented for all scenarios to estimate the potential changes in annual growth rate and population size during the operational lifespan of 35 years (Table 6-81). As requested by NatureScot, the PVA results are presented for 25 years and 50 years, with cumulative impact scenarios compared to a baseline (unimpacted) scenario within Volume 7B, Appendix 6-4: Population Viability Analysis.

Breeding Season

6.8.2.163 For the breeding season, as presented in Table 6-68 PVA was completed for annual mortality rates that exceeded the 0.02% threshold, this included:

- All projects scenario for mortality rates of 1% and 3% (Applicant and Guidance approach);
- All projects excluding Berwick Bank for a mortality rate of 3% only (Guidance approach); and
- Consented Only projects plus Caledonia OWF for a mortality rate of 3% only (Guidance approach).

6.8.2.164 For the all projects scenarios when considering a mortality rate of 1% (Applicant approach), the population growth rate is predicted to decline by 0.02% annually, which after 35 years would result in a reduction in population size of 0.84% compared to the baseline unimpacted population (Table 6-81).

6.8.2.165 For the guidance approach (mortality rate of 3%), the growth rate is predicted to decline 0.07% when considering all projects, 0.06% for all projects excluding Berwick Bank 0.05% for consented projects only plus Caledonia OWF (Table 6-81). After 35 years, this equates to a reduction in population size of 2.53%, 2.07% and 1.65% for all projects, all projects excluding Berwick Bank and consented projects only plus Caledonia OWF, respectively (Table 6-81).

Non-breeding Season

6.8.2.166 PVA was undertaken for all scenarios using the Guidance Approach and Applicant Approach for the non-breeding season.

6.8.2.167 For the all projects scenario when considering a mortality rate of 1% (Applicant approach), the population growth rate is predicted to decline by 0.06% annually, which after 35 years would result in a reduction in population size of 2.27% compared to the baseline unimpacted population (Table 6-81).

6.8.2.168 For the all projects excluding Berwick Bank scenario, when considering a mortality rate of 1% (Applicant approach), the population growth rate is predicted to decline by 0.06% annually, which after 35 years would result in a reduction in population size of 2.15% when compared to the baseline unimpacted population (Table 6-81).

6.8.2.169 For the consented projects only plus Caledonia OWF scenario, when considering a mortality rate of 1% (Applicant approach), the population growth rate is predicted to decline by 0.05% annually, which after 35 years would result in a reduction in population size of 1.79% when compared to the baseline unimpacted population (Table 6-81).

6.8.2.170 For the Guidance approach (mortality rate of 3%), the growth rate is predicted to decline by 0.19% when considering all projects, 0.18% for all projects excluding Berwick Bank and 0.15% for consented projects only plus Caledonia OWF annually (Table 6-81). After 35 years, this equates to a reduction in population size of 6.68%, 6.35% and 5.26% for all projects, all projects excluding Berwick Bank and consented projects only plus Caledonia OWF, respectively (Table 6-81).

Annual Total

6.8.2.171 PVA was undertaken for all scenarios using the Guidance Approach and Applicant Approach for annual impacts.

6.8.2.172 For the all projects scenario when considering a mortality rate of 1% (Applicant approach), The population growth rate is predicted to decline by 0.06% annually, which after 35 years would result in a reduction in population size of 1.97% when compared to the baseline unimpacted population (Table 6-81).

6.8.2.173 For the all projects excluding Berwick Bank scenario, when considering a mortality rate of 1% (Applicant approach), the population growth rate is predicted to decline by 0.05% annually, which after 35 years would result in a reduction in population size of 1.76% when compared to the baseline unimpacted population (Table 6-81).

6.8.2.174 For the consented projects only plus Caledonia OWF scenario, when considering a mortality rate of 1% (Applicant approach), the population growth rate is predicted to decline by 0.04% annually, which after 35 years would result in a reduction in population size of 1.44% when compared to the baseline unimpacted population (Table 6-81).

6.8.2.175 For the Guidance approach (mortality rate of 3%), the growth rate is predicted to decline by 0.17% when considering all projects, 0.15% for all projects excluding Berwick Bank and 0.12% for consented projects only plus Caledonia OWF annually (Table 6-81). After 35 years, this equates to a reduction in population size by 5.81%, 5.21% and 4.25% for all projects, all projects excluding Berwick Bank and consented projects only plus Caledonia OWF, respectively (Table 6-81).

Table 6-81: PVA results for gannet impacts alone for the Caledonia OWF during the operational phase, using the BDMPS population as a reference population.

Season	Scenario	Annual Mortality (Individuals)	Impact on Adult Survival	Median CGR (SD)	Median CPS (SD)	Difference in CGR	Difference in CPS
Baseline (unimpacted)	-	-		1.00	1.00	-	-
All Projects Including Berwick Bank							
Breeding	70%, 1%	184.12	0.020	1.000 ±<0.001	0.992 ±0.004	0.02%	0.84%
	70%, 3%	552.35	0.060	0.999 ±<0.001	0.975 ±0.004	0.07%	2.53%
Non-breeding	70%, 1%	252.89	0.055	0.999 ±<0.001	0.977 ±0.005	0.06%	2.27%
	70%, 3%	758.66	0.166	0.998 ±<0.001	0.933 ±0.005	0.19%	6.68%
Annual	70%, 1%	437.00	0.047	0.999 ±<0.001	0.980 ±0.004	0.06%	1.97%
	70%, 3%	1,311.01	0.142	0.998 ±<0.001	0.942 ±0.004	0.17%	5.81%
All Projects Excluding Berwick Bank							
Breeding	70%, 3%	452.92	0.049	0.999 ±<0.001	0.979 ±0.005	0.06%	2.07%
Non-breeding	70%, 1%	234.13	0.051	0.999 ±<0.001	0.978 ±0.005	0.06%	2.15%
	70%, 3%	702.40	0.154	0.998 ±<0.001	0.936 ±0.005	0.18%	6.35%
Annual	70%, 1%	385.11	0.042	1.00 ±<0.001	0.982 ±0.004	0.05%	1.76%
	70%, 3%	1,155.32	0.126	0.999 ±<0.001	0.948 ±0.004	0.15%	5.21%
Consented Projects Only (plus Caledonia OWF)							
Breeding	70%, 3%	360.81	0.039	1.000	0.983	0.05%	1.65%

Season	Scenario	Annual Mortality (Individuals)	Impact on Adult Survival	Median CGR (SD)	Median CPS (SD)	Difference in CGR	Difference in CPS
				±<0.001	0.004		
Non-breeding	70%, 1%	192.85	0.042	0.999 ±<0.001	0.982 ±0.005	0.05%	1.79%
	70%, 3%	578.55	0.127	0.998 ±<0.001	0.947 ±0.005	0.15%	5.26%
Annual	70%, 1%	313.12	0.034	1.000 ±<0.001	0.986 ±0.004	0.04%	1.44%
	70%, 3%	939.36	0.102	0.999 ±<0.001	0.958 ±0.004	0.12%	4.25%

6.8.2.176 The PVA outputs set out above across all seasons annually for both the Applicant and Guidance approach demonstrate a minimal change to the population annual growth rate (max reduction 0.17%) and final population size after 35 years (max reduction 5.81%), in contrast to baseline conditions, especially when considering gannets long term continual growth trend between 1970 – 2021 (Burnell *et al.*, 2023[91]). Such a level of predicted effect would almost certainly be indistinguishable from natural fluctuations in population size, which may be driven by other factors outside of the influence of the Proposed Development (Offshore) cumulatively with other plans and projects (such as avian influenza outbreak). Therefore, such a level of predicted effect is concluded to be of **Low** overall magnitude of impact.

Sensitivity of Receptor

6.8.2.177 Based upon the findings presented in the literature reviewed on this subject (Table 6-5), gannet sensitivity to cumulative distributional responses during the operation phase is considered to be **Medium**. The conservation value of the species is **Medium** (Table 6-22).

Significance of Effect

6.8.2.178 Taking the medium sensitivity of gannet (Table 6-22), the low magnitude of impact, and the relatively low contribution of the Proposed Development (Offshore) to the overall effect of distributional responses during operation is considered to be **Minor which is Not Significant in EIA terms** following the matrix approach (Table 6-17).

6.8.3 Cumulative Collision Risk

6.8.3.1 There is potential for cumulative collision risk to birds as a result of operational activities associated with the project and other developments. The risk to birds is via potential collision with WTGs as well as associated infrastructure which may result in injury or fatality. This is possible when birds fly through OWFs whilst foraging for food, moving between breeding sites and foraging locations or during the migratory period.

6.8.3.2 Projects identified for cumulative collision risk are listed in the respective tables below for each species at risk.

Kittiwake

Magnitude of Impact

6.8.3.3 Estimated collision risk for kittiwake per defined season for each project in-scope for cumulative assessment are presented in Table 6-82. The predicted collisions for planned and operational projects included within Table 6-82, are primarily based on the Northeast and East ScotWind Projects Cumulative totals dataset (excluding as-built updates), with the addition/ update of totals for Culzean (Xodus Group, 2024[182]), Five Estuaries (GoBe, 2024a[185]), Outer Dowsing (GoBe, 2024b[187]), Rampion (APEM, 2024[188]), Rampion 2 (APEM, 2023b[189]), Ossian (NIRAS & RPS, 2024[180]) and Salamander (ERM, 2024[181]) derived from their respective EIArs. Additionally, since publication of the Northeast and East ScotWind Projects Cumulative totals dataset, a further guidance update has occurred regarding recommended avoidance rate (Joint SNCB, 2024b[156]) for kittiwake. This update has therefore been applied accordingly where appropriate to projects which historically used an avoidance rate of 0.989, to align with the recommendation of an avoidance rate of 0.9929.

Table 6-82: Predicted kittiwake seasonal collision impacts for all associated projects.

Development	Breeding	Non-breeding	Total
Aberdeen OWF (EOWDC)	7.62	4.45	12.07
Beatrice	61.12	32.60	93.72
Berwick Bank (Scoping Approach)	398.25	238.17	636.42
Blyth Demonstration Site	-	2.39	2.39
Culzean	0.60	0.02	0.62
Dogger Bank A & B	-	277.80	277.80
Dogger Bank C & Sofia	-	198.54	198.54
Dogger Bank South	0.0	70.23	70.23
East Anglia One	-	133.74	133.74
East Anglia ONE North	-	7.49	7.49
East Anglia Three	-	68.81	68.81
East Anglia TWO	-	8.26	8.26
Five Estuaries	-	11.28	11.28
Galloper	-	38.47	38.47
Greater Gabbard	-	17.04	17.04
Green Volt	4.81	7.42	12.22
Hornsea Four	-	11.94	11.94
Hornsea Project One	-	49.57	49.57
Hornsea Project Two	-	7.75	7.75
Hornsea Three	-	29.69	29.69
Humber Gateway	-	3.29	3.29
Hywind 2 Demonstration	10.71	1.16	11.88
Inch Cape	25.82	20.65	46.47
Kentish Flats	-	1.03	1.03
Kentish Flats Extension	-	1.74	1.74
Kincardine	14.20	6.45	20.65
Lincs, Lynn & Inner Dowsing	-	1.23	1.23
London Array	-	2.64	2.65

Development	Breeding	Non-breeding	Total
Methil	0.26	0.0	0.26
Moray East	15.49	4.52	20.01
Moray West	49.70	19.36	69.06
Neart na Gaoithe	5.16	12.26	17.43
Norfolk Boreas	-	28.46	28.46
Norfolk Vanguard	-	23.04	23.04
North Falls	-	24.66	24.66
Outer Dowsing	-	5.96	5.95
Pentland Floating OWF	4.52	0.65	5.17
Race Bank	-	19.04	19.04
Rampion	-	12.30	12.30
Rampion 2	-	17.49	17.49
Seagreen Alpha & Bravo	82.05	141.92	223.97
Sheringham Shoal and Dudgeon Extension Project	-	5.20	5.20
Teesside	-	17.10	17.10
Thanet	-	0.58	0.58
Triton Knoll	-	119.59	119.02
Westermost Rough	-	0.19	0.19
Ossian	28.13	11.59	39.72
Salamander	14.00	0.0	14.00
West of Orkney	16.59	36.39	52.98
Caledonia OWF	**55.27**	**11.74**	**67.01**
All Projects Incl. Berwick Bank	**794.30**	**1,765.33**	**2,559.63**
All Projects Excl. Berwick Bank	**396.06**	**1,527.15**	**1,923.21**
Consented (plus Caledonia OWF)	**336.06**	**1,349.56**	**1,686.30**
Note, cells values of '–' denotes where data is either unavailable for a season, no impact is considered for a season or no connectivity is concluded for the breeding season.			

Table 6-83: Predicted cumulative kittiwake annual collision impacts for Caledonia OWF and other projects and predicted change to annual mortality rate of relevant background populations based on mean collision rate. Bold text represents percentage point change >0.02.

Defined Season	Estimated Number of Mortalities (Individuals per Annum)	Change in Average Survival Rate (% Point Change)
All Projects including Berwick Bank		
Breeding	794.30	**0.160**
Non-breeding	1,765.33	**0.213**
Annual	2,559.63	**0.308**
All Projects excluding Berwick Bank		
Breeding	396.06	**0.080**
Non-breeding	1,527.15	**0.184**
Annual	1,923.21	**0.232**
Consented Projects plus Caledonia OWF		
Breeding	336.74	**0.068**
Non-breeding	1,349.56	**0.163**
Annual	1,686.30	**0.203**

Breeding Season

6.8.3.4 During the breeding season, 794 (794.30) kittiwakes are predicted to be subject to collision mortality under an all projects scenario. The breeding season regional population size is estimated to be 496,826 individuals. Based on the average survival rate of 84.4%, the predicted annual baseline mortality for this population is 77,505 individuals per annum. The addition of 794 predicted additional mortalities per annum to this population due to collision would result in a 0.160 survival rate percentage point change (Table 6-83).

6.8.3.5 When considering the other scenarios presented, the predicted mortality rate as a result of collision reduces to 396 (396.06) and 337 (336.74) kittiwakes for all projects excluding Berwick Bank and consented projects only plus Caledonia OWF, respectively annually. This equates to 0.080 and 0.068 survival rate percentage point change (Table 6-83).

6.8.3.6 Given that the percentage point change in survival rate has exceeded the 0.02 threshold as set by NatureScot, PVA has been completed for these scenarios to further consider such a level of effect.

Non-Breeding Season

6.8.3.7 During the non-breeding season, 1,765 (1,765.33) kittiwakes are predicted to be subject to collision mortality per annum. The non-breeding season regional population size is estimated to be 829,937 individuals. Based on the average survival rate of 84.4%, the predicted annual baseline mortality for the non-breeding season population is 129,470 individuals. The addition of 1,765 predicted additional mortalities per annum to this population due to collision would result in a 0.213 survival rate percentage point change (Table 6-83).

6.8.3.8 When considering the other scenarios presented, the predicted mortality rate as a result of collision reduces to 1,527 (1,527.15) and 1,350 (1,349.56) for all projects excluding Berwick Bank and consented projects only plus Caledonia OWF, respectively annually. This equates to 0.184 and 0.163 survival rate percentage point change (Table 6-83).

6.8.3.9 Given that the percentage point change in survival rate has exceeded the 0.02 threshold as set by NatureScot, PVA has been completed for these scenarios to further consider such a level of effect.

Annual Total

6.8.3.10 The annual total of kittiwake subject to mortality due to collision is estimated to be 2,560 (2,559.63) individuals per annum. Using the largest BDMPS population of 829,937 with an average survival rate of 84.4%, the predicted annual baseline mortality of this population is 129,470. The addition of 2,560 predicted additional mortalities per annum due to collision would result in a 0.308 survival rate percentage point change for this population. When considering the annual potential level of impact at the biogeographic scale (5,100,000 individuals), the predicted annual baseline mortality across all seasons is 795,600.0 individuals. The addition of 2,560 predicted additional mortalities per annum due to collision would result in a of 0.05 survival rate percentage point change for this population (Table 6-83).

6.8.3.11 When considering the other scenarios presented, the predicted mortality rate as a result of collision reduces to 1,923 (1,923.21) and 1,686 (1,686.30) for all projects excluding Berwick Bank and consented projects only plus Caledonia OWF, respectively annually. This equates to 0.232 and 0.203 survival rate percentage point change (Table 6-83). Given that the percentage point change in survival rate has exceeded the 0.02 threshold as set by NatureScot, PVA has been completed for these scenarios to further consider such a level of effect.

Population Viability Analysis

6.8.3.12 PVA was undertaken using predicted cumulative operational phase mortalities as a result of collision and was calculated using the largest non-breeding BDMPS population (829,937 individuals) as the reference population for the non-breeding season and annually and the breeding BDMPS population (496,826) as the reference population for the breeding season. All scenarios were assessed as set out in Table 6-84.

6.8.3.13 The counterfactual of growth rate (CGR) and counterfactual of population size (CPS) estimate the potential changes in annual growth rate and population size during the operational lifespan of 35 years. As requested by NatureScot, the PVA results are presented for 25 years and 50 years additionally, with cumulative impact scenarios compared to a baseline (unimpacted) scenario within Volume 7B, Appendix 6-4: Population Viability Analysis.

6.8.3.14 During the breeding season, the population growth rate is predicted to decline by between 0.08 and 0.19% annually, which after 35 years would result in a reduction in population size by 2.87 - 6.60% compared to the no impact baseline population (Table 6-84).

6.8.3.15 During the non-breeding season, the population growth rate is predicted to decline by between 0.19 and 0.25% annually, which after 35 years would result in a reduction in population size by 6.70 – 8.67% compared to the no impact baseline population (Table 6-84).

6.8.3.16 The estimated annual mortality for kittiwake due to operational phase collision is between 1,686 and 2,560 individuals (Table 6-84). The population growth rate is predicted to decline by between 0.24 and 0.36% annually for the lower and upper predicted annual mortality predictions, respectively. After 35 years this would result in a reduction in population size of 8.31 - 12.32% when compared to the baseline unimpacted population (Table 6-84).

Table 6-84: PVA results for kittiwake cumulative impacts due to collision for the Caledonia OWF during the operational phase, using the BDMPS population as a reference population.

Season/ Scenario	Annual Mortality (Individuals)	Impact on Adult Survival	Median CGR (SD)	Median CPS (SD)	Difference in CGR	Difference in CPS
Baseline (unimpacted)	-	-	1.00	1.00	-	-
All Projects Including Berwick Bank						
Breeding	794.30	0.160	0.998 ±<0.001	0.934 ±0.006	0.19%	6.60%
Non-breeding	1,765.32	0.213	0.997 ±<0.001	0.913 ±0.004	0.25%	8.67%
Annual	2,559.63	0.308	0.999 ±<0.001	0.877 ±0.004	0.36%	12.32%
All Projects Excluding Berwick Bank						
Breeding	396.06	0.080	0.999 ±<0.001	0.967 ±0.006	0.09%	3.35%
Non-breeding	1,527.15	0.184	0.998 ±<0.001	0.925 ±0.004	0.22%	7.54%
Annual	2,559.63	0.308	0.997 ±<0.001	0.906 ±0.004	0.27%	9.40%
Consented Projects Only (plus Caledonia OWF)						
Breeding	336.74	0.068	0.999 ±<0.001	0.971 ±0.006	0.08%	2.87%
Non-breeding	1,349.56	0.163	0.998 ±<0.001	0.933 ±0.004	0.19%	6.70%
Annual	1,686.30	0.203	0.998 ±<0.001	0.917 ±0.004	0.24%	8.31%

6.8.3.18 An impact of this magnitude as estimated by PVA may potentially have a material effect on the BDMPS population, when considering the all projects scenario. Although, the predicted impact would likely be difficult to differentiate from natural population fluctuations caused by other factors such as changes in prey availability, avian influenza outbreaks, or adverse weather. It is important to note, the assessment above did not consider macro-avoidance of kittiwake, nor that it is likely that all projects will build out their worst case design scenarios as assess and thus likely to represent an overestimation of collision mortality. Further to this, the Proposed Development (Offshore) only provides a minor contribution (~2.6%) to the overall level of predicted effect, which when considered conclusion of **Low** overall magnitude of impact is considered appropriate.

Sensitivity of Receptor

6.8.3.19 Based upon the findings presented in the literature review (Table 6-5). Kittiwake sensitivity to collision risk during the operational phase is considered to be **Medium**. The conservation value of the species is **Medium** (Table 6-41).

Significance of Effect

6.8.3.20 Taking the **Medium** sensitivity of kittiwake (Table 6-41) and the low magnitude of impact, the overall significance of effect of collision during operation is **considered to be Minor and Not Significant in EIA terms** following the matrix approach when considering the factors outlined in the paragraph above (Table 6-17).

Great black-backed gull

Magnitude of Impact

6.8.3.21 Estimated collision risk for great black-backed gull per defined season for each project in-scope for cumulative assessment are presented in Table 6-85. The predicted collisions for planned and operational projects included within Table 6-85, are primarily based on the Northeast and East Scotwind Projects Cumulative totals dataset (excluding as-built updates), with the addition/ update of totals for Five Estuaries (GoBe, 2024a[185]), Rampion (APEM, 2024[188]), Rampion 2 (APEM, 2023b[189]) and Salamander (ERM, 2024[181]) derived from their respective EIARs.

6.8.3.22 As Berwick Bank is out of foraging range for this species (73km as per NatureScot guidance note 3), only the all projects and consented projects scenarios are presented for great black-backed gull.

Table 6-85: Great black-backed gull cumulative season and total estimate for collision risk.

Development	Breeding	Non-breeding	Total
Beatrice	36.20	145.00	181.2
Blyth Demonstration Site	-	6.10	6.1
Dogger Bank A & B	-	28.00	28
Dogger Bank C & Sofia	-	30.60	30.6
Dogger Bank South	-	3.92	3.92
East Anglia One	-	55.20	55.2
East Anglia ONE North	-	1.40	1.4
East Anglia Three	-	41.30	41.3
East Anglia TWO	-	4.10	4.10
European Offshore Wind Development Centre (EOWDC)	-	2.90	2.90
Five Estuaries	-	1.16	1.16
Galloper	-	21.60	21.60
Greater Gabbard	-	200.00	200.00
Green Volt	-	4.30	4.30
Hornsea Four	-	10.60	10.60
Hornsea Project One	-	82.30	82.30
Hornsea Project Two	-	24.00	24.00
Hornsea Three	-	33.60	33.60
Humber Gateway	-	6.10	6.10
Hywind 2 Demonstration	-	5.40	5.40
Inch Cape	-	44.20	44.20
Kentish Flats Extension	-	0.20	0.20
Methil	0.80	0.80	1.60
Moray Firth EDA	11.40	30.60	42.00
Moray West	4.80	6.00	10.80

Development	Breeding	Non-breeding	Total
Neart na Gaoithe	-	4.30	4.30
Norfolk Boreas	-	34.40	34.40
Norfolk Vanguard	-	25.80	25.80
Rampion	-	25.00	31.20
Rampion 2	-	13.59	13.59
Salamander	-	0.10	0.10
Seagreen Alpha and Bravo	-	64.10	64.10
SEP & DEP	-	0.30	0.30
Teesside	-	41.80	41.80
Thanet	-	0.50	0.50
Triton Knoll	-	117.10	117.10
Caledonia OWF	**-**	**14.98**	**14.98**
All Projects Incl. Berwick Bank	**53.20**	**1,131.35**	**1,184.55**
Consented (plus Caledonia OWF)	**53.20**	**1,112.58**	**1,1165.78**
Note, cells values of '–' denotes where data is either unavailable for a season, no impact is considered for a season or no connectivity is concluded for the breeding season.			

Table 6-86: Predicted great black-backed gull cumulative seasonal and annual collision impacts for Caledonia OWF and other projects and predicted change to annual mortality rate of relevant background populations based on mean collision rate. Bold text represents percentage point change >0.02.

Defined Season	Estimated Number of Mortalities (Individuals per Annum)	Change in Average Survival Rate (% Point Change)
All Projects Including Berwick Bank		
Breeding	53.20	**1.119**
Non-breeding	1,131.35	**1.238**
Annual	1,184.55	**1.296**
Consented Projects Only (plus Caledonia OWF)		
Breeding	53.20	**1.119**
Non-breeding	1,112.58	**1.217**
Annual	1,165.78	**1.275**

Breeding Season

6.8.3.23 As presented within the Section 6.7.2, the Proposed Development (Offshore) is predicted to have no impact on great black-backed gull during the breeding season. Therefore, there is no potential for a cumulative effect to occur during the breeding season.

Non-Breeding Season

6.8.3.24 During the non-breeding season, 1,131 (1,131.35) great black-backed gulls are predicted to be subject to collision mortality per annum when considering all projects cumulatively. The non-breeding season regional population size is estimated to be 91,399 individuals. Based on the average survival rate of 84%, the predicted annual baseline mortality for the non-breeding season population is 14,624 individuals. The addition of 1,131 predicted additional mortalities per annum to this population due to collision would result in a 1.238 survival rate percentage point change (Table 6-86).

6.8.3.25 When considering consented projects only plus Caledonia OWF, the predicted mortality rate as a result of collision reduces to 1,113 (1,112.58) annually. This equates to a 1.217 survival rate percentage point change (Table 6-86).

6.8.3.26 Given that the percentage point change in survival rate has exceeded the 0.02 threshold as set by NatureScot for both scenarios, PVA has been completed to further consider such a level of effect.

Annual Total

6.8.3.27 The annual total of great black-backed gull subject to mortality due to collision is estimated to be 1,185 (1,184.55) individuals per annum when considering all projects. Using the largest BDMPS population of 91,399 individuals with an average survival rate of 84%, the predicted annual baseline mortality of this population is 14,624. The addition of 1,185 predicted additional mortalities per annum due to collision would result in a 1.296 survival rate percentage point change for this population (Table 6-86). When considering the annual potential level of impact at the biogeographic scale (235,00 individuals), the predicted annual baseline mortality across all seasons is 37,600 individuals. The addition of 1,185 predicted additional mortalities per annum due to collision would result in a of 0.507 survival rate percentage point change for this population.

6.8.3.28 When considering consented projects only plus Caledonia OWF, the predicted mortality rate as a result of collision reduces to 1,166 (1,165.78) annually. This equates to a 1.275 survival rate percentage point change (Table 6-86).

6.8.3.29 Given that the percentage point change in survival rate has exceeded the 0.02 threshold as set by NatureScot for both scenarios, PVA has been completed to further consider such a level of effect.

Population Viability Analysis

6.8.3.30 PVA was undertaken using predicted cumulative operational phase mortalities as a result of collision and was calculated using the non-breeding BDMPS population (91,399 individuals) as the reference population for the non-breeding season and annually and the breeding BDMPS population (4,753 individuals) for the breeding season. All scenarios were assessed as set out in Table 6-87.

6.8.3.31 The counterfactual of growth rate (CGR) and counterfactual of population size (CPS) estimate the potential changes in annual growth rate and population size during the operational lifespan of 35 years (Table 6-87). As requested by NatureScot, the PVA results are presented for 25 years and 50 years, with cumulative impact scenarios compared to a baseline (unimpacted) scenario within Volume 7B, Appendix 6-4: Population Viability Analysis.

6.8.3.32 During the non-breeding season, the population growth rate is predicted to decline by between 1.42 and 1.45%, which after 35 years would result in a reduction in population size of 40.33 – 40.85% compared to the no impact baseline population (Table 6-87).

6.8.3.33 The estimated annual mortality for great black-backed gull due to operational phase collision is between 1,166 and 1,185 individuals when assessed against the BDMPS population size (Table 6-87). The population growth rate is predicted to decline annually by between 1.49 and 1.52% for the lower and upper predicted annual mortality predictions respectively, which after 35 years would result in a reduction in population size by 41.77 – 42.29% when compared to the baseline unimpacted population (Table 6-87).

Table 6-87: PVA results for great black-backed gull cumulative impacts for the Caledonia OWF during the operational phase, using the BDMPS population as a reference population.

Season/ Scenario	Annual Mortality (Individuals)	Impact on Adult Survival	Median CGR (SD)	Median CPS (SD)	Difference in CGR	Difference in CPS
Baseline (unimpacted)	-	-	1.00	1.00	-	-
All Projects including Berwick Bank						
non-breeding	1,131.35	1.238	0.986 ±<0.001	0.592 ±0.006	1.45%	40.85%
Annual	1,184.55	1.296	0.985 ±<0.001	0.577 ±0.006	1.52%	42.29%
Consented projects only (plus Caledonia OWF)						
non-breeding	1,112.58	1.217	0.986 ±<0.001	0.597 ±0.006	1.42%	40.33v
Annual	1,165.78	1.275	0.985 ±<0.001	0.582 ±0.006	1.49%	41.77%

6.8.3.34 An impact of this magnitude as estimated by PVA is likely to have a material effect on the BDMPS population, given the impact on growth rate and population size. However, as the Proposed Development (Offshore) contributes a negligible amount (~1.3% and limited only to the non-breeding season) of additional mortality for this species, a conclusion of **Low** overall magnitude of impact is considered appropriate.

Sensitivity of Receptor

6.8.3.35 Based upon the findings presented in the literature review (Table 6-5), great black-backed gull sensitivity to collision risk during the operational phase is considered to be **High**. The conservation value of the species is **Low** (Table 6-41).

Significance of Effect

6.8.3.36 Taking the **High** sensitivity of great black-backed gull (Table 6-41) and the low magnitude of impact, the overall significance of effect of collision during operation is **considered to be Minor and Not Significant in EIA terms** following the matrix approach when considering the Proposed Developments (Offshore) contribution to any cumulative effect (Table 6-17).

Herring Gull

Magnitude of Impact

6.8.3.37 Estimated collision risk for herring gull per defined season and as associated with each of the projects set out in Table 6-64 are presented in Table 6-88. The predicted collisions for planned and operational projects included within Table 6-88 are primarily based on the Northeast and East Scotwind Projects Cumulative totals dataset (excluding as-built updates), with the addition/ update of totals for Ossian (NIRAS & RPS, 2024[180]) and Salamander (ERM, 2024[181]) derived from their respective EIArs. To note, no updates were needed regarding herring gull avoidance rate following publication of the latest CRM guidance note (Joint SNCB, 2024b[156]).

Table 6-88: Herring gull cumulative season and total estimate for collision risk for all in scope projects.

Development	Breeding	Non-breeding	Total
Beatrice	59.28	236.88	296.16
Berwick Bank (scoping)	-	8.40	8.40
Blyth Demo	-	2.64	2.64
Green Volt	-	5.80	5.80
Hywind	0.72	9.36	10.08
Inch Cape	-	3.60	3.60
Kincardine	1.20	-	1.20
Methil	-	4.44	4.44
Moray East	62.40	-	62.40
Moray West	14.40	1.20	15.60
Neart na Gaoithe	-	4.80	4.80
Ossian	-	2.70	2.70
Salamander	-	4.00	4.00
Seagreen	-	16.97	16.97
Caledonia OWF	**-**	**3.12**	**3.12**
All Projects	**138.00**	**303.91**	**441.91**
All Projects Excl. Berwick Bank	**138.00**	**295.51**	**433.51**
Consented (plus Caledonia OWF)	**138.00**	**288.81**	**426.81**
Note, cells values of '–' denotes where data is either unavailable for a season, no impact is considered for a season or no connectivity is concluded for the breeding season.			

Table 6-89: Predicted herring gull cumulative collision impacts for the Caledonia OWF and predicted change to annual mortality rate of relevant background populations based on mean collision rate. Bold text represents percentage point change >0.02.

Defined Season	Estimated Number of Mortalities (Individuals per Annum)	Change in Average Survival Rate (% Point Change)
All Projects		
Breeding	138.00	**0.324**
Non-breeding	303.91	**0.065**
Annual	441.91	**0.095**
All Projects Excluding Berwick Bank		
Breeding	138.00	**0.324**
Non-breeding	295.51	**0.063**
Annual	433.51	**0.093**
Consented Projects Only (plus Caledonia OWF)		
Breeding	138.00	**0.324**
Non-breeding	288.81	**0.062**
Annual	426.81	**0.091**

Breeding Season

6.8.3.38 As presented within the Section 6.7.2, the Proposed Development (Offshore) is predicted to have no impact on herring gull during the breeding season. Therefore, there is no potential for a cumulative effect to occur during the breeding season.

Non-Breeding Season

6.8.3.39 During the non-breeding season, 304 (303.91) herring gull are predicted to be subject to collision mortality per annum for all projects. The non-breeding season regional population size is estimated to be 466,511 individuals. Based on the average survival rate of 84%, the predicted annual baseline mortality for the non-breeding season population is 80,240 individuals. The addition of 304 predicted additional mortalities per annum to this population due to collision would result in a 0.065 survival rate percentage point change (Table 6-89).

6.8.3.40 When considering the other scenarios presented, the predicted mortality rate as a result of collision reduces to 296 (295.51) and 289 (288.81) for all projects excluding Berwick Bank and consented projects only plus Caledonia OWF, respectively annually. This equates to 0.063 and 0.062 survival rate percentage point change (Table 6-89).

6.8.3.41 Given that the percentage point change in survival rate has exceeded the 0.02 threshold as set by NatureScot, PVA has been completed for these scenarios to further consider such a level of effect.

Annual Total

6.8.3.42 The annual total of herring gull subject to mortality due to collision is estimated to be 412 (411.91) individuals per annum for all projects. Using the largest BDMPS population of 466,511 with an average survival rate of 84%, the predicted annual baseline mortality of this population is 80,240. The addition of 442 predicted additional mortalities per annum due to collision would result in a 0.095 survival rate percentage point change for this population (Table 6-89). When considering the annual potential level of impact at the biogeographic scale (1,098,000 individuals), the predicted annual baseline mortality across all seasons is 188,856 individuals. The addition of 442 predicted additional mortalities per annum due to collision would result in a of 0.04 survival rate percentage point change for this population.

6.8.3.43 When considering the other scenarios presented, the predicted mortality rate as a result of collision reduces to 434 (433.51) and 427 (426.81) for all projects excluding Berwick Bank and consented projects only plus Caledonia OWF, respectively annually. This equates to 0.093 and 0.091 survival rate percentage point change (Table 6-89).

6.8.3.44 Given that the percentage point change in survival rate has exceeded the 0.02 threshold as set by NatureScot, PVA has been completed for these scenarios to further consider such a level of effect.

Population Viability Analysis

6.8.3.45 PVA was undertaken using predicted cumulative operational phase mortalities as a result of collision and was calculated using the largest non-breeding BDMPS population (466,511 individuals) as the reference population for the non-breeding season and annually and the breeding BDMPS population (42,584) for the breeding season. All scenarios were assessed as set out in Table 6-90.

6.8.3.46 The counterfactual of growth rate (CGR) and counterfactual of population size (CPS) estimate the potential changes in annual growth rate and population size during the operational lifespan of 35 years (Table 6-90). As requested by NatureScot, the PVA results are presented for 25 years and 50 years, with cumulative impact scenarios compared to a baseline (unimpacted) scenario within Volume 7B, Appendix 6-4: Population Viability Analysis.

6.8.3.47 During the non-breeding season, the population growth rate is predicted to decline by 0.08% annually, which after 35 years would result in a reduction in population size by 2.67-2.79% compared to the no impact baseline population (Table 6-90).

6.8.3.48 The estimated annual mortality for herring gull due to operational phase collision is 427 - 412 individuals when assessed against the BDMPS population size (Table 6-90). The population growth rate is predicted to reduce by less than 0.11% across all scenarios, which after 35 years would result in a reduction in population size by 3.92 – 4.04% when compared to the baseline unimpacted population (Table 6-90).

Table 6-90: PVA results for herring gull cumulative impacts for the Caledonia OWF during the operational phase, using the BDMPS population as a reference population.

Scenario	Annual Mortality (Individuals)	Impact on Adult Survival	Median CGR (SD)	Median CPS (SD)	Difference in CGR	Difference in CPS
Baseline (unimpacted)						
All Projects						
Non-breeding	303.91	0.065	0.999 ±<0.001	0.972 ±0.007	0.08%	2.79%
Annual	411.91	0.095	0.999 ±<0.001	0.960 ±0.007	0.11%	4.04%
All projects Excluding Berwick Bank						
Non-breeding	295.51	0.063	0.999 ±<0.001	0.973 ±0.007	0.08%	2.71%
Annual	433.51	0.093	0.999 ±<0.001	0.960 ±0.007	0.11%	3.97%
Consented Projects Only (plus Caledonia OWF)						
Non-breeding	288.81	0.062	0.999 ±<0.001	0.973 ±0.007	0.08%	2.67%
Annual	426.81	0.091	0.999 ±<0.001	0.961 ±0.007	0.11%	3.92%

6.8.3.49 The PVA outputs set out above across all seasons and annually demonstrate a minimal change to the population annual growth rate (max reduction 0.11%) and final population size after 35 years (max reduction 3.97%), in contrast to baseline conditions. Such a level of predicted effect would likely be indistinguishable from natural fluctuations in population size, which may be driven by other factors outside of the influence of the Proposed Development (Offshore) cumulatively with other plans and projects (such as changes in prey availability or avian influenza outbreaks). Therefore, such a level of predicted effect is concluded to be of **Low** overall magnitude of impact.

Sensitivity of Receptor

6.8.3.50 Based upon the findings presented in the literature review (Table 6-5) herring gull sensitivity to collision risk during the operational phase is considered to be **High**. The conservation value of the species is low (Table 6-41).

Significance of Effect

6.8.3.51 Taking the **High** sensitivity of herring gull (Table 6-41) and the **Low** magnitude of impact predicted, the overall significance of effect of cumulative collision during operation is considered to be **Minor and Not Significant in EIA terms** following the matrix approach (Table 6-17).

Gannet

Magnitude of Impact

6.8.3.52 Estimated collision risk for gannet per defined season and as associated with each of the projects set out in Table 6-64 are presented in Table 6-91. The predicted collisions for planned and operational projects included within Table 6-91, are primarily based on the Northeast and East Scotwind Projects Cumulative totals dataset (excluding as-built updates), with the addition/ update of totals for Culzean (Xodus Group, 2024[182]), Five Estuaries (GoBe, 2024a[185]), Outer Dowsing (GoBe, 2024b[187]), Rampion 2 (APEM, 2023b[189]), Ossian (NIRAS & RPS, 2024[180]) and Salamander (ERM, 2024[181]) derived from their respective EIArs. Since publication of the Northeast and East Scotwind Projects Cumulative totals dataset, a further guidance update has occurred regarding recommended avoidance rate (Joint SNCB, 2024b[156]) for gannet. This update has therefore been applied accordingly where appropriate to projects which historically used an avoidance rate of 0.989, to align with the recommendation of an avoidance rate of 0.9929. Additionally, consideration of macro avoidance is also now recommended for gannet (Joint SNCB, 2024b[156]) which alleviate the issue of double counting of effects. Macro avoidance has been applied appropriately for all season for English projects and for the non-breeding season only for Scottish projects.

6.8.3.53 To note two approaches are considered for gannet collision risk, an Applicant Approach which includes a 70% macro avoidance rate applied to all seasons and a Guidance approach which includes a 70% macro avoidance rate to the non-breeding season only.

Table 6-91: Gannet cumulative season and total estimate for collision risk.

Development	Breeding	Non-breeding	Total
Aberdeen OWF (EOWDC)	2.7	1.0	3.7
Beatrice	24.1	11.3	35.4
Berwick Bank (Scoping Approach)	109.7	4.1	113.8
Blyth Demonstration Site	0.7	0.9	1.6
Culzean	0.3	0.0	0.3
Dogger Bank A & B	15.8	26.7	42.5
Dogger Bank C & Sofia	2.9	4.0	6.9
Dogger Bank South	27.5	13.2	40.7
Dudgeon	-	11.2	11.2
East Anglia One	-	26.6	26.6
East Anglia ONE North	-	2.3	2.3
East Anglia Three	-	8.3	8.3
East Anglia TWO	-	5.2	5.2
Five Estuaries	-	3.0	3.0
Galloper	-	8.4	8.4
Greater Gabbard	-	2.6	2.6
Green Volt	12.1	0.6	12.7
Hornsea Four	3.0	1.3	4.3
Hornsea Project One	-	10.6	10.6
Hornsea Project Two	1.4	3.9	5.2
Hornsea Three	-	1.7	1.7
Humber Gateway	-	0.5	0.5
Hywind 2 Demonstration	3.6	0.3	3.9
Inch Cape	69.7	1.7	71.5
Kentish Flats	-	0.4	0.4

Development	Breeding	Non-breeding	Total
Kincardine	1.9	0.0	1.9
Lincs, Lynn & Inner Dowsing	-	0.6	0.6
London Array	-	0.6	0.6
Methil	3.9	-	3.9
Moray East	52.0	8.58	60.6
Moray West	6.3	0.4	6.8
Neart na Gaoithe	57.4	2.7	60.2
Norfolk Boreas	-	3.2	3.2
Norfolk Vanguard	-	4.6	4.6
North Falls	-	2.5	2.5
Outer Dowsing	-	0.3	0.3
Pentland Floating OWF	1.3	-	1.3
Race Bank	-	3.1	3.1
Rampion	-	12.7	12.7
Rampion 2	-	2.0	2.0
Seagreen Alpha & Bravo	185.0	5.9	190.9
Sheringham Shoal	-	0.7	0.7
Sheringham Shoal and Dudgeon Extension Project	-	0.7	0.7
Teesside	0.9	0.3	1.3
Thanet	-	0.0	0.0
Triton Knoll	-	18.2	18.2
Westermost Rough	0.0	0.1	0.1
Ossian	28.2	1.2	29.4
Salamander	4.0	0.6	4.6
West of Orkney	37.4	2.9	40.3

Development	Breeding	Non-breeding	Total
Caledonia OWF (Applicant Approach)	**3.70**	**0.7**	**4.4**
Caledonia OWF (Guidance Approach)	**12.35**	**0.7**	**13.0**
All Projects (Applicant Approach for Caledonia OWF)	**655.61**	**222.58**	**878.19**
All Projects (Guidance Approach for Caledonia OWF)	**664.26**	**222.58**	**886.84**
All Projects Excl. Berwick Bank (Applicant Approach for Caledonia OWF)	**545.88**	**218.52**	**764.40**
All Projects Excl. Berwick Bank (Guidance Approach for Caledonia OWF)	**554.53**	**218.52**	**773.05**
Consented Plus Caledonia OWF (Applicant Approach for Caledonia OWF)	**448.52**	**192.78**	**641.30**
Consented Plus Caledonia OWF (Guidance Approach for Caledonia OWF)	**457.17**	**192.78**	**649.95**
Note, cells values of '–' denotes where data is either unavailable for a season, no impact is considered for a season or no connectivity is concluded for the breeding season.			

Table 6-92: Predicted gannet cumulative seasonal and annual collision impacts for the Caledonia OWF and other projects and predicted change to annual mortality rate of relevant background populations based on mean collision rate. Bold text represents percentage populations based on mean collision rate and represents percentage point change >0.02.

Defined Season	Estimated Number of Mortalities (Individuals per Annum)	Change in Average Survival Rate (% Point Change)
All Projects (Applicant Approach)		
Breeding	655.61	**0.071**
Non-breeding	222.58	**0.049**
Annual	878.19	**0.095**
All Projects Excluding Berwick Bank (Applicant Approach)		
Breeding	545.88	**0.059**
Non-breeding	218.52	**0.048**
Annual	764.40	**0.083**
All Consented Projects plus Caledonia OWF (Applicant Approach)		
Breeding	448.52	**0.049**
Non-breeding	192.78	**0.042**
Annual	641.30	**0.070**
All Projects (Guidance Approach)		
Breeding	664.26	**0.072**
Non-breeding	222.58	**0.049**
Annual	886.84	**0.096**
All Projects Excluding Berwick Bank (Guidance Approach)		
Breeding	554.53	**0.060**
Non-breeding	218.52	**0.048**
Annual	773.05	**0.084**
All Consented Projects plus Caledonia OWF (Guidance Approach)		
Breeding	457.17	**0.050**
Non-breeding	192.78	**0.042**
Annual	649.95	**0.071**

Breeding Season

6.8.3.54 During the breeding season 656 (655.51) gannets are predicted to be subject to collision mortality per annum for all projects (Table 6-92). The breeding season regional population size is estimated to be 920,514 individuals. Based on the average survival rate of 81.3%, the predicted annual baseline mortality for this population is 172,136 individuals per annum. The addition of 656 predicted additional mortalities per annum to this population due to collision would result in a 0.071 survival rate percentage point change (Table 6-92).

6.8.3.55 When considering the other scenarios presented, the predicted mortality rate as a result of collision reduces to 546 (545.88) and 449 (448.52) gannets for all projects excluding Berwick Bank and consented projects only plus Caledonia OWF, respectively annually. This equates to 0.059 and 0.049 survival rate percentage point change (Table 6-92).

6.8.3.56 The Guidance Approach in which macro-avoidance is not applied during the breeding season only marginally increases predicted mortality rates and a slight increase to the survival rate percentage point change.

6.8.3.57 Given that the percentage point change in survival rate has exceeded the 0.02 threshold as set by NatureScot, PVA has been completed for these scenarios to further consider such a level of effect.

Non-Breeding Season

6.8.3.58 During the non-breeding season, 223 (222.58) gannets are predicted to be subject to collision mortality per annum when considering all projects. The non-breeding season regional population size is estimated to be 456,298 individuals. Based on the average survival rate of 81.3%, the predicted annual baseline mortality for the non-breeding season population is 85,328 individuals. The addition of 223 predicted additional mortalities per annum to this population due to collision would result in a 0.049 survival rate percentage point change (Table 6-92).

6.8.3.59 When considering the other scenarios presented, the predicted mortality rate as a result of collision reduces to 219 (218.52) and 193 (192.78) gannets for all projects excluding Berwick Bank and consented projects only plus Caledonia OWF, respectively annually. This equates to 0.048 and 0.042 survival rate percentage point change (Table 6-92).

6.8.3.60 There was no difference for the non-breeding season for the Guidance and Applicant Approach and thus predicted impacts were the same under both scenarios.

6.8.3.61 Given that the percentage point change in survival rate has exceeded the 0.02 threshold as set by NatureScot, PVA has been completed for these scenarios to further consider such a level of effect.

Annual Total

6.8.3.62 The annual total of gannet subject to mortality due to collision is estimated to be 878 (878.19) individuals per annum when considering all projects. Using the largest BDMPS population of 920,514 with an average survival rate of 81.3%, the predicted annual baseline mortality of this population is 172,136. The addition of 878 predicted additional mortalities per annum due to collision would result in a 0.095 survival rate percentage point change for this population. When considering the annual potential level of impact at the biogeographic scale (1,180,000 individuals), the predicted annual baseline mortality across all seasons is 220,660 individuals. The addition of 878 predicted additional mortalities per annum due to collision would result in a of 0.105 survival rate percentage point change for this population (Table 6-92).

6.8.3.63 When considering the other scenarios presented, the predicted mortality rate as a result of collision reduces to 764 (764.40) and 641 (641.30) gannets for all projects excluding Berwick Bank and consented projects only plus Caledonia OWF, respectively annually. This equates to 0.083 and 0.070 survival rate percentage point change (Table 6-92).

6.8.3.64 The Guidance Approach in which macro-avoidance is not applied during the breeding season only marginally increases predicted mortality rates and a slight increase to the survival rate percentage point change.

6.8.3.65 Given that the percentage point change in survival rate has exceeded the 0.02 threshold as set by NatureScot, PVA has been completed for these scenarios to further consider such a level of effect.

Population Viability Analysis

6.8.3.66 PVA was undertaken using predicted cumulative operational phase mortalities as a result of collision under the Applicant Approach and was calculated using the largest non-breeding BDMPS population (456,298 individuals) as the reference population for the non-breeding and the breeding BDMPS population (920,514) as the reference population for the breeding season and annually. All scenarios were assessed as set out in All scenarios were assessed as set out in Table 6-93. Consideration of the cumulative levels of collision risk for the guidance approach has also been modelled, though given the PVA predictions did not alter for either approach results are presented in Volume 7B, Appendix 6-4: Population Viability Analysis only.

6.8.3.67 The counterfactual of growth rate (CGR) and counterfactual of population size (CPS) estimate the potential changes in annual growth rate and population size during the operational lifespan of 35 years (Table 6-93). As requested by NatureScot, the PVA results are presented for 25 years and 50 years, with cumulative impact scenarios compared to a baseline (unimpacted) scenario within Volume 7B, Appendix 6-4: Population Viability Analysis.

6.8.3.68 During the breeding season, the population growth rate is predicted to decline by between 0.06% and 0.08% annually, which after 35 years would result in a reduction in population size by 2.06 - 2.99% compared to the no impact baseline population (Table 6-93).

6.8.3.69 During the non-breeding season, the population growth rate is predicted to decline by between 0.05 and 0.06% annually, which after 35 years would result in a reduction in population size by 1.78 – 2.05% compared to the no impact baseline population (Table 6-93).

6.8.3.70 The estimated annual mortality for gannet due to operational phase collision is 641 – 878 individuals when assessed against the BDMPS population size (Table 6-93). The population growth rate is predicted to reduce by between 0.08 and 0.11% across all scenarios annually, which after 35 years would result in a reduction in population size by 2.92 – 3.99% when compared to the baseline unimpacted population (Table 6-93).

Table 6-93: PVA results for gannet cumulative impacts for the Caledonia OWF during the operational phase, using the BDMPS population as a reference population.

Scenario	Annual Mortality (Individuals)	Impact on Adult Survival	Median CGR (SD)	Median CPS (SD)	Difference in CGR	Difference in CPS
Baseline (unimpacted)	-	-	1.00	1.00	-	-
All projects including Berwick Bank						
Breeding	655.51	0.071	0.999 ±<0.001	0.970 ±0.004	0.08%	2.99%
Non-breeding	222.58	0.128	0.999 ±<0.001	0.979 ±0.005	0.06%	2.06%
Annual	878.19	0.135	0.999 ±<0.001	0.960 ±0.004	0.11%	3.99%
All projects excluding Berwick Bank						
Breeding	545.88	0.071	0.999 ±<0.001	0.975 ±0.004	0.07%	2.49%
Non-breeding	218.52	0.128	0.999 ±<0.001	0.980 ±0.005	0.06%	2.02%
Annual	764.40	0.095	0.999	0.965	0.10%	3.47%
Consented projects only (plus Caledonia OWF)						
Breeding	448.52	0.064	0.999 ±<0.001	0.980 ±0.004	0.06%	2.05%
Non-breeding	192.78	0.109	0.999 ±<0.001	0.982 ±0.005	0.05%	1.78%
Annual	641.30	0.085	0.999 ±<0.001	0.971 ±0.004	0.08%	2.92%

6.8.3.71 An impact of this magnitude as estimated by PVA is unlikely to have a significant effect on the BDMPS population given the minimal impact on growth rate (max reduction 0.11) and population size (max reduction 3.99%). The predicted impact would likely be indistinguishable from natural population fluctuations variations which may be driven by other factors such as changes in prey availability, avian influenza outbreaks, or wrecks, leading to a **Low** overall magnitude of impact.

Sensitivity of Receptor

6.8.3.72 Based upon the findings presented in the literature review (Table 6-5Table 6-5) gannet sensitivity to collision risk during the operational phase is considered to be **Medium**. The conservation value of the species is medium (Table 6-41).

Significance of Effect

6.8.3.73 Taking the medium sensitivity of gannet (Table 6-41) and the low magnitude of impact predicted, the overall significance of effect of collision during operation is considered to be **Minor and Not Significant in EIA terms** following the matrix approach (Table 6-17).

6.8.4 Cumulative Combined Distributional Responses and Collision risk

6.8.4.1 As gannet and kittiwake has been scoped in for both distributional response and collision risk assessment during the operation and maintenance phase, these impacts could potentially cumulatively adversely impact gannet populations.

6.8.4.2 Combined impacts of cumulative distributional responses and collision risk may be greater than when considered along and thus consideration of both impacts is required. It is recognised that adding both impacts together will incorporate double counting of effects to some degree, as birds subject to distributional responses would not then also be subject to collision risk, as it is assumed they have not entered the windfarm area. Conversely, birds subject to collision mortality can then no longer be subject to distributional effects.

Gannet

6.8.4.3 The predicted level of mortality due to cumulative combined operational phase distributional responses and collision per defined season for gannet is presented in Table 6-94.

6.8.4.4 The combined assessment for gannet was completed using the Applicant Approach in which a displacement rate of 70% and mortality rate of 1% was applied, although the higher mortality rate of 3% as per the Guidance Approach is also presented. Collision risk was assessed using the Applicant Approach only of applying macro-avoidance in the breeding season as well as the non-breeding season for the Proposed Development (Offshore), to reduce the potential for double counting of effects.

Table 6-94: Seasonal cumulative combined distributional response estimates and collision impacts of gannet for the Caledonia OWF during the operational phase, as per the Applicant Approach. Bold text represents percentage point change >0.02.

Defined Season	Regional Baseline Populations and Baseline Mortality Rates (Individuals Per Annum)		Estimated Number of Mortalities from Combined CRM (Mean) and Distributional Responses Per Annum		Change in Average Survival Rate (% Point Change) (Displacement Rate; Mortality Rate)	
	Population (Individuals)	Baseline Mortality	30% Disp; 1% Mort	30% Disp; 3% Mort	30% Disp; 1% Mort	30% Disp; 3% Mort
All Projects including Berwick Bank						
Breeding season	920,514	172,136	848.38 (184.12 due to distributional responses (Table 6-80), 655.61 due to collision (Table 6-92))	1,216.61 (552.35 due to distributional responses (Table 6-80), 655.61 due to collision (Table 6-92))	**0.092**	**0.132**
Non-breeding season	456,298	85,327	469.10 (246.52 due to distributional responses (Table 6-80), 222.58 due to collision (Table 6-92))	962.13 (739.55 due to distributional responses (Table 6-80), 222.58 due to collision (Table 6-92))	**0.103**	**0.211**
Annual Total	920,514	172,136	1,317.48 (430.63 due to distributional responses (Table 6-80), 878.19 due to collision (Table 6-92))	2,178.74 (1,291.90 due to distributional responses (Table 6-80), 878.19 due to collision (Table 6-92))	**0.143**	**0.237**
All Projects excluding Berwick Bank						
Breeding season (Mid-April to August)	920,514	172,136	705.50 (150.97 due to distributional responses (Table 6-80), 545.88 due to collision (Table 6-92))	1,007.45 (452.92 due to distributional responses (Table 6-80), 545.88 due to collision (Table 6-92))	**0.077**	**0.109**
Non-breeding	456,298	85,327	452.65	920.92	**0.099**	**0.202**

Defined Season	Regional Baseline Populations and Baseline Mortality Rates (Individuals Per Annum)		Estimated Number of Mortalities from Combined CRM (Mean) and Distributional Responses Per Annum		Change in Average Survival Rate (% Point Change) (Displacement Rate; Mortality Rate)	
	Population (Individuals)	Baseline Mortality	30% Disp; 1% Mort	30% Disp; 3% Mort	30% Disp; 1% Mort	30% Disp; 3% Mort
season (September to early-April)			(234.13 due to distributional responses (Table 6-80), 218.52 due to collision (Table 6-92))	(702.40 due to distributional responses (Table 6-80), 218.52 due to collision (Table 6-92))		
Annual Total	920,514	172,136	1,158.15 (385.11 due to distributional responses (Table 6-80), 764.40 due to collision (Table 6-92))	1,928.37 (1,155.32 due to distributional responses Table 6-80), 764.40 due to collision (Table 6-92)	**0.126**	**0.209**
Consented Only plus Caledonia OWF						
Breeding season (Mid-April to August)	920,514	172,136	577.44 (120.27 due to distributional responses (Table 6-80), 448.52 due to collision (Table 6-92))	817.98 (360.81 due to distributional responses (Table 6-80), 448.52 due to collision (Table 6-92))	**0.063**	**0.089**
Non-breeding season (September to early-April)	456,298	85,327	385.63 (192.85 due to distributional responses (Table 6-80), 192.78 due to collision (Table 6-92))	771.33 (578.55 due to distributional responses (Table 6-80), 192.78 due to collision (Table 6-92)	**0.085**	**0.169**
Annual Total	920,514	172,136	963.07 (313.12 due to distributional responses (Table 6-80), 641.30 due to collision (Table 6-92)	1,589.31 (939.36 due to distributional responses (Table 6-80), 641.30 due to collision (Table 6-92))	**0.105**	**0.173**

6.8.4.5 As presented within in Table 6-94, for all combined cumulative collision risk and distributional response scenarios considered, the percentage point change in survival rate exceeded the 0.02 threshold as set by NatureScot, PVA has been completed for these scenarios to further consider such a level of effect.

Population Viability Analysis

6.8.4.6 PVA was undertaken using predicted cumulative operational phase mortalities as a result of collision and was calculated using the largest non-breeding BDMPS population (829,937 individuals) as the reference population for the non-breeding season and annually and the breeding BDMPS population (496,826) for the breeding season. All scenarios were assessed as set out in Table 6-95.

6.8.4.7 The counterfactual of growth rate (CGR) and counterfactual of population size (CPS) estimate the potential changes in annual growth rate and population size during the operational lifespan of 35 years when potential cumulative impacts on this species are considered (Table 6-95). As requested by NatureScot, the PVA results are also presented for 25 years and 50 years, with cumulative impact scenarios compared to a baseline (unimpacted) scenario within Volume 7B, Appendix 6-4: Population Viability Analysis.

Breeding Season

6.8.4.8 For the all projects scenario, the population growth rate is predicted to decline by between 0.11 and 0.16% annually, which after 35 years would result in a reduction in population size by 3.81 – 5.44% when compared to the baseline unimpacted population (Table 6-95).

6.8.4.9 When considering all projects excluding Berwick Bank, the population growth rate is predicted to decline by between 0.09 – 0.13% annually, which after 35 years would result in a reduction in population size by 3.17 – 4.53% when compared to the baseline unimpacted population (Table 6-95).

6.8.4.10 When considering consented projects only plus Caledonia OWF, the population growth rate is predicted to decline by between 0.07 and 0.10% annually, which after 35 years would result in a reduction in population size by 2.59 – 3.68% when compared to the baseline unimpacted population (Table 6-95).

Non-breeding Season

6.8.4.11 For the all projects scenario, the population growth rate is predicted to decline by between 0.12 and 0.25% annually, which after 35 years would result in a reduction in population size by 4.28 – 8.60% compared to the no impact baseline population (Table 6-95).

6.8.4.12 When considering all projects excluding Berwick Bank the population growth rate is predicted to decline by between 0.12 and 0.24% annually, which after 35 years would result in a reduction in population size by 4.14 – 8.27% when compared to the baseline unimpacted population (Table 6-95).

6.8.4.13 When considering consented projects only plus Caledonia OWF, the population growth rate is predicted to decline by between 0.10 and 0.20% annually, which after 35 years would result in a reduction in population size by 3.53 – 6.95% when compared to the baseline unimpacted population (Table 6-95).

Annual Total

6.8.4.14 The estimated annual mortality for gannet due to operational phase distributional responses and collision for all projects is 1,308.83 – 2,170.09 individuals when assessed against the BDMPS population size (Table 6-95). The population growth rate is predicted to decline by between 0.17 and 0.28% annually, which after 35 years would result in a reduction in population size by 5.88 – 9.58% compared to the no impact baseline population (Table 6-95).

6.8.4.15 When considering all projects excluding Berwick Bank, the population growth rate is predicted to decline by between 0.15 and 0.25% annually, which after 35 years would result in a reduction in population size by 5.18 – 8.52% when compared to the baseline unimpacted population (Table 6-95).

6.8.4.16 When considering consented projects only plus Caledonia OWF, the population growth rate is predicted to decline by between 0.12 and 0.20% annually, which after 35 years would result in a reduction in population size by 4.32 – 7.06% when compared to the baseline unimpacted population (Table 6-95).

Table 6-95: PVA results for collision and distributional response cumulative impacts for gannet for the Caledonia OWF during the operational phase, using the BDMPS population as a reference population.

Season	Scenario	Annual Mortality (Individuals)	Impact on Adult Survival	Median CGR (SD)	Median CPS (SD)	Difference in CGR	Difference in CPS
	Baseline (unimpacted)	-	-	1.00	1.00	-	-
All Projects Including Berwick Bank							
Breeding	70%, 1%	839.73	0.091	0.999 ± <0.001	0.962± 0.004	0.11%	3.81%
	70% 3%	1,207.96	0.131	0.998 ± <0.001	0.946± 0.004	0.16%	5.44%
Non-Breeding	70%, 1%	469.10	0.103	0.999± <0.001	0.957± 0.005	0.12%	4.28%
	70% 3%	952.13	0.211	0.998± <0.001	0.914± 0.005	0.25%	8.60%
Annual	70%, 1%	1,308.83	0.142	0.998 ± <0.001	0.941± 0.004	0.17%	5.88%

Season	Scenario	Annual Mortality (Individuals)	Impact on Adult Survival	Median CGR (SD)	Median CPS (SD)	Difference in CGR	Difference in CPS
	70% 3%	2,170.09	0.236	0.997 ± <0.001	0.904± 0.004	0.28%	9.58%
All projects Excluding Berwick Bank							
Breeding	70%, 1%	696.85	0.076	0.999± <0.001	0.968± 0.004	0.09%	3.17%
	70% 3%	998.80	0.109	0.999± <0.001	0.955± 0.004	0.13%	4.53%
Non-Breeding	70%, 1%	452.65	0.099	0.999± <0.001	0.959± 0.005	0.12%	4.14%
	70% 3%	920.92	0.202	0.998± <0.001	0.917± 0.005	0.24%	8.27%
Annual	70%, 1%	1,149.50	0.125	0.999± <0.001	0.948± 0.004	0.15%	5.18%
	70% 3%	1,919.72	0.209	0.998± <0.001	0.915± 0.003	0.25%	8.52%
Consented Projects Only (Plus Caledonia OWF)							
Breeding	70%, 1%	568.79	0.062	0.999 ± <0.001	0.965 ± 0.004	0.07%	2.59%
	70% 3%	809.33	0.088	0.999± <0.001	0.957 ± 0.004	0.10%	3.68%
Non-Breeding	70%, 1%	385.63	0.085	0.999± <0.001	0.965 ± 0.005	0.10%	3.53%
	70% 3%	771.33	0.169	0.998± <0.001	0.931 ± 0.005	0.20%	6.95%
Annual	70%, 1%	954.42	0.104	0.999± <0.001	0.957± 0.004	0.12%	4.32%
	70% 3%	1,580.66	0.172	0.998± <0.001	0.929± 0.004	0.20%	7.06%

6.8.4.17 Whilst the number of gannet potentially affected is not insignificant, an impact of this magnitude as estimated by PVA is unlikely to have a significant effect on the BDMPS population given the minimal impact on growth rate (max reduction 0.28%) and population size (max reduction 9.58%), especially when considering the overall long term stable growth rate of gannets within Scotland and the wider North Sea BDMPS (Burnell *et al*., 2023[91]). The predicted impact would likely be indistinguishable from natural population fluctuations, leading to a low overall magnitude of impact.

Sensitivity of Receptor

6.8.4.18 Based upon the findings presented in the literature review (Table 6-5) Table 6-5gannet sensitivity to collision risk during the operational phase is considered to be **Medium**. The conservation value of the species is **Medium** (Table 6-22 and Table 6-41).

Significance of Effect

6.8.4.19 Taking the **Medium** sensitivity of gannet (Table 6-22 and Table 6-41) and the **Low** magnitude of impact predicted for combined cumulative effects, the overall significance of effect is considered to be **Minor and Not Significant in EIA terms** following the matrix approach (Table 6-17).

Kittiwake

6.8.4.20 The predicted level of mortality due to cumulative combined operational phase distributional responses and collision per defined season for kittiwake is presented in Table 6-96.

6.8.4.21 The combined assessment for kittiwake was completed using the Guidance Approach as The Applicant considers kittiwake to be of low sensitivity to distributional response effects and thus not requiring assessment. Assessment has considered a displacement rate of 30% for all seasons and a range of 1% - 3% mortality rate as set out in the Guidance Approach.

Table 6-96: Seasonal cumulative combined distributional response estimates and collision impacts of kittiwake for the Caledonia OWF during the operational phase, as per the Guidance Approach. Bold text represents percentage point change >0.02.

Defined Season	Regional Baseline Populations and Baseline Mortality Rates (Individuals Per Annum)		Estimated Number of Mortalities from Combined CRM (Mean) and Distributional Responses Per Annum		Change in Average Survival Rate (% Point Change) (Displacement Rate; Mortality Rate)	
	Population (Individuals)	Baseline Mortality	30% Disp; 1% Mort	30% Disp; 3% Mort	30% Disp; 1% Mort	30% Disp; 3% Mort
All Projects Including Berwick Bank						
Breeding season (Mid-April to August)	496,826	77,505	952.32 (158.01 due to distributional responses (Table 6-67), 794.30 due to collision (Table 6-83))	1,268.34 (474.04 due to distributional responses (Table 6-67), 794.30 due to collision (Table 6-83))	**0.192**	**0.255**
Non-breeding season (September to early-April)	829,937	129,470	1,887.09 (121.76 due to distributional responses (Table 6-67), 1,765.33 due to collision (Table 6-83))	2,130.62 (365.29 due to distributional responses (Table 6-67), 1,765.33 due to collision (Table 6-83))	**0.227**	**0.257**
Annual Total	829,937	129,470	2,839.41 (279.78 due to distributional responses (Table 6-67, 2,559.63 due to collision (Table 6-83Table 6-83))	3,398.96 (839.33 due to distributional responses (Table 6-67), 2,559.63 due to collision (Table 6-83))	**0.342**	**0.410**
All Projects Excluding Berwick Bank						
Breeding season (Mid-April to August)	496,826	77,505	490.65 (94.59 due to distributional responses (Table 6-67), 396.06 due to collision (Table 6-83))	679.83 (283.77 due to distributional responses (Table 6-67), 396.06 due to collision (Table 6-83))	**0.099**	**0.137**
Non-breeding season	829,937	129,470	1,574.04 (46.90 due to distributional	1,667.84 (140.69 due to distributional	**0.190**	**0.201**

Defined Season	Regional Baseline Populations and Baseline Mortality Rates (Individuals Per Annum)		Estimated Number of Mortalities from Combined CRM (Mean) and Distributional Responses Per Annum		Change in Average Survival Rate (% Point Change) (Displacement Rate; Mortality Rate)	
	Population (Individuals)	Baseline Mortality	30% Disp; 1% Mort	30% Disp; 3% Mort	30% Disp; 1% Mort	30% Disp; 3% Mort
(September to early-April)			responses (Table 6-67), 1,527.15 due to collision (Table 6-83))	responses (Table 6-67), 1,527.15 due to collision (Table 6-83Table 6-83))		
Annual Total	829,937	129,470	2,064.70 (141.49 due to distributional responses (Table 6-67), 1,923.21 due to collision (Table 6-83))	2,347.67 (424.46 due to distributional responses (Table 6-67), 1,923.21 due to collision (Table 6-83))	**0.249**	**0.283**
Consented Only Plus Caledonia OWF						
Breeding season (Mid-April to August)	496,826	77,505	407.29 (70.55 due to distributional responses (Table 6-67), 336.74 due to collision (Table 6-83))	548.38 (211.64 due to distributional responses (Table 6-67), 336.74 due to collision (Table 6-83Table 6-83))	**0.082**	**0.110**
Non-breeding season (September to early-April)	829,937	129,470	1,390.40 (40.84 due to distributional responses (Table 6-67), 1,349.56 due to collision (Table 6-83))	1,472.08 (122.53 due to distributional responses (Table 6-67), 1,349.56 due to collision (Table 6-83Table 6-83))	**0.168**	**0.177**
Annual Total	829,937	129,470	1,797.69 (111.39 due to distributional responses (Table 6-67), 1,686.30 due to collision (Table 6-83))	2,020.47 (334.17 due to distributional responses (Table 6-67), 1,686.30 due to collision (Table 6-83))	**0.217**	**0.243**

6.8.4.22 As presented within in Table 6-96, for all combined cumulative collision risk and distributional response scenarios considered, the percentage point change in survival rate exceeded the 0.02 threshold as set by NatureScot, PVA has been completed for these scenarios to further consider such a level of effect.

Population Viability Analysis

6.8.4.23 PVA was undertaken using predicted cumulative operational phase mortalities as a result of collision under the Applicant Approach and was calculated using the following as the reference population:

- The regional breeding population (496,826 individuals) for the breeding season.
- The largest non-breeding population size (829,937 individuals) for the non-breeding season and annually.

6.8.4.24 The counterfactual of growth rate (CGR) and counterfactual of population size (CPS) estimate the potential changes in annual growth rate and population size during the operational lifespan of 35 years when potential cumulative impacts on this species are considered (Table 6-97). As requested by NatureScot, the PVA results are also presented for 25 years and 50 years, with cumulative impact scenarios compared to a baseline (unimpacted) scenario within Volume 7B, Appendix 6-4: Population Viability Analysis.

Breeding Season

6.8.4.25 For the all projects scenario, the population growth rate is predicted to decline by between 0.23 and 0.30% annually, which after 35 years would result in a reduction in population size by 7.87 – 10.31% when compared to the baseline unimpacted population (Table 6-97).

6.8.4.26 When considering all projects excluding Berwick Bank, the population growth rate is predicted to decline by between 0.12 – 0.16% and a reduction in population size of 4.15 – 5.67% when compared to the baseline unimpacted population (Table 6-97).

6.8.4.27 When considering consented projects only plus Caledonia OWF, the population growth rate is predicted to decline by between 0.10 and 0.13% and a reduction in population size of 3.44 – 4.61% when compared to the baseline unimpacted population (Table 6-97).

Non-breeding Season

6.8.4.28 For the all projects scenario, the population growth rate is predicted to decline by between 0.27 and 0.30% compared to the no impact baseline, which after 35 years would result in a reduction in population size by 9.23 – 10.39% when compared to the baseline unimpacted population (Table 6-97).

6.8.4.29 When considering all projects excluding Berwick Bank, the population growth rate is predicted to decline by between 0.22 and 0.24% and a reduction in population size of 7.78 – 8.21% when compared to the baseline unimpacted population (Table 6-97).

6.8.4.30 When considering consented projects only plus Caledonia OWF, the population growth rate is predicted to decline by between 0.17 and 0.18% and a reduction in population size of 5.91 – 6.31% when compared to the baseline unimpacted population (Table 6-97).

Annual Total

6.8.4.31 The estimated annual mortality for kittiwake due to operational phase distributional responses and collision for all projects is 2,839 – 3,399 individuals when assessed against the BDMPS population size (Table 6-97). The population growth rate is predicted to decline by between and 0.40 – 0.48% annually, which after 35 years would result in a reduction in population size of 13.58 – 16.05% when compared to the baseline unimpacted population (Table 6-97).

6.8.4.32 When considering all projects excluding Berwick Bank, the population growth rate is predicted to decline by between 0.29 and 0.33% and a reduction in population size of 10.08 – 11.38% when compared to the baseline unimpacted population (Table 6-97).

6.8.4.33 When considering consented projects only plus Caledonia OWF, the population growth rate is predicted to decline by between 0.22 and 0.25% and a reduction in population size of 7.67 – 8.72% when compared to the baseline unimpacted population (Table 6-97).

6.8.4.34 A full description of the methodology and results are presented in Volume 7B, Appendix 6-4: Population Viability Analysis.

Table 6-97: PVA results for collision and distributional response impacts for kittiwake for the Caledonia OWF during the operational phase, using the BDMPS population as a reference population.

Season	Scenario	Annual Mortality (Individuals)	Impact on Adult Survival	Median CGR (SD)	Median CPS (SD)	Difference in CGR	Difference in CPS
	Baseline (unimpacted)	-	-	1.00	1.00	-	-
All Projects Including Berwick Bank							
Breeding	30%, 1%	952.32	0.192	0.998 ± <0.001	0.922± 0.006	0.23%	7.85%
	30% 3%	1,268.34	0.255	0.997 ± <0.001	0.897± 0.005	0.30%	10.33%
Non-Breeding	30%, 1%	1,887.09	0.227	0.997± <0.001	0.908± 0.004	0.27%	9.23%
	30% 3%	2,130.61	0.257	0.997± <0.001	0.896± 0.004	0.30%	10.39%
Annual	30%, 1%	2,839.40	0.342	0.996 ± <0.001	0.864± 0.004	0.40%	13.58%
	30%, 3%	3,399	0.410	0.995 ± <0.001	0.839± 0.004	0.48%	16.05%
All Projects Excluding Berwick Bank							
Breeding	30%, 1%	490.65	0.099	0.999± <0.001	0.959± 0.006	0.12%	4.14%
	30% 3%	679.83	0.137	0.998± <0.001	0.943± 0.006	0.16%	5.66%
Non-Breeding	30%, 1%	1,574.04	0.190	0.998± <0.001	0.922± 0.004	0.22%	7.78%
	30% 3%	1,667.84	0.201	0.998± <0.001	0.918± 0.004	0.24%	8.21%
Annual	30%, 1%	2,064.69	0.249	0.997± <0.001	0.899± 0.004	0.29%	10.08%
	30%, 3%	2,347.66	0.283	0.997± <0.001	0.886± 0.004	0.33%	11.38%

Season	Scenario	Annual Mortality (Individuals)	Impact on Adult Survival	Median CGR (SD)	Median CPS (SD)	Difference in CGR	Difference in CPS
Consented Projects Only (Plus Caledonia OWF)							
Breeding	30%, 1%	366.06	0.074	0.999 ± <0.001	0.966 ± 0.006	0.10%	3.44%
	30% 3%	507.13	0.102	0.999± <0.001	0.954 ± 0.006	0.13%	4.61%
Non-Breeding	30%, 1%	1,188.02	0.143	0.998± <0.001	0.941 (0.0041)	0.17%	5.91%
	30% 3%	1,269.70	0.153	0.998± <0.001	0.937 (0.004)	0.18%	6.31%
Annual	30%, 1%	1,554.05	0.187	0.998± <0.001	0.923± 0.004	0.22%	7.67%
	30%, 3%	1,776.83	0.214	0.997± <0.001	0.913± 0.004	0.25%	8.72%

6.8.4.35 An impact of this magnitude as estimated by PVA may potentially have a material effect on the BDMPS population, when considering the all projects scenario. Although, the predicted impact would likely be difficult to differentiate from natural population fluctuations caused by other factors such as changes in prey availability, avian influenza outbreaks, or adverse weather. It is important to note, the assessment above did not consider macro-avoidance of kittiwake, nor that it is likely that all projects will build out their worst case design scenarios as assess and thus likely to represent an overestimation of collision mortality. Further to this, the Proposed Development (Offshore) only provides a minor contribution (~2.6%) to the overall level of predicted effect, which when considered a conclusion of **Low** overall magnitude of impact is considered appropriate.

Sensitivity of Receptor

6.8.4.36 Based upon the findings presented in the literature review (Table 6-5) kittiwake sensitivity to collision risk and distributional responses during the operational phase is considered to be **Medium**. The conservation value of the species is **Medium** (Table 6-22 and Table 6-41).

Significance of Effect

6.8.4.37 Taking the **Medium** sensitivity of kittiwake (Table 6-22 and Table 6-41) and the low magnitude of impact predicted by the PVA, as well as the small relative impact of the Proposed Development (Offshore), the overall significance of effect of combined cumulative effects is considered to be **Minor and Not Significant in EIA terms** following the matrix approach (Table 6-17).

6.9 Transboundary Effects

6.9.1.1 Transboundary effects arise when impacts from a development within one European Economic Area (EEA) state is likely to have a significant effect on the environment in another EEA state. Transboundary impacts upon offshore ornithological receptors are possible due to the wide foraging and migratory ranges of typical bird species in the North Sea.

6.9.1.2 Based on the location of the Proposed Development (Offshore) and the key receptors identified, it is considered that there will be no significant transboundary effects on birds in the breeding season, on the basis that there are no non-UK seabird colonies within MMFR +1S.D or other evidence to suggest connectivity (Wakefield *et al.,* 2017[33]; Woodward *et al.,* 2019[20]). Therefore, colonies outside of UK waters will not contribute to any transboundary effects in the breeding season.

6.9.1.3 During the non-breeding season, key receptors are able to travel more widely and as such, may come into contact with OWFs in other EEA states. However, since the spatial scope for a transboundary assessment would be much larger than that considered for the Proposed Development alone or cumulatively with other UK projects, then any assessment of potential impacts and effects would be against larger seabird population sizes accounting for wider a BDMPS. Therefore, it is apparent that the scale of OWF developments within such a wider context would be relatively much smaller with respect to any potential impacts considered at the UK North Sea (and English Channel where appropriate) scale. Therefore, the inclusion of non-UK offshore wind farms is considered very unlikely to alter the conclusions of the existing cumulative assessment, and highly likely to reduce estimated impacts at population levels if calculated at larger spatial scales.

6.10 Inter-related Effects

6.10.1.1 Inter-related effects assessment allows for the consideration of significant effects from multiple impacts and activities from the construction, operation and decommissioning of the Proposed Development (Offshore) on the same receptor, or a group of receptors.

6.10.1.2 These effects can include two core categories of effects:

- Project lifetime effects: assessment of effects that may occur throughout more than one phase of the project (construction, operational and maintenance, and decommissioning), which may interact and potentially create a more significant impact on a receptor than if assessed in isolation within a key project phase (e.g. vessel activity); and
- Receptor led effects: assessment of effects to interact, spatially and temporally, thus creating inter-related impacts on a single receptor. A key example is the consideration of all identified effects on offshore ornithology (collision risk, disturbance and displacement, barrier effects, lighting, and indirect effects) and how these effects may interact to produce a different, or greater, impact on a receptor than when considered in isolation. Receptor-led effects can be short term, temporary or transient, or longer-term.

6.10.1.3 Inter-relationships between EIA topics could lead to wider environmental effects. These may occur where a number of separate impacts, such as air quality, affect a single receptor such as fauna.

6.10.1.4 Inter-related effects assessment for the Proposed Development (Offshore) has considered receptor-led effects. This assessment has also been undertaken with reference to the potential for effects to arise relative to receptor groups. Receptor groups is used as the proposed approach to inter-relationships assessment has not assessed every receptor assessed at the EIA stage, but potentially sensitive groups of receptors.

6.10.1.5 The broad approach to inter-related effects assessment has followed the following key steps:

- Review of effects for individual EIA topics;
- Review of assessment carried out for each EIA topic, to identify "receptor groups" requiring assessment;
- Potential inter-related effects on receptor groups identified via review of the assessment carried out across a range of topics;
- Development of lists for potential receptor-led effects; and
- Qualitative assessment on how individual effects may combine to create inter-related effects.

6.10.1.6 The inter-relationships assessment has only considered effects produced by the Proposed Development (Offshore), and not those from other developments (these are considered within the Cumulative Effects

Assessment in Section 6.8). Note that no inter-related assessment has been undertaken for receptors and impacts scoped out of the EIA process.

6.10.1.7 Each phase of the Proposed Development (Offshore) may cause a range of effects on offshore ornithological receptors. The magnitude of these effects has been assessed individually, drawing from a wide science base that includes project-specific surveys and knowledge of the bird ecology within the North Sea.

6.10.1.8 Each effect has the potential to form an inter-relationship, directly impacting seabird receptors and become a source for impacts upon receptors beyond those considered within the context of offshore ornithology.

6.10.1.9 How impacts to offshore ornithological receptors may form inter-relationships with other receptor groups and assessments of significance are provided in the chapters listed in Table 6-98. This table sets out where other chapters have been used to inform offshore ornithology inter-relationships assessment.

6.10.1.10 As none of the offshore impacts on birds were assessed individually to have any greater than a minor adverse effect, it is considered highly unlikely that they will inter-relate to form an overall significant effect on offshore ornithology receptors.

Table 6-98: Inter-relationships chapter topics.

Topic	Chapter	Where Reviewed in this Chapter
Indirect impacts through effects on habitats and prey: Construction	Volume 2, Chapter 4: Benthic Subtidal and Intertidal Ecology (to be read in conjunction due to habitat intersections at MHWS).	Section 6.7.1
Indirect impacts through effects on habitats and prey: operation	Volume 2, Chapter 5: Fish and Shellfish Ecology (to be read in conjunction due to the potential indirect effects from potential changes in distribution and abundance of forage fish species).	Section 6.7.2
Indirect impacts through effects on habitats and prey: Decommissioning		Section 6.7.1

6.11 Mitigation Measures and Monitoring

6.11.1 Construction

6.11.1.1 No additional mitigation measures beyond those outlined in Table 6-19 are proposed for the construction phase.

6.11.2 Operation

6.11.2.1 Overall, impacts for all receptors for were assessed as minor at most (Table 6-99). Therefore, no additional mitigation measures beyond those outlined in Table 6-19 are proposed for the operation phase.

6.11.3 Decommissioning

6.11.3.1 No additional mitigation measures beyond those outlined in Table 6-19 are proposed for the decommissioning phase.

6.12 Summary of Effects

6.12.1.1 This EIAR chapter has investigated the potential effects on ornithological receptors arising for the Proposed Development (Offshore). The range of potential impacts and associated effects has been informed by consultation responses from stakeholders, alongside reference to existing legislation and guidance.

6.12.1.2 Table 6-99 presents a summary of the significant effects assessed within this EIAR chapter, any mitigation required, and the residual effects are provided.

Table 6-99: Summary of effects for Offshore Ornithology.

Potential Impact	Receptor	Magnitude	Sensitivity of Receptor	Significance	Mitigation Measure	Residual Effect
Construction and Decommissioning						
Distributional Responses: Array Area	Kittiwake	Negligible	Low	Negligible	No mitigation required above and beyond embedded mitigation measures outlined in Table 6-19.	Negligible
	Guillemot	Negligible	Medium	Negligible	No mitigation required above and beyond embedded mitigation measures outlined in Table 6-19.	Negligible
	Razorbill	Negligible	Medium	Negligible	No mitigation required above and beyond embedded mitigation measures outlined in.	Negligible
	Puffin	Negligible	Medium	Negligible	No mitigation required above and beyond embedded mitigation measures outlined in Table 6-19.	Negligible
	Gannet	Negligible	Low	Negligible	No mitigation required above and beyond embedded mitigation measures outlined in Table 6-19.	Negligible

Potential Impact	Receptor	Magnitude	Sensitivity of Receptor	Significance	Mitigation Measure	Residual Effect
Distributional Responses: OECC and Landfall	Red-throated diver	Negligible	High	Negligible	No mitigation required above and beyond embedded mitigation measures outlined in Table 6-19.	Negligible
Distributional Responses: Vessel Transit	Red-throated diver	Negligible	High	Negligible	No mitigation required above and beyond embedded mitigation measures outlined in Table 6-19.	Negligible
Indirect Impacts on Prey Species	All Receptors	Negligible	Low - High	Negligible	No mitigation required above and beyond embedded mitigation measures outlined in Table 6-19.	Negligible
Artificial Light	All Receptors	Negligible	N/A	Negligible	No mitigation required above and beyond embedded mitigation measures outlined in Table 6-19.	Negligible
Operation and Maintenance						
Distributional Responses: Array Area	Kittiwake	Negligible	Low	Negligible	No mitigation required above and beyond embedded mitigation	Negligible

Potential Impact	Receptor	Magnitude	Sensitivity of Receptor	Significance	Mitigation Measure	Residual Effect
					measures outlined in Table 6-19.	
	Guillemot	Negligible	Medium	Negligible	No mitigation required above and beyond embedded mitigation measures outlined in Table 6-19.	Negligible
	Razorbill	Negligible	Medium	Negligible	No mitigation required above and beyond embedded mitigation measures outlined in Table 6-19.	Negligible
	Puffin	Negligible	Medium	Negligible	No mitigation required above and beyond embedded mitigation measures outlined in Table 6-19.	Negligible
	Gannet	Negligible	Low	Negligible	No mitigation required above and beyond embedded mitigation measures outlined in Table 6-19.	Negligible
Distributional Responses: Vessel Transit	Red-throated diver	Negligible	High	Negligible	No mitigation required above and beyond embedded mitigation measures outlined in Table 6-19.	Negligible

Potential Impact	Receptor	Magnitude	Sensitivity of Receptor	Significance	Mitigation Measure	Residual Effect
Collision Risk	Kittiwake	Negligible	Medium	Negligible	No mitigation required above and beyond embedded mitigation measures outlined in Table 6-19.	Negligible
	Great black-backed gull	Negligible	High	Negligible	No mitigation required above and beyond embedded mitigation measures outlined in Table 6-19.	Negligible
	Herring gull	Negligible	High	Negligible	No mitigation required above and beyond embedded mitigation measures outlined in Table 6-19.	Negligible
	Great skua	Negligible	Medium	Negligible	No mitigation required above and beyond embedded mitigation measures outlined in Table 6-19.	Negligible
	Gannet	Negligible	Medium	Negligible	No mitigation required above and beyond embedded mitigation measures outlined in.	Negligible
	Kittiwake	Negligible	Medium	Negligible	No mitigation required above and beyond embedded mitigation	Negligible

Potential Impact	Receptor	Magnitude	Sensitivity of Receptor	Significance	Mitigation Measure	Residual Effect
Distributional Responses and collision risk					measures outlined in Table 6-19.	
	Gannet	Negligible	Medium	Negligible	No mitigation required above and beyond embedded mitigation measures outlined in Table 6-19.	Negligible
Artificial Light	All Receptors	Negligible	N/A	Negligible	No mitigation required above and beyond embedded mitigation measures outlined in Table 6-19.	Negligible
Cumulative						
Cumulative Distributional Responses	Kittiwake	Negligible	Low	Negligible	No mitigation required above and beyond embedded mitigation measures outlined in Table 6-19.	Negligible
	Guillemot	Low	Medium	Applicant:Minor Guidance: Minor - Moderate	No mitigation required above and beyond embedded mitigation measures outlined in Table 6-19.	Minor
	Puffin	Low	Medium	Minor	No mitigation required above and beyond embedded mitigation	Minor

Potential Impact	Receptor	Magnitude	Sensitivity of Receptor	Significance	Mitigation Measure	Residual Effect
					measures outlined in Table 6-19.	
	Razorbill	Low	Medium	Minor	No mitigation required above and beyond embedded mitigation measures outlined in Table 6-19.	Minor
	Gannet	Low	Medium	Minor	No mitigation required above and beyond embedded mitigation measures outlined in Table 6-19.	Minor
Cumulative Collision Risk	Kittiwake	Low	Medium	Minor	No mitigation required above and beyond embedded mitigation measures outlined in Table 6-19.	Minor
	Great black-backed gull	Low	High	Minor	No mitigation required above and beyond embedded mitigation measures outlined in Table 6-19.	Minor
	Herring gull	Low	High	Minor	No mitigation required above and beyond embedded mitigation measures outlined in Table 6-19.	Minor

Potential Impact	Receptor	Magnitude	Sensitivity of Receptor	Significance	Mitigation Measure	Residual Effect
	Gannet	Low	Medium	Minor	No mitigation required above and beyond embedded mitigation measures outlined in Table 6-19.	Minor
Cumulative combined distributional responses and collision	Gannet	Low	Medium	Minor	No mitigation required above and beyond embedded mitigation measures outlined in Table 6-19.	Minor
	Kittiwake	Low	Medium	Minor	No mitigation required above and beyond embedded mitigation measures outlined in Table 6-19.	Minor

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