Chapter 11: Offshore Ornithology

Array EIA Report

2024

ossian

Version	Comments	Authored by	Reviewed by	Approved by
FINAL	Final	NIRAS/RPS	RPS	RPS

Approval for Issue		
For and on behalf of Ossian OWFL	Rich Morris	28 June 2024

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11.1. INTRODUCTION

1. This chapter of the Array Environmental Impact Assessment (EIA) Report presents the assessment of the likely significant effects (LSE[1]) (as per the EIA Regulations) on offshore ornithology as a result of the Ossian Array which is the subject of this application (hereafter referred to as "the Array"). Specifically, this chapter considers the potential impacts of the Array on offshore ornithology during the construction, operation and maintenance, and decommissioning phases.

2. The following technical chapters also inform the assessment presented in this chapter:

- volume 2, chapter 8: Benthic Subtidal Ecology; and
- volume 2, chapter 9: Fish and Shellfish Ecology.

3. This chapter relies upon information contained within:

- volume 3, appendix 11.1: Offshore Ornithology Baseline Characterisation Technical Report;
  - annex A: Offshore Ornithology Design-Based Abundance Estimates;
  - annex B: Offshore Ornithology MRSea Abundance Estimates;
  - annex C: Offshore Ornithology Colony Counts for Breeding Season Regional Populations;
  - annex D: Offshore Ornithology Apportioned Design-Based Abundance Estimates;
- volume 3, appendix 11.2: Offshore Ornithology Collision Risk Model (CRM) Technical Report;
  - annex A: Offshore Ornithology Deterministic CRM Estimates;
  - annex B: Offshore Ornithology Migratory CRM Estimates;
- volume 3, appendix 11.3: Offshore Ornithology Displacement Technical Report;
  - annex A: Offshore Ornithology Displacement Data;
- volume 3, appendix 11.4: Offshore Ornithology MRSea Technical Report;
  - annex A: Offshore Ornithology MRSea Validation Methodology;
  - annex B: Offshore Ornithology MRSea and Design-Based Abundance Estimates Comparison;
- appendix 11.5: Offshore Ornithology Population Viability Analysis (PVA) Technical Report.

11.2. PURPOSE OF THE CHAPTER

4. The Array EIA Report provides the Scottish Ministers, statutory and non-statutory stakeholders with adequate information to determine the LSE[1] of the Array on the receiving environment. This is further outlined in volume 1, chapter 1.

5. The purpose of this offshore ornithology Array EIA Report chapter is to:

- present the existing environmental baseline established from desk studies, site-specific surveys, numerical modelling studies and consultation with stakeholders;
- identify any assumptions and limitations encountered in compiling the environmental information;
- present the environmental impacts on offshore ornithology arising from the Array and reach a conclusion on the LSE[1] on offshore ornithology, based on the information gathered and the analysis and assessments undertaken; and
- highlight any necessary monitoring and/or mitigation measures which are recommended to prevent, reduce or offset the likely significant adverse effects of the Array on offshore ornithology.

11.3. STUDY AREA

6. Figure 11.1 illustrates the offshore ornithology study area for the Array which encompasses:

- the Array (i.e. the area in which the wind turbines will be located);
- a 4 km buffer around the Array (the Array Offshore Ornithology Study Area); and
- an 8 km buffer around the Array (the Array Offshore Ornithology Survey Area).

7. In addition, it is important to consider that ornithological receptors are highly mobile, travelling potentially long distances whilst foraging and on migration. As such, the Array has the potential to impact seabird populations over a much wider region. Consideration has therefore also been given to regional populations of seabirds that may have connectivity to the Array. The geographic spread of these regional populations varies according to biological connectivity, which differs between species and seasons, as detailed in volume 3, appendix 11.1. The regional Zone of Influence (ZoI) is therefore not a single, defined area, but a dynamic area over which the Array's impacts may be felt according to the species and time of year.

8. In the breeding season, the regional ZoI is defined as the area within the site- and species-specific foraging range recommended by NatureScot (2023c). For most species, this is the species' mean-max + 1SD foraging range from Woodward *et al.* (2019), but in other cases the recommended foraging range is modified to take into account site-specific evidence.

9. Outside of the breeding season, for most species the regional ZoI is defined as the season- and species-specific BDMPS region as described in Furness (2015). However, in line with NatureScot (2023d), a different ZoI is applied to guillemot and large gulls (herring gull, lesser black-backed gull and greater black-backed gull). For those species, the ZoI is defined as the same region as per the breeding season, on the basis of tracking data that indicates birds remain within the general vicinity of their breeding colonies. It should however be noted that the population present within the ZoI may differ between seasons (even if the ZoI itself is the same) as the result of different population structures (i.e. during the breeding season, prior to fledging juvenile chicks will not be present at sea) and the potential for an influx of birds breeding elsewhere.

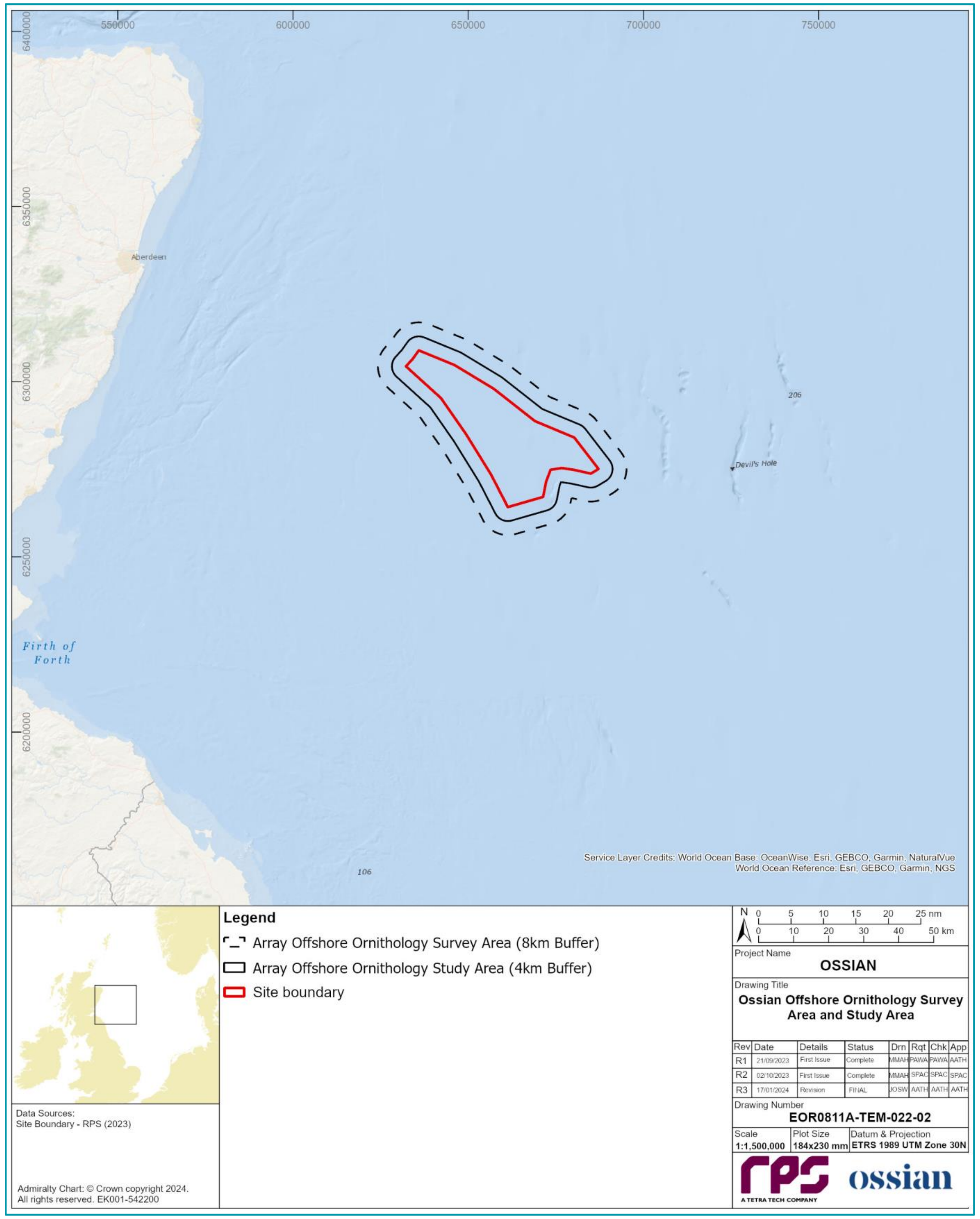

Figure 11.1: Offshore Ornithology Study Areas

11.4. POLICY AND LEGISLATIVE CONTEXT

10. Volume 1, chapter 2 of the Array EIA Report presents the policy and legislation of relevance to renewable energy infrastructure. Policy specifically in relation to offshore ornithology is contained in the Sectoral Marine Plan (SMP) for Offshore Wind Energy (Scottish Government, 2020), the Scottish National Marine Plan (NMP) (Scottish Government, 2015) and the United Kingdom (UK) Marine Policy Statement (MPS) (HM Government, 2011). Table 11.1 presents a summary of the legislative provisions relevant to offshore ornithology, with relevant policy provisions set out in Table 11.2 and Table 11.3. Further detail is presented in volume 1, chapter 2.

Table 11.1: Summary of Legislation Relevant to Offshore Ornithology

Summary of Relevant Legislation	How and Where Considered in the Array EIA Report
Biodiversity	
The Habitats Regulations: The Conservation of Offshore Marine Habitats and Species Regulations 2017 The Conservation of Habitats and Species Regulations 2017 The Conservation of Habitats and Species (Amendment) (European Union (EU) Exit) Regulations 2019	The Habitats Regulations require that where a plan or project that is not directly connected with, or necessary to the management of a European site, but likely to have a significant effect on a European site (either individually or in combination with other plans or projects), it shall be subject to appropriate assessment of its implications for the site in view of the site's conservation objectives. LSE[1] on ornithology features of European sites are considered from an EIA perspective within this report. Assessment of the likely significant effect (LSE[2]) (in Habitat Regulations Appraisal (HRA) terms) on the qualifying interest features of Special Protection Areas (SPAs), together with assessment on other Natura sites and qualifying interest features (e.g. Special Areas of Conservation (SAC)) from a habitats perspective are provided in a HRA; Array Report to Inform Appropriate Assessment (RIAA) (Ossian OWFL, 2024)).
The Nature Conservation (Scotland) Act 2004 (as amended)	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. This Array EIA Report as a whole demonstrates that the Array will comply with the Act and provides information to public bodies and office holders to enable them to fulfil their obligations under the Act.
Wildlife and Natural Environment (Scotland) Act 2011	The Act makes amendments to the 1981 Act (below) which concern the management of Sites of Specific Scientific Interests (SSSIs) and the enforcement of wildlife crime.
The Wildlife and Countryside Act 1981 (as amended)	The primary legislation protecting animals, plants and certain habitats in the UK, including all wild birds and their nests, eggs and chicks. This Array EIA Report as a whole demonstrates that the Array will comply with the Act and provides information to public bodies and office holders to enable them to fulfil their obligations under the Act.
EIA Regulations: The Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017 The Marine Works (Environmental Impact Assessment) Regulations 2007	The EIA Regulations set out when environmental impact assessments are required and the procedures for carrying out and reporting of environmental impact assessments. It is noted that the Array does meet the criteria for carrying out an environmental impact assessment, and this Array EIA Report is therefore set out to meet the requirements of the Regulations.

Table 11.2: Summary of Policy Provisions Relevant to Offshore Ornithology

Summary of Relevant Policy	How and Where Considered in the Array EIA Report
Scottish National Marine Plan	
Section 11, Part 1: Objectives and Marine Planning Policies Sustainable development of offshore wind, wave and tidal renewable energy in the most suitable locations.	The choice of location for the Array is discussed in volume 1 chapter 4.
Policy 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.	This Array EIA Report sets out how Ossian will comply with all relevant legal requirements (refer to Table 11.1). No ornithological features are classified as Priority Marine Features and so they are not discussed further in this Chapter, but may be considered in other Chapters as necessary. Measures taken to protect the marine area relevant to ornithology are set out in Table 11.18.
Living within Environmental Limits 11.32 A strategic approach to mitigating potential impacts and cumulative impacts on the marine environment forms an integral part of marine planning and decision making, whilst issues arising in the coastal interface should align between marine and terrestrial processes.	A Cumulative Effect Assessment (CEA) has been undertaken and is outlined in section 11.12 which can be used to inform the Scottish Government's strategic approach to planning and decision making.
Sectoral Marine Plan for offshore wind energy	
The Plan aims to identify sustainable plan options for the future development of commercial-scale offshore wind energy in Scotland.	The Array is located within the East 1 Plan Option. The location of the Array has therefore been informed by the Plan Development Process.
Within the East region a key pathway of concern relates to effects on bird populations, due to potential in-combination impacts resulting from collision risk and displacement for key seabird species.	The potential impact on bird populations from the Array alone and in-combination with other projects is assessed in this report and the accompanying Array RIAA.

11.5. CONSULTATION

11. Table 11.3 presents a summary of the key issues raised during consultation activities undertaken to date specific to offshore ornithology for the Array and in the Ossian Array Scoping Opinion (MD-LOT, 2023) along with how these have these have been considered in the development of this offshore ornithology Array EIA Report chapter. Further detail is presented within volume 1, chapter 5. Note that consultation activities/topics that related solely to HRA matters are presented in the Array RIAA (Ossian OWFL, 2024).

Table 11.3: Summary of Issues Raised During Consultation and Scoping Opinion Representations Relevant to Offshore Ornithology

Date	Consultee and Type of Consultation	Issue(s) Raised	Response to Issue Raised and/or Where Considered in this Chapter
Pre-Scoping Workshop			
November 2022	Marine Directorate[1] - Licensing Operations Team (MD-LOT)	Support for NatureScot preferred use of MRSea over design-based abundance estimates where possible.	MRSea abundance estimates have been used for assessment where available. Details on MRSea modelling are presented in volume 3, appendix 11.4. Abundance estimates based on MRSea modelling are presented in volume 3, appendix 11.1, annex B. For CRM and displacement analysis, the approach to calculating densities or abundances for assessment are described in volume 3, appendix 11.2 and volume 3, appendix 11.3, respectively.
November 2022	NatureScot	NatureScot advised to follow their published guidance regarding seasonality.	The seasons used are presented in Table 3.1 in volume 3, appendix 11.1, predominantly deviations from the guidance on seasonal definitions were agreed with NatureScot in advance.
November 2022	Royal Society for the Protection of Birds (RSPB)	RSPB raised the need to consider the impacts of Highly Pathogenic Avian Influenza (HPAI).	NatureScot advised that guidance was still being developed. The approach to HPAI taken in this report is further discussed in section 11.7.6.
Scoping Opinion			
June 2023	RSPB Scoping Representation (April 2023)	*"The RSPB has outstanding issues with the manner in which the bio-seasons definitions from Furness (2015) have been defined for gannet and kittiwake."*	The seasons used and justifications are presented in in volume 3, appendix 11.1.
		"Whilst the RSPB agree with the majority of the NatureScot advised avoidance rates including the use of a 98.9% avoidance rate for non-breeding gannets, in our opinion a 98% avoidance rate is more appropriate for breeding gannets."	The avoidance rates used and justification are presented in in volume 3, appendix 11.2. Avoidance rates have been informed by guidance (NatureScot, 2023g) and available evidence (Bowgen and Cook, 2018; Ozsanlav-Harris *et al.* 2023). The avoidance rate therefore used for gannet was 0.9928 (±0.0003)
		"This seasonally defined change in reactive behaviour will also be reflected in the distributional changes occurring due to the presence of wind turbines. As such, alongside the 70% displacement rate recommended by NatureScot for the assessment of gannet, we recommend the presentation of 60% displacement rate during the breeding season."	A range of displacement and mortality rates have been presented (refer to volume 3, appendix 11.3 and section 11.11).
		"RSPB Scotland disagree with the magnitude of impact being assessed in terms of predicted increases to baseline mortality. As above, small increases in mortality can have large impacts. It is more meaningful to view impacts across the lifeline of the development in comparison to population size in the absence of the development and consider long-term viability of colonies and time for recovery."	The increase in baseline mortality is used as an initial indication of whether or not there may be a potentially significant effect. In line with a proportionate approach to assessment, more detailed analysis of impacts across the life of the project (in the form of PVA) is then carried out where a potentially significant effect may occur (e.g. section 11.12.3).
June 2023	Natural England Scoping Representation (April 2023)	*"Note that the joint-Statutory Nature Conservation Bodies (SNCB) (2022) guidance on displacement assessment states that "no gradient of impact of displacement level should be applied to the buffer zone, as there is not sufficient evidence to underpin any such gradient application on a species-by-species basis". Natural England therefore advise that the same displacement and mortality rates should be applied throughout the project area and any buffer area."*	No gradient of impact has been applied to displacement or mortality rates, as detailed in section 11.11 and volume 3, appendix 11.3.

[1] Marine Directorate was known as Marine Scotland at the time of this workshop.

Date	Consultee and Type of Consultation	Issue(s) Raised	Response to Issue Raised and/or Where Considered in this Chapter
		"If there is clear evidence relating to the proportion of adults within the population likely to be taking a sabbatical in any given year, then this can be considered at the population modelling stage. The weight of evidence is on demonstrating: *a) the proportion of breeding adults in the population likely to be taking a sabbatical in any given year* *b) whether the SPA population estimates include or exclude sabbatical birds, and* *c) whether or not sabbatical birds are likely to use the area of sea around the SPA colony.* *This evidence can be used to inform whether and how sabbaticals are best incorporated in a PVA.* *In the absence of such evidence, Natural England's standard advice is to assume no sabbaticals, i.e. to assume all adult birds are breeding birds. Natural England advise that we do not agree with the use of sabbatical rates to exclude sabbatical birds from impact assessment, nor do we consider the inclusion of sabbatical rates to be appropriate within the apportioning process."*	For this Array EIA Report chapter, assessment considers the impact on all birds. Further consideration on the relevance of sabbatical birds to estimating impacts on designated breeding populations is given in the Array RIAA (Ossian OWFL, 2024).
		"We note the need for a precautionary assessment of impacts given the recent and ongoing outbreaks of HPAI in seabirds."	The impacts of HPAI on the baseline and future baseline are discussed in Section 11.7 and are taken into account when considering the recoverability of receptors section 11.11.
		"Collision risk avoidance rates advised by Natural England for kittiwake and gannet are expected to change in the near future. A report reviewing available evidence will shortly be published by Joint Nature Conservation Committee (JNCC) and following this Natural England will advise new rates are used for kittiwake and gannet. In the meantime Natural England have issued new interim guidance on avoidance rates for use in Collision Risk Modelling and have new interim guidance on avoidance rates for use in Collision Risk Modelling."	The avoidance rates used are presented with justification in volume 3, appendix 11.2. CRM has been undertaken using the avoidance rates recommended by NatureScot (2023g) alongside alternative avoidance rates where the Applicant considers these to be more appropriate, based on the most up-to-date research, as well as these new rates forming interim advice from the SNCB (as detailed within the NatureScot 2023g guidance).
June 2023	NatureScot Scoping Representation (May 2023)	*"As per our Guidance Note 2, our preference is that MRSea should be used for density modelling and note as per section 6.4.7 that design-based methods are proposed instead. This aspect should be discussed further once the baseline characterisation report is available so agreement can be reached as to the best method for this wind farm based on the availability of species-specific data."*	MRSea abundance estimates have been used for assessment where available. Details on MRSea modelling are presented in volume 3, appendix 11.1, annex B. Collision and displacement rates based on design-based estimates are presented for information in volume 3, appendix 11.2 and appendix 11.3, respectively.
		"It is acceptable at this stage to present breeding seasons as laid out in Table 6.15, however, going forward we would expect seasons as defined in our guidance note Seasonal Periods for Birds in the Scottish Marine Environment to be used."	The seasons used are presented with justification in volume 3, appendix 11.1.

Date	Consultee and Type of Consultation	Issue(s) Raised	Response to Issue Raised and/or Where Considered in this Chapter
		"For non-breeding populations, we support the use of Furness (2015) which is in line with our guidance. However, as is highlighted in paragraph 458, guillemot and herring gull do not disperse as widely as other species outside the breeding season, this was shown for guillemot in the recent study by Buckingham et al. (2022). Therefore, for guillemot we advise the non-breeding season population comprises the breeding population found within the MMFR+1SD (mean max foraging range plus 1 standard deviation) of the development + age classes, as per our Guidance Note 4. *"For herring gull we advise that the regional breeding population found within the MMFR+1SD with a correction factor is used as the non-breeding population. A correction factor should be applied to account for the influx of continental breeding birds into eastern Scotland during the nonbreeding season. The correction factor should be calculated from the proportions of overseas and western UK birds in the UK North Sea and Channel BDMPS (Furness, 2015)."*	The regional populations used are presented in volume 3, appendix 11.1. As there are no breeding colonies within foraging range, a bespoke calculation to calculate a breeding season population was used (this approach follows that used and agreed for Hornsea Three (Orsted, 2019)) and the BDMPS population from Furness used in the non-breeding season (as following NS's guidance we would conclude there should be no birds present in either season). It should be noted that the advised foraging ranges have been applied in the Array RIAA (Part 3) (Ossian OWFL, 2024). However, as requested by Natural England in their HRA Screening consultation response in June 2023, non-breeding guillemot from the Flamborough and Filey Coast SPA has also been included in the Array RIAA (Ossian OWFL, 2024).
		"The matrix-based approach is proposed for all species even where SeabORD is available and relevant. This is not in line with our Guidance Note 8. Instead, we would expect SeabORD to be used for puffin, guillemot, razorbill and kittiwake during the chick-rearing period and that the matrix-based model is used for all other species, and for puffin, guillemot, razorbill and kittiwake outside of the chick-rearing period. Guidance Note 8 details current displacement and mortality rates."	Displacement assessment has been carried out using the matrix approach for all species, as detailed in section 11.11 and in volume 3, appendix 11.3. The reasons for not carrying out SeabORD analysis have been presented to, and agreed with, NatureScot through subsequent consultation and engagement.
		"The proposed approach is to use the McGregor et al (2018) stochastic collision risk model which is in line with our guidance. We advise the use of the 2022 update to the sCRM tool shiny app (Caneco 2022). This update should also be used to run deterministic output, with seed values specified to enable repeatability. We require that outputs for both stochastic and deterministic CRM are presented using this tool. The EIA Scoping Report states that for all species Option 2 will be applied using generic flight height distributions from "Corrigendum," 2014 and Johnston et al (2014), and that where applicable Band option 3 will be run for species with available avoidance rates, this is in line with our guidance. *"Site-specific flight height data is not proposed for CRM. Johnston et al. (2014) currently remains the recommended reference for generic flight heights and is the default within the sCRM tool, and as per our guidance, we expect this to be used in the assessment."*	The approach to CRM is presented in volume 3, appendix 11.2. The CRM has been run using NatureScot's advised approach but additional runs have also been carried out where deemed appropriate (e.g. considering alternative flight speeds).
		"At the time of writing, we advise that collision impacts and distributional response impacts should be additive. This reflects the best publicly available evidence for considering species such as gannet and kittiwake which are susceptible to both impacts. We are aware of work being undertaken by Natural England on this topic, and NatureScot will review its position on this following publication."	Collision and displacement have been assessed additively (refer to section 11.11) although it should be noted that this approach is considered to be overly precautionary given the inherent interaction between those two pathways as further discussed in paragraph 326.
		"We welcome the designed in measures described in section 6.4.4. We advise that the full range of mitigation measures and published guidance is considered and discussed in the EIA Report."	Mitigation measures are presented in Table 11.18.
		"No specific monitoring for offshore ornithology is mentioned in the Mitigation and Monitoring Commitments Register in the EIA Scoping Report (Appendix 2). Further information on proposed ornithological monitoring should be discussed in the EIA Report."	Proposed monitoring is presented in section 11.13.
		"We note the proposed approach to Transboundary impacts set out in section 6.4.9 and Appendix 3, and the conclusion that transboundary impacts may arise during non-breeding season. We recommend further discussion on this topic with Marine Directorate and NatureScot following submission of the final baseline report."	The transboundary assessment is presented in section 11.14.

Date	Consultee and Type of Consultation	Issue(s) Raised	Response to Issue Raised and/or Where Considered in this Chapter
June 2023	MD-LOT	*"The Scottish Ministers agree with the NatureScot representation that the key species to be scoped into the EIA Report should be informed by the 24 month Digital Aerial Survey (DAS) campaign."*	The baseline characterisation and identification of Valued Ornithological Receptors (VORs) is based on 24 months of DAS, as described in volume 3, appendix 11.1.
		"The Scottish Ministers broadly agree with the impacts to be scoped into the EIA Report, in line with NatureScot, RSPB Scotland and Natural England representations."	The impacts scoped in are as agreed, with assessment presented in section 11.11.
		"In regards to the approach to assessment described at Section 6.4.7 of the Scoping Report, the Scottish Ministers advise that the NatureScot representation regarding density estimation, seasonal definitions, seabird foraging ranges, populations and apportioning, distributional responses, collision risk modelling and population viability modelling must be fully implemented by the Developer."	The approaches to density estimation, seasonal definitions, seabird foraging ranges, populations and apportioning, distributional responses, collision risk modelling and population viability modelling have been presented throughout this EIA. In some cases, where the Applicant does not agree with NatureScot's representation, this has been made clear and an alternative approach is also presented alongside NatureScot's recommended approach.
		"The Scottish Ministers further advise, in relation to the displacement assessment that no gradient of impact of displacement level should be applied to the buffer zone and that the same displacement and mortality rates should be applied throughout the project area and any buffer area, as outlined in the Natural England representation dated 20 April 2023 ("the April NE representation") and in line with the Joint SNCB Interim Displacement Advice Note."	No gradient of impact has been applied to displacement or mortality rates, as detailed in section 11.11 and volume 3, appendix 11.3.
		"Finally, in line with the April NE representation, the Scottish Ministers note the need for a precautionary assessment of impacts of highly pathogenic avian influenza in seabirds and highlight the Natural England guidance on this topic and future updates to the NatureScot guidance notes."	The impact of HPAI is discussed in volume 3, appendix 11.1.
		"The Scottish Ministers highlight the representation from RSPB Scotland which recommends that the minimum distance between the lower blade tip height and the Lowest Astronomical Tide (LAT) is defined early in the design process as this is key in avoiding and mitigating seabird collision risk. In addition, RSPB Scotland request the defined airgap is in excess of the minimum required for navigational purposes. The Scottish Ministers request that the Developer considers the recommendations from RSPB Scotland when compiling the EIA Report."	The wind turbine parameters, including lower blade tip height, are presented in Table 11.11. It should be noted that a height of 36 m air gap above LAT is proposed, which exceeds the minimum height of 22 m, as set in the Marine Guidance Note (MGN) 654 (Maritime and Coastguard Agency (MCA), 2021) in order to allow enough space for vessel movements.
		"In relation to mitigation and monitoring, the Scottish Ministers are content with the measures detailed in section 6.4.4 of the Scoping Report and advise that, where impact pathways have been identified, the full range of mitigation measures and published guidance must be included in the EIA Report. Designed in measures should be kept under review as the assessment progresses and there should be clear differentiation between mitigation and any proposed compensation measures if a derogation case is required. Further information on proposed ornithological monitoring must be provided in the EIA Report. This advice is informed by the representation from NatureScot."	Mitigation measures are presented in Table 11.18. Proposed monitoring is presented in section 11.13.
		"In regards to cumulative impacts, the Scottish Ministers are broadly content with the proposed approach but advise, in line with NatureScot representation, that multiple population viability models should be run with and without the proposed Berwick Bank offshore wind farm and that the cumulative assessment is discussed further with the Marine Directorate and NatureScot to ensure a comprehensive assessment, encompassing both worse case and realistic worse case scenarios."	The CEA and accompanying PVA are set out in section 11.12.3.
		"The Scottish Ministers acknowledge Appendix 3 of the Scoping Report which states that transboundary impacts may arise during the non-breeding season and advise that the Developer should engage further with NatureScot and MD-LOT on such impacts when the baseline report has been finalised."	The transboundary assessment is presented in section 11.14.

Date	Consultee and Type of Consultation	Issue(s) Raised	Response to Issue Raised and/or Where Considered in this Chapter
		"In regards to the operation and maintenance phase of the Proposed Development, Scottish Ministers, in line with NatureScot representation, advise that the fitting of lighting to the array needs to be assessed in respect to nocturnal species through HRA. Furthermore, if assessment concludes LSE[1]by means of disturbance and displacement, this species should be assessed across both breeding and non-breeding periods, rather than a single period. The Scottish Ministers also highlight NatureScot's representation regarding predator/prey interactions and advise that full consideration must be given to associated impacts in accordance with NatureScot advice."	Assessment of disturbance and displacement is presented in section 11.11. Disturbance and displacement effects are assessed across both breeding and non-breeding periods. Lighting is not considered separately within this chapter but the impacts of lighting are captured within the assessments undertaken for disturbance and displacement, barrier to movement, and collision risk. The impact of changes to prey availability is also assessed. This comment specifically refers to the HRA and LSE[2]. The Array RIAA (Part 3) assess the potential for adverse effects on the qualifying features of Special Protection Areas, and considers disturbance and displacement, lighting and changes to prey availability (Ossian OWFL, 2024).
Post-Scoping Consultation			
December 2023	Offshore Ornithology Consultation Note issued by Ossian OWFL to NatureScot (volume 3, appendix 15.1, annex F). This note set out the proposed assessment approaches and raised any proposed deviations from existing NatureScot guidance and/or scoping opinions.	Auk abundances and productivity. It was noted that the intra- and inter-annual variation in auk abundances observed within the DAS is within the range of variation that has been observed from DAS for other projects. It was further noted that data from the Isle of May indicate no unusual results in terms of productivity or phenology for auks in the 2023 breeding season. It was therefore concluded that there is no evidence that the auk abundances recorded in the DAS were impacted by unusual, large scale events but instead merely reflect normal spatial and temporal variation in auk abundance and distribution.	The baseline environment is further discussed in section 11.7.
		SeabORD. It was noted that there are significant practical and theoretical limitations to SeabORD and therefore concluded that running SeabORD would not be a practical or sensible approach to displacement analysis for this project.	Displacement assessment has been carried out using the matrix approach for all species, as detailed in section 11.11 and in volume 3, appendix 11.3.
		HPAI. It was noted that in the continued absence of further guidance or published, quantitative information on the impacts of HPAI and approach to assessment, HPAI will be considered only qualitatively in the EIA.	The impacts of HPAI on the baseline and future baseline are further discussed in section 11.7.
		CRM. It was noted that the CRM will rely on the set of parameters advised by NatureScot in their Guidance Note 7 (NatureScot, 2023g). Additional parameters and model runs are presented to highlight the uncertainty in the approach to CRM and subsequent mortality estimates.	The approach to CRM is presented in volume 3, appendix 11.2.
February 2024	Consultation by email with NatureScot	NatureScot confirmed that there is no current access to SeaBORD, and that NatureScot considers a matrix approach to be acceptable for the displacement assessment. NatureScot noted that should SeaBORD become available in time for it to be incorporated into the assessment then it should be used.	SeaBORD was not available for the assessment. Instead, the displacement assessment has been carried out using the matrix approach for all species, as detailed in section 11.11 and in volume 3, appendix 11.3.
March 2024	Consultation by email and meeting with NatureScot	NatureScot agreed that the large count of guillemot in August 2022 was caused by post-breeding dispersal and therefore the August survey should be included in the post-breeding season in the EIA and associated technical reports. NatureScot also agreed that the large counts of guillemot in July 2021 and 2022 are also likely to be inflated by post-breeding dispersal, and agreed to a qualitative consideration of this in the EIA.	The August 2022 count for guillemot has been included in the non-breeding season for calculating the bio-season mean peak abundance presented in volume 3, appendix 11.3, the results of which inform the assessment carried out within this chapter and the Array RIAA (Ossian OWFL, 2024).

Date	Consultee and Type of Consultation	Issue(s) Raised	Response to Issue Raised and/or Where Considered in this Chapter
		NatureScot confirmed that they have taken account of Ozsanlev-Harris *et al*. (2023) and now advise that when running CRM NatureScot only require: • Most likely scenario (MLS) – option 2 (using the generic flight height dataset); • Worst case scenario (WCS) – option 2 (using the generic flight height dataset)	As set out in section 11.11, although volume 3, appendix 11.2 presents the results of the Band model Options 2 and 3, the EIA collision assessment only uses Option 2 values. It should be noted that the CRM has focused on the MDS, which provides the WCS, rather than the MLS. This ensures that impacts will be no greater than those calculated, and may actually be lower than the assessment determines.
		With regards to the work undertaken by Natural England around macro-avoidance for gannet, NatureScot are not currently in a position to adopt the full recommendations of this work. NatureScot do however accept the outputs for gannet during the non-breeding season.	CRM results for gannet have not applied a correction for macro avoidance in any season. However, the implications of macro avoidance on the magnitude of impacts predicted are raised when assessing the significance of the impact.
		Migratory species – an updated review of migratory routes and vulnerabilities across the UK has been published by Marine Directorate and The Crown Estate. This work also includes development of a stochastic migration CRM tool (known as mCRM) to enable quantitative assessment of risks to migratory SPA species including swans, geese, divers, seaduck and raptors. This updated review should be used.	The updated review (Woodward *et al*., 2023) has been used as the basis of the qualitative approach to assessment for the risk of collision to migratory species in section 11.11. At time of writing, the quantitative mCRM is still in beta testing phase and not approved for use in assessment and therefore the assessment relies on a qualitative approach informed by Woodward *et al*. (2023) and supplemented by quantitative information from Wright *et al*. (2012).

11.6. METHODOLOGY TO INFORM BASELINE

12. Information on offshore ornithology has been reviewed and analysed to inform this offshore ornithology baseline. In addition, consultation has been carried out to aid the collection of baseline information.

11.6.1. DESKTOP STUDY

13. Information on offshore ornithology within the offshore ornithology study area and ZoI was collected through a detailed desktop review of existing studies and datasets which are summarised in Table 11.4.

14. Both the literature review of the reports and numerical modelling using the datasets were used to characterise the baseline. The offshore ornithology technical report (volume 3, appendix 11.1) includes full details of the analysis undertaken to develop the offshore ornithology baseline.

Table 11.4: Summary of Key Desktop Reports

Title	Source	Extent	Year	Author
Seabirds Count	Report for JNCC	Britain and Ireland	2023	Burnell *et al.*
Seabird Global Positioning System (GPS) tracking on the Isle of May, Fowlsheugh and St Abb's Head in 2021 in relation to offshore wind farms in the Forth/Tay region	Unpublished report to Neart na Gaoithe Offshore Wind Limited and SSE Renewables	Forth and Tay region	2022	Bogdanova *et al.*
Study to examine the impact of climate change on seabird species off the east coast of Scotland and potential implications for environmental assessments.	Report for Marine Scotland Science	East Scottish waters	2022	Searle *et al.*
Identifying important at-sea areas for seabirds using species distribution models and hotspot mapping.	RSPB FAME (Future of the Atlantic Marine Environment) and STAR (Seabird Tracking and Research) tracking projects	UK waters	2020	Cleasby *et al.*
Seasonal Periods for Birds in the Scottish Marine Environment	NatureScot guidance note	Scottish waters	2020	NatureScot
Distribution maps of cetacean and seabird populations in the North-East Atlantic	NERC (Natural Environment Research Council) and DEFRA (Department for Environment, Food and Rural Affairs) funded Marine Ecosystems Research Programme	North-east Atlantic	2019	Waggitt *et al.*
Review of evidence for identified seabird aggregations.	Report for JNCC	UK waters	2015	Cook *et al.*
Non-breeding season populations of seabirds in UK waters: Population sizes for Biologically Defined Minimum Population Scales (BDMPS)	Report for Natural England	UK waters	2015	Furness
Space partitioning without territoriality in gannets	Research paper	UK, Ireland and France	2013	Wakefield *et al.*
The identification of possible marine SPAs for seabirds in the UK: The application of Stage 1.1 – 1.4 of the SPA selection guidelines	Report for JNCC	UK waters	2012	Kober *et al.*
Literature Review of Foraging Distribution, Foraging Range and Feeding Behaviour of Common Guillemot, Razorbill, Atlantic Puffin, Black Legged Kittiwake and Northern Fulmar in the Forth/Tay Region	Report to Forth and Tay Offshore Wind Developers' Group	Forth and Tay region	2011	Daunt *et al.*
Summer Sandeel Consumption by Seabirds Breeding in the Firth of Forth, southeast Scotland	Research paper	Firth of Forth region	1998	Wanless *et al.*
Coasts and seas of the United Kingdom Region 4 South-east Scotland: Montrose to Eyemouth	Report for JNCC	South-east Scottish waters	1997	Barne *et al.*
An atlas of seabird distribution in north-west European waters	Report for JNCC and Nederlands Instituut voor Onderzoek der Zee	North-west European waters	1995	Stone *et al.*
Seabird concentrations in the North Sea: an atlas of vulnerability to surface pollutants.	Report for JNCC	North Sea	1993	Carter *et al.*
Seabirds and sandeels: the conflict between exploitation and conservation in the northern North Sea	Research paper	Northern North Sea	1992	Monaghan

11.6.2. IDENTIFICATION OF DESIGNATED SITES

15. All designated sites within the offshore ornithology study area and ZoI that could be affected by the construction, operation and maintenance, and decommissioning phases of the Array were identified. The criteria for identification are described below:

- all designated sites of international, national, and local importance that directly overlap with the offshore ornithology study area or have connectivity/are within the offshore ornithology ZoI (as set out in section 11.3) were identified using a number of sources (including the JNCC's online resource on the SPAs network, the Ramsar Sites Information Service, and NatureScot's SiteLink page);
- connectivity was established during the breeding season if a site (for which a species is a qualifying feature) is within foraging range of the Array (using species specific mean maximum foraging range + 1 SD (Woodward *et al.*, 2019) as recommended by NatureScot (2023d)).
- impacts are greatest on the sites with connectivity during the breeding season and therefore for the purpose of this report, only sites with connectivity during the breeding season are considered. During the non-breeding season, species are not as spatially constrained as in the breeding season and can therefore exploit much larger areas (Furness, 2015); and
- where a site has multiple designations, to avoid repetition only the highest designation is listed.

11.6.3. SITE-SPECIFIC SURVEYS

16. Site-specific surveys were undertaken, as agreed with NatureScot (refer to Table 11.3 for further details), to inform this offshore ornithology EIA Report chapter for the Array. A summary of the surveys undertaken used to inform the offshore ornithology assessment of effects is outlined in Table 11.5.

Table 11.5: Summary of Site-Specific Survey Data

Title	Extent of Survey	Overview of Survey	Survey Contractor	Date	Reference to Further Information
DAS	Array plus 8 km buffer	24 monthly, high-resolution DAS video transects, with approximately 10% coverage of the Array offshore ornithology survey area	HiDef Ltd	March 2021 – February 2023	Volume 3, appendix 11.1, annex D.

11.7. BASELINE ENVIRONMENT

11.7.1. OVERVIEW OF BASELINE ENVIRONMENT

17. The following sections provide a summary of the offshore ornithology baseline environment. The offshore ornithology technical report, volume 3, appendix 11.1, includes full details of the analysis undertaken to develop the offshore ornithology baseline.

11.7.2. DESIGNATED SITES

18. Designated sites and relevant qualifying interest features identified for this offshore ornithology Array EIA Report chapter are described in Table 11.6 and presented in Figure 11.2 (Figure 11.3 for zoomed in illustration). As set out in paragraph 15, the foraging ranges of the qualifying features determined the sites that were identified. Species listed include those named as main components of an assemblage feature, as well as individual qualifying features. Species listed are limited to those identified as VORs in volume 3, appendix 11.1. Within this Array EIA Report chapter, assessment is carried out for VORs in line with the methodology set out in section 11.9. An assessment of the impact of the Array on other designated features and the conservation objectives of protected sites it carried out in the Array RIAA (Ossian OWFL, 2024).

19. Where locally designated sites and national designations (other than European sites) fall within the boundaries of a European site (e.g. SSSIs which have not been assessed within the Array RIAA) and where qualifying interest features are the same, only the European site has been taken forward for assessment. Potential impacts on the integrity and conservation status of the offshore ornithology features of a locally or nationally designated site are assumed to be inherent within the assessment of the European site, so a separate assessment for the local or national site has not been undertaken.

20. It should be noted that distances given in Table 11.6 are measured as the shortest distance between the edge of the Array and the designated site boundary. The distance may therefore differ from measurements calculated using a different approach. In particular, for the apportionment of impacts to breeding colonies carried out as part of the Array RIAA (Ossian OWFL, 2024), following the relevant guidance (NatureScot, 2018), distances are measured from the geometric centre of the Array to the centre of the specific breeding colony location.

Table 11.6: Designated Sites and Relevant Qualifying Interest Features for the Offshore Ornithology Array EIA Report Chapter

Designated Site	Closest Distance to Array (km)	Relevant Qualifying Interest Feature(s)[2]
Fowlsheugh SPA	81.3	• **Kittiwake** *Rissa tridactyla* • **Fulmar** *Fulmarus glacialis* • **Guillemot** *Uria aalge* • **Herring gull** *Larus argentatus* • **Razorbil**l *Alca torda*
Buchan Ness to Collieston Coast SPA	82.7	• **Kittiwake** • **Fulmar** • **Guillemot** • **Herring gull**
Outer Firth of Forth and St Andrews Bay Complex SPA (breeding)	90.2	• **Kittiwake** • **Gannet** *Morus bassanus* • **Guillemot** • Herring gull
Troup, Pennan and Lion's Heads SPA	120.6	• **Kittiwake** • **Great skua** *Stercorarius skua* • **Razorbill**
Farne Islands SPA	120.9	• **Kittiwake** • Puffin
St Abb's Head to Fast Castle SPA	125.5	• **Kittiwake** • Razorbill
Forth Islands SPA	126.3	• **Kittiwake** • **Fulmar** • **Gannet** • **Lesser black-backed gull** *Larus fuscus* • **Puffin** • Razorbill
Northumberland Marine SPA	129.7	• **Kittiwake** • Guillemot • **Puffin** • Common tern *Sterna hirundo* • Arctic tern *Sterna paradisaea* • Sandwich tern *Sterna sandvicensis* • Little tern *Sternula albifrons*

[2] All relevant qualifying interest features qualify for their breeding populations. Species that fall within foraging range of the Array are shown in **bold**.

Designated Site	Closest Distance to Array (km)	Relevant Qualifying Interest Feature(s)[2]
Firth of Forth SPA and Ramsar	133.3	• **Gannet** • Guillemot • Herring gull • **Kittiwake** • **Lesser black-backed gull** • **Puffin** *Fratercula arctica* • Razorbill • Common tern • Arctic tern • Sandwich tern
Gamrie and Pennan Coast SSSI	139.9	• **Fulmar** • **Gannet** • Guillemot • **Kittiwake** • **Puffin**
Coquet Island SPA	147.6	• **Kittiwake** • **Fulmar** • **Lesser black-backed gull** • **Puffin**
East Caithness Cliffs SPA	211.8	• **Kittiwake** • **Fulmar**
North Caithness Cliffs SPA	229.1	• **Kittiwake** • **Fulmar** • **Puffin** • Razorbill
Copinsay SPA	245.4	• **Kittiwake** • **Fulmar**
Flamborough and Filey Coast SPA	248.5	• **Kittiwake** • **Gannet** • **Puffin**
Auskerry SPA	258	• **European storm petrel** *Hydrobates pelagicus*
Hoy SPA	260	• **Kittiwake** • **Fulmar** • **Puffin**
Calf of Eday SPA	280.9	• **Kittiwake** • **Fulmar**
Marwick Head SPA	287.3	• **Kittiwake**
Fair Isle SPA	291.5	• **Kittiwake** • **Great skua** • **Fulmar** • **Gannet**
West Westray SPA	293.0	• **Kittiwake** • **Great skua**
Cape Wrath SPA	305.0	• **Fulmar**
Handa SPA	306.9	• Kittiwake • **Great skua** • **Fulmar**
Sule Skerry and Sule Stack SPA	324	• **Gannet** • **European storm petrel** • **Leach's storm petrel** *Oceanodroma leucorhoa*
Sumburgh Head SPA	327.3	• **Great skua**
Seas off Foula SPA	329.7	• **Great skua**
Ailsa Craig SPA	335.4	• **Gannet**
Treshinish Isles SPA	344	• European storm petrel
The Shiant Isles SPA	348	• **Great skua**
Noss SPA	357.5	• Kittiwake • **Gannet** • **Great skua** • Guillemot • **Fulmar** • Puffin
Foula SPA	362.1	• **Great skua** • **Fulmar** • **Leach's storm petrel**
Rum SPA	367.8	• Kittiwake • **Manx shearwater** *Puffinus puffinus*
North Rona and Sula Sgeir SPA	383	• Kittiwake • **Gannet** • Guillemot • European storm petrel • **Leach's storm petrel** • **Fulmar** • Razorbill • Puffin
Copeland Islands SPA	383.8	• **Manx shearwater**
Ronas Hill – North Roe and Tingon SPA	403.3	• **Great skua**
Fetlar SPA	406.0	• **Great skua** • **Fulmar**
Ramna Stacks and Gruney SPA	420	• **Leach's storm petrel**
Hermaness, Saxa Vord and Valla Field SPA	424.9	• Kittiwake • **Gannet**
Irish Sea Front SPA	426	• **Manx shearwater**
Flannan Isles SPA	430	• **Fulmar** • **Leach's storm petrel**
St Kilda SPA	468.4	• Gannet • Leach's storm petrel • Manx shearwater

Designated Site	Closest Distance to Array (km)	Relevant Qualifying Interest Feature(s)[2]
Glannau Aberdaron Ynys Enlli/Aberdaron Coast and Bardsey Island SPA	495	• Manx shearwater
Seas off Kilda SPA	498.0	• Gannet
Skomer, Skokholm and the Seas off Pembrokeshire SPA	615	• Manx shearwater
Isle of Scilly SPA	825	• Fulmar • Manx shearwater

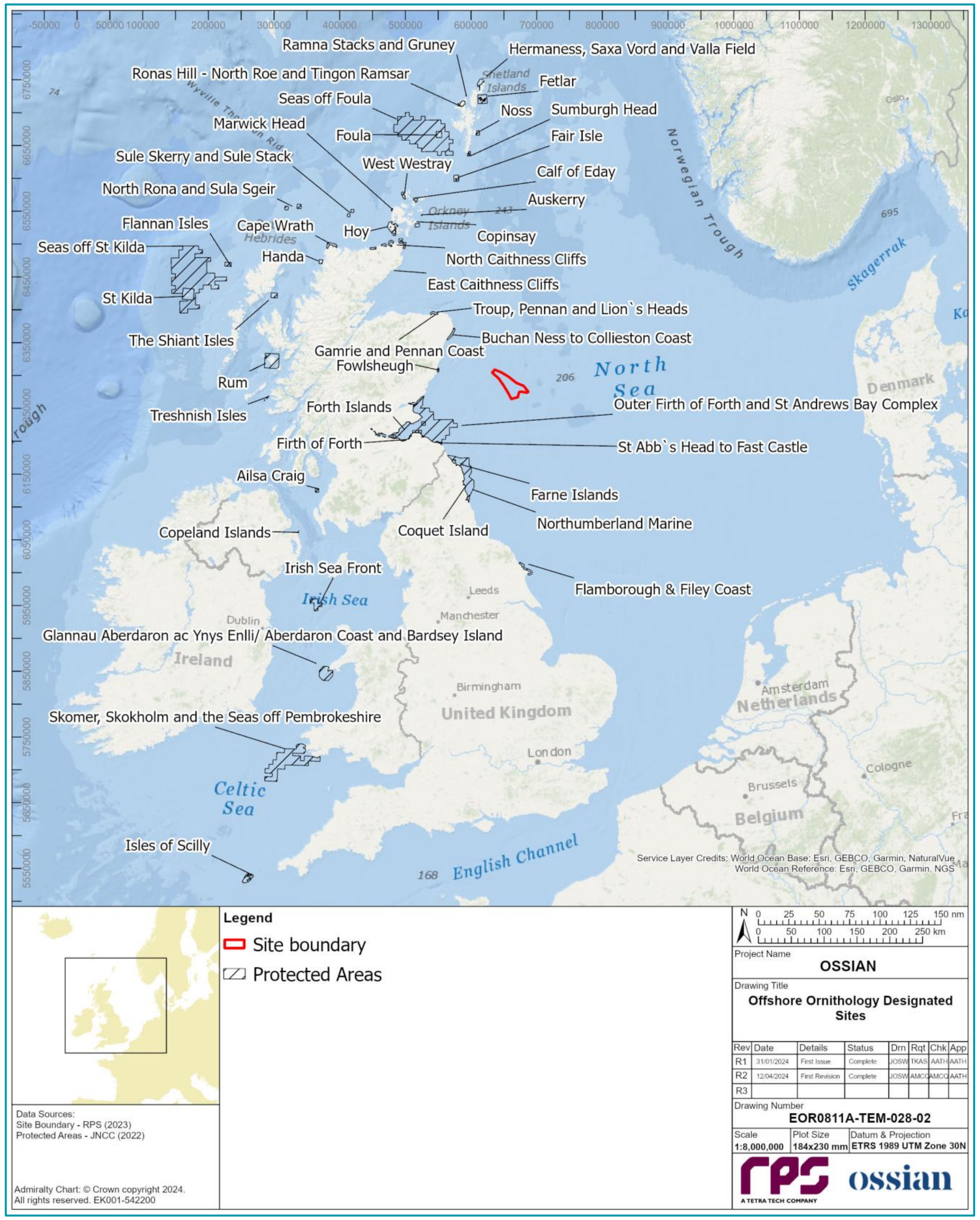

Figure 11.2: Offshore Ornithology Designated Sites

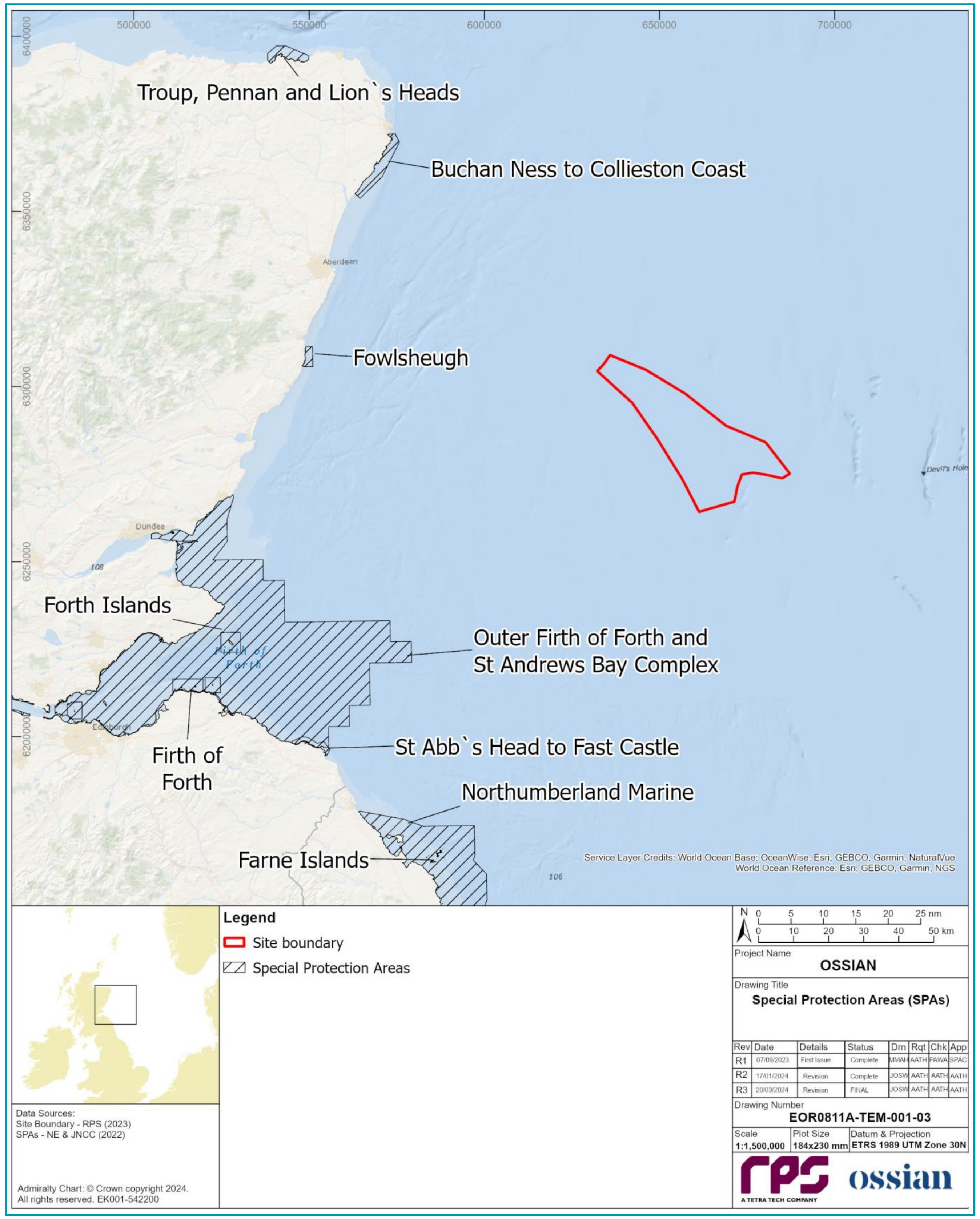

Figure 11.3: Offshore Ornithology Designated Sites (zoomed in)

11.7.3. IMPORTANT ECOLOGICAL FEATURES

21. With regards to offshore ornithology, the important ecological features are VORs. VORs have been selected based on the conservation status of the ornithological receptor, their vulnerability to impact (for each impact which has been scoped in for the assessment) and known abundance from site-specific surveys and desktop studies. This is further detailed in volume 3, appendix 11.1.

22. Table 11.7 lists all of the VORs identified for offshore ornithology and their population importance (as set out in volume 3, appendix 11.1).

23. The approach to seasonal definitions and regional populations is further detailed in volume 3, appendix 11.1 but for clarity, the defined seasons and population sizes are included in this report in Table 11.8 and Table 11.9.

24. The impact of additional mortality due to offshore wind farm effects is assessed in terms of the change in the baseline mortality rate. As detailed within volume 3, appendix 11.1, it has been assumed that all age classes are equally at risk of effects, with each age class affected in proportion to its presence in the population. The average mortality rates used within the assessment are provided in Table 11.10.

Table 11.7: Offshore Ornithology VORs[3]

VOR	Conservation Designation(s)	Conservation Value
Kittiwake	Red list	International
Herring gull	Red list; Scottish Biodiversity List	International
Lesser black-backed gull	Amber list	International
Sandwich tern *Thalasseus sandvicensis*	Amber list; Annex I; Scottish Biodiversity List	National
Little tern *Sternula albifrons*	Amber list; Annex I; Schedule 1; Scottish Biodiversity List	National
Common tern	Amber list; Annex I; Scottish Biodiversity List	National
Arctic tern	Amber list; Annex I; Scottish Biodiversity List	International
Great skua	Amber list	International
Guillemot	Amber list	International
Razorbill	Amber list	International
Puffin	Red list	International
European storm petrel	Amber list; Annex I; Scottish Biodiversity List	International
Leach's storm petrel	Red list; Annex I; Schedule 1; Scottish Biodiversity List	International
Fulmar	Amber list	International
Manx shearwater	Amber list; Schedule 1; Scottish Biodiversity List	International
Gannet	Amber list	International

[3] Conservation designations refer to status within the Fifth Birds of Conservation Concern in the United Kingdom (Stanbury *et al*., 2021); listing in Annex I of EU Birds Directive; listing in Schedule 1 of the Wildlife and Countryside Act 1981 (as amended); and listing in the Scottish Biodiversity List. For further details on selection of VORs refer to volume 3, appendix 11.1.

Table 11.8: **Seasonal Definitions for Species Considered in this Report[4]**

Species	Source	Seasonal Definitions			
		Breeding	Post-Breeding	Non-Breeding	Pre-Breeding
Kittiwake	NatureScot (2020); Furness (2015)	Mid-Apr to Aug	Sept to Dec	N/A	Jan to mid-Apr
Herring gull	NatureScot (2020); Furness (2015)	Apr to Aug	N/A	Sep to Mar	N/A
Lesser black-backed gull	NatureScot (2020); Furness (2015)	Mid-Mar to Aug	Sept to Oct	N/A	Nov to mid-Mar
Sandwich tern	NatureScot (2020); Furness (2015)	Mid-Apr to mid-Sept	N/A	N/A	Mar to mid-Apr
Little tern	NatureScot (2020); Furness (2015)	md-May to Aug	Sep	N/A	Apr to mid-May
Common tern	NatureScot (2020); Furness (2015)	May to mid-Sept	N/A	N/A	April
Arctic tern	NatureScot (2020); Furness (2015)	May to Aug	September	N/A	April
Great skua	NatureScot (2020); Furness (2015)	Mid-Apr to mid-Sept	Mid-Sept to Oct	Nov to Feb	Mar to mid-Apr
Guillemot	NatureScot (2020); Furness (2015)	April to mid-Aug	N/A	Mid-Aug to Mar	N/A
Razorbill	NatureScot (2020); Furness (2015)	Apr to mid-Aug	mid-Aug to Oct	Nov to Dec	Jan to Mar
Puffin	NatureScot (2020); Furness (2015)	Apr to mid-Aug	N/A	Mid-Aug to Mar	N/A
European storm petrel	NatureScot (2020); Kober *et al.* (2010)	Mid-May to Oct	Nov to Dec	N/A	Jan to md-May
Leach's storm petrel	NatureScot (2020); Kober *et al.* (2010)	May to mid-Oct	Mid-Oct to Dec[5]	N/A	Jan to Apr
Fulmar	NatureScot (2020); Furness (2015)	Apr to mid-Sept	Mid-Sept to Oct	Nov	Dec to Mar
Manx shearwater	NatureScot (2020); Furness (2015)	Apr to mid-Oct	N/A	N/A	Mar
Gannet	NatureScot (2020); Furness (2015)	Mid-Mar to Sept	Oct to Nov	N/A	Dec to mid-Mar

Table 11.9: **Regional Population Sizes for Species Included in this Report (All Population Estimates are for Individual Birds)[6].**

Species	Regional BDMPS			
	Breeding	Post-Breeding (Furness, 2015)	Non-Breeding	Pre-Breeding[9]
Kittiwake	261,047	829,937	N/A	627,816
Herring gull	13,836	N/A	466,511	N/A
Lesser black-backed gull	36,301	209,007	39,314	197,483
Sandwich tern	N/A	38,051	N/A	38,051
Little tern	N/A	N/A	N/A	N/A
Common tern	N/A	144,911	N/A	144,911
Arctic tern	N/A	163,930	N/A	163,930
Great skua	42,650	19,556	143	8,485
Guillemot	916,667[7]	N/A	1,617,306	N/A
Razorbill	54,552	591,874	218,622	591,874
Puffin	279,803	N/A	231,957	N/A
European storm petrel	10,480	N/A	N/A	N/A
Leach's storm petrel	N/A	N/A	N/A	N/A
Fulmar	476,165	957,502	568,736	957,502
Manx shearwater	N/A	8,507	N/A	8,507
Gannet	763,577	456,298	N/A	248,385

[4] Grey cells indicate not relevant for the species occurrence in the North Sea.

[5] Not available. Assumed to be the same as European storm petrel.

[6] Grey cells indicate that the season is not relevant for the species occurrence in the North Sea.

[7] As no guillemot breeding colonies are in foraging range of the Array, the breeding season regional population has been calculated by estimating the number of juvenile birds associated with colonies within 470 km of the Array. For further details, refer to volume 3, appendix 11.1.

Table 11.10: Demographic rates for key species. Derived from Horswill & Robinson (2015)[8]

Species	Parameter	Age Class (years)							Productivity (chicks per pair)	Average Mortality
		Juvenile	0 to 1	1 to 2	2 to 3	3 to 4	4 to 5	Adult		
Guillemot	Survival	N/A	0.56	0.792	0.917	0.939	0.939	0.939	0.583	0.1328
	Proportion in population	N/A	0.153	0.084	0.065	0.058	0.053	0.587		
Razorbill	Survival	N/A	0.63	0.63	0.895	0.895	N/A	0.895	0.532	0.1723
	Proportion in population	N/A	0.155	0.099	0.064	0.059	N/A	0.623		
Puffin	Survival	N/A	0.709	0.709	0.709	0.76	0.805	0.906	0.555	0.1764
	Proportion in population	N/A	0.155	0.113	0.082	0.06	0.046	0.544		
Fulmar	Survival	0.26	N/A	N/A	N/A	N/A	N/A	0.936	0.41	0.2215
	Proportion in population	0.233	N/A	N/A	N/A	N/A	N/A	0.767		
Gannet	Survival	N/A	0.424	0.829	0.891	0.895	0.895	0.919	0.766	0.1927
	Proportion in population	N/A	0.201	0.084	0.069	0.061	0.054	0.531		
Kittiwake	Survival	N/A	0.79	0.854	0.854	0.854	N/A	0.854	0.619	0.1562
	Proportion in population	N/A	0.16	0.126	0.107	0.09	N/A	0.517		
Herring gull	Survival	N/A	0.798	0.834	0.834	0.834	0.834	0.834	0.498	0.1708
	Proportion in population	N/A	0.132	0.11	0.096	0.084	0.073	0.505		
Great black-backed gull	Survival	N/A	0.798	0.93	0.93	0.93	0.93	0.93	1.061	0.0948
	Proportion in population	N/A	0.188	0.134	0.112	0.094	0.078	0.394		

[8] Grey cells indicate that the season is not relevant for the species occurrence in the North Sea.

11.7.5. FUTURE BASELINE SCENARIO

25. The EIA Regulations require that *"a description of the relevant aspects of the current state of the environment (the "baseline scenario") and an outline of the likely evolution thereof without implementation of the project as far as natural changes from the baseline scenario can be assessed with reasonable effort, on the basis of the availability of environmental information and scientific knowledge"* is included within the Array EIA Report.

26. If the Array does not come forward, the 'without development' future baseline conditions are described within this section.

27. The UK holds internationally important populations of seabirds (Mitchell *et al.*, 2004). UK seabird populations have shown a marked decline over the last two decades (JNCC, 2020; Mitchell *et al.*, 2020), with over a third of species experiencing declines in breeding abundance of up to 30% or more since the early 1990s (Mitchell *et al.*, 2020; Burnell *et al*., 2023).

28. A recent study suggests that in terms of number of species affected and the average impact, the three key threats to seabird populations globally are invasive species (165 species affected, across all the most threatened groups), bycatch in fisheries (100 species affected, but with the greatest average impact) and climate change (96 species affected) (Dias *et al.*, 2019; Mitchell *et al.*, 2020).

29. Most seabird species in the UK are at the southern limit of their range in the north-east Atlantic and therefore an increase in global temperatures could result in a northward shift in species' range with the potential for overall declines in population size (Frederiksen *et al.*, 2007, 2013 and Mitchell *et al.*, 2020). In the UK and Ireland, climate change is considered to be the likely primary cause of decline in seabird populations in the future, with anticipated depletion of breeding conditions for most species either indirectly, through changes in prey abundance, or directly during extreme weather events (Mitchell *et al.*, 2020).

30. Fisheries management will also likely impact on future seabird populations in the UK and Ireland. For many years, seabird species have benefitted from fisheries discards; for scavenging species such as herring gull, kittiwake, great skua and fulmar, population levels may already be above those that naturally occurring food sources would sustain (Votier *et al.*, 2004 and Frederiksen *et al.*, 2013). However, the introduction between 2015 and 2019 of the Common Fisheries Policy Landings Obligation ('discard ban') will likely reduce the discard available and ultimately put more pressure on scavenging species.

31. On the other hand, the UK and Scottish Governments recently announced their intention to close the sandeel fisheries in all Scottish waters and the English North Sea (DEFRA, 2024; Scottish Government, 2024a). The intention of this action is to improve the sandeel population, and therefore also benefit predators including seabirds such as kittiwake, puffin and guillemot which feed upon sandeels. This closure may therefore reduce the pressure on those species.

32. Therefore, without the Array, seabird populations would be expected to continue to follow their current population trends, which in many cases is a continuation of declining populations. Climate change is considered to be the likely primary cause of decline in seabird populations in the future. It is believed that the absence of the Array would further delay the transition of the UK from reliance on fossil fuels and therefore further contribute towards climate change impacts and declining seabird populations.

11.7.6. DATA LIMITATIONS AND ASSUMPTIONS

33. Baseline characterisation of the offshore ornithology study area and resulting assessments of significance use site-specific data (DAS) conducted over a period of 24 months (March 2021 to February 2023). As sampling is undertaken once a month for a period of 24 months, it may be considered to represent a snapshot of each month. Indeed, seabird numbers may fluctuate both spatially and temporally in response to environmental conditions. However, the sampling regime adopted is identical to other baseline characterisation surveys at offshore wind farms projects which have been previously agreed by SNCBs as suitable for baseline characterisation.

34. The population estimates for seabird SPA colonies used to inform the assessments in sections 11.11 and 11.12 are taken from the most recent colony count data (Seabirds Count; Burnell *et al*., 2023), which is based on census surveys undertaken between 2015 and 2021.

35. The current H5N1 strain of Highly Pathogenic Avian Influenza (HPAI) was first recorded in the UK in summer 2021 (Falchieri *et al*. 2022). Although existing systematic reviews indicate that diseases are seldom a key factor leading to the extinction of vertebrates, diseases can cause population crashes, leading to measurable declines in populations (Young and VanderWerf, 2023).

36. Thousands of seabird mortalities attributed to HPAI were reported across the UK in 2022, with minimum losses of almost 20,000 individuals in Scotland alone (NatureScot, 2023l) and by the end of 2022, 17 of the 25 UK breeding seabird species had tested positive for HPAI (APHA, 2023).

37. In response to the outbreak of HPAI, the RSPB established the HPAI Seabird Surveys Project (Tremlett *et al*., 2024). This involved a mixture of existing planned surveys, additional volunteer-led surveys and RSPB-led surveys of a number of SPA colonies for 14 priority seabird species, and was undertaken between May and July 2023. The survey method followed standard methods outlined in the Seabird Monitoring Handbook (Walsh *et al*. 1995), enabling comparisons in population changes with the Seabirds Count estimates, which are based on census surveys undertaken between 2015 to 2021 (Burnell *et al*., 2023).

38. The HPAI surveys were not intended to fully update the Seabirds Count data (for example, there were gaps in coverage of some sites, some counts lacked key information such as survey time, and some survey counts were estimates rather than accurate counts). However, the RSPB HPAI report (Tremlett *et al*., 2024) is a useful indicator of how certain species are faring in light of the recent HPAI outbreak.

39. The RSPB HPAI report (Tremlett *et al*., 2024) showed large declines in gannet of 25% across eight SPAs when compared against the Burnell *et al*. (2023) pre-HPAI baseline, whereas kittiwake increased by 10% across 21 SPAs and guillemot declined by 6% across 21 SPAs. The RSPB HPAI report (Tremlett *et al*., 2024) concludes that changes in species such as guillemot may be partially due to other factors as they were already in decline, whereas the decline in gannet is almost certainly attributable to HPAI due to the species showing recent population increases.

40. The baseline DAS data was collected between March 2021 and February 2023 and therefore overlaps with the HPAI outbreak. However, the data presented in volume 3, appendix 11.1 does not demonstrate any clear evidence of impact from HPAI when comparing between years.

41. Overall, the impact of the short, medium and long-term effects of the 2022 HPAI outbreak on seabird colony abundance and vital rates (productivity and survival) on UK breeding colonies is unclear. It is also unclear currently how the distribution and abundance of seabirds at sea has been affected as a result of the 2022 HPAI outbreak. The disease has affected over 60 bird species in the UK, including species such as gannet, razorbill, guillemot, puffin, Manx shearwater, fulmar and small and large gull species (Pearce-Higgins *et al.*, 2023). HPAI has affected gannet and great skua colonies profoundly, with both species now facing increased risk of global extinction (Pearce-Higgins *et al.*, 2023) (the UK supports 55.6% of the global gannet population and 60% of the global great skua population; JNCC, 2021).

42. In the absence of updated SNCB guidance, the assessment approach with regards to HPAI aligns as closely as possible to Natural England's interim guidance that was submitted as part of Natural England's Representation in response to the Array EIA Scoping Report (Ossian OWFL, 2023), in the Scoping Opinion (MD-LOT, 2023). Therefore, all quantitative assessment has been carried out without any adjustments in respect to HPAI. This reflects an assumption that reductions in population or colony sizes would translate to proportional reductions in at-sea densities and hence predicted mortalities from the Array.

11.8. KEY PARAMETERS FOR ASSESSMENT

11.8.1. MAXIMUM DESIGN SCENARIO

43. The Maximum Design Scenarios (MDSs) identified in Table 11.11 are those expected to have the potential to result in the greatest effect on an identified VOR. These scenarios have been selected from the details provided in volume 1, chapter 3 of the Array EIA Report. Effects of greater adverse significance are not predicted to arise should any other development scenario, based on details within the Project Description (volume 1, chapter 3) (e.g. different infrastructure layout) be taken forward in the final design scheme.

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Table 11.11: Maximum Design Scenario Considered for Each Potential Impact on Offshore Ornithology

Potential Impact	Phase[9] C	Phase[9] O	Phase[9] D	Maximum Design Scenario	Justification
Temporary habitat loss and disturbance	✓	×	✓	**Site Preparation and Construction Phases** • A total of up to 49,948,548 m^2 (49.95 km^2) of temporary habitat loss and/or disturbance due to: • a footprint area of 14,723,348 m^2 due to boulder clearance and relocation and sand wave clearance; • a footprint area of 9,540,000 m^2 due to disturbance due to Drag Embedment Anchor (DEA) installation; • a footprint area of 25,392,000 m^2 due to disturbance caused by the installation of inter-array and interconnector cables; • a footprint area of up to 250,000 m^2 for temporary offshore wet storage; and • a footprint area of 43,200 m^2 due to jack up vessel use for Offshore Substation Platform (OSP) installation. This represents 5.82% of the total site boundary. Vessels Maximum of 97 vessels on site at any one time during site preparation and construction totalling 7,902 return vessel trips during the total construction period of 8 years. Maximum of 7 helicopters on site at any one time, totalling 3,942 return trips during construction. Wind Turbine Towing Up to 3 wind turbines will be towed at one time. 160 hours of towing to site, at a speed of 2.5 knots. **Decommissioning Phase** At the end of the operational lifetime of the Array, it is anticipated that all floating structures will be completely removed. The decommissioning sequence will generally be the reverse of the construction sequence and involve similar types and numbers of vessels and equipment. The decommissioning plan and programme will be updated during the project lifespan to take account of changing industry practice and new technologies. It may be decided, closer to the time of decommissioning, that removal will result in greater environmental impacts than leaving components *in situ*. For the purposes of the MDS, it is assumed that decommissioning will be the same if not lower than construction.	Represents the greatest footprint area of temporary habitat loss. For further details, see volume 2, chapters 7 to 9. Represents the maximum number of vessel and helicopter movements that would cause greatest visual and noise disturbance to birds from the Array during construction activities. Decommissioning activities are assumed to be the same if not of a lower impact than construction. This impact applies to the construction and decommissioning phases only. Operation and maintenance activities will typically be confined to the existing Array footprint, and won't lead to temporary habitat loss. Operational disturbance is covered by the 'Disturbance and displacement from the physical presence of wind turbines and maintenance activities' impact below.

[9] C = Construction, O = Operation and maintenance, D = Decommissioning

Potential Impact	Phase[9] C	O	D	Maximum Design Scenario	Justification
Indirect impacts from construction/decommissioning noise	✓	×	✓	**Construction Phase** <u>Wind turbine foundations</u> • up to 265 wind turbine foundations; • up to 6 piles per foundation; • up to 8 hours maximum piling per pile, therefore 3 piles installed over 24 hour period. Up to 2 concurrent piling events; and • minimum distance between piling events 950 m, maximum distance 41 km. Piling may occur up to 795 days over construction phase. Drilling of piles for wind turbine foundations is not anticipated, however, drilling at 10% of pile locations is being considered as contingency in the event that challenging ground conditions are identified. Maximum of 200 hrs drilling per pile. Maximum of one drilling event at any one time. <u>OSPs</u> • up to 6 large OSPs, • each OSP with 12 legs per foundation and 24 piles per foundation (144 piles in total), pile diameter 4.5 m, 70 m penetration depth; and • The MDS assumes that all OSP piles require drilling. Maximum of 425 hours per pile, maximum drilling duration 850 days. Maximum of one drilling event at any one time. **Decommissioning Phase** At the end of the operational lifetime of the Array, it is anticipated that all floating structures will be completely removed. The decommissioning sequence will generally be the reverse of the construction sequence and involve similar types and numbers of vessels and equipment. The decommissioning plan and programme will be updated during the project lifespan to take account of changing industry practice and new technologies. It may be decided, closer to the time of decommissioning, that removal will result in greater environmental impacts than leaving components *in situ*. For the purposes of the MDS, it is assumed that decommissioning will be the same as construction.	Construction noise activities including installation of wind turbine and OSP foundations. Represents the maximum number of piling events for the relevant infrastructure foundation options. Decommissioning impacts assumed to be lesser than construction impacts.
Indirect impacts from UXO clearance	✓	×	×	**Site Preparation Phase** • up to 2 UXO vessels on site at any one time. Totalling four return vessel trips during UXO clearance; and • up to 15 UXOs to be cleared, totalling 8 days of clearance activities, with a maximum of 2 detonations in a 24 hour period.	Noise resulting from UXO clearance activities. Represents the maximum number of UXO clearances events for the relevant infrastructure foundation options.
Disturbance and displacement from the physical presence of wind turbines and maintenance activities	×	✓	×	**Operation and Maintenance Phase** <u>Wind turbines</u> • up to 265 wind turbines; • maximum rotor diameter 236 m, hub height 148 m above LAT, minimum blade clearance 36 m above LAT, upper blade tip height 266 m above LAT; and • wind turbine spacing minimum 1,000 m, maximum 2,832 m. <u>Operation and maintenance vessels</u> Maximum of 31 vessels on site at any one time totalling 508 return vessel trips per year. Maximum of 3 helicopters on site at any one time, totalling 216 return trips per year.	Represents the maximum number of vessel and helicopter movements that would cause greatest visual and noise disturbance and displacement to birds from the Array during operation and maintenance activities. Represents the maximum number of wind turbines that would cause disturbance and displacement to birds from the Array during operation.

Potential Impact	Phase[9] C	O	D	Maximum Design Scenario	Justification
Barrier to movement	×	✓	×	**Operation and Maintenance Phase** Wind turbines • up to 265 wind turbines; • maximum rotor diameter 236 m, hub height 148 m above LAT, minimum blade clearance 36 m above LAT, upper blade tip height 266 m above LAT; and • wind turbine spacing minimum 1,000 m, maximum 2,832 m. OSPs • 6 OSPs, main structure 93 m above LAT in height (tallest point 104 m above LAT). Topside 121 m long x 89 m wide.	Represents the maximum number and density of wind turbines and structures across the Array, which maximises the potential barrier to foraging grounds and migration routes for migratory bird species. For seabirds occurring within the Array, in-line with NatureScot guidance, barrier to movement impacts are assessed as part of displacement and therefore not considered separately for these species.
Collision with wind turbines	×	✓	×	**Operation and Maintenance Phase** • up to 265 wind turbines; • maximum rotor diameter 236 m, chord width 6.7 m, hub height 148 m above LAT, minimum blade clearance 36 m above LAT, upper blade tip height 266 m above LAT; • wind turbine spacing minimum 1,000 m, maximum 2,832 m; and • rotor speed of 8.4 rpm. Aviation lighting in accordance with MGN 654, Annex 5 and CAP 764. Winching lights as per CAP 437. Periphery turbines: Red 2,000 cd dimmable to 200 cd if visibility is greater than 5 km. Flashing Morse W. All structures (i.e., including internal WTGs and the OSPs) will be fitted with a dual purpose 200 cd red SAR light / green heli hoist status light.	The potential for collision risk is derived from wind turbines parameters including rotor diameter, chord width, rotor speed and minimum blade clearance above LAT. The parameters associated with the most numerous wind turbine parameters (265 wind turbines) represents the MDS because it will result in the greatest potential for collision risk.

Potential Impact	Phase[9] C	O	D	Maximum Design Scenario	Justification
Changes to prey availability	✓	✓	✓	**Site Preparation and Construction Phases** A total of up to 49,948,548m^2 (49.95 km^2) of temporary habitat loss and/or disturbance due to: • a footprint area of 14,723,348 m^2 due to boulder clearance and relocation and sand wave clearance; • a footprint area of 9,540,000 m2 due to disturbance due to Drag Embedment Anchor (DEA) installation; • a footprint area of 25,392,000 m^2 due to disturbance caused by the installation of inter-array and interconnector cables; • a footprint area of up to 250,000 m^2 for temporary offshore wet storage; and • a footprint area of 43,200 m^2 due to jack up vessel use for Offshore Substation Platform (OSP) installation. This represents 5.82% of the total site boundary. **Operation and Maintenance Phase** A total of up to 51,411,500 m^2 (51.41 km^2) of temporary habitat loss and/or disturbance over the 35 year lifecycle of the Array due to: • a footprint area of 367,500 m^2 due to jack up vessel usage for operation and maintenance activities (10,500 m^2 per year over the 35 year lifecycle); and • a footprint area of 51,044,000 m^2 due to disturbance caused by reburial of inter-array and interconnector cables (1,222,400 m^2 and 236,000 m^2, respectively per year). This represents 5.99% of the total site boundary. **Decommissioning Phase** A total of up to 43,200 m^2 of temporary habitat loss and/or disturbance due to the footprint area of jack up vessel use for decommissioning activities. This represents 0.01% of the total site boundary.	Sets out activities contributing to habitat loss (which in turn affects prey availability), such as clearance of boulders and sand waves, as well as installation of foundations and cables. Sets out construction activities that would cause disturbance to prey, including clearance of boulders and sand waves, foundation and cable installation, and vessel movements. Decommissioning impacts assumed to be similar or lesser than construction impacts.
Entanglement	×	✓	×	**Operation and Maintenance Phase** • up to 265 floating wind turbine foundations; • up to six mooring lines per foundation, each 750 m length, of which 200 m will fall within the water column during operation. Mooring touchdown will be 25 m to 150 m from the foundation; and • up to 1,261 km of inter-array cable, with maximum 116 km in the water column.	Represents the greatest mooring line and inter-array cable length, based on the deepest water depth with tides (95 m) and the connection at the top of the column.

11.8.2. SPECIES ASSESSED FOR EACH IMPACT

44. Table 11.12 sets out the VORs that are considered for each impact being assessed, alongside an explanatory justification when species are ruled out for a particular impact.

Table 11.12: Species Assessed for Each Impact

Impact	VOR Considered	Justification
Temporary habitat loss and disturbance	• Kittiwake • Guillemot • Razorbill • Puffin • Fulmar • Gannet	• Volume 3, appendix 11.3 identified potential for displacement and disturbance
Indirect impacts from construction/decommissioning noise	• Kittiwake • Herring gull • Lesser black-backed gull • Sandwich tern • Little tern • Common tern • Arctic tern • Great skua • Guillemot • Razorbill • Puffin • European storm petrel • Leach's storm petrel • Fulmar • Manx shearwater • Gannet	• Potential for indirect construction and decommissioning impacts
Indirect impacts from UXO clearance	• Kittiwake • Herring gull • Lesser black-backed gull • Sandwich tern • Little tern • Common tern • Arctic tern • Great skua • Guillemot • Razorbill • Puffin • European storm petrel • Leach's storm petrel • Fulmar • Manx shearwater • Gannet	• Potential for indirect construction and decommissioning impacts
Disturbance and displacement from the physical presence of wind turbines and maintenance activities	• Kittiwake • Guillemot • Razorbill • Puffin • Fulmar • Gannet	• Volume 3, appendix 11.3 identified potential for displacement and disturbance; • N.B. Barrier to movement is covered under displacement impacts and not considered separately for these species
Barrier to movement	• Migratory species	• Considered to be migrating through the area, and therefore at risk of barrier to movement
Collision with wind turbines	• Kittiwake • Herring gull • Lesser black-backed gull • Fulmar • Gannet • Migratory species	• Volume 3, appendix 11.2 identified potential for collision risk
Changes to prey availability	• Kittiwake • Herring gull • Lesser black-backed gull • Sandwich tern • Little tern • Common tern • Arctic tern • Great skua • Guillemot • Razorbill • Puffin • European storm petrel • Leach's storm petrel • Fulmar • Manx shearwater • Gannet • Migratory species	• Considered to be vulnerable to changes to prey availability
Entanglement	• Sandwich tern • Little tern • Common tern • Arctic tern • Great skua • Guillemot • Razorbill • Puffin • European storm petrel • Leach's storm petrel • Fulmar • Manx shearwater • Gannet	• Volume 3, appendix 11.1 identified potential for entanglement

11.8.3. IMPACTS SCOPED OUT OF THE ASSESSMENT

45. The offshore ornithology pre-Scoping workshop (see Table 11.3) was used to facilitate stakeholder engagement on topics to be scoped out of the assessment.

46. On the basis of the baseline environment and the Project Description outlined in volume 1, chapter 3 of the Array EIA Report, a number of impacts are proposed to be scoped out of the assessment for offshore ornithology. This was either agreed with key stakeholders through consultation as discussed in volume 1, chapter 5, or otherwise, the impact was proposed to be scoped out in the Array EIA Scoping Report (Ossian OWFL, 2023) and no concerns were raised by key consultees within the Ossian Array Scoping Opinion (MD-LOT, 2023).

47. These impacts are outlined, together with justification for scoping them out, in Table 11.13.

Table 11.13: Impacts Scoped Out of the Assessment for Offshore Ornithology (Tick Confirms the Impact is Scoped Out)

Potential Impact	Phase[10]			Justification
	C	O	D	
Temporary habitat loss and disturbance	×	✓	×	This impact is only applicable in the construction and decommissioning phases, and scoped out of the operational phase. Operation and maintenance activities will typically be confined to the existing Array footprint, and won't lead to temporary habitat loss. Operational disturbance is covered by the 'Disturbance and displacement from the physical presence of wind turbines and maintenance activities' impact below.
Indirect impacts from construction/ decommissioning noise	×	✓	×	This impact is only applicable in the construction and decommissioning phases, and scoped out of the operational phase.
Indirect impacts from UXO clearance	×	✓	✓	This impact is only applicable in the construction phase, and scoped out of the operational and decommissioning phases.
Disturbance and displacement from the physical presence of wind turbines and maintenance activities	✓	×	✓	The impact of disturbance and displacement is expected to be highest during the operational phase when all wind turbines and *in situ* and maintenance activities are underway. Impacts during the construction and decommissioning phase are expected to be significantly lower and so have been scoped out. Instead they are covered under temporary habitat loss and disturbance.
Barrier to movement	✓	×	✓	The impact of barrier to movement is expected to be highest during the operational phase when all wind turbines are *in situ*. Impacts during the construction and decommissioning phase are expected to be significantly lower and so have been scoped out.
Collision with wind turbines	✓	×	✓	The risk of collision with wind turbines is highest during the operational phase when all wind turbines are present and operational. The risk of collision with static structures such as jack-up vessels is negligible and therefore collision risk during the construction and decommissioning phases has been scoped out.
Entanglement	✓	×	✓	With the advent of floating offshore wind, the potential for entanglement of diving seabirds with floating foundations during the operation and maintenance period has been raised. However, this risk is expected to be minimal during the construction and decommissioning phases as no or fewer moorings will be present.
Accidental pollution	✓	✓	✓	The outline Environmental Management Plan (EMP) will be implemented during all phases and will include a Marine Pollution Contingency Plan (MPCP) (see Table 11.18) which will include measures to avoid (and if necessary, contain and resolve) accidental pollution events.

[10] C = Construction, O = Operation and maintenance, D = Decommissioning

11.9. METHODOLOGY FOR ASSESSMENT OF EFFECTS

11.9.1. OVERVIEW

48. The offshore ornithology assessment of effects has followed the methodology set out in volume 1, chapter 6 of the Array EIA Report. Specific to the offshore ornithology EIA, the following guidance documents have also been considered:

- NatureScot Marine Ornithology Guidance Notes to support Offshore Wind Applications (NatureScot, 2023a-k):
  - Guidance Note 1: Guidance to support Offshore Wind Applications: Marine Ornithology – Overview (NatureScot, 2023a);
  - Guidance Note 2: Guidance to support Offshore Wind Applications: Advice for Marine Ornithology Baseline Characterisation Surveys and Reporting (NatureScot, 2023b);
  - Guidance Note 3: Guidance to support Offshore Wind applications: Marine Birds – Identifying theoretical connectivity with breeding site Special Protection Areas using breeding season foraging ranges (NatureScot, 2023c);
  - Guidance Note 4: Guidance to Support Offshore Wind Applications: Ornithology – Determining Connectivity of Marine Birds with Marine Special Protection Areas and Breeding Seabirds from Colony SPAs in the Non Breeding Season (NatureScot, 2023d);
  - Guidance Note 5: Guidance to support Offshore Wind Applications: Recommendations for marine bird population estimates (NatureScot, 2023e);
  - Guidance Note 6: Guidance to support Offshore Wind Applications – Marine Ornithology Impact Pathways for Offshore Wind Developments (NatureScot, 2023f);
  - Guidance Note 7: Guidance to support Offshore Wind Applications: Marine Ornithology – Advice for assessing collision risk of marine birds (NatureScot, 2023g);
  - Guidance Note 8: Guidance to support Offshore Wind applications: Marine Ornithology Advice for assessing the distributional responses, displacement and barrier effects of Marine birds (NatureScot, 2023h);
  - Guidance Note 9: Guidance to support Offshore Wind applications: Marine Ornithology Advice for Seasonal Definitions for Birds in the Scottish Marine Environment (NatureScot, 2023i);
  - Guidance Note 10: Guidance to support Offshore Wind applications: Marine Ornithology Advice for apportioning impacts to breeding colonies (NatureScot, 2023j); and
  - Guidance Note 11: Guidance to support Offshore Wind Applications: Marine Ornithology – Recommendations for Seabird Population Viability Analysis (PVA) (NatureScot, 2023k).
- Incorporating data uncertainty when estimating potential vulnerability of Scottish seabirds to marine renewable energy developments (Wade *et al.*, 2016);
- Assessing vulnerability of marine bird populations to offshore wind farms (Furness *et al.*, 2013);
- Scaling possible adverse effects of marine wind farms on seabirds: developing and applying a vulnerability index (Garthe and Hüppop, 2004);
- Joint SNCB Interim Displacement Advice Note: Advice on how to present assessment information on the extent and potential consequences of seabird displacement from Offshore Wind Farm developments (JNCC, 2022);
- Modelling flight heights of marine birds to more accurately assess collision risk with offshore wind turbines (Johnston *et al.*, 2014);
- Using a Collision Risk Model to Assess Bird Collision Risks for Offshore Wind Farms (Band, 2012);
- A Stochastic Collision Risk Model for Seabirds in Flight (McGregor *et al.*, 2018);
- Guidelines for Ecological Impact Assessment in the UK and Ireland (CIEEM, 2022); and

- Developing Guidance on Ornithological Cumulative Impact Assessment for Offshore Wind Farm Developers (King *et al.*, 2009).

49. The methodology has also considered the needs of the relevant policy and legislation, as described in volume 1, chapter 2 of this Array EIA Report, and Table 11.1 and Table 11.2 within this chapter.

11.9.2. CRITERIA FOR ASSESSMENT OF EFFECTS

50. When determining the significance of effects, a two stage process is used which involves defining the magnitude of the potential impacts and the sensitivity of the receptors. This section describes the criteria applied in this chapter to assign values to the magnitude of potential impacts and the sensitivity of the receptors. The terms used to define magnitude and sensitivity are based on those which are described in further detail in volume 1, chapter 6 of the Array EIA Report.

51. The criteria for defining magnitude in this chapter are outlined in Table 11.14. Each assessment considers the spatial extent, duration, frequency and reversibility of impact when determining magnitude, and these are outlined within the magnitude section of each impact assessment (e.g. a duration of hours or days would be considered for most receptors to be of short-term duration, which is likely to result in a low magnitude of impact). The definitions have been adapted to be suitable for offshore ornithology, following the approach and guidance set out by CIEEM (2022).

52. To aid with categorising the magnitude of impact, a 1% threshold in increase in baseline mortality was utilised, with the level of impact from the offshore wind farm divided by the baseline mortality estimate. Generally, based on findings from population viability analyses for bird species, it would be considered that increases in mortality rates of less than 1% would be undetectable in terms of changes in population size, whereas increases above 1% may produce detectable effects (Natural England, 2022). Note that NatureScot (2023k) guidance states that a 0.02 percentage point change in survival rate is to be used when assessing the impact to SPA populations. As the EIA deals with larger combined populations (that include non-SPA colonies) and not individual SPA populations, the 1% was deemed as the most appropriate approach for the EIA. A 0.02 percentage point change in survival rate threshold has been used within the Array RIAA (Ossian OWFL, 2024).

Table 11.14: Definition of Terms Relating to the Magnitude of an Impact

Magnitude of Impact	Definition
High	Total change or major alteration to key elements/features of the baseline conditions: Occurs over a large spatial extent, resulting in widespread, long-term, or permanent changes of the baseline conditions, or affects a large proportion of a receptor population (as a guide, typically greater than 5% increase in baseline mortality). The impact is very likely to occur and/or will occur at a high frequency or intensity.
Medium	Partial change or alteration to one or more key elements/features of the baseline conditions: The impact occurs over a local to medium extent with a short- to medium-term change to baseline conditions, or affects a moderate proportion of a receptor population (as a guide, typically greater than 1% increase in baseline mortality). The impact is likely to occur and/or will occur at a moderate frequency or intensity.
Low	Minor shift away from the baseline conditions: The impact is localised and temporary or short-term, leading to a detectable change in baseline conditions or a noticeable effect on a small proportion of a receptor population (as a guide, typically less than 1% increase in baseline mortality). The impact is unlikely to occur or may occur but at low frequency or intensity.
Negligible	Very slight change from baseline conditions: The impact is highly localised and short-term, with full rapid recovery expected to result in very slight or imperceptible changes to baseline conditions or a receptor population (as a guide, typically less than 0.1% increase in baseline mortality). The impact is very unlikely to occur; if it does, it will occur at a very low frequency or intensity.

53. Further information on levels of population importance and conservation value are given in volume 3, appendix 11.1. Criteria used to determine potential for recovery are given in Table 11.15.

Table 11.15: Definition of Potential for Recovery

Potential for Recovery	Description
High	A species with a medium to high reproductive potential and a stable or increasing UK trend in breeding abundance and productivity.
Medium	A species with a low to medium reproductive potential and a stable or increasing UK long-term trend in breeding abundance and productivity.
Low	A species with a low reproductive potential and a declining UK long-term trend in breeding abundance and productivity or uncertainty regarding the long-term trend (due to data availability).

54. The criteria for defining sensitivity in this chapter are outlined in Table 11.16. The definitions have been adapted to be suitable for offshore ornithology, following the approach and guidance set out by CIEEM (2022). The conservation value of ornithological receptors is based on the population from which individuals are predicted to be drawn. This reflects current understanding of the movements of species, with site-based protection (e.g. SPAs) generally limited to specific periods of the year (e.g. the breeding season). Therefore, conservation value can vary through 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. Conservation value therefore corresponds to the degree of connectivity which is predicted between the offshore wind farm site and protected populations.

Table 11.16: Definition of Terms Relating to the Sensitivity of the Receptor

Value (Sensitivity of the Receptor)	Description
Very High	Highly vulnerable to impact, very high conservation value and rarity, international receptor with no potential or very limited potential for recovery.
High	Medium to high vulnerability to impact, high conservation value and rarity, international and/or national receptor and limited potential for recovery.
Medium	Low to high vulnerability to impact, high or medium conservation value and rarity, regional receptor, and potential for recovery.
Low	Low or medium vulnerability to impact, low or medium conservation value and rarity, local receptor and high potential for recovery.
Negligible	Low or very low vulnerability to impact; very low conservation value and rarity, local receptor and very high potential for recovery.

55. The magnitude of the impact and the sensitivity of the receptor are combined when determining the significance of the effect upon offshore ornithology VORs. The particular method employed for this assessment is presented in Table 11.17.

56. Where a range is suggested for the significance of effect, for example, minor to moderate, it is possible that this may span the significance threshold. The technical specialist's professional judgement will be applied to determine which outcome defines the most likely effect, whilst taking into account the sensitivity of the receptor and the magnitude of impact. Where professional judgement is applied to quantify final significance from a range, the assessment will set out the factors that result in the final assessment of significance. These factors may include the likelihood that an effect will occur, data certainty and relevant information about the wider environmental context.

57. For the purposes of this assessment:

- A level of residual effect of moderate or more will be considered a 'significant' effect in terms of the EIA Regulations; and
- A level of residual effect of minor or less will be considered 'not significant' in terms of the EIA Regulations.

58. Effects of moderate significance or above are therefore considered important in the decision-making process, whilst effects of minor significance or less warrant little, if any, weight in the decision-making process.

[11] Council Directive 92/43/EEC on the Conservation of natural habitats and of wild fauna and flora) and Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds.

Table 11.17: Matrix Used for the Assessment of the Significance of the Effect

Sensitivity of Receptor	Magnitude of Impact:	Negligible	Low	Medium	High
	Negligible	Negligible	Negligible to Minor	Negligible to Minor	Minor
	Low	Negligible to Minor	Negligible to Minor	Minor	Minor to Moderate
	Medium	Negligible to Minor	Minor	Moderate	Moderate to Major
	High	Minor	Minor to Moderate	Moderate to Major	Major
	Very High	Minor	Moderate to Major	Major	Major

11.9.3. DESIGNATED SITES

59. This offshore ornithology Array EIA Report chapter assesses the LSE[1] in EIA terms on the qualifying interest feature(s) of Natura 2000 sites (i.e. nature conservation sites in Europe designated under the Habitats or Birds Directives[11]) and sites in the UK that comprise the National Site Network (collectively termed 'European sites') as described within section 11.7.2 of this chapter. The Array RIAA (Ossian OWFL, 2024) includes the assessment of the potential impacts on the features of each protected site individually in terms of the Habitats Regulations (Ossian OWFL, 2024).

60. Where locally designated sites and national designations (other than European sites) fall within the boundaries of a European site (e.g. SSSIs which have not been assessed within the Array RIAA) and where qualifying interest features are the same, only the European site has been taken forward for assessment. Potential impacts on the integrity and conservation status of the offshore ornithology features of a locally or nationally designated site are assumed to be inherent within the assessment of the European site, so a separate assessment for the local or national site has not been undertaken.

61. However, assessment of the LSE[1] on a local or nationally designated site which falls outside the boundaries of a European site, but within the offshore ornithology study area, has been considered within this chapter. Given ornithological features are highly mobile, birds within the Array's ZoI (as defined in section 11.3) may by associated with designated sites over a wide area, or they may not be associated with a designated site. An individual bird may be associated with different designated sites at different times of year or across different years. Therefore, unless there is evidence to the contrary, it is assumed that the impact on a designated site is proportional to the impact of the Array on the wider regional population containing that designated site. Such evidence may include tracking data or similar indicating disproportionately high levels of connectivity between a site and the Array. While impacts have been apportioned to non-European sites, these have not been assessed in any great detail as it is not the standard approach to do so. It is assumed the overall EIA-level effect conclusion is also applicable to any such designated site.

11.10. MEASURES ADOPTED AS PART OF THE ARRAY

62. As part of the Array design process, a number of designed in measures have been proposed to reduce the potential for impacts on offshore ornithology (refer to Table 11.18). They are considered inherently part of the design of the Array and, as there is a commitment to implementing these measures, these have been considered in the assessment presented in section 11.11 (i.e. the determination of magnitude and

therefore significance assumes implementation of these measures). These designed in measures are considered standard industry practice for this type of development.

Table 11.18: Designed In Measures Adopted as Part of the Array

Designed In Measures Adopted as Part of the Array	Justification
Minimum blade tip clearance height of 36 m above LAT	As most seabirds tend to fly low, increased blade tip clearance leads to a reduction in collision mortality.
Development of, and adherence to an EMP (volume 4, appendix 21)	To reduce the risk of accidental release of contaminants from vessels as far as reasonably practicable, thus providing protection for marine life across all phases of the Array. Measures will be adopted to ensure that the potential for release of pollutants from construction, operation and maintenance and decommissioning plant is reduced so far as reasonably practicable. These will likely include designated areas for refuelling where spillages can be easily contained, storage of chemicals in secure designated areas in line with appropriate regulations and guidelines, double skinning of pipes containing hazardous substances, and storage of these substances in impenetrable bunds. All vessels associated with the Array will be required to comply with the standards set out by International Convention for the Prevention of Pollution from Ships (MARPOL).
Development of, and adherence to a MPCP (volume 4, appendix 21).	To reduce the potential for release of pollutants from construction, operation and maintenance and decommissioning plant is reduced so far as reasonably practicable. These will likely include designated areas for refuelling where spillages can be easily contained, storage of chemicals in secure designated areas in line with appropriate regulations and guidelines, double skinning of pipes containing hazardous substances, and storage of these substances in impenetrable bunds. All vessels associated with the Array will be required to comply with the standards set out by MARPOL.
UXO clearance using low order disposal techniques where technically feasible.	Low order techniques will be adopted wherever practicable (e.g. deflagration and clearance shots) as mitigation to reduce noise levels and thereby injury and disturbance to sound-sensitive receptors during UXO clearance. There is a small risk that low order disposal could unintentionally result in a high order detonation and therefore this scenario has also been considered in the assessment of likely significant effects.
Implementation of soft start measures for UXO clearance using a sequence of small explosive charges detonated over set time intervals.	These measures will reduce the likelihood of injury from elevated underwater noise to marine mammals in the immediate vicinity of piling/UXO clearance operations as far as practicable, allowing individuals to move away from the area before sound levels reach a level at which injury may occur. This is in line with the most up to date guidance for piling/UXO clearance operations (JNCC, 2010a; JNCC, 2010b) and, in most cases, compliance with this guidance reduce the likelihood of injury to marine mammal receptors to negligible levels.
Development of and adherence to a Navigational Safety and Vessel Management Plan (NSVMP) (volume 4, appendix 24)	The NSVMP will include measures to reduce disturbance to marine mammal receptors from transiting vessels, requiring them to: • not deliberately approach marine mammals as a minimum; and • avoid abrupt changes in course or speed should marine mammals approach the vessel to bow-ride. The NSVMP will be implemented as far as practicable and where it does not compromise the safety of vessels.
Routine inspections of the inter-array cables and mooring lines	Mooring lines and dynamic inter-array cables in the water column will undergo regular inspections during the operation and maintenance phase with inspection frequency more frequent initially for the first two years and then decreasing to an annual schedule. The removal of marine debris from mooring lines and inter-array cables will be undertaken as necessary following monitoring and further relevant action taken if required, based on findings from the inspections. The removal of debris from mooring lines and cables further reduces the likelihood of secondary entanglement.

11.11. ASSESSMENT OF SIGNIFICANCE

63. The Maximum Design Scenarios (MDSs) identified in Table 11.11 are those expected to have the potential to result in the greatest effect on an identified VOR. These scenarios have been selected from the details provided in volume 1, chapter 3 of the Array EIA Report. Effects of greater adverse significance are not predicted to arise should any other development scenario, based on details within the Project Description (volume 1, chapter 3) (e.g. different infrastructure layout) be taken forward in the final design scheme.

64. Table 11.11 summarises the potential impacts arising from the construction, operation and maintenance and decommissioning phases of the Array, as well as the maximum design scenario against which each impact has been assessed. An assessment of the significance of the effects of the Array on the offshore ornithology VORs caused by each identified impact is given in sections 11.11 to 11.15.

TEMPORARY HABITAT LOSS AND DISTURBANCE

65. There is potential for temporary, direct benthic habitat loss as a result of activities during the construction and decommissioning phases (e.g. seabed preparation, UXO detonation, drilling, and inter-array and interconnector cables installation and removal). These activities have the potential to affect the foraging efficiency of diving birds.

66. In addition to this direct habitat loss, temporary disturbance as the result of activities during the construction and decommissioning phases of an offshore wind farm has the potential to displace seabirds from an area of sea in which the activity is occurring. In relation to offshore wind farm development, displacement is defined as a reduction in the number of seabirds occurring within or immediately adjacent to an offshore wind farm (Furness *et al.*, 2013).

67. Displacement can be considered as indirect habitat loss, as it results in birds unable to utilise the habitat in the area from which they have been displaced. Therefore, the impacts from both direct habitat loss and disturbance have been considered together.

68. The loss of habitat means that displaced birds may move to areas already occupied by other birds and thus may face higher intra- or inter-specific competition due to a higher density of individuals competing for the same resources. Alternatively, displaced birds may be forced to move into areas of lower quality (e.g. areas of lower prey availability) or travel longer distances to reach habitat of a suitable quality. This could therefore affect their demographic fitness (i.e. survival rates and breeding productivity), as well as potentially impacting on other birds in areas that displaced birds move to (for example, by increasing competition for resources).

69. The MDS (Table 11.11) gives the scenario that would lead to the greatest amount of temporary habitat loss and disturbance during the construction and decommissioning phases. The amount of direct habitat loss is small, with a maximum of 5.82% of the Array expected to be impacted. In addition, no significant adverse effects are expected on fish, shellfish or benthic invertebrate populations as a result of

construction or decommissioning activities (see volume 2, chapters 8 and 9). Therefore, it is expected that disturbance and subsequent displacement would be the main impact pathway.

70. The displacement assessment for construction is based on a qualitative approach, considering the magnitude of impact and the sensitivity of the receptor. The species considered for temporary habitat and temporary disturbance during construction and decommissioning are kittiwake, guillemot, razorbill, puffin, fulmar and gannet. All other species were excluded on the basis there is no potential for a significant effect as a result of temporary habitat loss and disturbance (volume 3, appendix 11.3).

71. Few studies have directly considered displacement rates during the construction phase of an offshore wind farm. Most studies have compared pre-construction to post-construction. It is expected that the amount of displacement during the construction phase of the Array would be less than that during the operational phase due to there being a smaller footprint whilst the Array is being constructed.

Construction phase

Magnitude of impact

72. Disturbance and temporary loss of habitat (including habitat becoming temporarily unsuitable due to disturbance) will occur intermittently throughout the construction period. The construction period is expected to take up to eight years, with activities and locations varying within this time.

73. The impact is predicted to be of local spatial extent, intermittent and medium-term duration (although only a small proportion of the total area will be affected at any one time, with individual elements of construction having much shorter durations) and will affect any birds in the vicinity of these activities directly. The construction disturbance and temporary loss of habitat impacts will also be of high reversibility. The magnitude is therefore, considered to be negligible For all species being considered for disturbance and temporary loss of habitat impacts (kittiwake, guillemot, razorbill, puffin, fulmar and gannet).

Kittiwake

Sensitivity of receptor

74. In terms of behavioural response to offshore vessel traffic and helicopters, kittiwake are considered have a low vulnerability (Wade *et al.*, 2016).

75. Kittiwake is a qualifying interest for several SPAs likely to be connected to the Array (within the mean-max + SD foraging range), with several non-SPA colonies also within range and so the species is considered to be of international value. Refer to Table 6.2 of volume 3, appendix 11.1 for details of SPAs with connectivity to the Array with regards to kittiwake.

76. Kittiwake lay two eggs and breed from the age of three onwards, typically living on average for 12 years (Burnell *et al*., 2023). Kittiwake have undergone decreases of approximately 57% in Scotland since the early 2000s. Surveys managed by the RSPB in 2023 have recorded indicative increases of 8% across a number of sites in Britain in 2023 when compared against a pre-HPAI baseline (Tremlett *et al*., 2024). Overall, kittiwake is deemed to have low recoverability.

77. Kittiwake is deemed to be of low vulnerability, low recoverability and international value. The sensitivity of the receptor is therefore, considered to be high.

Significance of the effect

78. Overall, the magnitude of the impact is deemed to be negligible and the sensitivity of the receptor is considered to be high. The effect will, therefore, be of **minor** adverse significance, which is not significant in EIA terms.

Guillemot

Sensitivity of the receptor

79. Guillemot are considered to be moderately vulnerable to disturbance (Wade *et al.*, 2016). Whilst there is evidence from studies that guillemot respond adversely to vessel traffic (Rojek *et al.*, 2007), behavioural response to underwater and airborne sounds resulting from construction activities are unknown. Although guillemot are likely to respond to visual stimuli during the construction phase, the impacts of disturbance/displacement are short-term and guillemot have the ability to return to the baseline abundance and distribution after construction.

80. Guillemot raise a single chick per year and breed from the age of six onwards, typically living on average for 23 years (Burnell *et al*., 2023). Guillemot have undergone decreases of approximately 31% in Scotland since the early 2000s. Surveys managed by the RSPB in 2023 have recorded indicative decreases of 6% across a number of sites in Britain in 2023 when compared against a pre-HPAI baseline (Tremlett *et al*., 2024). Overall, Guillemot is deemed to have low recoverability.

81. Guillemot is a qualifying interest for three SPAs likely to be connected to the Array (within the mean-max + SD foraging range), with several non-SPA colonies also within range and so the species is considered to be of international value. The population recorded during baseline surveys of the Array was found to be of regional importance. Therefore, guillemot is considered to be of international value.

82. Guillemot is deemed to be of medium vulnerability, low recoverability and international value. The sensitivity of the receptor is therefore, considered to be high.

Significance of the effect

83. Overall, the magnitude of the impact is deemed to be negligible and the sensitivity of the receptor is considered to be high. The effect will, therefore, be of **minor** adverse significance, which is not significant in EIA terms.

Razorbill

Sensitivity of the receptor

84. As with guillemot, razorbill are deemed to be moderately vulnerable to disturbance from vessels and helicopters at offshore wind farms (Wade *et al.,* 2016). Although razorbill are likely to respond to visual stimuli during the construction phase, the impacts of disturbance/displacement are short-term and razorbill have the ability to return to the baseline conditions after construction.

85. Although the species has a low reproductive potential (only laying one egg) and does not breed until four years old (Robinson, 2005), razorbill are deemed to have a medium recoverability given their increasing trend in abundance in the UK (JNCC, 2020).

86. The Array is within the foraging range of razorbill from two SPAs at which the species is a qualifying feature (Fowlsheugh SPA and Troup, Pennan and Lion’s Heads SPA). In addition, there are a number of smaller colonies within foraging range. The numbers of razorbills recorded during baseline surveys of the Array are considered to be of national importance. Therefore, razorbill is considered to be of international conservation value.

87. Razorbill is deemed to be of medium vulnerability, medium recoverability and international value. The sensitivity of the receptor is therefore, considered to be high.

Significance of the effect

88. Overall, the magnitude of the impact is deemed to be negligible and the sensitivity of the receptor is considered to be high. The effect will, therefore, be of **minor** adverse significance, which is not significant in EIA terms.

Puffin

Sensitivity of the receptor

89. Puffin are considered to be moderately vulnerable to disturbance (Wade *et al.*, 2016). Behavioural responses to underwater and airborne sounds resulting from construction activities are unknown. Although puffin are likely to respond to visual stimuli during the construction phase, the impacts of disturbance/displacement are short-term and puffin have the ability to return to the baseline abundance and distribution after construction (MacArthur Green, 2023).

90. Puffin have a low reproductive potential (i.e. typically laying only one egg and not breeding until five years old) (Robinson, 2005). Given puffin nest in burrows, and often in inaccessible locations, abundance estimates are relatively infrequent. The long-term pattern indicates a population increase since the counts conducted for Operation Seafarer (1969/70) but small declines in recent years (JNCC, 2021; Burnell, 2023). Puffin is therefore assessed as having low recoverability.

91. Puffin is a qualifying interest for several SPAs likely to be connected to the Array (within the mean-max + SD foraging range), with several non-SPA colonies also within range and so the species is considered to be of international value. The population recorded during baseline surveys of the Array was found to be of regional importance. Therefore, puffin is considered to be of international value.

92. Puffin is deemed to be of medium vulnerability, limited potential recoverability and international value. The sensitivity of the receptor is therefore considered to be high.

Significance of the effect

93. Overall, the magnitude of the impact is deemed to be negligible and the sensitivity of the receptor is considered to be high. The effect will, therefore, be of **minor** adverse significance, which is not significant in EIA terms.

Fulmar

Sensitivity of the receptor

94. In terms of behavioural response to vessel and helicopter traffic, fulmar are considered have a very low vulnerability (Wade *et al.*, 2016).

95. Fulmar is a qualifying interest for several SPAs likely to be connected to the Array (within the mean-max + SD foraging range), with several non-SPA colonies also within range and so the species is considered to be of international value. Refer to Table 6.26 of volume 3, appendix 11.1 for details of SPAs with connectivity to the Array with regards to fulmar.

96. Fulmar are considered to have very low reproductive potential, due to an average age of recruitment of nine years old and typically laying only a single egg (Robinson, 2005; Horswill and Robinson, 2015). The fulmar population increased by 77% between the 1969 to 1970 and 1985 to 1988 censuses and remained relatively stable until the early 2000s. Numbers have since declined slightly since, but remain above the level in 1969 to 1970 (JNCC, 2022).

97. Fulmar is deemed to be of very low vulnerability, low recoverability and international value. The sensitivity of the receptor is therefore, considered to be high.

Significance of the effect

98. Overall, the magnitude of the impact is deemed to be negligible and the sensitivity of the receptor is considered to be high. The effect will, therefore, be of **minor** adverse significance, which is not significant in EIA terms.

Gannet

Sensitivity of the receptor

99. Gannet are considered to have a very low vulnerability to other sources of disturbance such as vessel and helicopter traffic (Wade *et al.*, 2016), and so gannet are considered to be of very low vulnerability.

100. Gannet have low reproductive potential given a typical age of first breeding of five years and typically laying only a single egg per breeding season. However, although gannet has a low reproductive potential, the species has demonstrated a consistent increasing trend in abundance since the 1990s (JNCC, 2020). It is of note that the species has suffered from the outbreak of HPAI during the 2022 breeding season (Pearce-Higgins *et al*., 2023), with declines of 25% recorded at certain sites in Britain in 2023 when compared against a pre-HPAI baseline (Tremlett *et al*., 2024). Therefore, whilst the overall population has shown steady growth, HPAI has led to some short-term declines. Therefore, overall gannet is deemed to have low recoverability.

101. Due to the large foraging range, gannet is a qualifying interest for several SPAs likely to be connected to the Array (within the mean-max + SD foraging range), including the UK's largest gannet colony at Bass Rock. Bass Rock, which falls within the Outer Firth of Forth and St Andrews Bay Complex SPA, located 106.4 km south-west of the Array. The species is therefore considered to be of international value. Refer to volume 3, appendix 11.1 (Table 6.30) for details of SPAs with connectivity to the Array with regards to gannet.

102. Gannet is deemed to be of very low vulnerability, low recoverability and international value. The sensitivity of the receptor is therefore considered to be high.

Significance of the effect

103. Overall, the magnitude of the impact is deemed to be negligible and the sensitivity of the receptor is considered to be medium. The effect will, therefore, be of **minor** adverse significance, which is not significant in EIA terms.

Secondary mitigation and residual effect

104. No offshore ornithology secondary mitigation is considered necessary for any of the ornithological receptors, because the likely effect in the absence of mitigation is not significant in EIA terms.

Decommissioning phase

105. The MDS for the decommissioning phase is assumed to be equal or less than the construction phase (Table 11.11). As such, the assessment of the impacts is the same and is not repeated here. Therefore, as concluded in the construction phase, the impact of temporary habitat loss and disturbance in the decommissioning phase is of **minor** adverse significance, which is not significant in EIA terms.

INDIRECT IMPACTS FROM CONSTRUCTION/DECOMMISSIONING NOISE

106. Underwater sound produced during construction and decommissioning activities may impact upon the availability of prey items, for example by causing fish and mobile invertebrates to avoid the Array during construction and decommissioning. Underwater sound may also affect the physiology and behaviour of fish and mobile invertebrates. The reduction or disruption of prey availability due to underwater sound may cause reduced energy intake affecting productivity or survival of offshore ornithology receptors.

107. The potential effects on benthic invertebrates, fish and shellfish has been assessed in volume 2, chapters 8 and 9.

Construction phase

Magnitude of impact

108. A number of potential impacts on benthic subtidal ecology (including benthic invertebrates) associated with the Array were identified in volume 2, chapter 8, including disturbance during construction. The assessment identified an effect of minor adverse significance as a result of disturbance during construction, which is not significant in EIA terms.

109. With regards to fish and shellfish prey, volume 2, chapter 9 considered the potential impacts of disturbance during construction on marine species (including shellfish), sandeel, herring and diadromous fish. The assessment identified an effect of minor adverse significance on all fish and shellfish receptors as a result of disturbance during construction, which is not significant in EIA terms.

110. Based on the information presented in volume 2, chapters 8 and 9, the direct impact of construction noise on fish and mobile invertebrates is expected to be of minor adverse significance. The impact on ornithological receptors is predicted to be of local spatial extent, medium duration, intermittent and reversible. The magnitude is therefore considered to be of negligible significance.

Sensitivity of the receptor

111. None of the VORs considered in this assessment (as set out in Table 11.7) are highly specialist, with all VORs I a moderate degree of flexibility in their habitat preferences and prey items (Del Hoyo *et al.*, 1992). As set out in volume 3, appendix 11.1, the VORs listed in Table 11.7 have a moderate or high habitat flexibility as assessed by Wade *et al*. (2016), with the exception of little tern, which has low flexibility. This moderate or high habitat flexibility equates to a medium or low vulnerability to changes in prey availability (low flexibility equates to high vulnerability).

112. The recoverability of kittiwake, guillemot, razorbill, puffin, fulmar and gannet is shown in Table 11.19.

113. Herring gull lay up to three eggs and breed from the age of four onwards, typically living on average for 12 years (Burnell *et al*., 2023). Natural nesting colonies of herring gull have undergone decreases of approximately 44% in Scotland since the early 2000s, whereas urban-nesting populations have increased considerably. Given that the urban population is small compared to the natural population (Burnell *et al*., 2023), the overall trend is likely to be a decline. Surveys managed by the RSPB in 2023 have recorded indicative declines of 7% across a number of sites in Britain in 2023 when compared against a pre-HPAI baseline (Tremlett *et al*., 2024). Overall herring gull is considered to have low recoverability.

114. Lesser black-backed gull lay an average of three eggs and breed from the age of four onwards, typically living on average for 15 years (Burnell *et al*., 2023). Coastal colonies of lesser black-backed gull have undergone decreases of approximately 61% in Scotland since the early 2000s, whereas inland populations have increased by 145%, resulting in an overall decline of 48% (Burnell *et al*., 2023). Surveys managed by the RSPB in 2023 have recorded indicative declines of 25% across a number of sites in Britain in 2023 when compared against a pre-HPAI baseline (Tremlett *et al*., 2024). Overall lesser black-backed gull is considered to have low recoverability.

115. Sandwich tern typically lay two eggs and breed from the age of three onwards, typically living on average for 12 years (Burnell *et al*., 2023). Sandwich tern have undergone national decreases of approximately 54% since the early 2000s. Surveys managed by the RSPB in 2023 have recorded indicative decreases of 35% across a number of sites in Britain in 2023 when compared against a pre-HPAI baseline (Tremlett *et al*., 2024). Therefore, overall Sandwich tern is deemed to have low recoverability.

116. Little tern typically lay two to three eggs and breed from the age of three onwards, typically living on average for 12 years (Burnell *et al*., 2023). Little tern have undergone decreases of approximately 29% in Scotland since the early 2000s. Little tern is considered to have low recoverability.

117. Common tern typically lay two to three eggs and breed from the age of three onwards, typically living on average for 12 years (Burnell *et al*., 2023). Common tern have undergone a decline of 24% in Scotland since the early 2000s, but an overall increase of approximately 7% across Britain, Ireland, Isle of Man and Channel Islands (Burnell *et al*., 2023). Surveys managed by the RSPB in 2023 have recorded indicative decreases of 42% across a number of sites in Britain in 2023 when compared against a pre-HPAI baseline (Tremlett *et al*., 2024). Therefore, overall common tern is deemed to have low recoverability.

118. Arctic tern typically lay one to two eggs and breed from the age of four onwards. Although their average age is unknown, Arctic terns are long-lived and have been known to breed at 30-34 years of age (Burnell *et al*., 2023). Arctic tern have undergone a decrease of approximately 54% in Scotland since the early 2000s. Surveys managed by the RSPB in 2023 have recorded indicative decreases of 1% across a number of sites in Britain in 2023 when compared against a pre-HPAI baseline (Tremlett *et al*., 2024). Therefore, overall Arctic tern is considered to have low recoverability.

119. Great skua typically lay two eggs and breed from the age of four onwards. Although their average age is unknown, great skua are long-lived and have been known to reach 38 years of age (Burnell *et al*., 2023). Great skua have undergone an increase of approximately 14% in Scotland since the early 2000s. However, surveys managed by the RSPB have recorded indicative declines of 76% across a number of sites in Britain in 2023 when compared against a pre-HPAI baseline (Tremlett *et al*., 2024). Therefore, whilst the overall population has shown steady growth, HPAI has led to some significant short-term declines. Overall great skua is currently considered to have low recoverability.

120. European storm petrel lay one egg and breed from the age of four onwards, typically living on average for 12 years (Burnell *et al*., 2023). Storm petrel have undergone an increase of approximately 48% in Scotland since the early 2000s. Storm petrel is considered to have medium recoverability.

121. Leach's storm petrel lay one egg and breed from the age of five onwards. Although their average age is unknown, Leach's storm petrel are long-lived and have been known to reach 36 years of age (Burnell *et al*., 2023). Leach's storm petrel have undergone declines of approximately 79% in Scotland since the early 2000s. Leach's storm petrel is considered to have low recoverability.

122. Manx shearwater lay one egg and breed from the age of five onwards. Manx shearwater are long-lived and have been known to reach over 50 years of age (Burnell *et al*., 2023). Manx shearwater have undergone increases of approximately 133% in Scotland since the early 2000s. Manx shearwater is considered to have medium recoverability.

123. With the exception of little tern, the VORs are all deemed to be of low to medium vulnerability, low to medium recoverability and national to international value. The sensitivity of these receptors is therefore considered to range between medium to high sensitivity (refer to Table 11.19) .

124. Little tern has a high vulnerability to changes in prey availability, has a low recoverability and is of national conservation value. Therefore, little tern has a high sensitivity.

Table 11.19: Sensitivity of Receptors to Indirect Impacts from Construction/Decommissioning Noise

VOR	Vulnerability to Changes in Prey Availability	Recoverability	Conservation Value	Sensitivity
Kittiwake	Medium	Low	International	High
Herring gull	Low	Low	International	High
Lesser black-backed gull	Low	Low	International	High
Sandwich tern	Medium	Low	National	High
Little tern	High	Low	National	High
Common tern	Medium	Low	National	High
Arctic tern	Medium	Low	International	High
Great skua	Medium	Low	International	High
Guillemot	Medium	Low	International	High
Razorbill	Medium	Medium	International	High
Puffin	Medium	Low	International	High
European storm petrel	Low	Medium	International	High
Leach's storm petrel	Low	Low	International	High
Fulmar	Low	Low	International	High
Manx shearwater	Low	Medium	International	High
Gannet	Low	Low	International	High

Significance of the effect

125. Given a magnitude of impact of negligible adverse significance, and a high sensitivity, the significance of the effect is concluded to be of **minor** adverse significance for all receptors, which is not significant in EIA terms.

Secondary mitigation and residual effect

126. No offshore ornithology secondary mitigation is considered necessary because the likely effect in the absence of mitigation is not significant in EIA terms.

Decommissioning phase

127. The MDS for the decommissioning phase is assumed to be equal to the construction phase (Table 11.11). As such, the assessment of the effects is the same and is not repeated here. Therefore, as concluded in the construction phase, the effect of indirect impacts from noise in the decommissioning phase is not significant in EIA terms.

INDIRECT IMPACTS FROM UXO CLEARANCE

128. There is potential for disturbance, auditory injury and/or mortality for sensitive benthic invertebrates, fish and shellfish species as a result of UXO clearance during the construction phase. The reduction or disruption of prey availability due to UXO detonations may cause reduced energy intake affecting productivity or survival of offshore ornithology receptors.

Construction phase

Magnitude of impact

129. A number of potential impacts on benthic subtidal ecology (including benthic invertebrate prey) associated with the Array were identified in volume 2, chapter 8, including disturbance during construction. The assessment identified an effect of minor adverse significance as a result of disturbance during construction, which is not significant in EIA terms.

130. With regards to fish and shellfish prey, volume 2, chapter 9 considered the potential impacts of disturbance during construction on marine species (including shellfish), sandeel, herring and diadromous fish. The assessment identified an effect of minor adverse significance on all fish and shellfish receptors as a result of disturbance during construction, which is not significant in EIA terms.

131. Based on the information presented in volume 2, chapters 8 and 9, the direct impact of construction noise on fish and mobile invertebrates is expected to be of minor adverse significance. The impact on ornithological receptors is predicted to be of local spatial extent, medium duration, intermittent and reversible. The magnitude is therefore considered to be of negligible significance.

Sensitivity of the receptor

132. As with indirect impacts from construction/decommissioning noise, sensitivity is determined by vulnerability to changes in prey availability, recoverability of a species and its conservation value. Therefore, the sensitivity of the receptors is as set out in Table 11.19, with all VORs having a high sensitivity to changes in prey availability.

Significance of the effect

133. Given a magnitude of impact of negligible adverse significance, and a high sensitivity, the significance of the effect is concluded to be of **minor** adverse significance for all receptors, which is not significant in EIA terms.

Secondary mitigation and residual effect

134. No offshore ornithology secondary mitigation is considered necessary because the likely effect in the absence of mitigation is not significant in EIA terms.

DISTURBANCE AND DISPLACEMENT FROM THE PHYSICAL PRESENCE OF WIND TURBINES AND MAINTENANCE ACTIVITIES

135. Disturbance as the result of the presence of wind turbines and operational activities during the operation and maintenance phase of an offshore wind farm has the potential to displace seabirds from the area of sea in which wind turbines are located or the activity is occurring. In relation to offshore wind farm development, displacement is defined as a reduction in the number of seabirds occurring within or immediately adjacent to an offshore wind farm (Furness *et al.*, 2013).

136. Displacement can be considered indirect habitat loss, as the result is that that birds are unable to utilise the habitat in the area from which they have been displaced. The loss of habitat means birds may move to areas already occupied by other birds and thus face higher intra- or inter-specific competition due to a higher density of individuals competing for the same resource. Alternatively, displaced birds may be forced to move into areas of lower quality (e.g. areas of lower prey availability) or travel longer distances to reach habitat of a suitable quality. This could therefore affect their demographic fitness (i.e. survival rates and breeding productivity), as well as potentially impacting on other birds in areas that displaced birds move to (for example, by increasing competition for resources).

137. Table 11.11 gives the scenario that would lead to the greatest amount of disturbance and displacement during the operation and maintenance phase. This results from the largest Array and the greatest amount of vessel and helicopter activity.

138. The displacement assessment is based on the use of the matrix approach (JNCC *et al.*, 2022), which was agreed as suitable in the post-Scoping consultation (see Table 11.3). As sensitivity to displacement differs considerably between seabird species, species were screened and progressed for the matrix approach using 'Disturbance Sensitivity' and 'Habitat Specialisation' scores from Bradbury *et al.* (2014) and Wade *et al.* (2016) as recommended by the Joint SNCB Interim Displacement Advice Note (JNCC *et al.*, 2022). In addition to the species' sensitivity rating, the importance of a species abundance as recorded during baseline surveys of the Array was considered as to whether species were progressed to the matrix stage (see volume 3, appendix 11.3). The species progressed to the matrix stage were kittiwake, guillemot, razorbill, puffin, fulmar and gannet, and these species are considered in detail in this section. All other species were excluded on the basis there was no potential for a significant effect (volume, 3, appendix 11.3).

139. For each of the species considered (kittiwake, guillemot, razorbill, puffin, fulmar and gannet: as identified in volume 3, appendix 11.3), displacement impacts were quantified for the population within the Array plus 2 km buffer. SNCBs recommend for most species a standard displacement buffer of 2 km with the exception of the species groups of divers as they can be affected at distances over 4 km (Natural England, 2022; JNCC, 2022).

140. Full displacement matrices showing the estimated mortality resulting from 0% to 100% displacement and 0% to 100% mortality of displaced individuals are provided in volume 3, appendix 11.3. Within the displacement matrices, the rates advocated for by NatureScot (2023h) have been utilised and presented alongside an Applicant's Approach. These rates are discussed within volume 3, appendix 11.3 and within each species' section below.

141. Where available, abundance estimates based on MRSea modelling have been used, with design-based abundance estimates used otherwise (see volume 3, appendix 11.1 for details on approaches to abundance estimation). Displacement matrices based solely on design-based abundance estimates are also presented in volume 3, appendix 11.3.

Evidence used to inform displacement and mortality rates used in Applicant's Approach

142. There is limited empirical evidence on which mortality rate to use when assessing the impacts of displacement of offshore wind farms. However, the current NatureScot guidance, based on expert opinion, is to consider a mortality rate of up to 5% (NatureScot, 2023h). Van Kooten et al. (2019) studied the effects of displacement of seabirds using energy-budget models for two scenarios using habitat utilisation maps and a fixed 10% mortality rate. The evidence from this study suggests that a 1% mortality rate for displaced birds is more appropriate than the potentially over-precautionary 5% mortality rate.

143. APEM (2022a,b) also considered mortality rates, though fewer studies have attempted to quantify displacement-consequent mortality given the practical and theoretical limitations in doing so. The review concluded that the available evidence is "incompatible" with a 10% mortality rate and the most likely mortality rate is considered to be "negligible or undetectable". APEM (2022a,b) suggest that a mortality rate of 1% or less would be more consistent with the available evidence and still precautionary. Therefore, the Applicant's Approach applies a 1% mortality rate, based on this evidence. The mortality rate of 1% follows previous advice from the Marine Scotland on Forth & Tay projects (Marine Scotland, 2017).

Puffin, guillemot and razorbill

144. Evidence shows that auk species exhibit a medium level of sensitivity to vessel and helicopter traffic (Garthe and Hüppop, 2004; Furness and Wade, 2012; Bradbury *et al*., 2014). Furthermore, displacement impacts from post-consent monitoring studies (from 13 different European offshore windfarm sites) have been collated and reviewed by Dierschke *et al*., (2016), which found auk species to show 'weak displacement' overall, but results were highly variable. Similarly, a recent review submitted by Hornsea Four Offshore Wind Farm (APEM, 2022a) summarises all current post consent-monitoring studies undertaken to date within the North Sea and UK Western Waters and provides an extensive study and analysis of the empirical data from offshore wind farms. This review found that auk displacement varies considerably across different sites, with displacement rates ranging from +112% to -75%, with the most common finding being no significant effect.

145. Of projects that have quantified displacement post-construction, the closest to the Array is Beatrice Offshore Wind Farm (191.63 km from the Array), which has found low levels of guillemot displacement (MacArthur Green, 2023) with results suggesting that the area of decreased abundance which overlaps the wind farm is no more than partially related to the wind farm (and only in the pre-post-1 comparison), and is either linked to other changes in the area such as moving prey hotspots, or may simply be due to chance.

146. Furthermore, evidence suggests that although auk species are somewhat sensitive to displacement, the effects are short-term, and studies indicate auk habituation to offshore windfarms. For example, a study at Thanet Offshore Windfarm found auk species became habituated, and the displacement rate of between 75% and 85% in the first year of operations fell to between 31% and 41% within years two and three of operations (Royal Haskoning, 2013). Further evidence is emerging through additional post-construction monitoring of offshore windfarms; for instance, there are reports of auk numbers increasing and observations of foraging behaviour within the offshore wind farm itself (Leopold and Verdaat, 2018). This suggests the displacement rates of auk species within the Array will reduce over time.

147. Based on the review of the relevant literature, a displacement rate of 50% during the operations and maintenance phase of the Array has been deemed appropriate for the auk species (i.e. guillemot, razorbill and puffin) considered in this assessment. This rate is considered to be highly precautionary as a study of offshore wind farms in the German North Sea found reduced displacement rates (~20%) of guillemots during the breeding season compared to the non-breeding season (Peschko *et al*., 2020). This is of important consideration, as the mean displacement rates derived from the Dierschke *et al*. (2016) review was primarily

from data collected in the non-breeding season. Therefore, by applying a single displacement rate of 50% across all bio-seasons within the Array, this ensures a precautionary rate is used for the assessment. Additionally, the recent study by MacArthur Green (2019 and 2023) highlighted that a displacement rate of 50% was also suitable for puffin and is therefore the displacement rate utilised within the Applicant's Approach for all auk species.

Gannet

148. Evidence suggests that gannet show a low level of sensitivity to ship and helicopter traffic (Garthe and Hüppop, 2004; Furness and Wade, 2012). However, their avoidance rates to offshore wind farms can be high. Natural England recently reviewed nine studies that reported on northern gannet avoidance rates using a variation of survey methods (Pavat *et al*., 2023). The avoidance rates reported range from 61.7% to 100%. Another review by APEM (2022b) looked at studies across 25 offshore wind farms, over different seasons, and reported displacement rates of 40% to 60% during the breeding season, and 60% to 80% during the non-breeding season. In light of literature, and following guidance from NatureScot (2023h), using a displacement rate of 70% has been deemed appropriate for the Applicant's Approach.

Kittiwake

149. Kittiwake are considered to have a low habitat specialisation score and low sensitivity to displacement (Bradbury *et al.,* 2014; Furness and Wade, 2012; Nature Scot, 2023h).

150. Studies regarding the displacement at Egmond aan Zee Offshore Wind Farm (Leopold *et al.,* 2011), Bligh Bank Offshore Wind Farm and Thorntonbank Offshore Wind Farm (Vanermen, 2013). Horns Rev Offshore Wind Farm, Princess Amalia Windpark (Furness, 2013) reported no significant displacement of kittiwake.

151. Nature Scot advise a 30% displacement for kittiwake in both the breeding and non-breeding season (Nature Scot, 2023h). In light of this guidance and additional evidence stated, for the purpose of this assessment, precautionary rates of 30% for displacement have been used for the operations and maintenance phase of the Array as part of the Applicant's Approach.

Fulmar

152. Fulmar are considered to have a very low sensitivity to displacement (Bradbury *et al.* 2014). However Wade *et al.* (2016) states that the uncertainty surrounding this classification is very high, indicating that evidence around displacement impacts on fulmar are not well understood.

153. Dierschke *et al*. (2016) classified fulmars as weakly avoiding offshore wind farms, based on post-construction studies at 20 sites, however the authors note that data for this species are limited and fulmar may actually display stronger avoidance behaviour. It is possible that the lack of fishing vessels within wind farm areas makes them unattractive to fulmars (Neumann *et al*., 2013; Braasch *et al*., 2015). The study conducted at BARD Offshore Wind Farm showed that some displacement of fulmar occurred, with higher densities observed outside the wind farm area (Braasch *et al*., 2015), indicating that small scale displacement may be present. Vanermen *et al*. (2019) stated that no significant displacement results were found for fulmar at Thorntonbank Offshore Wind farm, with Furness (2013) indicating that it is very unlikely that fulmar would be affected by displacement.

154. NatureScot (2023h) do not provide recommended displacement rates for this species and so as a precaution, the Applicant utilised a wide range of displacement rates of 0 to 50% as part of their Applicant's Approach. Fulmar was assessed as a precaution due to the large scale of uncertainty surrounding fulmar displacement. However, based on expert judgement and the fact that several post-construction monitoring studies have concluded little to no effect, focus has been placed on the 30% displacement rate. This rate was also utilised within the Pentland Floating Offshore Wind Farm Application (HiDef, 2022) as it was deemed the most appropriate rate for fulmar.

Operation and maintenance phase

Kittiwake

Magnitude of impact

155. The estimated mortality resulting from displacement during operation and maintenance was assessed for each season, and also on an annual basis by combining seasonal impacts and comparing them against the largest regional seasonal population (as set out in volume 3, appendix 11.3, and summarised in Table 11.20).

156. In all seasons and on an annual basis, even when using the NatureScot displacement and mortality rates, the predicted increase in the baseline mortality rate does not surpass the 1% threshold. The impact in each season using the NatureScot Approach is predicted to be below 0.07% increase in baseline mortality, and on an annual basis a maximum of 0.03% increase in baseline mortality (Table 11.20).

157. Using the Applicant's Approach rates, the increase in baseline mortality is expected to be well below a 0.1% increase in baseline mortality in each season. On an annual basis, an annual increase of 0.011% estimated (Table 11.20).

158. The impact is predicted to be of local spatial extent. The impact is expected to occur for the lifespan of the project and therefore be long term, although it is reversible following decommissioning of the Array. It is predicted that the impact will affect the receptor directly. However, even considering the NatureScot Approach, the increase in baseline mortality is expected to be well below 1% and is unlikely to be detectable compared to natural variation in mortality rates. The magnitude is therefore considered to be negligible**.**

Table 11.20: Kittiwake Seasonal and Annual Displacement Estimates for the Array Plus 2 km Buffer During Operation and Maintenance

Season	Seasonal Abundance (Array + 2 km buffer)[12]	Regional Baseline		Number of Kittiwake Subject to Mortality (Applicant's Approach)	Number of Kittiwake Subject to Mortality (NatureScot)	Increase in Baseline Mortality (Applicant's Approach) (%)	Increase in Baseline Mortality (NatureScot Approach) (%)
		Population[13]	Baseline Mortality[14]				
Pre-breeding	581	627,816	98,065	2	2 to 5	0.002	0.002 to 0.005
Breeding	3,183	261,047	40,776	10	10 to 29	0.025	0.025 to 0.071
Post-breeding	566	829,937	129,636	2	2 to 5	0.002	0.002 to 0.004
Annual	**-**	**829,937**	129,636	**14**	**14 to 39**	0.011	0.011 to 0.030

[12] Seasonal abundances are taken from volume 3, appendix 11.3:

[13] Population counts are taken from Table 11.9.

[14] Baseline mortality is calculated using mortality rates given in volume 3, appendix 11.1.

Sensitivity of the receptor

159. In terms of behavioural response to offshore wind farm structures, kittiwake are considered to be of low vulnerability, with a score of two (out of five) assigned by Wade *et al*. (2016).

160. Kittiwake is a qualifying interest for several SPAs likely to be connected to the Array (within the mean-max + SD foraging range), with several non-SPA colonies also within range and so the species is considered to be of international value. Refer to Table 6.2 of volume 3, appendix 11.1 for details of SPAs with connectivity to the Array with regards to kittiwake.

161. Kittiwake lay two eggs and breed from the age of three onwards, typically living on average for 12 years (Burnell *et al*., 2023). Kittiwake have undergone decreases of approximately 57% in Scotland since the early 2000s. Surveys managed by the RSPB in 2023 have recorded indicative increases of 8% across a number of sites in Britain in 2023 when compared against a pre-HPAI baseline (Tremlett *et al*., 2024). Overall, kittiwake is deemed to have low recoverability.

162. Kittiwake is deemed to be of low vulnerability, low recoverability and international value. The sensitivity of the receptor is therefore, considered to be high.

Significance of the effect

163. Overall, the magnitude of the impact is deemed to be negligible and the sensitivity of the receptor is considered to be high. The effect will, therefore, be of **minor** adverse significance, which is not significant in EIA terms.

Secondary mitigation and residual effect

164. No offshore ornithology secondary mitigation is considered necessary because the likely effect in the absence of mitigation is not significant in EIA terms.

Guillemot

Magnitude of impact

165. The estimated mortality resulting from displacement during operation and maintenance was assessed for each season, and also on an annual basis by combining seasonal impacts and comparing them against the largest regional seasonal population (as set out in volume 3, appendix 11.3, and summarised in Table 11.21).

166. When using the displacement and mortality rates recommended by NatureScot, (2023h) the predicted number of mortalities is 490 to 817 in the breeding season, and 290 to 870 in the non-breeding season. This is an increase in the baseline mortality rate of 0.40% to 0.67% in the breeding season, and 0.14% to 0.41% in the non-breeding season. On an annual basis, the number of mortalities is 780 to 1,687, which is an increase in baseline mortality rates of 0.36% to 0.79% (Table 11.21).

167. Using the Applicant's Approach of 50% displacement and 1% mortality (in all seasons) the number of mortalities is 136 in the breeding season and 242 in the non-breeding season. This is an increase in the baseline mortality rate of 0.11% in the breeding season, and 0.11% in the non-breeding season. On an annual basis, the number of mortalities is 378, which is an increase in baseline mortality rates of 0.18% (Table 11.21).

168. It should be noted that recent work using time-depth-recorders to monitor auk diving activity indicates that there is significant variation in diving behaviour (Dunn *et al.*, 2024). The results presented by Dunn *et al.* (2024) indicate that the correction factors applied to account for auk availability bias (see volume 3, appendix 11.1) are likely to lead to overestimates of the true abundance of auks within the Array Study Area. Therefore, the number of mortalities predicted, based on the abundance of birds present, is also likely to be an overestimate and the conclusions must be considered highly precautionary.

169. The impact is predicted to be of local spatial extent. The impact is expected to occur for the lifespan of the Array, although is reversible following decommissioning of the Array and is therefore considered to be of long-term duration. It is predicted that the impact will affect the receptor directly. However, even considering the NatureScot impact values, the increase in baseline mortality is expected to be below 1% and is unlikely to be detectable compared to natural variation in mortality rates. The magnitude of the impact is therefore deemed to be low.

Table 11.21: Guillemot Seasonal and Annual Displacement Estimates for the Array Plus 2 km Buffer During Operation

Season	Seasonal Abundance (Array + 2 km buffer)	Regional Baseline Population	Regional Baseline Baseline Mortality	Number of Guillemot Subject to Mortality (Applicant's Approach)	Number of Guillemot Subject to Mortality (NatureScot Approach)	Increase in Baseline Mortality (Applicant's Approach) (%)	Increase in Baseline Mortality (NatureScot Approach) (%)
Breeding	27,247	916,667	121,733	136	490 to 817	0.112	0.403 to 0.671
Non-breeding	48,340	1,617,306	214,778	242	290 to 870	0.113	0.135 to 0.405
Annual	**-**	**1,617,306**	**214,778**	**378**	**780 to 1,687**	**0.176**	**0.363 to 0.785**

Sensitivity of the receptor

170. Guillemot is considered to have a high vulnerability to displacement from offshore wind farm structures, being assigned a score of 4 (out of 5) by Wade *et al*. (2016).

171. Guillemot raise a single chick per year and breed from the age of six onwards, typically living on average for 23 years (Burnell *et al*., 2023). Guillemot have undergone decreases of approximately 31% in Scotland since the early 2000s. Surveys managed by the RSPB in 2023 have recorded indicative decreases of 6% across a number of sites in Britain in 2023 when compared against a pre-HPAI baseline (Tremlett *et al*., 2024). Overall, guillemot is deemed to have low recoverability. The Array is not within the foraging range of guillemot from any SPAs at which the species is a qualifying feature. Based on the regional importance of the population recorded during baseline surveys of the Array guillemot is considered to be of international value.

172. Guillemot is deemed to be of high vulnerability, low recoverability and international value. The sensitivity of the receptor is therefore considered to be high.

Significance of the effect

173. Overall, the magnitude of the impact is deemed to be low and the sensitivity of the receptor is considered to be high. The effect will, therefore, be of minor to moderate adverse significance. However, as the predicted impact did not surpass 1% in increased mortality, the overall impact is categorised as having a **minor** adverse significance, which is not significant in EIA terms.

Secondary mitigation and residual effect

174. No offshore ornithology secondary mitigation is considered necessary because the likely effect in the absence of mitigation is not significant in EIA terms.

Razorbill

Magnitude of impact

175. The estimated mortality resulting from displacement during operation and maintenance was assessed for each season, and also on an annual basis by combining seasonal impacts and comparing them against the largest regional seasonal population (as set out in volume 3, appendix 11.3, and summarised in Table 11.22).

176. When using the displacement and mortality rates recommended by NatureScot,(2023h) the predicted number of mortalities is one to four in the pre-breeding season, 47 to 78 in the breeding season, nine to 27 in the post-breeding season, and one to two in the non-breeding season. This is an increase in the baseline mortality rate of 0.001% to 0.004% in the pre-breeding season, 0.50% to 0.83% in the breeding season, 0.01% to 0.03% in the post-breeding season, and 0.003% to 0.01% in the non-breeding season. On an annual basis, the number of mortalities is 58 to 111, which is an increase in baseline mortality rates of 0.06% to 0.11% (Table 11.22).

177. Using the Applicant's Approach, the number of mortalities is one in the pre-breeding season, 13 in the breeding season, seven in the post-breeding season and one in the non-breeding season. This is an increase in the baseline mortality rate of 0.001% in the pre-breeding season, 0.14% in the breeding season, 0.01% in the post-breeding season, and 0.003% in the non-breeding season. On an annual basis, the number of mortalities is 22, which is an increase in baseline mortality rates of 0.02% (Table 11.22).

178. It should be noted that recent work using time-depth-recorders to monitor auk diving activity indicates that there is significant variation in diving behaviour (Dunn *et al*., 2024). The results presented by Dunn *et al*. (2024) indicate that the correction factors applied to account for auk availability bias (see volume 3, appendix 11.1) are likely to lead to overestimates of the true abundance of auks within the Array Study Area. Therefore, the number of mortalities predicted, based on the abundance of birds present, is also likely to be an overestimate and the conclusions must be considered highly precautionary.

179. The impact is predicted to be of local spatial extent. The impact is expected to occur for the lifespan of the project, although is reversible following decommissioning of the project and is therefore considered to be of long-term duration. It is predicted that the impact will affect the receptor directly. Using both the Applicant's Approach rates and the rates recommended by NatureScot (2023h), the increase in mortality is below 1% of baseline mortality in each season and also on an annual basis. Therefore, the magnitude of impact is considered to be low**.**

Table 11.22: Razorbill Seasonal and Annual Displacement Estimates for the Array Plus 2 km Buffer During Operation and Maintenance

Season	Seasonal Abundance (Array + 2 km buffer)	Regional Baseline Population	Regional Baseline Baseline Mortality	Number of Razorbill Subject to Mortality (Applicant's Approach)	Number of Razorbill Subject to Mortality (NatureScot Approach)	Increase in Baseline Mortality (Applicant's Approach) (%)	Increase in Baseline Mortality (NatureScot Approach) (%)
Pre-breeding	224	591,874	101,980	1	1 to 4	0.001	0.001 to 0.004
Breeding	2,608	54,552	9,399	13	47 to 78	0.138	0.500 to 0.830
Post-breeding	1,493	591,874	101,980	7	9 to 27	0.007	0.009 to 0.026
Non-breeding	138	218,622	37,669	1	1 to 2	0.003	0.003 to 0.005
Annual	**-**	**591,874**	**101,980**	**22**	**58 to 111**	**0.022**	**0.057 to 0.109**

Sensitivity of the receptor

180. As with guillemot, razorbill are deemed to be highly vulnerable to displacement from offshore wind farms, being assigned a score of 4 (out of 5) by Wade *et al*. (2016). Although the species has a low reproductive potential (only laying one egg) and does not breed until four years old (Robinson, 2005), razorbill are deemed to have a medium recoverability given their increasing trend in abundance in the UK (JNCC, 2020).

181. The Array is within the foraging range of razorbill from two SPAs at which the species is a qualifying feature (Fowlsheugh SPA and Troup, Pennan and Lion's Heads SPA). In addition, there are a number of smaller colonies within foraging range. The numbers of razorbills recorded during baseline surveys of the Array are considered to be of national importance. Therefore, razorbill is considered to be of international conservation value.

182. Razorbill is deemed to be of high vulnerability, medium recoverability and international value. The sensitivity of the receptor is therefore, considered to be high**.**

Significance of the effect

183. Overall, the magnitude of the impact is deemed to be low and the sensitivity of the receptor is considered to be high. The effect will, therefore, be of minor to moderate adverse significance. However, as the predicted impact did not surpass 1% in increased mortality, the overall impact is categorised as having a **minor** adverse significance, which is not significant in EIA terms.

Secondary mitigation and residual effect

184. No offshore ornithology secondary mitigation is considered necessary because the likely effect in the absence of mitigation is not significant in EIA terms.

Puffin

Magnitude of impact

185. The estimated mortality resulting from displacement during operation and maintenance was assessed for each season, and also on an annual basis by combining seasonal impacts and comparing them against the largest regional seasonal population (as set out in volume 3, appendix 11.3, and summarised in Table 11.23).

186. When using the displacement and mortality rates recommended by NatureScot, the predicted number of mortalities is 35 to 58 in the breeding season, and seven to 21 in the non-breeding season. This is an increase in the baseline mortality rate of 0.07% to 0.12% in the breeding season, and 0.02% to 0.05% in the non-breeding season. On an annual basis, the number of mortalities is 42 to 79, which is an increase in baseline mortality rates of 0.09% to 0.16% (Table 11.23).

187. Using the Applicant's Approach, the predicted number of mortalities is 10 in the breeding season, and six in the non-breeding season. This is an increase in the baseline mortality rate of 0.02% in the breeding season, and 0.02% in the non-breeding season. On an annual basis, the number of mortalities is 16, which is an increase in baseline mortality rates of 0.03% (Table 11.23).

188. It should be noted that recent work using time-depth-recorders to monitor auk diving activity indicates that there is significant variation in diving behaviour (Dunn *et al*., 2024). The results presented by Dunn *et al*. (2024) indicate that the correction factors applied to account for auk availability bias (see volume 3, appendix 11.1) are likely to lead to overestimates of the true abundance of auks within the Array Study Area. Therefore, the number of mortalities predicted, based on the abundance of birds present, is also likely to be an overestimate and the conclusions must be considered highly precautionary.

189. The impact is predicted to be of local spatial extent. The impact is expected to occur for the lifespan of the project, although is reversible following decommissioning of the project and is therefore considered to be of long-term duration. It is predicted that the impact will affect the receptor directly. However, even considering the NatureScot impact values, the increase in baseline mortality is expected to be below 1% and is unlikely to be detectable compared to natural variation in mortality rates. The magnitude of the impact is therefore deemed to be negligible.

Table 11.23: Puffin Seasonal and Annual Displacement Estimates for the Array Plus 2 km Buffer During Operation and Maintenance

Season	Seasonal Abundance (Array + 2 km buffer)	Regional Baseline		Number of Puffin Subject to Mortality (Applicant's Approach)	Number of Puffin Subject to Mortality (NatureScot Approach)	Increase in Baseline Mortality (Applicant's Approach) (%)	Increase in Baseline Mortality (NatureScot Approach) (%)
		Population	Baseline mortality				
Breeding	1,928	279,803	49,357	10	35 to 58	0.020	0.071 to 0.118
Non-breeding	1,178	231,957	40,917	6	7 to 21	0.015	0.017 to 0.051
Annual	**-**	**279,803**	**49,357**	**16**	**42 to 79**	**0.032**	**0.085 to 0.160**

Sensitivity of the receptor

190. Puffin are considered to be moderately vulnerable to displacement from offshore structures, being assigned a score of 3 (out of 5) by Wade *et al*. (2016).

191. Puffin have a low reproductive potential (i.e. typically laying only one egg and not breeding until five years old) (Robinson, 2005). Given puffin nest in burrows, and often in inaccessible locations, abundance estimates are relatively infrequent. The long-term pattern indicates a population increase since the counts conducted for Operation Seafarer (1969/70) but small declines in recent years (JNCC, 2021; Burnell, 2023). Puffin is therefore assessed as having low potential for recovery.

192. Puffin is a qualifying interest for several SPAs likely to be connected to the Array (within the mean-max + SD foraging range), with several non-SPA colonies also within range and so the species is considered to be of international value. The population recorded during baseline surveys of the Array was found to be of regional importance. Therefore, puffin is considered to be of international value.

193. Puffin is deemed to be of medium vulnerability, limited potential recoverability and international value. The sensitivity of the receptor is therefore considered to be high.

Significance of the effect

194. Overall, the magnitude of the impact is deemed to be negligible and the sensitivity of the receptor is considered to be high. The effect will, therefore, be of **minor** adverse significance, which is not significant in EIA terms.

Secondary mitigation and residual effect

195. No offshore ornithology secondary mitigation is considered necessary because the likely effect in the absence of mitigation is not significant in EIA terms.

Fulmar

Magnitude of impact

196. The estimated mortality resulting from displacement during operation and maintenance was assessed for each season, and also on an annual basis by combining seasonal impacts and comparing them against the largest regional seasonal population (as set out in volume 3, appendix 11.3, and summarised in Table 11.24).

197. NatureScot (2023h) does not specify an alternative displacement or avoidance rate for fulmar due to the uncertainty surrounding the impact on the species.

198. An Applicant's Approach for fulmar was established due to the high abundances recorded during DAS of the Array, as well as the significant uncertainty surrounding displacement on fulmar, as reported by Wade *et al* (2016).

199. Using the Applicant's Approach range, the predicted number of mortalities is zero to seven in the pre-breeding season, zero to 19 in the breeding season, zero to six in the post-breeding season and zero to four in the non-breeding season. This is an increase in the baseline mortality rate of <0.001% to 0.003% in the pre-breeding, <0.001% to 0.018% in the breeding season, <0.001% to 0.003% in the post-breeding season and 0.001% to 0.003% in the non-breeding season. On an annual basis, the number of mortalities is zero to 36, which is an increase in baseline mortality rates of <0.001% to 0.02% (Table 11.24).

200. Using the Applicant's Approach and placing focus on the 30% displacement rate, the predicted number of mortalities is one in the pre-breeding season, three in the breeding season, one in the post-breeding season and one in the non-breeding season. This is an increase in the baseline mortality rate of <0.001% in the pre-breeding, 0.003% in the breeding season, <0.001% in the post-breeding season and 0.001% in the non-breeding season. On an annual basis, the number of mortalities is six, which is an increase in baseline mortality rates of 0.003% (Table 11.24).

201. The impact is predicted to be of local spatial extent, long-term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptor directly. However, even considering the upper end of the range of impact values, the increase in baseline mortality is expected to be well below 1% and is unlikely to be detectable compared to natural variation in mortality rates. The magnitude is therefore, considered to be negligible.

Table 11.24: Fulmar Seasonal and Annual Displacement Estimates for the Array Plus 2 km Buffer During Operation and Maintenance

Season	Seasonal Abundance (Array + 2 km buffer)	Regional Baseline		Number of Fulmar Subject to Mortality (Applicant's Approach Range)	Number of Fulmar Subject to Mortality (Applicant's Approach 30%)	Increase in Baseline Mortality (Applicant's Approach Range) (%)	Number of Fulmar Subject to Mortality (Applicant's Approach 30%)
		Population	Baseline mortality				
Pre-breeding	671	957,502	212,087	0 to 7	1	0.000 to 0.003	0.000
Breeding	1,932	476,165	105,471	0 to 19	3	0.000 to 0.018	0.003
Post-breeding	609	957,502	212,087	0 to 6	1	0.000 to 0.003	0.001
Non-breeding	442	568,736	125,975	0 to 4	1	0.000 to 0.003	0.001
Annual	**-**	**957,502**	**212,087**	**0 to 36**	**6**	**0.000 to 0.017**	**0.003**

Sensitivity of the receptor

202. In terms of behavioural response to wind farm structures, fulmar are considered have a very low vulnerability (Wade *et al.*, 2016).

203. Owing to their large foraging range, fulmar is a qualifying interest for several SPAs likely to be connected to the Array (within the mean-max + SD foraging range). Most of the world population is found in the UK and over 90% of the UK population is found on the Islands of Rum and Eigg (Scotland) and Skomer and Skokholm (Wales) (Mitchell *et al*., 2004; JNCC, 2020). The species is considered to be of international value.

204. Fulmar has a low reproductive potential (i.e. only laying one egg and not breeding until nine years old; Robinson, 2005). There has been a moderate decline in the regional and national population of fulmar, with this likely due to a reduction in the amount of offal discarded from fishing vessels, reductions in natural prey and climate change (JNCC, 2020). The recoverability of the receptor is therefore, considered to be low.

205. Fulmar is deemed to be of very low vulnerability, low recoverability and international value. The sensitivity of the receptor is therefore, considered to be high.

Significance of the effect

206. Overall, the magnitude of the impact is deemed to be negligible and the sensitivity of the receptor is considered to be high. The effect will, therefore, be of **minor** adverse significance, which is not significant in EIA terms.

Secondary mitigation and residual effect

207. No offshore ornithology secondary mitigation is considered necessary because the likely effect in the absence of mitigation is not significant in EIA terms.

Gannet

Magnitude of impact

208. The estimated mortality resulting from displacement during operation and maintenance was assessed for each season, and also on an annual basis by combining seasonal impacts and comparing them against the largest regional seasonal population (as set out in volume 3, appendix 11.3, and summarised in Table 11.25).

209. When using the displacement and mortality rates recommended by NatureScot, the predicted number of mortalities is zero to one in the pre-breeding season, 10 to 29 in the breeding season and five to 16 in the post-breeding season. This is an increase in the baseline mortality rate of <0.001% to 0.002% in the pre-breeding season, 0.01% to 0.02% in the breeding season and 0.01 to 0.02% in the post-breeding season. On an annual basis, the number of mortalities is 15 to 46, which is an increase in baseline mortality rates of 0.01% to 0.03% (Table 11.23).

210. Using the Applicant's Approach, the predicted number of mortalities is zero in the pre-breeding season, 10 in the breeding season and five in the post-breeding season. This is an increase in the baseline mortality rate of <0.001% in the pre-breeding season, 0.01% in the breeding season and 0.01% in the post-breeding season. On an annual basis, the number of mortalities is 15, which is an increase in baseline mortality rates of 0.01% (Table 11.23).

211. The impact is predicted to be of local spatial extent, long-term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptor directly. However, even considering the upper end of the range of impact values, the increase in baseline mortality is expected to be well below 1% and is unlikely to be detectable compared to natural variation in mortality rates. The magnitude is therefore considered to be negligible.

Table 11.25: Gannet Seasonal and Annual Displacement Estimates for the Array Plus 2 km Buffer During Operation and Maintenance

Season	Seasonal Abundance (Array + 2 km buffer)	Regional Baseline Population	Regional Baseline mortality	Number of Gannet Subject to Mortality (Applicant's Approach)	Number of Gannet Subject to Mortality (NatureScot Approach)	Increase in Baseline Mortality (Applicant's Approach) (%)	Increase in Baseline Mortality (NatureScot Approach) (%)
Pre-breeding	42	248,385	47,864	0	0 to 1	0.000	0.000 to 0.002
Breeding	1,393	763,577	147,141	10	10 to 29	0.007	0.007 to 0.020
Post-breeding	775	456,298	87,929	5	5 to 16	0.006	0.006 to 0.018
Annual	**-**	**763,577**	**147,141**	**15**	**15 to 46**	**0.010**	**0.010 to 0.031**

Sensitivity of the receptor

212. In terms of behavioural response to offshore wind farm structures, gannet are considered to be of high vulnerability, with a score of four out of five assigned by Wade *et al*. (2016). During the breeding season, northern gannet show a strong avoidance of offshore wind farms (Peschko *et al*., 2021).

213. Gannet have low reproductive potential given a typical age of first breeding of five years and typically laying only a single egg per breeding season. However, although gannet has a low reproductive potential, the species has demonstrated a consistent increasing trend in abundance since the 1990s (JNCC, 2020). It is of note that the species has suffered from the outbreak of avian flu during the 2022 breeding season (Pearce-Higgins *et al*., 2023), with declines of 25% recorded at certain sites in Britain in 2023 when compared against a pre-HPAI baseline (Tremlett *et al*., 2024). Therefore, whilst the overall population has shown steady growth, HPAI has led to some short-term declines. Therefore, overall gannet is deemed to have low recoverability.

214. Due to the large foraging range, gannet is a qualifying interest for several SPAs likely to be connected to the Array (within the mean-max + SD foraging range), including the UK's largest gannet colony at Bass Rock (refer to Table 6.30 of volume 3 appendix 11.1). The species is therefore considered to be of international value.

215. Gannet is deemed to be of high vulnerability, low recoverability and international value. The sensitivity of the receptor is therefore considered to be high.

Significance of the effect

216. Overall, the magnitude of the impact is deemed to be negligible and the sensitivity of the receptor is considered to be high. The effect will, therefore, be of **minor** adverse significance, which is not significant in EIA terms.

Secondary mitigation and residual effect

217. No offshore ornithology secondary mitigation is considered necessary because the likely effect in the absence of mitigation is not significant in EIA terms.

BARRIER TO MOVEMENT

218. JNCC *et al.* (2022) defines barrier effects as "*A barrier is a physical factor that limits the migration, or free movement of individuals or populations, thus requiring them to divert from their intended path in order to reach their original destination. This effect is expected to increase the energy expenditure of birds if they have to fly around the area in question in order to reach their goal*". It is typically considered to affect birds in flight only, either whilst they are on migration between breeding and wintering areas (for example) or between a breeding colony and a foraging area. The latter of these scenarios may impose an additional energetic cost to movements at a key period in the annual cycle when seabirds are making daily commutes between foraging grounds at sea and their breeding sites. Additional energetic costs could have long-term implications for individuals, impacting bird fitness (breeding productivity and survival) and for populations. Barrier effects are considered to be less impactful when affecting migratory flights, as avoidance of a single wind farm may be trivial relative to the total length and cost of the journey (Masden *et al.*, 2010; 2012).

219. Masden *et al*. (2010) found additional costs, expressed in relation to typical daily energetic expenditures, to be the highest per unit flight for seabirds with high wing loadings, such as gannets. For example, results suggest that increasing gannet flight distance by 2 km increases daily energetic cost by 1.25%. A 10 km increase may result in a 4.50% increase in daily energy expenditure. However, this is based on a foraging range of 160 km, where 10 km represents a 6.25% increase in distance flown. Scaling this to the mean maximum plus 1 SD foraging range of 709 km (Woodward *et al*., 2019), an additional flight distance of 10 km (4.5%) represents a scaled 1.02% increase in expenditure. This minimal increase in energy expenditure is unlikely to result in notable mortalities. Most importantly the authors found costs of extra flight to avoid a wind farm to appear to be much less than those imposed by low food abundance or adverse weather, although such costs will be additive to these.

220. For breeding seabirds, NatureScot (2023h) consider barrier effects alongside displacement as "distributional responses". This is because it can be difficult to distinguish barrier effects from the effects of displacement, for breeding seabirds foraging in the region. NatureScot (2023h) advise that distributional responses are assessed using the matrix approach, and therefore for breeding seabirds, no separate assessment of barrier to movement is carried out, with impacts considered to be included in the assessments carried out under the impact: Disturbance and Displacement from the Physical Presence of Wind Turbines and Maintenance Activities.

221. This section therefore only considers the impact of the barrier to movement on migratory receptors such as those listed in Table 11.32.

Operation and maintenance phase

Magnitude of impact

222. In the absence of quantitative information available for individual species, the magnitude is considered qualitatively for all receptors.

223. The diversion of flight lines as a result of a barrier effect created by the presence of the Array for migratory birds is considered less of an impact than for those barrier effects to daily foraging flights. Speakman *et al.* (2009) and Masden *et al.* (2010; 2012) calculated that the costs of one-off avoidances during migration were small, accounting for less than 2% of available fat reserves.

224. The impact is predicted to be of local spatial extent, long-term duration, continuous and reversible. It is predicted that the impact will affect the receptor directly. Due to the likely absence of any detectable impact on the fitness of individuals and the demography of the populations, the magnitude is therefore considered to be negligible**.**

Sensitivity of the receptor

225. Migratory birds are deemed to be of low vulnerability, low to high recoverability and regional to international value. The sensitivity of the receptor is therefore considered to be low to high**.**

Significance of the effect

226. Overall, the magnitude of the impact is deemed to be negligible and the sensitivity of the receptor is considered to be low to high. The effect will, therefore, be of **negligible to minor** adverse significance, which is not significant in EIA terms.

Secondary mitigation and residual effect

227. No offshore ornithology secondary mitigation is considered necessary because the likely effect in the absence of mitigation is not significant in EIA terms.

COLLISION WITH WIND TURBINES

228. During the operation and maintenance phase of the Array, the turning rotors of the wind turbines may present a risk of collision for seabirds. Stationary structures, such as the tower, nacelle or when rotors are not operating, are not expected to result in a material risk of collision. When a collision occurs between the turning rotor blade and the bird, it is assumed to result in direct mortality of the bird, which potentially could result in population level impacts.

229. The ability of seabirds to detect and manoeuvre around wind turbine blades is a factor that is considered when modelling and assessing the risk. In response to this, it is standard practice to calculate differing levels of avoidance for different species or species groups. Avoidance rates are applied to CRMs to predict levels of impact more realistically, based on available literature and expert advice about seabird behaviour and their flight response to wind turbines.

230. Species differ in their susceptibility to collision risk, depending on their flight behaviour and avoidance responses, and the vulnerability of their populations (Bradbury *et al.* 2014; Wade *et al.*, 2016). As sensitivity to collision differs considerably between species, species were screened and progressed for assessment of significance on the basis of the importance of the population of each species recorded within the Array offshore ornithology study area and consideration of their perceived risk from collision (Bradbury *et al.*, 2014; Wade *et al.*, 2016).

231. Four regularly occurring seabird species were identified as potentially at risk of collision due to their recorded abundance in the Array offshore ornithology study area and their high vulnerability to collision (Bradbury *et al.*, 2014; Wade *et al.*, 2016): kittiwake, herring gull, lesser black-backed gull and gannet. Furthermore, fulmar was included in the collision risk assessment due to its high abundances recorded within the Array. Wade *et al*. (2016) highlighted the high uncertainty surrounding fulmar vulnerability to collision, despite Bradbury *et al*. (2014) classifying them as having a low vulnerability to collision impacts.

232. Species included were therefore kittiwake, herring gull, lesser black-backed gull, gannet and fulmar. Modelling for these species is provided in volume 3, appendix 11.2. Additionally, consideration was given to species that may not have been accurately captured during traditional baseline DAS. This included migratory seabirds and waterbirds, with modelling for these species groups provided in volume 3, appendix 11.2, annex B.

233. The magnitude of change was determined by calculating the estimated number of collisions with the wind turbines and the resulting percentage increase in the background mortality rate of the relevant regional population.

234. There is the potential that aviation and navigation lighting on wind turbines might attract seabirds and thus increase the risk of collision. Conversely, aviation and navigation lighting could deter birds from moving through the Array. To our knowledge there is little published evidence showing the effects of lighting on seabird collision and displacement. Earlier work on seaducks by Desholm and Kahlert (2005) showed that migrating flocks were more prone to enter the wind farm. However, the higher risk of collision in the dark was counteracted by increasing distance from individual turbines and flying in the corridors between turbines. For true seabirds, there is published evidence showing that seabirds are less active at night compared to daytime (Furness *et al*., 2018). Wade *et al*. (2016) ranked vulnerability of seabirds to collision by accounting for the nocturnal activity rate of seabirds. A recent review highlighted that certain species of birds (especially those that nest underground such as shearwaters and petrel species) are often attracted to powerful light sources (Deakin *et al*., 2022). However, in the examples given, the light sources to which birds were attracted are significantly brighter than the lights associated with an offshore wind farm. Lights on offshore structures, including offshore wind turbines must comply with minimum requirements as set out in the International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) Recommendation O-117 on 'The Marking of Offshore Wind Farms' for navigation lighting and by the Civil Aviation Authority in the Air Navigation Orders (CAP 393 and guidance in CAP 764). Such lighting is not comparable to the examples given in Deakin *et al*. (2022) and it is therefore considered unlikely that attraction will occur.

235. CRM for regularly occurring species was undertaken using the Stochastic Collision Risk Model (sCRM) developed by Marine Scotland (McGregor *et al.*, 2018). The User Guide for the sCRM Shiny App provided by Marine Scotland (Donovan, 2017) has been followed for the modelling of collision impacts predicted for the Array. The full methodology and results are provided in volume 3, appendix 11.2.

236. For all regularly occurring species, the assessment has been carried out on the basis of the input parameters recommended by NatureScot (2023g). However, it should be noted that there is considerable uncertainty around several of the key input parameters, including flight speed and avoidance rates. Therefore, in addition to the assessment value, a range of other input parameters has also been considered, as detailed in volume 3, appendix 11.2. The minimum and maximum collision estimates from this range are also presented. However, these do not represent the Applicant's position and only highlight the level of uncertainty surrounding the NatureScot advocated rates. Adopting an 'Applicant's Approach' as undertaken for displacement would involve employing the same rates as recommended by NatureScot, which would yield identical results and thus are not presented separately.

237. Volume 3, appendix 11.2 presents the results of the Band model Options 2 and 3[15].However, it should be noted that recent NatureScot advice has indicated that Option 3 (and 4) will no longer be required (refer to Table 11.3). Therefore, although Options 2 and 3 are presented on volume 3, appendix 11.2, this assessment will only use Option 2 values.

238. It is acknowledged that migratory passage movements may not be adequately captured by traditional survey methods. Therefore, the SOSS Migration Assessment Tool (SOSSMAT) was used to assess the population size of migratory bird species designated as features of the UK SPA network that may cross the Array; instructions are given in Wright *et al.* (2012).

239. The resulting number of migratory seabirds and waterbirds estimated to cross the Array was inputted into the Band (2012) single transit CRM.

[15] Options 1 and 2 use the Basic model with Options 3 and 4 utilising the Extended model. The difference between the two Options under each model is linked to the use of flight height data. Options 2 and 3 use generic data from Johnston *et al*. (2014) whereas Options 1 and 4 use site-specific data derived from site-specific surveys.

240. The methodology and detailed results of the CRM for 56 migratory waterbirds and seabirds are provided in volume 3, appendix 11.2, annex B.

Operation and maintenance phase

Kittiwake

Magnitude of impact

241. When using the parameters recommended by NatureScot (2023g) the predicted number of kittiwake mortalities is 6.24 individuals in the pre-breeding season, 28.13 individuals in the breeding season and 5.35 individuals in the post-breeding season. This is an increase in the baseline mortality rate of 0.01% in the pre-breeding season, 0.07% in the breeding season and 0.004% in the post-breeding season. On an annual basis, the number of mortalities is 39.72 individuals, which is an increase in baseline mortality rates of 0.03% (Table 11.26).

242. Using the range, the predicted number of kittiwake mortalities is 1.44 to 6.24 individuals in the pre-breeding season, 6.51 to 28.13 individuals in the breeding season and 1.24 to 5.35 individuals in the post-breeding season. This is an increase in the baseline mortality rate of 0.001% to 0.01% in the pre-breeding season, 0.02% to 0.07% in the breeding season and 0.001% to 0.004% in the post-breeding season. On an annual basis, the number of mortalities is 9.19 to 39.72 individuals, which is an increase in baseline mortality rates of 0.03% (Table 11.26).

243. The impact is predicted to be of local spatial extent. The impact is expected to occur for the lifespan of the project, although is reversible following decommissioning of the project and is therefore considered to be of long-term duration. It is predicted that the impact will affect the receptor directly. Using both the Applicant's range and the rates recommended by NatureScot (2023g), the increase in mortality is below 1% of baseline mortality in each season and also on an annual basis. Therefore, the magnitude of impact is considered to be negligible.

Table 11.26: Assessment of Predicted Collision Risk Estimates for Kittiwake on Seasonal and Annual Bases Against the Baseline Mortality of Relevant Regional Populations

Season	Regional Baseline		Number of Kittiwake Subject to Mortality (NatureScot rates)	Number of Kittiwake Subject to Mortality (range)	Increase in Baseline Mortality (NatureScot rates) (%)	Increase in Baseline Mortality (range) (%)
	Population[16]	Baseline mortality[17]				
Pre-breeding	627,816	98,065	6.24	1.44 to 6.24	0.006	0.001 to 0.006
Breeding	261,047	40,776	28.13	6.51 to 28.13	0.069	0.016 to 0.069
Post-breeding	829,937	129,636	5.35	1.24 to 5.35	0.004	0.001 to 0.004
Annual	**829,937**	**129,636**	**39.72**	**9.19 to 39.72**	**0.031**	**0.007 to 0.031**

[16] Population counts are taken from Table 11.9.

[17] Baseline mortality is calculated using mortality rates given in volume 3, appendix 11.1.

Sensitivity of the receptor

244. Kittiwake was rated as highly vulnerable to collision impacts by Wade *et al.* (2016), due to the proportion of flights likely to occur at potential risk height and percentage of time in flight. In terms of nocturnal activity rate, kittiwake are considered to have a medium rate of activity at night with a score of three (out of five) (Wade *et al.* 2016).

245. Kittiwake lay two eggs and breed from the age of three onwards, typically living on average for 12 years (Burnell *et al*., 2023). Kittiwake have undergone decreases of approximately 57% in Scotland since the early 2000s. Surveys managed by the RSPB in 2023 have recorded indicative increases of 8% across a number of sites in Britain in 2023 when compared against a pre-HPAI baseline (Tremlett *et al*., 2024). Overall, kittiwake is deemed to have low recoverability.

246. Kittiwake is a qualifying interest for several SPAs likely to be connected to the Array (within the mean-max + SD foraging range), with several non-SPA colonies also within range and so the species is considered to be of international conservation value. Refer to Table 6.2 of volume 3, appendix 11.1 for details of SPAs with connectivity to the Array with regards to kittiwake.

247. Kittiwake is deemed to be of high vulnerability, low recoverability and international value. The sensitivity of the receptor is therefore considered to be high**.**

Significance of the effect

248. Overall, the magnitude of the impact is deemed to be negligible and the sensitivity of the receptor is considered to be high. The effect will, therefore, be of **minor** adverse significance, which is not significant in EIA terms.

Secondary mitigation and residual effect

249. No offshore ornithology secondary mitigation is considered necessary because the likely effect in the absence of mitigation is not significant in EIA terms.

Herring gull

Magnitude of impact

250. When using the parameters recommended by NatureScot,(2023g) the predicted number of herring gull mortalities is <0.01 individuals in the breeding season and 2.74 individuals in the non-breeding season. This is an increase in the baseline mortality rate of <0.001% in the breeding season and 0.003% in the non-breeding season. On an annual basis, the number of mortalities is 2.74 individuals, which is an increase in baseline mortality rates of 0.003% (Table 11.27).

251. Using the range, the predicted number of herring gull mortalities is <0.01 individuals in the breeding season and 1.20 to 2.74 individuals in the non-breeding season. This is an increase in the baseline mortality rate of <0.001% in the breeding season and 0.002% to 0.003% in the non-breeding season. On an annual basis, the number of mortalities is 1.20 to 2.74 individuals, which is an increase in baseline mortality rates of 0.002% to 0.003% (Table 11.27).

252. The impact is predicted to be of local spatial extent. The impact is expected to occur for the lifespan of the project, although is reversible following decommissioning of the project and is therefore considered to be of long-term duration. It is predicted that the impact will affect the receptor directly. Using both the Applicant's range and the rates recommended by NatureScot (2023g), the increase in mortality is below 1% of baseline mortality in each season and also on an annual basis. Therefore, the magnitude of impact is considered to be negligible**.**

Table 11.27: Assessment of Predicted Collision Risk Estimates for Herring Gull on Seasonal and Annual Bases Against the Baseline Mortality of Relevant Regional Populations

Season	Regional Baseline		Number of Herring gull Subject to Mortality (NatureScot rates)	Number of Herring gull Subject to Mortality (range)	Increase in Baseline Mortality (NatureScot rates) (%)	Increase in Baseline Mortality (range) (%)
	Population	Baseline mortality				
Breeding	13,836	2,363	0.00	0.00 to 0.00	0.000	0.000 to 0.000
Non-breeding	466,511	79,680	2.74	1.20 to 2.74	0.003	0.002 to 0.003
Annual	**466,511**	**79,680**	**2.74**	**1.20 to 2.74**	**0.003**	**0.002 to 0.003**

Sensitivity of the receptor

253. Herring gull was rated as one of the most vulnerable seabird species to collision impacts by Wade *et al.* (2016), due to the proportion of flights likely to occur at potential risk height and percentage of time in flight. In terms of nocturnal activity rate, herring gull are considered to have a medium rate of activity at night with a score of three (out of five) (Wade *et al.* 2016).

254. As herring gull is a qualifying interest for several SPAs likely to be connected to the Array (within the mean-max + SD foraging range) with multiple non-SPA colonies within range, the species is considered to be of international value. Refer to Table 6.7 of volume 3, appendix 11.1 for details of SPAs with connectivity to the Array with regards to herring gull.

255. Herring gull lay up to three eggs and breed from the age of four onwards, typically living on average for 12 years (Burnell *et al*., 2023). Natural nesting colonies of herring gull have undergone decreases of approximately 44% in Scotland since the early 2000s, whereas urban-nesting populations have increased considerably. Given that the urban population is small compared to the natural population (Burnell *et al.*, 2023), the overall trend is likely to be a decline. Surveys managed by the RSPB in 2023 have recorded indicative declines of 7% across a number of sites in Britain in 2023 when compared against a pre-HPAI baseline (Tremlett *et al*., 2024). Overall herring gull is considered to have low recoverability.

256. Herring gull is deemed to be of very high vulnerability, low recoverability and international value. The sensitivity of the receptor is therefore, considered to be high**.**

Significance of the effect

257. Overall, the magnitude of the impact is deemed to be negligible and the sensitivity of the receptor is considered to be high. The effect will, therefore, be of **minor** adverse significance, which is not significant in EIA terms.

Secondary mitigation and residual effect

258. No offshore ornithology secondary mitigation is considered necessary because the likely effect in the absence of mitigation is not significant in EIA terms.

Lesser black-backed gull

Magnitude of impact

259. When using the parameters recommended by NatureScot (2023g) the predicted number of lesser black-backed gull mortalities is <0.01 individuals in the pre-breeding season, 0.26 individuals in the breeding

season and <0.01 individuals in the post-breeding season. This is an increase in the baseline mortality rate of <0.001% in the pre-breeding season, 0.01% in the breeding season and <0.001% in the post-breeding season. On an annual basis, the number of mortalities is 0.26 individuals, which is an increase in baseline mortality rates of 0.001% (Table 11.28).

260. Using the range, the predicted number of lesser black-backed gull mortalities is <0.01 individuals in the pre-breeding season, 0.11 to 0.26 individuals in the breeding season and <0.01 individuals in the post-breeding season. This is an increase in the baseline mortality rate of <0.001% in the pre-breeding season, 0.003% to 0.006% in the breeding season and <0.001% in the post-breeding season. On an annual basis, the number of mortalities is 0.11 to 0.26 individuals, which is an increase in baseline mortality rates of <0.001% to 0.001% (Table 11.28).

261. The impact is predicted to be of local spatial extent. The impact is expected to occur for the lifespan of the project, although is reversible following decommissioning of the project and is therefore considered to be of long-term duration. It is predicted that the impact will affect the receptor directly. Using both the Applicant's range and the rates recommended by NatureScot (2023g), the increase in mortality is below 1% of baseline mortality in each season and also on an annual basis. Therefore, the magnitude of impact is considered to be negligible.

Table 11.28: Assessment of Predicted Collision Risk Estimates for Lesser Black-backed Gull on Seasonal and Annual Bases Against the Baseline Mortality of Relevant Regional Populations

Season	Regional Baseline		Number of Lesser black-backed gull Subject to Mortality (NatureScot rates)	Number of Lesser black-backed gull Subject to Mortality (range)	Increase in Baseline Mortality (NatureScot rates) (%)	Increase in Baseline Mortality (range) (%)
	Population	Baseline mortality				
Pre-breeding	197,483	23,895	0.00	0.00 to 0.00	0.000	0.000 to 0.000
Breeding	36,301	4,392	0.26	0.11 to 0.26	0.006	0.003 to 0.006
Post-breeding	209,007	25,290	0.00	0.00 to 0.00	0.000	0.000 to 0.000
Annual	**209,007**	**25,290**	**0.26**	**0.11 to 0.26**	**0.001**	**0.000 to 0.001**

Sensitivity of the receptor

262. Lesser black-backed gull was rated as one of the most vulnerable seabird species to collision impacts by Wade *et al.* (2016), due to the proportion of flights likely to occur at potential risk height and percentage of time in flight. In terms of nocturnal activity rate, lesser black-backed gull are considered to have a medium rate of activity at night with a score of three (out of five) (Wade *et al.* 2016).

263. As lesser black-backed gull is a qualifying interest for several SPAs likely to be connected to the Array (within the mean-max + SD foraging range), with multiple non-SPA colonies within range, the species is considered to be of international conservation value. Refer to Table 6.9 of volume 3, appendix 11.1 for details of SPAs with connectivity to the Array with regards to lesser black-backed gull.

264. Lesser black-backed gull lay an average of three eggs and breed from the age of four onwards, typically living on average for 15 years (Burnell *et al*., 2023). Coastal colonies of lesser black-backed gull have undergone decreases of approximately 61% in Scotland since the early 2000s, whereas inland populations have increased by 145%. Whilst the urban population of lesser black-backed gulls is increasing, the much larger natural population is declining and therefore the overall national trend is one of decline, with an overall decline of 48% (Burnell *et al*., 2023). Surveys managed by the RSPB in 2023 have recorded indicative declines of 25% across a number of sites in Britain in 2023 when compared against a pre-HPAI baseline (Tremlett *et al*., 2024). Overall lesser black-backed gull is considered to have low recoverability.

265. Lesser black-backed gull is deemed to be of very high vulnerability, low recoverability and international value. The sensitivity of the receptor is therefore, considered to be high.

Significance of the effect

266. Overall, the magnitude of the impact is deemed to be negligible and the sensitivity of the receptor is considered to be high. The effect will, therefore, be of **minor** adverse significance, which is not significant in EIA terms.

Secondary mitigation and residual effect

267. No offshore ornithology secondary mitigation is considered necessary because the likely effect in the absence of mitigation is not significant in EIA terms.

Fulmar

Magnitude of impact

268. When using the parameters recommended by NatureScot (2023g) and the Applicant’s range, the predicted number of fulmar mortalities is 1.99 individuals in the pre-breeding season, 2.13 individuals in the breeding season, 0.19 individuals in the post-breeding season and 0.46 individuals in the non-breeding season. This is an increase in the baseline mortality rate of 0.001% in the pre-breeding season, 0.002% in the breeding season, <0.001% in the post-breeding season and <0.001% in the non-breeding season. On an annual basis, the number of mortalities is 4.77 individuals, which is an increase in baseline mortality rates of 0.002% (Table 11.29).

269. The impact is predicted to be of local spatial extent. The impact is expected to occur for the lifespan of the project, although is reversible following decommissioning of the project and is therefore considered to be of long-term duration. It is predicted that the impact will affect the receptor directly. Using both the Applicant's range and the rates recommended by NatureScot (2023g), the increase in mortality is below 1% of baseline mortality in each season and also on an annual basis. Therefore, the magnitude of impact is considered to be negligible.

Table 11.29: Assessment of Predicted Collision Risk Estimates for Fulmar on Seasonal and Annual Bases Against the Baseline Mortality of Relevant Regional Populations

Season	Regional Baseline		Number of Gannet Subject to Mortality (NatureScot rates)	Number of Gannet Subject to Mortality (range)	Increase in Baseline Mortality (NatureScot rates) (%)	Increase in Baseline Mortality (range) (%)
	Population	Baseline Mortality				
Pre-breeding	957,502	212,087	1.99	1.99	0.001	0.001
Breeding	476,165	105,471	2.13	2.13	0.002	0.002
Post-breeding	957,502	212,087	0.19	0.19	0.000	0.000
Non-breeding	568,736	125,975	0.46	0.46	0.000	0.000
Annual	**957,502**	**212,087**	**4.77**	**4.77**	**0.002**	**0.002**

Sensitivity of the receptor

270. Fulmar are considered to have very low vulnerability to collision with wind turbines (Wade *et al.*, 2016) and have been included on a precautionary basis due to a high uncertainty score in Wade *et al.* (2016).

271. Fulmar is a qualifying interest for several SPAs likely to be connected to the Array (within the mean-max + SD foraging range). The species is therefore considered to be of international value. Refer to Table 6.26 of volume 3, appendix 11.1 for details of SPAs with connectivity to the Array with regards to fulmar.

272. Fulmar has a low reproductive potential, due to laying a single egg per breeding attempt, and typical age of recruitment of nine years. Fulmar populations have been declining in recent years (JNCC, 2020). Fulmar is therefore considered to have low recoverability.

273. Fulmar is deemed to be of low vulnerability, low recoverability and international value. The sensitivity of the receptor is therefore considered to be high**.**

Significance of the effect

274. Overall, the magnitude of the impact is deemed to be negligible and the sensitivity of the receptor is considered to be high. The effect will, therefore, be of **minor** adverse significance, which is not significant in EIA terms.

Secondary mitigation and residual effect

275. No offshore ornithology secondary mitigation is considered necessary because the likely effect in the absence of mitigation is not significant in EIA terms.

Gannet

Magnitude of impact

276. When using the parameters recommended by NatureScot (2023g) the predicted number of gannet mortalities is 0.24 individuals in the pre-breeding season, 28.18 individuals in the breeding season and 3.76 individuals in the post-breeding season. This is an increase in the baseline mortality rate of 0.001% in the pre-breeding season, 0.02% in the breeding season and 0.004% in the post-breeding season. On an annual basis, the number of mortalities is 32.18 individuals, which is an increase in baseline mortality rates of 0.02% (Table 11.30).

277. Using the range, the predicted number of gannet mortalities is 0.23 to 0.24 individuals in the pre-breeding season, 27.30 to 28.18 individuals in the breeding season and 3.61 to 3.76 individuals in the post-breeding season. This is an increase in the baseline mortality rate of 0.001% in the pre-breeding season, 0.02% in the breeding season and 0.004% in the post-breeding season. On an annual basis, the number of mortalities is 31.14 to 32.18 individuals, which is an increase in baseline mortality rates of 0.02% (Table 11.30).

278. It should further be noted that there is strong evidence that gannet avoid OWFs to a significant extent (Garthe and Hüppop, 2004; Furness and Wade, 2012; Pavat *et al*., 2023), and this “macro avoidance” is not captured by the method used to calculate avoidance rates for CRM (Ozsanlav-Harris *et al*., 2023). Therefore, the collision estimates provided are likely to be significant overestimates.

279. The impact is predicted to be of local spatial extent. The impact is expected to occur for the lifespan of the project, although is reversible following decommissioning of the project and is therefore considered to be of long-term duration. It is predicted that the impact will affect the receptor directly. Using both the Applicant's range and the rates recommended by NatureScot (2023g), the increase in mortality is below 1% of baseline mortality in each season and also on an annual basis. Therefore, the magnitude of impact is considered to be negligible**.**

Table 11.30: Assessment of Predicted Collision Risk Estimates for Gannet on Seasonal and Annual Bases Against the Baseline Mortality of Relevant Regional Populations

Season	Regional Baseline		Number of Gannet Subject to Mortality (NatureScot rates)	Number of Gannet Subject to Mortality (range)	Increase in Baseline Mortality (NatureScot rates) (%)	Increase in Baseline Mortality (range) (%)
	Population	Baseline Mortality				
Pre-breeding	248,385	47,864	0.24	0.23 to 0.24	0.001	0.001 to 0.001
Breeding	763,577	147,141	28.18	27.30 to 28.18	0.019	0.019 to 0.019
Post-breeding	456,385	87,945	3.76	3.61 to 3.76	0.004	0.004 to 0.004
Annual	**763,577**	**147,141**	**32.18**	**31.14 to 32.18**	**0.022**	**0.021 to 0.022**

Sensitivity of the receptor

280. Although the latest scientific guidance showed the species to display a high level of macro-avoidance (Peschko *et al.*, 2020), the species is rated as relatively vulnerable to collision impacts by Wade *et al.* (2016).

281. Gannet is a qualifying interest for several SPAs likely to be connected to the Array (within the mean-max + SD foraging range). The species is therefore considered to be of international value. Refer to Table 6.30 of volume 3, appendix 11.1 for details of SPAs with connectivity to the Array with regards to gannet.

282. Gannet have low reproductive potential given a typical age of first breeding of five years and typically laying only a single egg per breeding season. However, although gannet has a low reproductive potential, the species has demonstrated a consistent increasing trend in abundance since the 1990’s (JNCC, 2020).. It is of note that the species has suffered from the outbreak of avian flu during the 2022 breeding season (Pearce-Higgins *et al*., 2023), with declines of 25% recorded at certain sites in Britain in 2023 when compared against a pre-HPAI baseline (Tremlett *et al*., 2024). Therefore, whilst the overall population has shown steady growth, HPAI has led to some short-term declines. Therefore, overall gannet is deemed to have low recoverability.

283. Gannet is deemed to be of high vulnerability, low recoverability and international value. The sensitivity of the receptor is therefore considered to be high**.**

Significance of the effect

284. Overall, the magnitude of the impact is deemed to be negligible and the sensitivity of the receptor is considered to be high. The effect will, therefore, be of **minor** adverse significance, which is not significant in EIA terms.

Secondary mitigation and residual effect

285. No offshore ornithology secondary mitigation is considered necessary because the likely effect in the absence of mitigation is not significant in EIA terms.

Migratory birds

Magnitude of impact

286. It is recognised that migratory birds may not be adequately characterised by the site-specific DAS carried out at the Array. Migratory birds may fly at night (when no DAS are carried out) or in pulse movements which could easily be missed by DAS, as they are conducted on a monthly basis. Therefore, the risk to migratory birds cannot be assessed using the same methodology as has been applied for regularly occurring seabirds (above). Instead, the potential effect on migratory birds has been assessed using a qualitative approach drawing on available resources (principally Woodward *et al.*, 2023), as well as a quantitative approach, using the Strategic Ornithological Support Services Migration Assessment Tool (SOSSMAT) (Wright *et al*., 2012).

287. Woodward *et al.* (2023) provide a review of available information regarding to migratory birds in Scottish waters and the potential for collision risk. Key information compiled includes population estimates, migratory routes, timing of migration, migratory flight heights, migratory flight speeds, and migratory avoidance rates and behaviour. Woodward *et al.* (2023) compile this information for 69 species or sub-species, which are non-seabird features of Special Protection Areas (SPAs) including swans, geese, ducks, waders, raptors and other non-passerines. A summary of the key information for each species considered is given in Table 11.31.

288. For all species, the impact is predicted to be of local spatial extent, long-term duration, continuous and high reversibility. It is predicted that the impact will affect the receptor directly. Based on the information in Woodward *et al.* (2023) and summarised in Table 11.31, 55 species have connectivity to the Array on migration and therefore are potentially at risk from collision. Of these, due to very high avoidance rate (>0.99), the magnitude of impact is expected to be negligible for 33 species. For the remaining 22 species, the recommended avoidance rate was high but not very high (between 0.98 and 0.99) and therefore on a highly precautionary basis the expected magnitude of impact is deemed to be low following this qualitative approach to assessment.

289. In addition, a quantitative assessment of collision risk to migratory birds has been carried out using SOSSMAT (Wright *et al*. 2012). The Applicant is aware that a new quantitative migration collision risk model (mCRM) is under development, but this model is currently undergoing testing and seeking approval, and therefore not yet ready to be used for assessment (mCRM Authors, 2021) at the time of writing this chapter (April 2024). The SOSSMAT therefore represents the best available tool currently available to provide quantitative estimates of the collision risk to migratory birds. An assessment using a range of avoidance rates for collision risk to migratory birds has been carried out and provided in volume 3, appendix 11.2, annex B. A summary of the results are presented in Table 11.32.

290. At the default recommended avoidance rate of 98% by SNH guidance (SNH, 2010), all of the predicted collision mortalities are well below a 0.005 percentage point increase in mortality rate. This level of impact would be negligible and would not be distinguishable from natural variation.

291. The impact is predicted to be of local spatial extent, long-term duration, continuous and high reversibility. It is predicted that the impact will affect the receptor directly. Under this approach, the magnitude for all species is therefore considered to be negligible**.**

Table 11.31: Assessment of Collision Risk to Migratory Species based on Woodward *et al*. (2023)

Species	Migratory Route	Migratory Flight Height	Migratory Avoidance	Summary and Conclusion
'East Atlantic' light-bellied brent goose	Main route has connectivity to the Array.	Recommend assuming 50% at potential collision risk height.	Recommend avoidance rate of 0.9998 ± 0.00001.	Migratory route and flight heights indicate potential risk, but very high avoidance rate. Therefore magnitude of impact considered to be **negligible**.
'Nearctic' Light–bellied brent goose	No connectivity to the Array.	Recommend assuming 50% at potential collision risk height.	Recommend avoidance rate of 0.9998 ± 0.00001.	No connectivity and therefore **no impact.**
Dark-bellied brent goose	No connectivity to the Array.	Recommend assuming 50% at potential collision risk height.	Recommend avoidance rate of 0.9998 ± 0.00001.	No connectivity and therefore **no impact.**
'Svalbard' barnacle goose	Main route has connectivity to the Array.	Recommend assuming 100% at potential collision risk height.	Recommend avoidance rate of 0.9998 ± 0.00001.	Migratory route and flight heights indicate potential risk, but very high avoidance rate. Therefore magnitude of impact considered to be **negligible**.
'Greenland' barnacle goose	No connectivity to the Array.	Recommend assuming 100% at potential collision risk height.	Recommend avoidance rate of 0.9998 ± 0.00001.	No connectivity and therefore **no impact.**
'Icelandic' greylag goose	No connectivity to the Array.	Recommend assuming 50% at potential collision risk height.	Recommend avoidance rate of 0.9996 ± 0.00001.	No connectivity and therefore **no impact.**
Taiga Bean goose	Main route has connectivity to the Array.	Recommend assuming 100% at potential collision risk height.	Recommend avoidance rate of 0.9998 ± 0.00001.	Migratory route and flight heights indicate potential risk, but very high avoidance rate. Therefore magnitude of impact considered to be **negligible**.
Pink-footed goose	Main route has connectivity to the Array.	Recommend assuming 50% at potential collision risk height.	Recommend avoidance rate of 0.9999 ± 0.00002.	Migratory route and flight heights indicate potential risk, but very high avoidance rate. Therefore magnitude of impact considered to be **negligible**.
'Greenland' white-fronted goose	No connectivity to the Array.	Recommend assuming 100% at potential collision risk height.	Recommend avoidance rate of 0.9998 ± 0.00001.	No connectivity and therefore **no impact.**
'European' white-fronted goose	No connectivity to the Array.	Recommend assuming 100% at potential collision risk height.	Recommend avoidance rate of 0.9998 ± 0.00001.	No connectivity and therefore **no impact.**
Bewick's swan	No connectivity to the Array.	Recommend assuming 50% at potential collision risk height.	Recommend avoidance rate of 0.9885 ± 0.00091.	No connectivity and therefore **no impact.**
Whooper swan	Main route has connectivity to the Array.	Recommend assuming 50% at potential collision risk height.	Recommend avoidance rate of 0.9874 ± 0.00138.	Migratory route and flight heights indicate potential risk, but high avoidance rate. Therefore magnitude of impact considered to be **low**.
Shelduck	Main route has connectivity to the Array.	Recommend assuming 50% at potential collision risk height.	Recommend avoidance rate of 0.9851 ± 0.00088.	Migratory route and flight heights indicate potential risk, but high avoidance rate. Therefore magnitude of impact considered to be **low**.
Shoveler	Main route has connectivity to the Array.	Recommend assuming 100% at potential collision risk height.	Recommend avoidance rate of 0.9851 ± 0.00088.	Migratory route and flight heights indicate potential risk, but high avoidance rate. Therefore magnitude of impact considered to be **low**.
Gadwall	No connectivity to the Array.	Recommend assuming 100% at potential collision risk height.	Recommend avoidance rate of 0.9851 ± 0.00088.	No connectivity and therefore **no impact.**
Wigeon	Main route has connectivity to the Array.	Recommend assuming 100% at potential collision risk height.	Recommend avoidance rate of 0.9851 ± 0.00088.	Migratory route and flight heights indicate potential risk, but high avoidance rate. Therefore magnitude of impact considered to be **low**.
Mallard	Main route has connectivity to the Array.	Recommend assuming 100% at potential collision risk height.	Recommend avoidance rate of 0.9851 ± 0.00088.	Migratory route and flight heights indicate potential risk, but high avoidance rate. Therefore magnitude of impact considered to be **low**.
Pintail	Main route has connectivity to the Array.	Recommend assuming 100% at potential collision risk height.	Recommend avoidance rate of 0.9851 ± 0.00088.	Migratory route and flight heights indicate potential risk, but high avoidance rate. Therefore magnitude of impact considered to be **low**.
Teal	Main route has connectivity to the Array (wintering population only).	Recommend assuming 100% at potential collision risk height.	Recommend avoidance rate of 0.9851 ± 0.00088.	Migratory route and flight heights indicate potential risk, but high avoidance rate. Therefore magnitude of impact considered to be **low**.
Pochard	Main route has connectivity to the Array (wintering population only).	Recommend assuming 100% at potential collision risk height.	Recommend avoidance rate of 0.9851 ± 0.00088.	Migratory route and flight heights indicate potential risk, but high avoidance rate. Therefore magnitude of impact considered to be **low**.
Tufted duck	Main route has connectivity to the Array.	Recommend assuming 100% at potential collision risk height.	Recommend avoidance rate of 0.9851 ± 0.00088.	Migratory route and flight heights indicate potential risk, but high avoidance rate. Therefore magnitude of impact considered to be **low**.
Scaup	Main route has connectivity to the Array.	Recommend assuming 100% at potential collision risk height.	Recommend avoidance rate of 0.9851 ± 0.00088.	Migratory route and flight heights indicate potential risk, but high avoidance rate. Therefore magnitude of impact considered to be **low**.
Eider	Main route has connectivity to the Array.	Recommend assuming 25% at potential collision risk height.	Recommend avoidance rate of 0.9851 ± 0.00088.	Migratory route and flight heights indicate potential risk, but high avoidance rate. Therefore magnitude of impact considered to be **low**.
Velvet scoter	Main route has connectivity to the Array.	Recommend assuming 100% at potential collision risk height.	Recommend avoidance rate of 0.9851 ± 0.00088.	Migratory route and flight heights indicate potential risk, but high avoidance rate. Therefore magnitude of impact considered to be **low**.
Common scoter	Main route has connectivity to the Array (breeding and wintering populations).	Recommend assuming 100% at potential collision risk height.	Recommend avoidance rate of 0.9851 ± 0.00088.	Migratory route and flight heights indicate potential risk, but high avoidance rate. Therefore magnitude of impact considered to be **low**.
Long-tailed duck	Main route has connectivity to the Array.	Recommend assuming 100% at potential collision risk height.	Recommend avoidance rate of 0.9851 ± 0.00088.	Migratory route and flight heights indicate potential risk, but high avoidance rate. Therefore magnitude of impact considered to be **low**.
Goldeneye	Main route has connectivity to the Array.	Recommend assuming 100% at potential collision risk height.	Recommend avoidance rate of 0.9851 ± 0.00088.	Migratory route and flight heights indicate potential risk, but high avoidance rate. Therefore magnitude of impact considered to be **low**.
Goosander	Main route has connectivity to the Array.	Recommend assuming 100% at potential collision risk height.	Recommend avoidance rate of 0.9851 ± 0.00088.	Migratory route and flight heights indicate potential risk, but high avoidance rate. Therefore magnitude of impact considered to be **low**.

Species	Migratory Route	Migratory Flight Height	Migratory Avoidance	Summary and Conclusion
Red-breasted merganser	Main route has connectivity to the Array.	Recommend assuming 100% at potential collision risk height.	Recommend avoidance rate of 0.9851 ± 0.00088.	Migratory route and flight heights indicate potential risk, but high avoidance rate. Therefore magnitude of impact considered to be **low**.
Nightjar	Main route has connectivity to the Array (non-UK breeding population only).	Recommend assuming 100% at potential collision risk height.	Recommend avoidance rate of 0.9954 ± 0.00002.	Migratory route and flight heights indicate potential risk, but very high avoidance rate. Therefore magnitude of impact considered to be **negligible**.
Corncrake	Main route has connectivity to the Array.	Recommend assuming 100% at potential collision risk height.	Recommend avoidance rate of 0.9875 ± 0.00174.	Migratory route and flight heights indicate potential risk, but high avoidance rate. Therefore magnitude of impact considered to be **low**.
Spotted Crake	Main route has connectivity to the Array (non-UK breeding population only).	Recommend assuming 100% at potential collision risk height.	Recommend avoidance rate of 0.9875 ± 0.00174.	Migratory route and flight heights indicate potential risk, but high avoidance rate. Therefore magnitude of impact considered to be **low**.
Great crested grebe	Main route has connectivity to the Array.	Recommend assuming 100% at potential collision risk height.	Recommend avoidance rate of 0.9954 ± 0.00002.	Migratory route and flight heights indicate potential risk, but high avoidance rate. Therefore magnitude of impact considered to be **low**.
Slavonian grebe	Main route has connectivity to the Array.	Recommend assuming 100% at potential collision risk height.	Recommend avoidance rate of 0.9954 ± 0.00002.	Migratory route and flight heights indicate potential risk, but high avoidance rate. Therefore magnitude of impact considered to be **low**.
Stone-curlew	No connectivity to the Array.	Recommend assuming 100% at potential collision risk height.	Recommend avoidance rate of 0.9996 ± 0.00002.	No connectivity and therefore **no impact.**
Oystercatcher	Main route has connectivity to the Array (breeding and wintering populations).	Recommend assuming 100% at potential collision risk height.	Recommend avoidance rate of 0.9996 ± 0.00002.	Migratory route and flight heights indicate potential risk, but very high avoidance rate. Therefore magnitude of impact considered to be **negligible**.
Avocet	No connectivity to the Array.	Recommend assuming 100% at potential collision risk height.	Recommend avoidance rate of 0.9996 ± 0.00002.	No connectivity and therefore **no impact.**
Lapwing	Main route has connectivity to the Array.	Recommend assuming 100% at potential collision risk height.	Recommend avoidance rate of 0.9996 ± 0.00002.	Migratory route and flight heights indicate potential risk, but very high avoidance rate. Therefore magnitude of impact considered to be **negligible**.
Golden plover	Main route has connectivity to the Array (non-UK breeding population, and UK and non-UK wintering populations).	Recommend assuming 100% at potential collision risk height.	Recommend avoidance rate of 0.9996 ± 0.00002.	Migratory route and flight heights indicate potential risk, but very high avoidance rate. Therefore magnitude of impact considered to be **negligible**.
Grey plover	Main route has connectivity to the Array.	Recommend assuming 100% at potential collision risk height.	Recommend avoidance rate of 0.9996 ± 0.00002.	Migratory route and flight heights indicate potential risk, but very high avoidance rate. Therefore magnitude of impact considered to be **negligible**.
Ringed plover	Main route has connectivity to the Array (breeding and wintering populations).	Recommend assuming 100% at potential collision risk height.	Recommend avoidance rate of 0.9996 ± 0.00002.	Migratory route and flight heights indicate potential risk, but very high avoidance rate. Therefore magnitude of impact considered to be **negligible**.
Dotterel	Main route has connectivity to the Array.	Recommend assuming 100% at potential collision risk height.	Recommend avoidance rate of 0.9996 ± 0.00002.	Migratory route and flight heights indicate potential risk, but very high avoidance rate. Therefore magnitude of impact considered to be **negligible**.
Whimbrel	Main route has connectivity to the Array.	Recommend assuming 100% at potential collision risk height.	Recommend avoidance rate of 0.9996 ± 0.00002.	Migratory route and flight heights indicate potential risk, but very high avoidance rate. Therefore magnitude of impact considered to be **negligible**.
Curlew	Main route has connectivity to the Array.	Recommend assuming 100% at potential collision risk height.	Recommend avoidance rate of 0.9996 ± 0.00002.	Migratory route and flight heights indicate potential risk, but very high avoidance rate. Therefore magnitude of impact considered to be **negligible**.
Bar-tailed godwit	Main route has connectivity to the Array.	Recommend assuming 100% at potential collision risk height.	Recommend avoidance rate of 0.9996 ± 0.00002.	Migratory route and flight heights indicate potential risk, but very high avoidance rate. Therefore magnitude of impact considered to be **negligible**.
Black-tailed godwit	No connectivity to the Array (UK and non-UK breeding *limosa* population). Route has connectivity to the Array (non-UK wintering *islandica* population).	Recommend assuming 100% at potential collision risk height.	Recommend avoidance rate of 0.9996 ± 0.00002.	For the *limosa* population, there is no connectivity and therefore **no impact**. For the *islandica* population, migratory route and flight heights indicate potential risk, but very high avoidance rate. Therefore magnitude of impact considered to be **negligible**.
Turnstone	Main route has connectivity to the Array.	Recommend assuming 100% at potential collision risk height.	Recommend avoidance rate of 0.9996 ± 0.00002.	Migratory route and flight heights indicate potential risk, but very high avoidance rate. Therefore magnitude of impact considered to be **negligible**.
Knot	Main route has connectivity to the Array.	Recommend assuming 100% at potential collision risk height.	Recommend avoidance rate of 0.9996 ± 0.00002.	Migratory route and flight heights indicate potential risk, but very high avoidance rate. Therefore magnitude of impact considered to be **negligible**.
Ruff	Main route has connectivity to the Array.	Recommend assuming 100% at potential collision risk height.	Recommend avoidance rate of 0.9996 ± 0.00002.	Migratory route and flight heights indicate potential risk, but very high avoidance rate. Therefore magnitude of impact considered to be **negligible**.
Sanderling	Main route has connectivity to the Array.	Recommend assuming 100% at potential collision risk height.	Recommend avoidance rate of 0.9996 ± 0.00002.	Migratory route and flight heights indicate potential risk, but very high avoidance rate. Therefore magnitude of impact considered to be **negligible**.
Dunlin	Main route has connectivity to the Array.	Recommend assuming 100% at potential collision risk height.	Recommend avoidance rate of 0.9996 ± 0.00002.	Migratory route and flight heights indicate potential risk, but very high avoidance rate. Therefore magnitude of impact considered to be **negligible**.
Purple sandpiper	Main route has connectivity to the Array.	Recommend assuming 100% at potential collision risk height.	Recommend avoidance rate of 0.999 ± 0.00003.	Migratory route and flight heights indicate potential risk, but very high avoidance rate. Therefore magnitude of impact considered to be **negligible**.
Snipe	Main route has connectivity to the Array (non-UK breeding population, and UK and non-UK wintering populations).	Recommend assuming 100% at potential collision risk height.	Recommend avoidance rate of 0.9996 ± 0.00002.	Migratory route and flight heights indicate potential risk, but very high avoidance rate. Therefore magnitude of impact considered to be **negligible**.
Red-necked phalarope	No connectivity to the Array.	Recommend assuming 100% at potential collision risk height.	Recommend avoidance rate of 0.9996 ± 0.00002.	No connectivity and therefore **no impact.**
Redshank	Main route has connectivity to the Array (breeding and wintering populations).	Recommend assuming 100% at potential collision risk height.	Recommend avoidance rate of 0.9996 ± 0.00002.	Migratory route and flight heights indicate potential risk, but very high avoidance rate. Therefore magnitude of impact considered to be **negligible**.
Wood sandpiper	Main route has connectivity to the Array (non-UK breeding population only).	Recommend assuming 100% at potential collision risk height.	Recommend avoidance rate of 0.9996 ± 0.00002.	Migratory route and flight heights indicate potential risk, but very high avoidance rate. Therefore magnitude of impact considered to be **negligible**.

Species	Migratory Route	Migratory Flight Height	Migratory Avoidance	Summary and Conclusion
Greenshank	Main route has connectivity to the Array.	Recommend assuming 100% at potential collision risk height.	Recommend avoidance rate of 0.9996 ± 0.00002.	Migratory route and flight heights indicate potential risk, but very high avoidance rate. Therefore magnitude of impact considered to be **negligible**.
Red-throated diver	Main route has connectivity to the Array (breeding and wintering populations).	Recommend assuming 25% at potential collision risk height.	Recommend avoidance rate of 0.9954 ± 0.00002.	Migratory route and flight heights indicate potential risk, but very high avoidance rate. Therefore magnitude of impact considered to be **negligible**.
Black-throated diver	Main route has connectivity to the Array (non-UK breeding population, and UK and non-UK wintering populations).	Recommend assuming 25% at potential collision risk height.	Recommend avoidance rate of 0.9954 ± 0.00002.	Migratory route and flight heights indicate potential risk, but very high avoidance rate. Therefore magnitude of impact considered to be **negligible**.
Great Northern diver	Main route has connectivity to the Array.	Recommend assuming 25% at potential collision risk height.	Recommend avoidance rate of 0.9954 ± 0.00002.	Migratory route and flight heights indicate potential risk, but very high avoidance rate. Therefore magnitude of impact considered to be **negligible**.
Bittern	Main route has connectivity to the Array.	Recommend assuming 100% at potential collision risk height.	Recommend avoidance rate of 0.9928 ± 0.00092.	Migratory route and flight heights indicate potential risk, but very high avoidance rate. Therefore magnitude of impact considered to be **negligible**.
Osprey	Main route has connectivity to the Array.	Recommend assuming 50% at potential collision risk height.	Recommend avoidance rate of 0.9957 ± 0.00006.	Migratory route and flight heights indicate potential risk, but very high avoidance rate. Therefore magnitude of impact considered to be **negligible**.
Honey-buzzard	No connectivity to the Array.	Recommend assuming 50% at potential collision risk height.	Recommend avoidance rate of 0.9957 ± 0.00006.	No connectivity and therefore **no impact.**
Marsh harrier	Main route has connectivity to the Array.	Recommend assuming 50% at potential collision risk height.	Recommend avoidance rate of 0.9957 ± 0.00006.	Migratory route and flight heights indicate potential risk, but very high avoidance rate. Therefore magnitude of impact considered to be **negligible**.
Hen harrier	Main route has connectivity to the Array (non-UK breeding population, and UK and non-UK wintering populations).	Recommend assuming 100% at potential collision risk height.	Recommend avoidance rate of 0.9957 ± 0.00006.	Migratory route and flight heights indicate potential risk, but very high avoidance rate. Therefore magnitude of impact considered to be **negligible**.
Montagu's harrier	No connectivity to the Array.	Recommend assuming 100% at potential collision risk height.	Recommend avoidance rate of 0.9957 ± 0.00006.	No connectivity and therefore **no impact.**
White-tailed eagle	No connectivity to the Array.	Recommend assuming 100% at potential collision risk height.	Recommend avoidance rate of 0.9872 ± 0.00192.	No connectivity and therefore **no impact.**
Short-eared owl	Main route has connectivity to the Array.	Recommend assuming 100% at potential collision risk height.	Recommend avoidance rate of 0.9957 ± 0.00006.	Migratory route and flight heights indicate potential risk, but very high avoidance rate. Therefore magnitude of impact considered to be **negligible**.
Merlin	Main route has connectivity to the Array.	Recommend assuming 100% at potential collision risk height.	Recommend avoidance rate of 0.9891 ± 0.00033.	Migratory route and flight heights indicate potential risk, but high avoidance rate. Therefore magnitude of impact considered to be **low**.

Table 11.32: Quantitative Assessment of Collision Risk to Migratory Species Using SOSSMAT (Wright *et al*., 2012) and the Band (2012) CRM

Species	Scientific Name	UK Population Size	Number of Individuals Crossing the Array per Annum	Estimated Collision Mortality per Annum (98% Avoidance)	Increase in Mortality Rate (Percentage Points)
Whooper swan	*Cygnus cygnus*	19,500	642	0	0.000
Bean goose	*Anser fabalis*	230	18	0	0.000
Pink-footed goose	*Anser brachyrhynchus*	510,000	1,9354	3	0.001
Barnacle goose (Svalbard population)	*Branta leucopsis*	33,000	4,560	1	0.003
Shelduck	*Tadorna tadorna*	51,000	2,290	0	0.000
Wigeon	*Anas penelope*	450,000	6,544	0	0.000
Teal	*Anas crecca*	435,000	6,292	0	0.000
Mallard	*Anas platyrhynchos*	675,000	12,120	1	0.000
Pintail	*Anas acuta*	20,000	144	0	0.000
Shoveler	*Anas clypeata*	19,500	256	0	0.000
Pochard	*Aythya ferina*	29,000	380	0	0.000
Tufted duck	*Aythya fuligula*	140,000	1,972	0	0.000
Scaup	*Aythya marila*	6,400	28	0	0.000
Eider	*Somateria mollissima*	49,000	14,550	1	0.003
Long-tailed duck	*Clangula hyemalis*	13,500	606	0	0.000
Common scoter	*Melanitta nigra*	135,000	2,930	0	0.000
Velvet scoter	*Melanitta fusca*	3,350	236	0	0.000
Goldeneye	*Bucephala clangula*	21,000	378	0	0.000
Red-breasted merganser	*Mergus serrator*	11,000	78	0	0.000
Goosander (non-breeding)	*Mergus merganser*	14,500	424	0	0.000
Goosander (breeding male moult migration)	*Mergus mergus*	4,800	660	0	0.000
Red-throated diver (breeding)	*Gavia stellata*	2,500	54	0	0.000
Red-throated diver (non-breeding)	*Gavia stellata*	21,500	456	0	0.000
Manx shearwater	*Puffinus puffinus*	600,000	8,372	0	0.000
Cormorant	*Phalacrocorax carbo*	64,500	572	0	0.000

Species	Scientific Name	UK Population Size	Number of Individuals Crossing the Array per Annum	Estimated Collision Mortality per Annum (98% Avoidance)	Increase in Mortality Rate (Percentage Points)
Shag	*Phalacrocorax aristotelis*	110,000	2,304	0	0.000
Great crested grebe	*Podiceps cristatus*	18,000	44	0	0.000
Slavonian Grebe	*Podiceps auritus*	995	14	0	0.000
Hen harrier (breeding)	*Circus cyaneus*	1,090	8	0	0.000
Hen harrier (non-breeding)	*Circus cyaneus*	545	12	0	0.000
Merlin	*Falco columbarius*	2,300	30	0	0.000
Oystercatcher (breeding)	*Haematopus ostralegus*	191,000	6,000	1	0.001
Oystercatcher (non-breeding)	*Haematopus ostralegus*	305,000	4,412	1	0.000
Ringed plover (breeding)	*Charadrius hiaticula*	10,900	232	0	0.000
Ringed plover (non-breeding)	*Charadrius hiaticula*	42,500	686	0	0.000
Golden plover (breeding)	*Pluvialis apricaria*	101,000	2142	0	0.000
Golden plover (non-breeding)	*Pluvialis apricaria*	410,000	6,546	1	0.000
Grey plover	*Pluvialis squatarola*	33,500	604	0	0.000
Lapwing	*Vanellus vanellus*	635,000	11,438	1	0.000
Knot	*Calidris canutus*	265,000	3,830	0	0.000
Sanderling	*Calidris alba*	20,500	296	0	0.000
Purple sandpiper	*Calidris maritima*	9,900	100	0	0.000
Dunlin (passage)	*Calidris alpina schinzii and C.a.arctica*	979,000	14,238	2	0.000
Dunlin (passage and winter)	*Calidris alpina alpina*	350,000	3,724	0	0.000
Ruff	*Philomachus pugnax*	920	12	0	0.000
Snipe	*Gallinago gallinago*	1,100,000	15,926	2	0.000
Black-tailed godwit	*Limosa limosa islandica*	41,000	608	0	0.000
Bar-tailed godwit	*Limosa lapponica*	53,500	1,052	0	0.000
Whimbrel	*Numenius phaeopus*	41	0	0	0.000
Curlew (breeding)	*Numenius arquata*	117,000	2,516	0	0.000
Curlew (non-breeding)	*Numenius arquata*	125,000	2,274	0	0.000
Greenshank	*Tringa nebularia*	920	8	0	0.000
Redshank (breeding)	*Tringa totanus britannica*	44,000	1,308	0	0.000
Redshank (Icelandic population) (non-breeding)	*Tringa totanus robusta*	100,000	1,486	0	0.000
Turnstone	*Arenaria interpres*	43,000	622	0	0.000
Red-necked phalarope	*Phalaropus lobatus*	128	2	0	0.000
Short-eared owl	*Asio flammeus*	4,400	74	0	0.000

Sensitivity of the receptor

292. Although migratory waterbirds have not been significantly studied in the offshore environment, vulnerability to collisions is likely to be generally low, since most migration will occur on a broad front and also above rotor height, although during periods of poor weather this risk may increase.

293. Recoverability of populations of migrants may vary considerably, with smaller wader species with a relatively favourable conservation status (e.g. dunlin) faring better than larger species with lower reproductive rates (e.g. Eurasian curlew).

294. Migratory birds are deemed to be of low to medium vulnerability, low to high recoverability and local to international value. On a precautionary basis and purposes of this assessment these species are assumed to have high sensitivity to collision (i.e. medium vulnerability, low recoverability and international value).

Significance of the effect

295. Using a qualitative approach and the information presented in Woodward *et al.* (2023), it was found that the magnitude of impact was expected to be negligible to low. However, this qualitative approach is limited in its ability to accurately predict the magnitude of impact, as it does not provide an estimate of the number of birds likely to be subject to mortality. The prediction of a low magnitude of impact is therefore highly precautionary, as an impact of that magnitude could not be ruled out on the basis of the information presented.

296. This qualitative approach is therefore supplemented with a quantitative approach, using the SOSSMAT (Wright *et al.*, 2012). Whilst it is recognised that significant work has been carried out since the SOSSMAT was developed, until the new mCRM tool is approved for use, SOSSMAT remains the best available tool to quantitatively assess collision risk to migratory birds. Using SOSSMAT, it is evident that the numbers of birds subject to collision mortality are, for all species, zero or negligible. It should also be noted that this conclusion is based on an avoidance rate of 0.98 for all species, while the more recent review (Woodward *et al.*, 2023) suggests a higher avoidance rate (0.9851 to 0.9998; Table 11.31) for all species, and therefore the collision estimates in Table 11.32 are highly precautionary.

297. Therefore, based on considering both the qualitative and quantitative approaches to assessment, the magnitude of the impact is deemed to be negligible (for all species) and the sensitivity of the receptor is considered to be high (based on a precautionary basis). The effect will, therefore, be of **minor** adverse significance, which is not significant in EIA terms for any species.

Secondary mitigation and residual effect

298. No offshore ornithology secondary mitigation is considered necessary because the likely effect in the absence of mitigation is not significant in EIA terms.

CHANGES TO PREY AVAILABILITY

299. Changes to prey availability may occur as a result of construction and decommissioning activities, especially those that disturb the seabed. During the operational phase, changes to prey availability are expected to be minimal. However, as requested by NatureScot (Table 11.3), changes to prey availability have been considered for all phases.

Construction phase

Magnitude of impact

300. A number of potential impacts on benthic subtidal ecology (including benthic invertebrate prey) associated with the Array were identified in volume 2, chapter 8, including disturbance during construction. The assessment identified an effect of minor adverse significance as a result of disturbance during construction, which is not significant in EIA terms.

301. With regards to fish and shellfish prey, volume 2, chapter 9 considered the potential impacts on marine species (including shellfish), sandeel, herring and diadromous fish of disturbance during construction. The assessment identified an effect of minor adverse significance on all fish and shellfish receptors as a result of disturbance during construction, which is not significant in EIA terms.

302. Based on the information presented in volume 2, chapters 8 and 9, the direct impact of construction noise on fish and mobile invertebrates is expected to be of minor adverse significance. Construction works will be spatially and temporally restricted, covering only a small portion of the site at any given time. Construction impacts are restricted to the duration of the construction phase, and once construction has finished, the adverse impacts will cease and any change on prey species is likely to be reversed. The impact on ornithological receptors is predicted to be of local spatial extent, medium duration, intermittent and reversible. The magnitude is therefore considered to be of negligible significance.

Sensitivity of the receptor

303. None of the VORs considered in this assessment are highly specialist. All VORs have a moderate degree of flexibility in their habitat preferences and prey items (Del Hoyo *et al.*, 1992). VORs vary in their recoverability from low to high and population status from local to international. Therefore, sensitivity of the receptors overall is assessed as ranging from low to high.

Significance of the effect

304. Given a magnitude of impact of negligible, and a sensitivity ranging from low to high, the significance of the effect is concluded to be of **negligible to minor** adverse significance, which is not significant in EIA terms.

Secondary mitigation and residual effect

305. No offshore ornithology secondary mitigation is considered necessary because the likely effect in the absence of mitigation is not significant in EIA terms.

Operation and maintenance phase

Magnitude of impact

306. The impact is predicted to be of local spatial extent, long-term duration, irregular and high reversibility. Operation and maintenance works will be spatially and temporally restricted, covering only a small portion of the site at any given time. It is predicted that the impact will affect the receptor indirectly. The magnitude is therefore considered to be negligible.

307. The assessment in volume 2, chapter 8 considered the potential impacts on benthic subtidal ecology (including benthic invertebrate prey) associated with the Array during operation and maintenance to be of minor adverse significance, which is not significant in EIA terms.

308. With regards to fish and shellfish prey, volume 2, chapter 9 considered the potential impacts on marine species (including shellfish), sandeel, herring and diadromous fish during operation and maintenance to be of minor adverse significance, which is not significant in EIA terms.

309. Based on the information presented in volume 2, chapters 8 and 9, the direct impact of operation and maintenance on fish and mobile invertebrates (i.e. prey) is expected to be of minor adverse significance. The impact on ornithological receptors is predicted to be of local spatial extent, long-term but short-duration, intermittent and reversible. The magnitude is therefore considered to be of negligible significance.

Sensitivity of the receptor

310. None of the VORs considered in this assessment are highly specialist. All VORs have a moderate degree of flexibility in their habitat preferences and prey items (Del Hoyo *et al.*, 1992). VORs vary in their recoverability from low to high and population status from local to international. Therefore, sensitivity of the receptors overall is assessed as ranging from low to high.

Significance of the effect

311. Given a magnitude of impact of negligible, and a sensitivity ranging from low to high, the significance of the effect is concluded to be of **negligible to minor** adverse significance, which is not significant in EIA terms.

Secondary mitigation and residual effect

312. No offshore ornithology secondary mitigation is considered necessary because the likely effect in the absence of mitigation is not significant in EIA terms.

Decommissioning phase

313. The MDS for the decommissioning phase is assumed to be equal to the construction phase (Table 11.11). As such, the assessment of the effects is the same and is not repeated here. Therefore, as concluded in the construction phase, the effect of changes to prey availability in the decommissioning phase is not significant in EIA terms.

ENTANGLEMENT

314. There is a risk to diving seabirds of becoming entangled in submerged ropes, chains and cables whilst foraging underwater. This risk can be split into “primary entanglement” in which the bird becomes entangled in ropes, chains and cables deployed as part of the Array, and also “secondary entanglement”, in which the bird becomes entangled in drifting debris (primarily fishing gear) that has become snagged on infrastructure associated with the Array. If seabirds become entangled, it is likely to lead to injury and death.

315. The ornithological features considered to be at risk from entanglement are those diving seabirds established to be present in the Array (i.e. guillemot, razorbill, puffin and gannet; refer to Table 4.1 of volume 3 appendix 11.1 for vulnerability to drowning).

Operation and maintenance phase

Magnitude of impact

316. The risk from primary entanglement is deemed to be very low, because the diameter, weight and tension of mooring lines and cables associated with floating wind farms means they are physically unlikely to entangle seabirds (SEER, 2022).

317. Secondary entanglement is the more likely pathway for seabirds getting entangled, as drifting fishing gear has characteristics (such as netting or free-floating fishing line) that make entanglement of diving seabirds more likely. Currently, however, there is very little evidence that secondary entanglement of seabirds occurs with any frequency (SEER, 2022). If secondary entanglement was a high risk to seabirds, it is expected that it would have been detected and reported in relation to other offshore deployments including oil and gas platforms (Benjamins *et al.*, 2014).

318. Furthermore, the operation and maintenance schedule for the Array will include measures to detect and remove accumulations of debris, as is standard practice for floating offshore wind farms (Kincardine Offshore Windfarm, 2016; Pentland Floating Offshore Wind Farm, 2022). This will further reduce the risk of entanglement.

319. The impact is predicted to be of local spatial extent, long-term duration, continuous and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore considered to be negligible.

Sensitivity of the receptor

320. For all ornithological features considered, it is assumed that entanglement would be potentially fatal for the individual concerned. The sensitivity to entanglement is likely to depend on both behavioural characteristics, sensory characteristics and physical characteristics, all of which may influence the probability of encountering debris and subsequently becoming entangled in it (Benjamins *et al.*, 2014). The framework Benjamins *et al.* (2014) developed for marine megafauna would appear to suggest the ornithological features (i.e. seabirds) associated with the Array are less sensitive to entanglement due to their small size, relatively flexible bodies, good underwater vision and pursuit hunting mode of foraging.

321. Guillemot, razorbill, puffin are deemed to be of high vulnerability to entanglement (as set out in Table 4.1 of volume 3 appendix 11.1, indicated as vulnerability to drowning) and gannet is considered to be of medium vulnerability to entanglement.

322. As set out in Table 11.19, guillemot, puffin and gannet are of low recoverability and international value. Razorbill is of medium recoverability and international value. The sensitivity of all four receptors is therefore considered to be high.

Significance of the effect

323. Overall, the magnitude of the impact is deemed to be negligible and the sensitivity of the receptor is considered to be high. The effect will, therefore, be of **minor** adverse significance, which is not significant in EIA terms.

Secondary mitigation and residual effect

324. No offshore ornithology secondary mitigation is considered necessary because the likely effect in the absence of mitigation is not significant in EIA terms.

COMBINED IMPACT – COLLISION AND DISPLACEMENT

325. Three species are considered to be at risk from both displacement and collision during the operation and maintenance phase. These are kittiwake, fulmar and gannet. To better understand the magnitude of the potential impact on these species, the predicted effects of both collision and displacement have been combined.

326. It is recognised that assessing these two potential impacts together could amount to double counting, as birds that are subject to displacement could not be subject to potential collision risk as they are already assumed to have not entered the Array. Equally, birds estimated to be subject to collision risk mortality would not be subjected to displacement mortality as well. The results presented in this section are therefore considered highly precautionary, especially for species with high displacement rates (i.e. gannet).

327. Currently, no more refined method to consider displacement and collision together has been agreed with NatureScot and therefore the precautionary and highly unlikely additive approach is presented in this assessment.

Operation and maintenance phase

Kittiwake

Magnitude of impact

328. In all three seasons (pre-breeding, breeding and post breeding) and also on an annual basis, the estimated increase in baseline mortality remains well below the 1% increase threshold (Table 11.33), with the upper end of the range for increase in annual baseline mortality being 0.061%.

329. The main value for assessment uses the CRM parameters advised by NatureScot to predict collision mortality, and a displacement rate of 30% and mortality rate of 3%. Using this rate, the increase in predicted mortality in the breeding season was 0.140%. In the pre-breeding increase in mortality was predicted to be 0.11% and in the post-breeding 0.008%

330. The impact is predicted to be of local spatial extent, long-term duration, continuous and reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore considered to be negligible to low.

Table 11.33: Assessment of Predicted Combined Collision Risk and Displacement Impacts for Kittiwake on Seasonal and Annual Bases Against the Baseline Mortality of Relevant Regional Populations

Season	Regional Baseline		Number of Kittiwake Subject to Mortality (NatureScot rates)	Number of Kittiwake Subject to Mortality (range)	Increase in Baseline Mortality (Applicant's Approach) (%)	Increase in Baseline Mortality (NatureScot Approach) (%)
	Population	Baseline Mortality				
Pre-breeding	627,816	98,065	8	8 to 11	0.008	0.008 to 0.011
Breeding	261,047	40,776	38	38 to 57	0.094	0.094 to 0.140
Post-breeding	829,937	129,636	7	7 to 10	0.006	0.006 to 0.008
Annual	**829,937**	129,636	54	**54 to 79**	0.041	0.041 to 0.061

Sensitivity of the receptor

331. Kittiwake were assessed as having low vulnerability to displacement impacts but higher vulnerability to collision impacts, and therefore considered to have medium vulnerability to the combined impact of displacement and collision.

332. Kittiwake is a qualifying interest for several SPAs likely to be connected to the Array (within the mean-max + SD foraging range), with several non-SPA colonies also within range and so the species is considered to be of international value. Refer to Table 6.2 of volume 3, appendix 11.1 for details of SPAs with connectivity to the Array with regards to kittiwake.

333. Kittiwake lay two eggs and breed from the age of three onwards, typically living on average for 12 years (Burnell *et al*., 2023). Kittiwake have undergone decreases of approximately 57% in Scotland since the early 2000s. Surveys managed by the RSPB in 2023 have recorded indicative increases of 8% across a number of sites in Britain in 2023 when compared against a pre-HPAI baseline (Tremlett *et al*., 2024). Overall, kittiwake is deemed to have low recoverability.

334. Kittiwake is deemed to be of medium vulnerability, low recoverability and international value. The sensitivity of the receptor is therefore considered to be high.

Significance of the effect

335. Overall, the magnitude of the impact is deemed to be negligible to low and the sensitivity of the receptor is considered to be high. The effect will, therefore, be of minor to moderate adverse significance. However, due to predicted increases in baseline mortality for all seasons and annually falling well below 1%, even at the upper range of parameters, it is considered that **minor** adverse significance is appropriate, which is not significant in EIA terms.

Secondary mitigation and residual effect

336. No offshore ornithology secondary mitigation is considered necessary because the likely effect in the absence of mitigation is not significant in EIA terms.

Fulmar

Magnitude of impact

337. In all four seasons (pre-breeding, breeding, post breeding and non-breeding) and also on an annual basis, the estimated increase in baseline mortality remains well below the 1% increase threshold (Table 11.34), with the upper end of the range for increase in annual baseline mortality being 0.02%.

338. The main value for assessment uses the CRM parameters advised by NatureScot to predict collision mortality, and a displacement rate of 30% and mortality rate of 1%. Using this rate, the predicted annual mortality is 0.005%.

339. The impact is predicted to be of local spatial extent, long-term duration, continuous and reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be negligible.

Table 11.34: Assessment of Predicted Combined Collision Risk and Displacement Impacts for Fulmar on Seasonal and Annual Bases Against the Baseline Mortality of Relevant Regional Populations

Season	Regional Baseline		Number of Fulmar Subject to Mortality (Applicant's Approach Range)	Number of Fulmar Subject to Mortality (Applicant's Approach 30%)	Increase in Baseline Mortality (Applicant's Approach Range) (%)	Number of fulmar Subject to Mortality (Applicant's Approach 30%)
	Population	Baseline Mortality				
Pre-breeding	957,502	212,087	2 to 9	2.99	0.001 to 0.004	0.001
Breeding	476,165	105,471	2 to 21	5.13	0.002 to 0.020	0.005
Post-breeding	957,502	212,087	0 to 6	1.19	0.000 to 0.003	0.001
Non-breeding	568,736	125,975	0 to 4	1.46	0.000 to 0.004	0.001
Annual	**957,502**	**212,087**	**5 to 41**	**10.77**	**0.002 to 0.019**	**0.005**

Sensitivity of the receptor

340. Fulmar were assessed as having very low vulnerability to displacement impacts and very low vulnerability to collision impacts, and therefore considered to have very low vulnerability to the combined impact of displacement and collision.

341. Fulmar is a qualifying interest for several SPAs likely to be connected to the Array (within the mean-max + SD foraging range), with several non-SPA colonies also within range and so the species is considered to be of international value. Refer to table 6.26 of volume 3, appendix 11.1 for details of SPAs with connectivity to the Array with regards to fulmar.

342. Fulmar are considered to have very low reproductive potential, due to an average age of recruitment of nine years old and typically laying only a single egg (Robinson, 2005; Horswill and Robinson, 2015). The fulmar population increased by 77% between the 1969 to 1970 and 1985 to 1988 Censuses and remained relatively stable until the early 2000s. Numbers have since declined slightly since but remain above the level in 1969 to 1970 (JNCC, 2022). Overall, fulmar is deemed to have low recoverability.

343. Fulmar is deemed to be of very low vulnerability, low recoverability and international value. The sensitivity of the receptor is therefore considered to be high.

Significance of the effect

344. Overall, the magnitude of the impact is deemed to be negligible and the sensitivity of the receptor is considered to be high. The effect will, therefore, be of **minor** adverse significance, which is not significant in EIA terms.

Secondary mitigation and residual effect

345. No offshore ornithology secondary mitigation is considered necessary because the likely effect in the absence of mitigation is not significant in EIA terms.

Gannet

Magnitude of impact

346. In all three seasons (pre-breeding, breeding and post breeding) and also on an annual basis, the estimated increase in baseline mortality remains well below the 1% increase threshold (Table 11.35), with the upper end of the range for increase in annual baseline mortality being 0.053%

347. The main value for assessment uses the CRM parameters advised by NatureScot to predict collision mortality, and a displacement rate of 70% and mortality rate of 1% to 3%. Using this range, the predicted increase in baseline mortality was 0.026 to 0.039% in the breeding season.

348. The impact is predicted to be of local spatial extent, long-term duration, continuous and reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore considered to be negligible.

Table 11.35: Assessment of Predicted Combined Collision Risk and Displacement Impacts for Gannet on Seasonal and Annual Bases Against the Baseline Mortality of Relevant Regional Populations

Season	Regional Baseline		Number of Gannet Subject to Mortality (Applicant's Approach)	Number of Gannet Subject to Mortality (NatureScot Approach	Increase in Baseline Mortality (Applicant's Approach) (%)	Number of fulmar Subject to Mortality (NatureScot Approach) (%)
	Population	Baseline Mortality				
Pre-breeding	248,385	47,864	0	0 to 1	0.001	0.001 to 0.003
Breeding	763,577	147,141	38	10 to 29	0.026	0.026 to 0.039
Post-breeding	456,385	87,945	9	5 to 16	0.010	0.010 to 0.22
Annual	763,577	147,141	47	**15 to 46**	0.032	**0.032 to 0.053**

Sensitivity of the receptor

349. Gannet were assessed as having low vulnerability to displacement impacts but higher vulnerability to collision impacts, and therefore considered to have medium vulnerability to the combined impact of displacement and collision.

350. Gannet is a qualifying interest for several SPAs likely to be connected to the Array (within the mean-max + SD foraging range), with several non-SPA colonies also within range and so the species is considered to be of international value. Refer to Table 6.30 of volume 3, appendix 11.1 for details of SPAs with connectivity to the Array with regards to gannet.

351. Gannet have low reproductive potential given a typical age of first breeding of five years and typically laying only a single egg per breeding season. However, although gannet has a low reproductive potential, the species has demonstrated a consistent increasing trend in abundance since the 1990's (JNCC, 2020). It is of note that the species has suffered from the outbreak of HPAI during the 2022 breeding season (Pearce-Higgins *et al*., 2023), with declines of 25% recorded at certain sites in Britain in 2023 when compared against a pre-HPAI baseline (Tremlett *et al*., 2024). Therefore, whilst the overall population has shown steady growth, HPAI has led to some short-term declines. Therefore, overall gannet is deemed to have low recoverability.

352. Gannet is deemed to be of medium vulnerability, medium recoverability and international value. The sensitivity of the receptor is therefore considered to be high.

Significance of the effect

353. Overall, the magnitude of the impact is deemed to be negligible to low and the sensitivity of the receptor is considered to be high. The effect will, therefore, be of minor to moderate adverse significance. However, due to predicted increases in baseline mortality for all seasons and annually falling well below 1%, even at the upper range of parameters, it is considered that **minor** adverse significance is appropriate, which is not significant in EIA terms.

Secondary mitigation and residual effect

354. No offshore ornithology secondary mitigation is considered necessary because the likely effect in the absence of mitigation is not significant in EIA terms.

11.12. CUMULATIVE EFFECTS ASSESSMENT

11.12.1. METHODOLOGY

355. The CEA assesses the impacts associated with the Array together with other relevant plans, projects and activities. Cumulative effects are defined as the combined effect of the Array in combination with the effects from a number of different projects, on the same receptor or resource. Further details on CEA methodology are provided in volume 1, chapter 6.

356. The projects and plans selected as relevant to the CEA presented within this chapter are based upon the results of a screening exercise (see volume 3, appendix 6.4). Volume 3, appendix 6.4 further provides information regarding how information pertaining to other plans and projects is gained and applied to the assessment. Each project or plan has been considered on a case-by-case basis for screening in or out of this chapter's assessment based upon data confidence (the availability and accuracy of quantitative information, and the confidence that the information is likely to reflect the project's consented design), impact-receptor pathways and the spatial/temporal scales involved. All projects screened out are detailed within volume 3, appendix 6.4.

357. In undertaking the CEA for the Array, it should be noted that other projects and plans under consideration will have differing potential for proceeding to an operational stage and hence a differing potential to ultimately contribute to a cumulative impact alongside the Array. Therefore, a tiered approach has been adopted which provides a framework for placing relative weight upon the potential for each project/plan to be included in the CEA to ultimately be realised, based upon the project/plan's current stage of maturity and certainty in the project's parameters. The tiered approach which will be utilised within the Array CEA employs the following tiers:

- tier 1 assessment – Array and Proposed offshore export cable corridor(s) and Proposed onshore transmission infrastructure and all plans/projects which became operational since baseline characterisation, those under construction, and those with consent and submitted but not yet determined;
- tier 2 assessment – All plans/projects assessed under Tier 1, plus those projects with a Scoping Report; and
- tier 3 assessment – All plans/projects assessed under Tier 2, which are reasonably foreseeable, plus those projects likely to come forward where an Agreement for Lease (AfL) has been granted.

358. For consistency with the finalised CEA long list presented in volume 3, appendix 6.4, (which was finalised at the end of March 2024, three months prior to submission of the Array EIA Report), Table 11.36 provides a detailed overview of all screened in projects. However, it is important to note that where detailed quantitative analysis was undertaken, the cumulative assessment only considered project-specific data up to January 2024 (six months prior to submission of the Array EIA Report), as outlined in the Ossian Array EIA Scoping Report (Ossian OWFL, 2023) and agreed as part of the Ossian Array Scoping Opinion (MD-LOT, 2023). Project information available at the end of March 2024 has been considered qualitatively within the CEA.

359. Table 11.36 only includes projects which have been assigned tier 1 or tier 2, with tier 3 projects not listed. This is due to tier 3 projects being predominantly 'proposed' or only identified in development plans, and so may not actually be taken forward. Projects under construction are likely to contribute to cumulative impacts (providing effect or spatial pathways exist), whereas those proposals (listed as tier 3 projects) not yet approved are less likely to contribute to such an impact, as some may not achieve approval or may not ultimately be built due to other factors. Tier 3 projects are detailed within volume 3, appendix 6.4.

360. Some of the potential impacts considered within the Array alone assessment are specific to a particular phase of development (e.g. construction, operations and maintenance or decommissioning). Where the potential for cumulative effects with other plans or projects only have potential to occur where there is spatial or temporal overlap with the Array during certain phases of development, impacts associated with a certain phase may be omitted from further consideration where no plans or projects have been identified that have the potential for cumulative effects during this period.

361. In addition, some of the projects considered cumulatively only have potential to impact species during a specific season (e.g. breeding or non-breeding seasons). During the breeding season, projects within a species' foraging range were considered as there is the potential for individuals to have connectivity to the Array area and the other plans/projects specific to each species. Foraging ranges by Woodward *et al*., (2019) were used. Within the non-breeding season all developments within the BDMPS area relevant to a species (Furness, 2015) are included. As such, all 'breeding season' projects are also included within the non-breeding period given that the BDMPS areas defined by Furness (2015) are larger than the breeding foraging ranges. Additional projects not included within a breeding season assessment may be included within the non-breeding season assessment. Projects considered for each species during each season are presented within Table 11.36.

362. It should be noted that the Greater Gabbard, Gunfleet Sands 1 and 2, Inner Dowsing, Lynn, Methil Demo and Scroby Sands are currently operational however, the operational consents for these projects expires before the Array becomes operational. These projects are therefore discounted from the CEA as there is no temporal overlap between the operational phases of these projects and the Array.

363. Other aspects, such as indirect impacts associated with prey distribution and availability, are very difficult to quantify. Although it is acknowledged that cumulative effects related to these impacts are possible, the magnitude of these impacts is not considered to be significant at a population level for any offshore

ornithology receptor. It should further be noted that some activities which may contribute to a cumulative effect related to these impacts (e.g. fishing activities) are considered to already be captured within the baseline conditions established in section 11.7 and therefore already taken into account. These impacts are therefore not considered further within the CEA. The impacts included and excluded from the cumulative assessment are detailed within Table 11.37. The impacts included in the CEA are:

- disturbance and displacement from the physical presence of wind turbines and maintenance activities; and
- collision with wind turbines.

Table 11.36: List of Other Projects and Plans Considered Within the CEA for Offshore Ornithology

Project/Plan	Status [i.e. Application, Consented, Under Construction, Operational]	Distance from Array (km)	Description of Project/Plan	Dates of Construction (If Applicable)	Dates of Operation (If Applicable)	Overlap with the Array [e.g. Project Construction Phase Overlaps with Array Construction Phase]
Tier 1						
Proposed offshore export cable corridor(s)	Planned	0.00	The Proposed offshore export cable corridor(s) for the Array.	2030 to 2037	2038 to 2072	Project operation and maintenance phase overlaps with Array operation and maintenance phase.
Proposed onshore transmission infrastructure	Planned	342.97	Onshore Transmission Infrastructure for the Array	2030 to 2037	2038 to 2072	Project operation and maintenance phase overlaps with Array operation and maintenance phase.
Offshore Wind Projects and Associated Cables						
Aberdeen Offshore Wind Farm	Active/In Operation	79.32	Up to 11 wind turbines at a capacity of 96.8 MW.	N/A	Up to 2045	The construction phase might overlap and operation and maintenance and decommissioning phases of the project will overlap with the construction and operation and maintenance phase of the Array.
Beatrice Offshore Wind Farm	Active/In Operation	191.63	84 wind turbines at a capacity of 588 MW.	N/A	Up to 2044	The construction phase might overlap and operation and maintenance and decommissioning phases of the project will overlaps with the construction and operation and maintenance phase of the Array.
Berwick Bank Offshore Wind Farm	Planning	56.84	Up to 307 wind turbines with a capacity of up to 4.1 GW	2025 to 2032	2033 onwards	The construction and operation and maintenance phases of the project overlaps with the construction and operation and maintenance phase of the Array.
Blyth Demo Phase 1	Active/In Operation	162.77	Up to 15 wind turbines at a capacity of 41.5 MW.	N/A	Up to 2044	The construction phase might overlap and operation and maintenance and decommissioning phases of the project will overlaps with the construction and operation and maintenance phase of the Array.
Blyth Demo Phase 2 and 3	Under construction	154.48	Up to 5 floating wind turbines at a capacity of 58.4 MW.	2024	2025 to 2050	The operation and maintenance and decommissioning phases of the project overlaps with the construction and operation and maintenance phase of the Array.
Dogger Bank A Offshore Wind Farm[27]	Under construction	218.64	Up to 95 wind turbines with no maximum generating capacity.	2024	2025 to 2060	The operation and maintenance and decommissioning phases of the project overlaps with the construction and operation and maintenance phase of the Array.
Dogger Bank B Offshore Wind Farm[18]	Under construction	191.20	Up to 95 wind turbines with no maximum generating capacity.	2024 to 2025	2026 to 2061	The operation and maintenance and decommissioning phases of the project overlaps with the construction and operation and maintenance phase of the Array.
Dogger C Offshore Wind Farm[19]	Under construction	227.37	Up to 87 wind turbines with no maximum generating capacity.	2024 to 2026	2027 to 2063	The operation and maintenance and decommissioning phases of the project overlaps with the construction and operation and maintenance phase of the Array.
Dudgeon Offshore Wind Farm	Active/In Operation	370.22	Up to 67 wind turbines at a capacity of 402 MW.	N/A	Up to 2042	The construction phase might overlap and operation and maintenance and decommissioning phases of the project will overlaps with the construction and operation and maintenance phase of the Array.
Dudgeon Extension Project	Consented	365.35	Up to 30 wind turbines at a capacity of 402 MW.	2024 to 2027	2028 to 2063	The operation and maintenance and decommissioning phases of the project overlaps with the construction and operation and maintenance phase of the Array.
East Anglia One Offshore Wind Farm	Active/In Operation	486	Up to 102 turbines at a capacity of up to 714 MW.	N/A	Up to 2043	The construction phase might overlap and operation and maintenance and decommissioning phases of the project will overlaps with the construction and operation and maintenance phase of the Array.
East Anglia One North Offshore Wind Farm	Under Construction	485	Up to 67 turbines at a capacity of 800 MW.	2024 to 2026	2027 to 2052	The operation and maintenance and decommissioning phases of the project overlaps with the construction and operation and maintenance phase of the Array.

[18] Dogger Bank A and B are assessed together within cumulative section as projects submitted a combined application.

[19] Dogger Bank C and Sofia are assessed together within cumulative section as projects submitted a combined application.

Project/Plan	Status [i.e. Application, Consented, Under Construction, Operational]	Distance from Array (km)	Description of Project/Plan	Dates of Construction (If Applicable)	Dates of Operation (If Applicable)	Overlap with the Array [e.g. Project Construction Phase Overlaps with Array Construction Phase]
East Anglia Two Offshore Wind Farm	Under Construction	502	Up to 75 wind turbines at a capacity of 900 MW.	2024 to 2026	2027 to 2052	The operation and maintenance and decommissioning phases of the project overlaps with the construction and operation and maintenance phase of the Array..
East Anglia Three Offshore Wind Farm	Under Construction	492	Up to 172 wind turbines with no maximum generating capacity.	2024 to 2026	2027 to 2052	The operation and maintenance and decommissioning phases of the project overlaps with the construction and operation and maintenance phase of the Array..
Forthwind Demonstration Project	Active/In Operation	154.64	Up to 7 wind turbines with no maximum generating capacity.	N/A	Up to 2049	The construction phase might overlap and operation and maintenance and decommissioning phases of the project will overlaps with the construction and operation and maintenance phase of the Array.
Galloper Offshore Wind Farm	Active/In Operation	524	Up to 56 wind turbines at a capacity of 353 MW.	N/A	Up to 2046	The construction phase might overlap and operation and maintenance and decommissioning phases of the project will overlaps with the construction and operation and maintenance phase of the Array.
Green Volt Offshore Wind Farm	Planning	97.90	Up to 35 wind turbines at a capacity of 560 MW.	2025 to 2029	2030 to 2065	The operation and maintenance phase of the project overlaps with the construction and operation and maintenance phase of the Array.
Gunfleet Sands 3 Demonstration Project	Active/In Operation	576 (distance by sea)	2 wind turbines at a capacity of 12 MW.	N/A	Up to 2038	The construction phase might overlap and operation and maintenance and decommissioning phases of the project will overlaps with the construction and operation and maintenance phase of the Array.
Hornsea Project One Offshore Wind Farm	Active/In Operation	320	Up to 174 wind turbines at a capacity of 1,200 MW.	N/A	Up to 2044	The construction phase might overlap and operation and maintenance and decommissioning phases of the project will overlaps with the construction and operation and maintenance phase of the Array.
Hornsea Project Two Offshore Wind Farm	Active/In Operation	318.72	Up to 165 wind turbines at a capacity of 1,300 MW.	N/A	Up to 2047	The construction phase might overlap and operation and maintenance and decommissioning phases of the project will overlaps with the construction and operation and maintenance phase of the Array.
Hornsea Project Three Offshore Wind Farm	Consented	317	Up to 231 wind turbines with no maximum generating capacity.	2025 to 2030	2031 onwards	The operation and maintenance phase of the project overlaps with the construction and operation and maintenance phase of the Array.
Hornsea Project Four Offshore Wind Farm	Consented	270	Up to 180 wind turbines at a capacity of 2,600 MW.	2025 to 2028	2029 to 2064	The operation and maintenance phase of the project overlaps with the construction and operation and maintenance phase of the Array.
Hornsea Project 4 (HOW04) Cable	Under Construction	307.92	Up to 1 cable at a capacity of 170 kV.	2024 to 2028	2029 to 2055	The operation and maintenance phase of the project overlaps with the construction and operation and maintenance phase of the Array.
Humber Gateway Offshore Wind Farm	Active/In Operation	319.38	Up to 73 wind turbines at a capacity of 219 MW.	N/A	Up to 2040	The construction phase might overlap and operation and maintenance and decommissioning phases of the project will overlaps with the construction and operation and maintenance phase of the Array.
Hywind Offshore Wind Farm	Active/In Operation	72.08	Up to 5 wind turbines at a capacity of 30 MW.	N/A	Up to 2042	The construction phase might overlap and operation and maintenance and decommissioning phases of the project will overlaps with the construction and operation and maintenance phase of the Array.
Inch Cape Offshore Wind Farm	Consented	86.92	Up to 72 wind turbines with no maximum generating capacity.	2025 to 2026	2027 onwards	The operation and maintenance phase of the project overlaps with the construction and operation and maintenance phase of the Array.
Kentish Flats Offshore Wind Farm [20]	Active/In Operation	590 (distance by sea)	Up to 30 wind turbines at a capacity of 90 MW.	N/A	Up to 2046	The construction phase might overlap and operation and maintenance and decommissioning phases of the project will overlaps with the construction and operation and maintenance phase of the Array.

[20] Kentish Flats and Kentish Flats Extension are assessed together within cumulative section as projects submitted a combined application.

Project/Plan	Status [i.e. Application, Consented, Under Construction, Operational]	Distance from Array (km)	Description of Project/Plan	Dates of Construction (If Applicable)	Dates of Operation (If Applicable)	Overlap with the Array [e.g. Project Construction Phase Overlaps with Array Construction Phase]
Kentish Flats Extension[29]	Active/In Operation	567.38	Up to 15 wind turbines at a capacity of 49.5 MW.	N/A	Up to 2041	The construction phase might overlap and operation and maintenance and decommissioning phases of the project will overlaps with the construction and operation and maintenance phase of the Array.
Kincardine Offshore Wind Farm	Active/In Operation	61.65	6 wind turbines at a capacity of 50 MW.	N/A	Up to 2046	The construction phase might overlap and operation and maintenance and decommissioning phases of the project will overlaps with the construction and operation and maintenance phase of the Array.
Lincs Offshore Wind Farm	Active/In Operation	377	75 wind turbines at a capacity of 270 MW.	N/A	Up to 2037	The construction phase might overlap and operation and maintenance and decommissioning phases of the project will overlaps with the construction and operation and maintenance phase of the Array.
London Array Offshore Wind Farm	Active/In Operation	688 (distance by sea)	Up to 175 wind turbines at a capacity of 630 MW.	N/A	Up to 2037	The construction phase might overlap and operation and maintenance and decommissioning phases of the project will overlaps with the construction and operation and maintenance phase of the Array.
Moray East Offshore Wind Farm	Active/In Operation	174.37	Up to 100 wind turbines at a capacity of 950 MW.	N/A	Up to 2066	The construction phase might overlap and operation and maintenance and decommissioning phases of the project will overlaps with the construction and operation and maintenance phase of the Array.
Moray West Offshore Wind Farm	Under Construction	182.19	Up to 60 wind turbines with no maximum generating capacity.	2023 to 2024	2025 onwards	The operation and maintenance phase of the project overlaps with the construction and operation and maintenance phase of the Array.
Neart na Gaoithe Offshore Wind Farm	Under Construction	5.50	Up to 54 wind turbines with no maximum generating capacity.	2024	2025 to 2049	The operation and maintenance phase of the project overlaps with the construction and operation and maintenance phase of the Array.
Norfolk Boreas Offshore Wind Farm	Consented	420	Up to 158 wind turbines with no maximum generating capacity.	2025 to 2030	2031 to 2054	The operation and maintenance and decommissioning phases of the project overlaps with the construction and operation and maintenance phase of the Array..
Norfolk Boreas Transmission Asset	Consented	419.31	4 cables with no maximum capacity.	2025 to 2029	2030 onwards	The operation and maintenance phase of the project overlaps with the construction and operation and maintenance phase of the Array.
Norfolk Vanguard Offshore Wind Farm	Consented	452	Up to 200 wind turbines with no maximum generating capacity.	2025 to 2028	2029 to 2053	The operation and maintenance and decommissioning phases of the project overlaps with the construction and operation and maintenance phase of the Array.
Pentland Floating Offshore Wind Farm	Consented	520 (distance by sea)	Up to 10 wind turbines with no maximum generating capacity.	2024 to 2026	2027 to 2056	The operation and maintenance and decommissioning phases of the project overlaps with the construction and operation and maintenance phase of the Array.
Race Bank Offshore Wind Farm	Active/In Operation	357	Up to 91 wind turbines at a capacity of 573 MW.	N/A	Up to 2043	The construction phase might overlap and operation and maintenance and decommissioning phases of the project will overlaps with the construction and operation and maintenance phase of the Array.
Rampion Offshore Wind Farm	Active/In Operation	748 (distance by sea)	Up to 116 wind turbines at a capacity of 400 MW.	N/A	Up to 2043	The construction phase might overlap and operation and maintenance and decommissioning phases of the project will overlaps with the construction and operation and maintenance phase of the Array.
Rampion 2 (Extension)	Planning	768 (distance by sea)	Up to 116 wind turbines at a capacity of 1,200 MW.	2026 to 2030	2031 to 2060	The operation and maintenance and decommissioning phases of the project overlaps with the construction and operation and maintenance phase of the Array.
Seagreen 1 Offshore Wind Farm[21]	Active/In Operation	150	Up to 114 wind turbines at a capacity of 1,075 MW.	N/A	Up to 2048	The operation and maintenance and decommissioning phases of the project overlaps with the construction and operation and maintenance phase of the Array.

[21] Seagreen 1 Offshore Wind Farm and Seagreen 1A Project are assessed together within cumulative section as projects submitted a combined application.

Project/Plan	Status [i.e. Application, Consented, Under Construction, Operational]	Distance from Array (km)	Description of Project/Plan	Dates of Construction (If Applicable)	Dates of Operation (If Applicable)	Overlap with the Array [e.g. Project Construction Phase Overlaps with Array Construction Phase]
Seagreen 1A Project[30]	Consented	66.28	Up to 36 turbines with no maximum generating capacity.	2024 to 2025	2026 to 2046	The operation and maintenance and decommissioning phases of the project overlaps with the construction and operation and maintenance phase of the Array.
Sheringham Shoal Offshore Wind Farm	Active/In Operation	381.27	Up to 88 turbines at a capacity of 317MW.	N/A	Up to 2037	The operation and maintenance and decommissioning phases of the project overlaps with the construction phase of the Array.
Sheringham Shoal Extension	Consented	375	Up to 27 turbines at a capacity of 317 MW.	2024 to 20275	2028 to 2063	The construction phase might overlap and operation and maintenance and decommissioning phases of the project will overlaps with the construction phase of the Array.
Sofia Offshore Wind Farm [28]	Under Construction	227.37	Up to 100 turbines at a capacity of 1400MW.	2024 to 2025	2026 to 2061	The operation and maintenance and decommissioning phases of the project overlaps with the construction and operation and maintenance phase of the Array.
Teesside Offshore Wind Farm	Active/In Operation	204	Up to 62 turbines at a capacity of 27 MW.	N/A	Up to 2038	The construction phase might overlap and operation and maintenance and decommissioning phases of the project will overlap with the construction phase of the Array.
Thanet Offshore Wind Farm	Active/In Operation	584 (distance by sea)	Up to 100 wind turbines at a capacity of 300 MW.	N/A	Up to 2050	The construction phase might overlap and operation and maintenance and decommissioning phases of the project will overlaps with the construction and operation and maintenance phase of the Array.
Triton Knoll Offshore Wind Farm	Active/In Operation	335	Up to 90 wind turbines at a capacity of 860 MW.	N/A	Up to 2047	The construction phase might overlap and operation and maintenance and decommissioning phases of the project will overlaps with the construction and operation and maintenance phase of the Array.
West of Orkney Wind Farm	Planning	292	Up to 125 wind turbines at a capacity of 2,250 MW.	2028 to 2031	2032 to 2062	The operation and maintenance and decommissioning phases of the project overlaps with the construction and operation and maintenance phase of the Array.
Westermost Rough Offshore Wind Farm	Active/In Operation	298	Up to 35 wind turbines at a capacity of 210 MW.	N/A	Up to 2040	The construction phase might overlap and operation and maintenance and decommissioning phases of the project will overlaps with the construction and operation and maintenance phase of the Array.
Oil and Gas Activities						
No relevant Oil and Gas Projects identified during the CEA screening.						
Aggregate Extraction						
No relevant Aggregate Extraction projects identified during the CEA screening.						
Disposal Sites						
No relevant Disposal Sites identified during the CEA screening.						
Coastal Protection/Infrastructure						
No relevant Coastal Protection/Infrastructure projects identified during the CEA screening.						
Subsea Cables (Telecommunications and Interlinks) and Pipelines						
No relevant subsea cables have been screened into the offshore ornithology cumulative study area.						
Tidal Farms						

Project/Plan	Status [i.e. Application, Consented, Under Construction, Operational]	Distance from Array (km)	Description of Project/Plan	Dates of Construction (If Applicable)	Dates of Operation (If Applicable)	Overlap with the Array [e.g. Project Construction Phase Overlaps with Array Construction Phase]
Bluemull Sound (Shetland) Tidal Array[22]	Active/In Operation	422.71	Up to six turbines at a capacity of 600 kW.	N/A	Up to 2038	The construction phase might overlap and operation and maintenance and decommissioning phases of the project will overlap with the construction phase of the Array..
Brough Ness Tidal Array[22]	Active/In Operation	229.70	Up to 66 turbines at a capacity of 99 MW.	N/A	Up to 2045	The construction phase might overlap and operation and maintenance and decommissioning phases of the project will overlaps with the construction and operation and maintenance phase of the Array.
EMEC Fall of Warness	Active/In Operation	272.00	Tidal test site at the Fall of Warness. 8 cabled test berths at various depths in an approximately 8 km² area.	N/A	Up to 2045	The construction phase might overlap and operation and maintenance and decommissioning phases of the project will overlaps with the construction and operation and maintenance phase of the Array.
Inner Sound[22]	Active/In Operation	288.44	Tidal Stream Electricity Generating Station - Inner Sound, Pentland Firth?	N/A	Up to 2041	The construction phase might overlap and operation and maintenance and decommissioning phases of the project will overlaps with the construction and operation and maintenance phase of the Array.
Shapinsay Sound Tidal Array	Active/In Operation	356.60	Up to 15 turbines at a capacity of 30 MW.	N/A	Up to 2055	The construction phase might overlap and operation and maintenance and decommissioning phases of the project will overlaps with the construction and operation and maintenance phase of the Array.
Mull of Kintyre Demonstation[22]	Active/In Operation	604.10	Up to 30 MW.	N/A	Up to 2040	The construction phase might overlap and operation and maintenance and decommissioning phases of the project will overlaps with the construction and operation and maintenance phase of the Array.
Ness of Duncansby	Active/In Operation	236.16	Up to 95 turbines at a capacity of 95 MW.	N/A	Up to 2047	The construction phase might overlap and operation and maintenance and decommissioning phases of the project will overlaps with the construction and operation and maintenance phase of the Array.
North Yell (Shetland)[22]	Active/In Operation	278.90	1 turbine at a capacity of 30 kW.	N/A	Up to 2039	The construction phase might overlap and operation and maintenance and decommissioning phases of the project will overlaps with the construction and operation and maintenance phase of the Array.
Orkney Islands[22]	Active/In Operation	296.30	Up to 12 turbines at a capacity of 30 MW.	N/A	Up to 2046	The construction phase might overlap and operation and maintenance and decommissioning phases of the project will overlaps with the construction and operation and maintenance phase of the Array.
St Catherine's Point (Isle of Wight)	Under Construction	683.50	St Catherine's Point Tidal Array is consented at a capacity of up to 30 MW.	2024	2025 to 2050	The operation and maintenance and decommissioning phases of the project overlaps with the construction and operation and maintenance phase of the Array.
Ministry of Defence sites						
No relevant Ministry of Defence sites identified within the offshore ornithology cumulative study area.						
Tier 2						
Offshore Wind Projects and Associated Cables						
Broadshore Offshore Wind Farm	Scoping	148.14	Proposed for a capacity of 500MW.	2028 to 2029	2030 onwards	The construction and operation and maintenance phases of the project overlaps with the construction and operation and maintenance phase of the Array
Buchan Offshore Wind Farm	Scoping	151.62	Proposed for up to 60 turbines at a capacity of 960MW.	2028 to 2030	2026 to 2055	The construction and operation and maintenance phases of the project overlaps with the construction and operation and maintenance phase of the Array

[22] Note that publicly available shapefiles could not be located for these sites and therefore are not shown within Figure 11.5. They have been considered within the assessment.

Project/Plan	Status [i.e. Application, Consented, Under Construction, Operational]	Distance from Array (km)	Description of Project/Plan	Dates of Construction (If Applicable)	Dates of Operation (If Applicable)	Overlap with the Array [e.g. Project Construction Phase Overlaps with Array Construction Phase]
Caledonia Offshore Wind Farm	Scoping	157.49	Proposed for up to 150 turbines at a capacity of 2,000 MW.	2028 to 2029	2029 onwards	The construction and operation and maintenance phases of the project overlaps with the construction and operation and maintenance phase of the Array
Cenos Offshore Wind Farm	Scoping	91.70	Proposed for up to 1400MW	Unknown	Unknown	The construction phase, operation and maintenance and decommissioning phases of the project might overlap with the construction and operation and maintenance phase of the Array.
Dogger Bank D[23]	Scoping	233.00	Proposed for a capacity of 2,000MW.	2027 to 2028	2029 to 2064	The operation and maintenance phase of the project overlaps with the operation and maintenance phase of the Array
Dogger Bank South Offshore Wind Farm[22]	Scoping	219.40	Proposed for up to 200 turbines at a capacity of 1500MW.	Unknown	Unknown	The construction phase, operation and maintenance and decommissioning phases of the project might overlap with the construction and operation and maintenance phase of the Array.
Dogger Bank South East - RWE Renewables	Scoping	241.02	Proposed for up to 150 turbines at a capacity of 750MW.	Unknown	Unknown	The construction phase, operation and maintenance and decommissioning phases of the project might overlap with the construction and operation and maintenance phase of the Array.
Dogger Bank South West - RWE Renewables	Scoping	219.40	Proposed for up to 150 turbines at a capacity of 750MW.	Unknown	Unknown	The construction phase, operation and maintenance and decommissioning phases of the project might overlap with the construction and operation and maintenance phase of the Array.
Five Estuaries	Scoping	526.18	Five Estuaries Offshore Wind Farm is proposed for up to 79 turbines at a capacity of 353MW.	2028 to 2030	2031 onwards	The operation and maintenance phase of the project overlaps with the operation and maintenance phase of the Array
Marram Offshore Wind Farm	Scoping	123.55	Proposed for up to 150 turbines at a capacity of 3000MW.	2031 to 2038	2039 onwards	The construction, operation and maintenance and decommissioning phases of the project overlaps with the construction and operation and maintenance phase of the Array.
Morven BP – EnBW Offshore Wind Farm	Scoping	5.50	Proposed for up to 191 turbines at a capacity of 2300MW.	2031 to 2037	2038 onwards	The construction and operation and maintenance phases of the project overlaps with the construction and operation and maintenance phase of the Array.
Muir Mhor Offshore Wind Farm	Scoping	51.38	Proposed capacity of up to 798 MW.	2027 to 2029	2030 to 2055	The construction and operation and maintenance phases of the project overlaps with the construction and operation and maintenance phase of the Array
North Falls Offshore Wind Farm	Scoping	520.42	Proposed for up to 71 turbines at a capacity of 504MW.	2028 to 2029	2030 to 2054	The construction and operation and maintenance phases of the project overlaps with the construction and operation and maintenance phase of the Array
Outer Dowsing Offshore Wind (Generating Station)	Scoping	333.63	Outer Dowsing is proposed up to 1,500 MW	unknown	unknown	The construction and operation and maintenance phases of the project overlaps with the construction and operation and maintenance phase of the Array
Salamander Offshore Wind Farm	Scoping	79.49	Proposed for up to 100 MW	Unknown	Unknown	The construction phase, operation and maintenance and decommissioning phases of the project might overlap with the construction and operation and maintenance phase of the Array.
Stromar Offshore Wind Farm	Scoping	182.39	Proposed for up to 1,000 MW capacity.	2025 to 2032	2033 to 2058	The construction and operation and maintenance phases of the project overlaps with the construction and operation and maintenance phase of the Array.
Subsea Cables (Telecommunications and Interlinks) and Pipelines						
No relevant subsea cables have been screened into the offshore ornithology cumulative study area.						

[23] Shown as part of Dogger Bank C (left hand side)

Table 11.37: Potential Cumulative Effects for Ornithological Receptors

Potential Impact	Phase[24]			Potential for Cumulative Effect	Rationale
	C	O	D		
Temporary habitat loss and disturbance	✓	×	✓	No	Low potential for cumulative effect because the contribution from the Array is negligible to minor and there is low potential for cumulative effect due to the contribution from the Array and surrounding wind farms is small (and even if these occurred at the same time this would not constitute a significant effect).
Indirect Impacts from construction/ decommissioning noise	✓	×	✓	No	Low potential for cumulative effect because the contribution from the Array is negligible to minor and will be spatially limited and even if considered cumulatively with other projects at the same time this would not constitute a significant effect.
Indirect impacts from UXO clearance	✓	×	×	No	Low potential for cumulative effect because the contribution from the Array is negligible to minor and will be spatially limited and even if considered cumulatively with other projects at the same time this would not constitute a significant effect.
Disturbance and displacement from the physical presence of wind turbines and maintenance activities	×	✓	×	Yes	There is potential for a cumulative effect, so a detailed, quantitative cumulative effect assessment is required. For projects assigned tier 2, impact information will be limited, with insufficient project information in the public domain to allow the effects to be reasonably understood and a cumulative assessment of those projects to be undertaken.
Barrier to movement	×	✓	×	No	Low potential for cumulative effect because the contribution from the Array is negligible to minor and there is low potential for cumulative effect due to the contribution from the Array and surrounding wind farms is small (and even if these occurred at the same time this would not constitute a significant effect).
Collision with wind turbines	×	✓	×	Yes	There is potential for a cumulative effect, so a detailed, quantitative cumulative effect assessment is required. For projects assigned tier 2, impact information will be limited, with insufficient project information in the public domain to allow the effects to be reasonably understood and a cumulative assessment of those projects to be undertaken.
Changes to prey availability	✓	×	✓	No	Low potential for cumulative effect because the contribution from the Array is negligible to minor and will be spatially limited and even if considered cumulatively with other projects at the same time this would not constitute a significant effect.
Entanglement	×	✓	×	No	Low potential for cumulative effect because the contribution from the Array is negligible to minor and will be spatially limited and even if considered cumulatively with other projects at the same time this would not constitute a significant effect.

[24] C = Construction, O = Operation and maintenance, D = Decommissioning

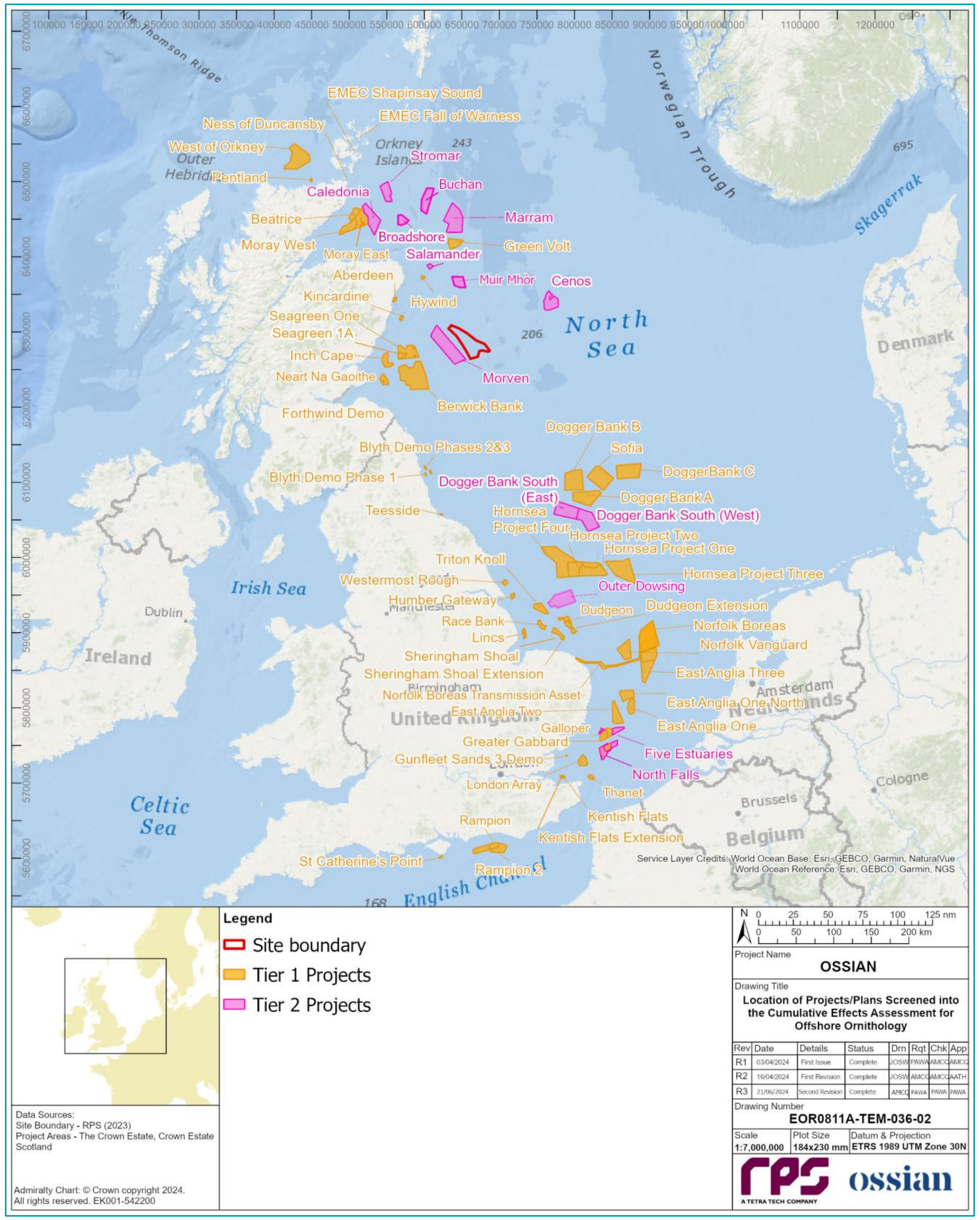

Figure 11.4: Location of Projects/Plans Screened into the Cumulative Effects Assessment for Offshore Ornithology

11.12.2. MAXIMUM DESIGN SCENARIO

364. The MDS for the cumulative assessment is defined as the combination of design parameters for both the Array and all other relevant projects that would result in the greatest impact on VORs. Normally the cumulative MDS is identical to the sum of the MDS of each relevant project individually, but this is not necessarily the case – for example, a longer construction phase may be the MDS for a single project, but if that means that there is a reduction in the overlap with other relevant projects of the operational phase, then the cumulative MDS may consider a shorter construction phase. The MDSs identified in Table 11.38 have been selected as those having the potential to result in the greatest effect on an identified receptor or receptor group. The cumulative effects presented and assessed in this section have been selected from the details provided in volume 1, chapter 3 of the Array EIA Report as well as the information available on other projects and plans (see volume 3, appendix 6.4). Effects of greater adverse significance are not predicted to arise should any other development scenario, based on details within the Project Description (volume 1, chapter 3) (e.g. different wind turbine layout), to that assessed here, be taken forward in the final design scheme.

Table 11.38: Maximum Design Scenario Considered for Each Impact as Part of the Assessment of Likely Significant Cumulative Effects on Offshore Ornithology

Potential Cumulative Effect	Phase[25] C	Phase[25] O	Phase[25] D	Maximum Design Scenario	Justification
Disturbance and displacement from the physical presence of wind turbines and maintenance activities	×	✓	×	MDS as described for the Array (Table 11.11) assessed cumulatively with the following projects: **Operations and Maintenance Phase:** **Tier 1** • Aberdeen Offshore Wind Farm • Bluemull Sound (Shetland) Tidal Farm • Beatrice Offshore Wind Farm • Berwick Bank Offshore Wind Farm • Blyth Demo Phase 1 • Blyth Demo Phase 2 and 3 • Brough Ness Offshore Wind Farm • Dogger Bank A Offshore Wind Farm • Dogger Bank B Offshore Wind Farm • Dogger C Offshore Wind Farm • Dudgeon Offshore Wind Farm • Dudgeon Extension • East Anglia One Offshore Wind Farm • East Anglia One North Offshore Wind Farm • East Anglia Three Offshore Wind Farm • East Anglia Two Offshore Wind Farm • EMEC Fall of Warness Tidal Farm • Forthwind Demonstration Project • Galloper Offshore Wind Farm • Green Volt Offshore Wind Farm • Gunfleet Sands 3 Demonstration • Hornsea Project 4 (HOW04) Cable • Hornsea Project Four Offshore Wind Farm • Hornsea Project One Offshore Wind Farm • Hornsea Project Three Offshore Wind Farm • Hornsea Project Two Offshore Wind Farm • Humber Gateway • Hywind Offshore Wind Farm • Inch Cape Offshore Wind Farm • Inner Sound Tidal Farm • Kentish Flats Offshore Wind Farm • Kentish Flats Extension • Kincardine Offshore Wind Farm • Lashy Sound Offshore Wind Farm • Lincs Offshore Wind Farm • London Array Offshore Wind Farm • Moray East Offshore Wind Farm • Moray West Offshore Wind Farm • Mull of Kintyre Tidal Farm • Neart na Gaoithe Offshore Wind Farm • Ness of Duncansby Tidal Farm	There is potential for a cumulative effect from operations and maintenance activities and so a cumulative effect assessment is required.

[25] C = Construction, O = Operation and maintenance, D = Decommissioning

Potential Cumulative Effect	Phase[25] C	O	D	Maximum Design Scenario	Justification
				• Norfolk Boreas Offshore Wind Farm • Norfolk Boreas Transmission Asset • Norfolk Vanguard Offshore Wind Farm • Pentland Floating Offshore Wind • Race Bank Offshore Wind Farm • Rampion Offshore Wind Farm • Rampion 2 Offshore Wind Farm • Seagreen 1 Offshore Wind Farm • Seagreen 1A Project • Sheringham Shoal Offshore Wind Farm • Sheringham Shoal Extension • Sofia Offshore Wind Farm • Teesside Offshore Wind Farm • Thanet Offshore Wind Farm • Triton Knoll Offshore Wind Farm • West of Orkney Wind Farm • Westermost Rough Offshore Wind Farm • North Yell Tidal Farm (Shetland) • Orkney Islands Tidal Farm • St Catherine's Point Tidal Farm (Isle of Wight) **Tier 2** • Broadshore Offshore Wind Farm • Buchan Offshore Wind Farm • Caledonia Offshore Wind Farm • Cenos Offshore Wind Farm • Dogger Bank D Offshore Wind Farm • Dogger Bank South Offshore Wind Farm • Dogger Bank South East - RWE Renewables • Dogger Bank South West - RWE Renewables • Five Estuaries Offshore Wind Farm • Marram Offshore Wind Farm • Morven BP – EnBW Offshore Wind Farm • Muir Mhor Offshore Wind Farm • North Falls Offshore Wind Farm • Outer Dowsing Offshore Wind Farm • Salamander Offshore Wind Farm • Stromar Offshore Wind Farm In line with NatureScot's representation in Table 11.3, the cumulative effects have been calculated both with and without Berwick Bank.	
Collision with wind turbines	×	✓	×	MDS as described for the Array (Table 11.11) assessed cumulatively with the following projects **Operations and maintenance Phase:** **Tier 1** • Aberdeen Offshore Wind Farm • Beatrice Offshore Wind Farm • Berwick Bank Offshore Wind Farm	There is potential for a cumulative effect from operations and maintenance activities and so a cumulative effect assessment is required.

Potential Cumulative Effect	Phase[25] C	O	D	Maximum Design Scenario	Justification
				• Blyth Demo Phase 1 • Blyth Demo Phase 2 and 3 • Dogger Bank A Offshore Wind Farm • Dogger Bank B Offshore Wind Farm • Dogger C Offshore Wind Farm • Dudgeon Offshore Wind Farm • Dudgeon Extension Offshore Wind Farm • East Anglia One Offshore Wind Farm • East Anglia One North Offshore Wind Farm • East Anglia Two Offshore Wind Farm • East Anglia Three Offshore Wind Farm • Forthwind Demonstration Project • Galloper Offshore Wind Farm • Green Volt Offshore Wind Farm (INTOG Site 6 Flotation Energy) • Gunfleet Sands 3 Demo • Hornsea Project One Offshore Wind Farm • Hornsea Project Two Offshore Wind Farm • Hornsea Project Three Offshore Wind Farm • Hornsea Project Four Offshore Wind Farm • Hornsea Project 4 (HOW04) Cable • Humber Gateway • Hywind Offshore Wind Farm • Inch Cape Offshore Wind Farm • Kentish Flats Offshore Wind Farm • Kentish Flats Extension Offshore Wind Farm • Kincardine Offshore Wind Farm • Lincs Offshore Wind Farm • London Array Offshore Wind Farm • Moray East Offshore Wind Farm • Moray West Offshore Wind Farm • Neart na Gaoithe Offshore Wind Farm • Norfolk Boreas Offshore Wind Farm • Norfolk Boreas Transmission Asset • Norfolk Vanguard Offshore Wind Farm • Pentland Floating Offshore Wind • Race Bank Offshore Wind Farm • Rampion Offshore Wind Farm • Rampion 2 Offshore Wind Farm • Seagreen 1 Offshore Wind Farm • Seagreen 1A Project • Sheringham Shoal Offshore Wind Farm • Sheringham Shoal Extension Offshore Wind Farm • Sofia Offshore Wind Farm • Teesside Offshore Wind Farm • Thanet Offshore Wind Farm • Triton Knoll Offshore Wind Farm • West of Orkney Wind Farm Offshore Wind Farm • Westermost Rough Offshore Wind Farm	

Potential Cumulative Effect	Phase[25] C	O	D	Maximum Design Scenario	Justification
				Tier 2 • Broadshore Offshore Wind Farm • Buchan Offshore Wind Farm • Caledonia Offshore Wind Farm • Cenos Offshore Wind Farm • Dogger Bank D Offshore Wind Farm • Dogger Bank South Offshore Wind Farm • Dogger Bank South East - RWE Renewables • Dogger Bank South West - RWE Renewables • Five Estuaries Offshore Wind Farm • Marram Offshore Wind Farm • Morven BP – EnBW Offshore Wind Farm • Muir Mhor Offshore Wind Farm • North Falls Offshore Wind Farm • Outer Dowsing Offshore Wind Farm • Salamander Offshore Wind Farm • Stromar Offshore Wind Farm In line with NatureScot's representation in Table 11.3, the cumulative effects have been calculated both with and without Berwick Bank.	
Combined displacement and collision with wind turbines	×	✓	×	MDS as described for the Array (Table 11.11) assessed cumulatively with the following projects **Operations and maintenance Phase:** **Tier 1** • Aberdeen Offshore Wind Farm • Bluemull Sound (Shetland) Offshore Wind Farm • Beatrice Offshore Wind Farm • Berwick Bank Offshore Wind Farm • Blyth Demo Phase 1 • Blyth Demo Phase 2 and 3 • Brough Ness Offshore Wind Farm • Dogger Bank A Offshore Wind Farm • Dogger Bank B Offshore Wind Farm • Dogger C Offshore Wind Farm • Dudgeon Offshore Wind Farm • Dudgeon Extension • East Anglia One Offshore Wind Farm • East Anglia One North Offshore Wind Farm • East Anglia Three Offshore Wind Farm • East Anglia Two Offshore Wind Farm • EMEC Fall of Warness Tidal Farm • Forthwind Demonstration Project • Galloper Offshore Wind Farm • Green Volt Offshore Wind Farm • Gunfleet Sands 3 Demonstration • Hornsea Project 4 (HOW04) Cable • Hornsea Project Four Offshore Wind Farm	There is potential for a cumulative effect from operations and maintenance activities and so a cumulative effect assessment is required.

Potential Cumulative Effect	Phase[25] C	O	D	Maximum Design Scenario	Justification
				• Hornsea Project One Offshore Wind Farm • Hornsea Project Three Offshore Wind Farm • Hornsea Project Two Offshore Wind Farm • Humber Gateway • Hywind Offshore Wind Farm • Inch Cape Offshore Wind Farm • Inner Sound Offshore Wind Farm • Kentish Flats Offshore Wind Farm • Kentish Flats Extension • Kincardine Offshore Wind Farm • Lashy Sound Tidal Farm • Lincs Offshore Wind Farm • London Array Offshore Wind Farm • Moray East Offshore Wind Farm • Moray West Offshore Wind Farm • Mull of Kintyre Tidal Farm • Neart na Gaoithe Offshore Wind Farm • Ness of Duncansby Tidal Farm • Norfolk Boreas Offshore Wind Farm • Norfolk Boreas Transmission Asset • Norfolk Vanguard Offshore Wind Farm • Pentland Floating Offshore Wind • Race Bank Offshore Wind Farm • Rampion Offshore Wind Farm • Rampion 2 Offshore Wind Farm • Seagreen 1 Offshore Wind Farm • Seagreen 1A Project • Sheringham Shoal Offshore Wind Farm • Sheringham Shoal Extension • Sofia Offshore Wind Farm • Teesside Offshore Wind Farm • Thanet Offshore Wind Farm • Triton Knoll Offshore Wind Farm • West of Orkney Wind Farm • Westermost Rough Offshore Wind Farm • North Yell Tidal Farm • Orkney Islands Tidal Farm • St Catherine's Point Tidal Farm (Isle of Wight) **Tier 2** • Broadshore Offshore Wind Farm • Buchan Offshore Wind Farm • Caledonia Offshore Wind Farm • Cenos Offshore Wind Farm • Dogger Bank D Offshore Wind Farm • Dogger Bank South Offshore Wind Farm • Dogger Bank South East - RWE Renewables • Dogger Bank South West - RWE Renewables • Five Estuaries Offshore Wind Farm • Marram Offshore Wind Farm • Morven BP – EnBW Offshore Wind Farm	

Potential Cumulative Effect	Phase[25] C	O	D	Maximum Design Scenario	Justification
				• Muir Mhor Offshore Wind Farm • North Falls Offshore Wind Farm • Outer Dowsing Offshore Wind Farm • Salamander Offshore Wind Farm • Stromar Offshore Wind Farm In line with NatureScot's representation in Table 11.3, the cumulative effects have been calculated both with and without Berwick Bank.	

11.12.3. CUMULATIVE EFFECTS ASSESSMENT

365. An assessment of the likely significance of the cumulative effects of the Array in combination with other plans and projects upon offshore ornithology receptors arising from each identified impact is given below.

366. The CEA is limited by the data available upon which to base the assessment. Due to the age of developments in the North Sea and surrounding areas which have the potential to have a cumulative impact upon receptors, few have comparable datasets upon which to base an assessment. However, every effort has been made to obtain quantitative estimates for both displacement and collision from project-specific documentation. For displacement impacts this includes following the approach applied by many previous offshore wind farms using any available population data to calculate mean-pack or peak population estimates for use in displacement analyses.

367. Additionally, older developments did not carry out certain impact assessments (e.g. displacement and/or collision risk) for species such as kittiwake, gannet, fulmar, Manx shearwater and gull species (herring gull, great black-backed gull and lesser black-backed gull) due to limited data at the time of assessment on the species' behavioural response to the presence of offshore turbines. As such the CEA is carried out using data from offshore wind farms with available species data to do so. For projects in early stages (i.e. Tier 3), there was insufficient project information in the public domain to allow the effects to be reasonably understood and a cumulative assessment undertaken. Tier 3 projects have therefore not been included in the cumulative assessment below.

368. For the cumulative assessment, impacts from Tier 1 and Tier 2 projects have been assessed together, with Tier 2 impacts included if there is sufficient data to do so. This provides the most precautionary impact on the population. If any Tier 2 project does not get consented/built, the assessment presented here still includes the impacts. The only Tier 2 projects with sufficient data, which therefore has been included within the assessment are Five Estuaries, North Falls and Outer Dowsing. All other Tier 2 projects (Table 11.38) were at an early stage of planning at the time of writing, and there is therefore insufficient robust project information in the public domain to allow the effects to be reasonably understood and for them to be included within the cumulative assessment at this time. Impacts included from Five Estuaries, North Falls and Outer Dowsing may be subject to change following examination.

DISTURBANCE AND DISPLACEMENT FROM THE PHYSICAL PRESENCE OF WIND TURBINES AND MAINTANENCE ACTIVITIES

369. There is potential for cumulative displacement as a result of operational activities associated with the Array cumulatively with other developments. Disturbance and subsequent displacement of seabirds during the construction phase is primarily centred around where construction vessels and piling activities are occurring. The activities may displace individuals that would normally reside within and around the area of sea where the Array is located. This in effect represents indirect habitat loss, which will potentially reduce the area available to those seabirds to forage, loaf and/or moult.

370. The level of data available and the ease with which disturbance and displacement impacts can be combined across the wind farms is quite variable, reflecting the availability of relevant data for other projects and the approach to assessment taken. A maximum design approach would be to assume complete overlap in construction for all projects, while the minimum design approach would be to assume no overlap. The most realistic assumption is that at most there will be a degree of construction overlap (and hence increased vessel and helicopter activity), but that it will be limited to a small number of cumulative effects associated with projects and other activities and that the impact from construction and decommissioning will be small with no significant effects occurring.

371. During the operations and maintenance phase, the presence of offshore wind turbines has the potential to directly disturb and displace seabirds that would normally reside within and around the area of sea where offshore wind farms are located. Displacement may contribute to individual birds experiencing fitness consequences, which at an extreme level could lead to the mortality of individuals. Cumulative displacement therefore has the potential to lead to effects on a wider scale.

372. Impacts from tidal farms is still relatively unknown (Isaksson *et al.* 2020) due to the limited number and small spatial footprint of operational devices currently deployed in a few tidal lease sites (Fox *et al*., 2018). The study by Long (2017) stated that some displacement was detected during construction, but that numbers returned to around previous levels once turbines were installed and operational. Consequently, impacts from tidal farms is not considered in the cumulative assessment due to this uncertainty.

373. The species assessed for cumulative displacement impacts were kittiwake, guillemot, puffin, razorbill and gannet. The predicted impact for fulmar from the Array represented less than 0.01% of the baseline mortality of all seasonal and annual regional populations. It is therefore considered that the Array will not materially contribute to any existing cumulative displacement impact on this species.

374. There is no displacement impact from the Proposed onshore application. Whilst there may be a displacement resulting from maintenance/repair activities associated with the Proposed offshore export cable(s), any such displacement would be highly localised and temporary in nature, and is therefore expected to be negligible.

Tier 1 and Tier 2

Kittiwake

375. The estimated abundance of kittiwake for the purpose of estimating displacement impacts is given in Table 11.39. Estimated abundances for projects are those presented by Berwick Bank (SSE Renewables, 2022), for which NatureScot has not raised any concerns or noted any errors. In addition, estimates have been obtained from Green Volt Offshore Wind Farm (Green Volt, 2023), Pentland Floating Offshore Wind (Pentland Floating Offshore Wind Farm, 2022), West of Orkney (Offshore Wind Power Limited, 2023), North Falls (North Falls, 2023), Five Estuaries (Five Estuaries, 2023) and Outer Dowsing (Outer Dowsing, 2023) offshore wind farms, as those projects had not published their estimates at the time of the Berwick Bank application.

Table 11.39: Kittiwake Cumulative Abundance Estimates

Project	Season		
	Breeding	Post-breeding	Pre-breeding
Aberdeen	663	14	23
Beatrice	1,430	1,112	1,112
Blyth Demo Phase 1	591	740	740
Blyth Demo Phase 2 and 3	-	-	-
Dogger Bank A and B (Creyke Beck)	7,898	3,450	15,482
Dogger Bank C and Sofia (Teesside)	4,395	2,181	11,805
Dudgeon	N/A (outside foraging range)	-	-
Dudgeon Expansion and Sheringham Shoal Extension	N/A (outside foraging range)	1,481	1,217
East Anglia ONE	N/A (outside foraging range)	1,158	758
East Anglia ONE North	N/A (outside foraging range)	159	435
East Anglia THREE	N/A (outside foraging range)	3,419	1,309
East Anglia TWO	N/A (outside foraging range)	127	301

Project	Season		
	Breeding	Post-breeding	Pre-breeding
Five Estuaries	N/A (outside foraging range)	209	84
Forthwind Demonstration Project	-	-	-
Galloper	N/A (outside foraging range)	-	-
Gunfleet Sands 3 Demonstration Project	N/A (outside foraging range)	-	-
Green Volt Offshore Wind Farm	183	149	83
Hornsea Project One	N/A (outside foraging range)	31,481	767
Hornsea Project Two	N/A (outside foraging range)	1,449	1,975
Hornsea Project Three	N/A (outside foraging range)	2,550	3,795
Hornsea Project Four	3,771	3,608	2,626
Humber Gateway	N/A (outside foraging range)	-	-
Hywind	112	-	-
Inch Cape Offshore Wind Farm	3,866	1,069	1,069
Kentish Flats	N/A (outside foraging range)	-	-
Kentish Flats extension	N/A (outside foraging range)	-	-
Kincardine Offshore Wind Farm	229	-	-
Lincs	N/A (outside foraging range)	-	-
London Array	N/A (outside foraging range)	-	-
Moray East	1,963	-	-
Moray West	6,902	1,470	1,074
Neart na Gaoithe	2,164	2,016	139
Norfolk Boreas	N/A (outside foraging range)	2,576	949
North Falls (PEIR)	N/A (outside foraging range)	804	1,225
Norfolk Vanguard	N/A (outside foraging range)	916	1,294
Outer Dowsing	N/A (outside foraging range)	5,207	1,760
Pentland Floating Offshore Wind	N/A (outside foraging range)	118	41
Race Bank	N/A (outside foraging range)	-	-
Rampion	N/A (outside foraging range)	N/A (outside BDMPS)	N/A (outside BDMPS)
Rampion 2	N/A (outside foraging range)	N/A (outside BDMPS)	N/A (outside BDMPS)
Seagreen 1 and 1A Offshore Wind Farm	3,235	2,286	2,286
Sheringham Shoal	N/A (outside foraging range)	-	-
Teesside	N/A	-	-
Thanet	N/A (outside foraging range)	-	-
Triton Knoll	N/A (outside foraging range)	332	226
Westermost Rough	N/A	-	-
West of Orkney	1,113	799	1,217
Total	**38,515**	**70,880**	**53,792**
Berwick Bank	21,141	11,190	13,766
Ossian	3,183	566	581
Total (including Berwick Bank)	**62,839**	**82,636**	**68,139**
Total (excluding Berwick Bank)	**41,698**	**71,446**	**54,373**

376. The cumulative displacement mortality is given in Table 11.40 (with Berwick Bank included) and Table 11.41 (with Berwick Bank excluded). Mortality is calculated using 30% displacement and a range of 1% to 3% mortality in all seasons, in line with guidance (NatureScot, 2023h). Additionally, the Applicant's Approach which utilises a 30% displacement rate and 1% mortality rate is presented.

Table 11.40: Kittiwake Cumulative Displacement Mortality Estimates Inclusive of Berwick Bank

Season	Regional Baseline		Cumulative displacement mortality (Applicant's Approach)	Cumulative displacement mortality (NatureScot Approach)	Increase in baseline mortality (Applicant's Approach) (%)	Increase in baseline mortality (NatureScot Approach) (%)
	Population	Baseline mortality				
Pre-breeding	627,816	98,065	204	204 to 613	0.208	0.208 to 0.625
Breeding	261,047	40,776	189	189 to 566	0.462	0.462 to 1.387
Post-breeding	829,937	129,636	248	248 to 744	0.191	0.191 to 0.574
Annual	**829,937**	**129,636**	**641**	**641 to 1,923**	**0.494**	**0.494 to 1.483**

377. With Berwick Bank, and using the NatureScot rates, the estimated displacement mortality for kittiwake is 204 to 613 individuals in the pre-breeding season, 189 to 566 individuals in the breeding season and 248 to 744 individuals in the post-breeding season. This is equivalent to an increase in baseline mortality of 0.21% to 0.63% in the pre-breeding season, 0.46% to 1.39% in the breeding season and 0.19% to 0.57% in the post-breeding season. On an annual basis, the number of mortalities is estimated as 641 to 1,923 individuals, which equates to an increase in baseline mortality of 0.49% to 1.48% (Table 11.40).

378. When following the Applicant's Approach, the estimated displacement mortality with Berwick Bank, for kittiwake is 204 individuals in the pre-breeding season, 189 individuals in the breeding season and 248 individuals in the post-breeding season. This is equivalent to an increase in baseline mortality of 0.21% in the pre-breeding season, 0.46% in the breeding season and 0.19% in the non-breeding season. On an annual basis, the number of mortalities is estimated as 641 individuals, which equates to an increase in baseline mortality of 0.49%.

Table 11.41: Kittiwake Cumulative Displacement Mortality Estimates Exclusive of Berwick Bank

Season	Regional Baseline		Cumulative displacement mortality (Applicant's Approach)	Cumulative displacement mortality (NatureScot Approach)	Increase in baseline mortality (Applicant's Approach) (%)	Increase in baseline mortality (NatureScot Approach) (%)
	Population	Baseline mortality				
Pre-breeding	627,816	98,065	163	163 to 489	0.166	0.166 to 0.499
Breeding	261,047	40,776	125	125 to 375	0.307	0.307 to 0.920
Post-breeding	829,937	129,636	214	214 to 643	0.165	0.165 to 0.496
Annual	**829,937**	**129,636**	**503**	**503 to 1,508**	**0.388**	**0.388 to 1.163**

379. Without Berwick Bank and using the NatureScot rates, the estimated displacement mortality for kittiwake is 163 to 489 individuals in the pre-breeding season, 125 to 375 individuals in the breeding season and 214 to 643 individuals in the post-breeding season. This is equivalent to an increase in baseline mortality of 0.17% to 0.50% in the pre-breeding season, 0.31% to 0.92% in the breeding season and 0.17% to 0.50% in the post-breeding season. On an annual basis, the number of mortalities is estimated as 503 to 1,508 individuals, which equates to an increase in baseline mortality of 0.39% to 1.16% (Table 11.41).

380. When following the Applicant's Approach, the estimated displacement mortality without Berwick Bank, for kittiwake is 163 individuals in the pre-breeding season, 125 individuals in the breeding season and 214 individuals in the post-breeding season. This is equivalent to an increase in baseline mortality of 0.17% in the pre-breeding season, 0.31% in the breeding season and 0.17% in the non-breeding season. On an annual basis, the number of mortalities is estimated as 503 individuals, which equates to an increase in baseline mortality of 0.39%.

381. The upper range of the NatureScot Approach represents an increase in mortality of over 1% of baseline mortality with Berwick Bank included for the breeding season. Impacts estimated both with and without Berwick Bank included surpasses the 1% increase on an annual basis using the NatureScot rates. Therefore, to further assess the significance of this effect, a PVA has been carried out for kittiwake as described in volume 3, appendix 11.5.

<u>PVA Assessment Including Berwick Bank</u>

382. When considering the impact during the breeding season on the regional population defined for the breeding season, using the most extreme scenario of the NatureScot approach (30% displacement and 3% mortality) and with Berwick Bank included, the PVA predicted that the Counterfactual Population Size (CPS) was 0.841 (Table 11.42). The median population size was therefore projected to be 15.87% smaller than the unimpacted population over a 35 year time period, with a 50th centile value of 38.24. In terms of the population size, this means that the median of the impacted population fell within the 38th percentile of the unimpacted population (a value of 50 would indicate that they are the same). This suggests that the impacted scenario was still within the margin of error of the non-impacted scenario, and therefore there would likely be no adverse effect to the population. However, as outlined within volume 3, appendix 11.5, the Counterfactual of Population Growth Rate (CPGR) is considered a more robust metric compared to the CPS in this analysis due to the models being conducted with density independence, in line with NatureScot (2023k) guidance. The PVA model predicted that the CPGR was 0.995 (Table 11.42) which translates to a median reduction of 0.48% in population growth rate after 35 years. Such a decrease indicates that this level of impact would not adversely affect the population and would likely remain undetectable against natural population fluctuations. Furthermore, it is not expected to significantly alter the background mortality rate.

Table 11.42 Kittiwake 35 Year Cumulative PVA Results for Displacement Impacts Including Berwick Bank during the Breeding Season

Scenario	Predicted Mortality (Original Impact) (no. of birds)	Growth Rate (Annual GR)	Median CPGR	Median CPS	U=50%I
NatureScot Approach – 30% displacement, 3% mortality	566	0.9939	0.9952	0.8413	38.24

383. When considering the annual impact on the annual regional population (which is defined as the largest of the seasonal regional populations), under the most extreme scenario (30% displacement and 3% mortality) and with Berwick Bank included, the PVA predicted that the CPS was 0.843 (Table 11.43). The median population size was therefore projected to be 15.69% smaller than the unimpacted population over a 35 year time period, with a 50th centile value of 39.48. In terms of the population size, this means that the median of the impacted population fell within the 39th percentile of the unimpacted population (a value of 50 would indicate that they are the same). This suggests that the impacted scenario was still within the margin of error of the non-impacted scenario, and therefore there would likely be no adverse effect to the population. However, as stated, the CPGR is considered a more robust metric compared to the CPS in this analysis due to the models being conducted with density independence, in line with NatureScot (2023k) guidance. The PVA model predicted that the CPGR was 0.995 (Table 11.43) which translates to a median reduction of 0.47% in population growth rate after 35 years. Such a decrease indicates that this level of impact would not adversely affect the population and would only result in a slight reduction in the growth rate currently seen in the BDMPS population and would therefore be undetectable against natural population fluctuations. Furthermore, it is not expected to significantly alter the background mortality rate.

Table 11.43. Kittiwake 35 Year Cumulative PVA Results for Displacement Impacts Including Berwick Bank on an Annual Basis

Scenario	Predicted Mortality (Original Impact) (no. of birds)	Growth Rate (Annual GR)	Median CPGR	Median CPS	U=50%I
NatureScot Approach – 30% displacement, 3% mortality	1,923	0.9903	0.9953	0.8431	39.48

384. Based on the PVA results using the 30% displacement and 3% mortality rate of the NatureScot Approach, the magnitude of impact on the kittiwake population during the breeding season is considered to be of low magnitude.

385. Based on the PVA results using the 30% displacement and 3% mortality rate of the NatureScot Approach, the magnitude of impact on the kittiwake population annually is considered to be of low magnitude.

<u>PVA Assessment Excluding Berwick Bank</u>

386. When considering the annual impact on the annual regional population, under the most extreme scenario (30% displacement and 3% mortality) and with Berwick Bank excluded, the PVA predicted that the CPS was 0.875 (Table 11.44). The median population size was therefore projected to be 12.53% smaller than

the unimpacted population over a 35 year time period, with a 50th centile value of 41.88. In terms of the population size, this means that the median of the impacted population fell within the 41st percentile of the unimpacted population (a value of 50 would indicate that they are the same). This suggests that the impacted scenario was still well within the margin of error of the non-impacted scenario, and therefore there would likely be no adverse effect to the population. However, as stated the CPGR is considered a more robust metric compared to the CPS in this analysis due to the models being conducted with density independence, in line with NatureScot (2023k) guidance. The PVA model predicted that the CPGR was 0.996 (Table 11.44) which translates to a median reduction of 0.37% in population growth rate after 35 years. Such a decrease indicates that this level of impact would not adversely affect the population and would only result in a slight reduction in the growth rate currently seen in the BDMPS population and would therefore be undetectable against natural population fluctuations. Furthermore, it is not expected to significantly alter the background mortality rate.

Table 11.44 Kittiwake 35 Year Cumulative PVA Results for Displacement Impacts Excluding Berwick Bank on an Annual Basis

Scenario	Predicted Mortality (Original Impact) (no. of birds)	Growth Rate (Annual GR)	Median CPGR	Median CPS	U=50%l
NatureScot Approach – 30% displacement, 3% mortality	1,508	0.9914	0.9963	0.8747	41.88

387. Based on the PVA results using the 30% displacement and 3% mortality rate of the NatureScot Approach, the magnitude of impact on the kittiwake population annually is considered to be of low magnitude.

<u>Magnitude of impact</u>

388. The estimated mortality resulting from displacement during operation and maintenance was assessed for each season, and also on an annual basis by combining seasonal impacts and comparing them against the largest regional seasonal population (as set out in volume 3, appendix 11.3, and summarised in Table 11.20).

389. Based on the displacement assessment, for the pre-breeding and post-breeding season with Berwick Bank included and following the NatureScot Approach using a 30% displacement and 1% mortality rate, the cumulative impact was perceived as low magnitude.

390. Based on the displacement assessment, for the pre-breeding and post-breeding season with Berwick Bank included and following the NatureScot Approach using a 30% displacement and 3% mortality rate, the cumulative impact was perceived as low magnitude.

391. Based on the displacement assessment, for the pre-breeding and post-breeding season with Berwick Bank included and following the Applicant Approach using a 30% displacement and 1% mortality rate, the cumulative impact was perceived as low magnitude.

392. Based on the PVA results for the breeding season with Berwick Bank included and following the NatureScot Approach using a 30% displacement and 3% mortality rate, the impact from the cumulative assessment was perceived as low magnitude.

393. Based on the displacement assessment, for the breeding season with Berwick Bank included and following the NatureScot Approach using a 30% displacement and 1% mortality rate, the cumulative impact was perceived as low magnitude.

394. Based on the displacement assessment, for the breeding season with Berwick Bank included and following the Applicant Approach using a 30% displacement and 1% mortality rate, the impact from the cumulative assessment was perceived as low magnitude.

395. Based on the PVA results, on an annual basis with Berwick Bank included and following the NatureScot Approach using a 30% displacement and 3% mortality rate, the impact from the cumulative assessment was perceived as low magnitude.

396. Based on the displacement assessment, on an annual basis with Berwick Bank included and following the NatureScot Approach using a 30% displacement and 1% mortality rate, the impact from the cumulative assessment was perceived as low magnitude.

397. Based on the displacement assessment, on an annual basis with Berwick Bank included and following the Applicant Approach using a 30% displacement and 1% mortality rate, the impact from the cumulative assessment was perceived as low magnitude.

398. Based on the displacement assessment, for the pre-breeding, breeding and post-breeding season with Berwick Bank excluded and following the NatureScot Approach using a 30% displacement and 3% mortality rate, the cumulative impact was perceived as low magnitude.

399. Based on the displacement assessment, for the pre-breeding, breeding and post-breeding season with Berwick Bank excluded and following the NatureScot Approach using a 30% displacement and 1% mortality rate, the cumulative impact was perceived as low magnitude.

400. Based on the displacement assessment, for the pre-breeding, breeding and post-breeding season with Berwick Bank excluded and following the Applicant Approach using a 30% displacement and 1% mortality rate, the cumulative impact was perceived as low magnitude.

401. Based on the PVA results, on an annual basis with Berwick Bank excluded and following the NatureScot Approach using a 30% displacement and 3% mortality rate, the impact from the cumulative assessment was perceived as low magnitude.

402. Based on the displacement assessment, on an annual basis with Berwick Bank excluded and following the NatureScot Approach using a 30% displacement and 1% mortality rate, the impact from the cumulative assessment was perceived as low magnitude.

403. Based on the displacement assessment, on an annual basis with Berwick Bank excluded and following the Applicant Approach using a 30% displacement and 1% mortality rate, the impact from the cumulative assessment was perceived as low magnitude.

404. Kittiwake populations have been declining within the UK with Burnell et al. (2023) reporting that the population has decreased by 21%. However it is evident that this decline is attributed to the presence of other pressures such as poor prey resources which can impact productivity (Furness & Tasker, 2000; Frederiksen et al., 2008; Carroll et al., 2017) and challenges from climate change (Heath et al, 2012). The PVA indicated that cumulative mortality attributed to offshore wind farms would have a minimal impact on the overall population trajectory.

405. The cumulative effect is predicted to be of national spatial extent, long-term duration, continuous and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be low.

<u>Sensitivity of the receptor</u>

406. In terms of behavioural response to offshore vessel traffic and helicopters, kittiwake are considered have a low vulnerability (Wade *et al.*, 2016).

407. Kittiwake is a qualifying interest for several SPAs likely to be connected to the Array (within the mean-max + SD foraging range), with several non-SPA colonies also within range and so the species is considered to be of international value. Refer to Table 6.2 of volume 3, appendix 11.1 for details of SPAs with connectivity to the Array with regards to kittiwake.

408. Kittiwake lay two eggs and breed from the age of three onwards, typically living on average for 12 years (Burnell *et al*., 2023). Kittiwake have undergone decreases of approximately 57% in Scotland since the early 2000s. Surveys managed by the RSPB in 2023 have recorded indicative increases of 8% across a number of sites in Britain in 2023 when compared against a pre-HPAI baseline (Tremlett *et al*., 2024). Overall, kittiwake is deemed to have low recoverability.

409. Kittiwake is deemed to be of low vulnerability, low recoverability and international value. The sensitivity of the receptor is therefore considered to be high.

Significance of the effect

410. Overall, the magnitude of the impact is deemed to be low and the sensitivity of the receptor is considered to be high. The effect will, therefore, be of minor to moderate adverse significance. However, due to the pre-breeding season and post-breeding season falling below 1% and due to PVA results concluding there to be a low impact both with and without Berwick Bank and following both the NatureScot and Applicant's Approach, it is considered that **minor** adverse significance is appropriate, which is not significant in EIA terms.

Guillemot

411. The estimated abundance of guillemot for the purpose of estimating displacement impacts is given in Table 11.45. Estimated abundances for projects are those presented by Berwick Bank (SSE Renewables, 2022), for which NatureScot has not raised any concerns or noted any errors. In addition, estimates have been obtained from Green Volt Offshore Wind Farm (Green Volt, 2023), Pentland Floating Offshore Wind (Pentland Floating Offshore Wind Farm, 2022), West of Orkney (Offshore Wind Power Limited, 2023), North Falls (North Falls, 2023), Five Estuaries (Five Estuaries, 2023) and Outer Dowsing (Outer Dowsing, 2023) offshore wind farms, as those projects had not published their estimates at the time of the Berwick Bank application.

Table 11.45: Guillemot Cumulative Abundance Estimates

Project	Season	
	Breeding	Non-breeding
Aberdeen	547	225
Beatrice	N/A (outside foraging range)	2,755
Blyth Demo Phase 1	N/A (outside foraging range)	1,321
Blyth Demo Phase 2 and 3	N/A (outside foraging range)	-
Dogger Bank A and B	N/A (outside foraging range)	16,763
Dogger C and Sofia	N/A (outside foraging range)	5,969
Dudgeon	N/A (outside foraging range)	542
Dudgeon Extension and Sheringham Shoal/Extension	N/A (outside foraging range)	8,671
East Anglia 1 North	N/A (outside foraging range)	1,888
East Anglia 2	N/A (outside foraging range)	1,675
East Anglia 3	N/A (outside foraging range)	2,859
East Anglia One	N/A (outside foraging range)	640
Five Estuaries	N/A (outside foraging range)	3,698
Forthwind Demonstration Project	-	-
Galloper	N/A (outside foraging range)	593
Gunfleet Sands 3 Demonstration Project	N/A (outside foraging range)	-
Green Volt Offshore Wind Farm	N/A (outside foraging range)	16,105
Hornsea Project Four	N/A (outside foraging range)	69,555
Hornsea Project One	N/A (outside foraging range)	8,097
Hornsea Project Three	N/A (outside foraging range)	17,772
Hornsea Project Two	N/A (outside foraging range)	13,164
Humber Gateway	N/A (outside foraging range)	138
Hywind	249	2,136
Inch Cape Offshore Wind Farm	4,371	3,177
Kentish Flats + Extension	N/A (outside foraging range)	7
Kincardine Offshore Wind Farm	632	0
Lincs	N/A (outside foraging range)	814
London Array	N/A (outside foraging range)	377
Moray East	N/A (outside foraging range)	547
Moray West	N/A (outside foraging range)	38,174
Neart na Gaoithe	1,755	3,761
Norfolk Boreas	N/A (outside foraging range)	13,777
North Falls (PEIR)	N/A (outside foraging range)	4,497
Norfolk Vanguard	N/A (outside foraging range)	4,776
Outer Dowsing	N/A (outside foraging range)	28,373
Pentland Floating Offshore Wind	N/A (outside foraging range)	N/A (outside BDMPS)
Race Bank	N/A (outside foraging range)	708
Rampion	N/A (outside foraging range)	15,536
Rampion 2	N/A (outside foraging range)	5,723
Seagreen 1 and 1A Offshore Wind Farm	24,724	8,800
Sheringham Shoal	N/A (outside foraging range)	715
Teesside	N/A (outside foraging range)	901
Thanet	N/A (outside foraging range)	124
Triton Knoll	N/A (outside foraging range)	746
West of Orkney	N/A (outside foraging range)	N/A (outside BDMPS)
Westermost Rough	N/A (outside foraging range)	486
Total	**32,278**	**306,585**
Berwick Bank	74,154	44,171
Ossian	27,247	48,340
Total (including Berwick Bank)	**133,679**	**399,096**
Total (excluding Berwick Bank)	**59,525**	**354,925**

412. The cumulative displacement mortality is given in Table 11.46 (with Berwick Bank included) and Table 11.47 (with Berwick Bank excluded). Mortality is calculated using 60% displacement and a range of 3% to 5% mortality in the breeding season and 1% to 3% mortality in the non-breeding season, in line with guidance (NatureScot, 2023h). Additionally, the Applicant's Approach which utilises a 50% displacement rate and 1% mortality rate is presented.

Table 11.46: Guillemot Cumulative Displacement Mortality Estimates Inclusive of Berwick Bank

Season	Regional Baseline		Cumulative displacement mortality (Applicant's Approach)	Cumulative displacement mortality (NatureScot Approach)	Increase in baseline mortality (Applicant's Approach) (%)	Increase in baseline mortality (NatureScot Approach) (%)
	Population	Baseline mortality				
Breeding	916,667	121,733	668	2,406 to 4,010	0.549	1.977 to 3.294
Non-breeding	1,617,306	214,778	1,995	2,395 to 7,184	0.929	1.115 to 3.345
Annual	**1,617,306**	**214,778**	**2,664**	**4,801 to 11,194**	**1.240**	**2.235 to 5.212**

413. With Berwick Bank, the estimated displacement mortality for guillemot, following the NatureScot Approach, is 2,406 to 4,010 individuals in the breeding season and 2,395 to 7,184 individuals in the non-breeding season. This is equivalent to an increase in baseline mortality of 1.98% to 3.29% in the breeding season and 1.12% to 3.35% in the non-breeding season. On an annual basis, the number of mortalities is estimated as 4,801 to 11,194 individuals, which equates to an increase in baseline mortality of 2.24% to 5.21% (Table 11.46).

414. When following the Applicant's Approach, the estimated displacement mortality with Berwick Bank, for guillemot is 668 individuals in the breeding season and 1,995 individuals in the non-breeding season. This is equivalent to an increase in baseline mortality of 0.55% in the breeding season and 0.93% in the non-breeding season. On an annual basis, the number of mortalities is estimated as 2,664 individuals, which equates to an increase in baseline mortality of 1.24%.

415. Without Berwick Bank, the estimated displacement mortality for guillemot, following the NatureScot Approach, is 1,071 to 1,786 individuals in the breeding season and 2,130 to 6,389 individuals in the non-breeding season. This is equivalent to an increase in baseline mortality of 0.88% to 1,47% in the breeding season and 0.92% to 2.98% in the post-breeding season. On an annual basis, the number of mortalities is estimated as 3,201 to 8,175 individuals, which equates to an increase in baseline mortality of 1.50% to 3.81% (Table 11.47).

Table 11.47: Guillemot Cumulative Displacement Mortality Estimates Exclusive of Berwick Bank

Season	Regional Baseline		Cumulative displacement mortality (Applicant's Approach)	Cumulative displacement mortality (NatureScot Approach)	Increase in baseline mortality (Applicant's Approach) (%)	Increase in baseline mortality (NatureScot Approach) (%)
	Population	Baseline mortality				
Breeding	916,667	121,733	298	1,071 to 1,786	0.245	0.880 to 1.467
Non-breeding	1,617,306	214,778	1,775	2,130 to 6,389	0.826	0.922 to 2.975
Annual	**1,617,306**	**214,778**	**2,073**	**3,201 to 8,175**	**0.965**	**1.490 to 3.806**

416. When following the Applicant's Approach, the estimated displacement mortality with Berwick Bank, for guillemot is 298 individuals in the breeding season and 1,775 individuals in the non-breeding season. This is equivalent to an increase in baseline mortality of 0.25% in the breeding season and 0.83% in the non-breeding season. On an annual basis, the number of mortalities is estimated as 2,073 individuals, which equates to an increase in baseline mortality of 0.97%.

417. The estimated cumulative displacement mortality therefore represents an increase in mortality of over 1% of baseline mortality, when including Berwick Bank or applying the NatureScot Approach range without Berwick Bank. Therefore, to further assess the significance of this effect, a PVA has been carried out for guillemot during the breeding season, non-breeding season and on an annual basis as described in volume 3, appendix 11.5.

PVA Assessment Including Berwick Bank

418. When considering the impact during the breeding season on the regional population defined for the breeding season, using the NatureScot approach (60% displacement and 3% to 5% mortality) and with Berwick Bank included, the PVA predicted that the CPS was 0.299 to 0.130 (Table 11.48:). The median population size was therefore projected to be between 70.14% to 86.97% smaller than the unimpacted population over a 35 year time period, with a 50th centile value of 0. In terms of the population size, this implies that the median of the impacted population falls outside the percentile range of the unimpacted population (a value of 50 would indicate that they are the same). This suggests that this level of impact would have an adverse effect on the population, with an impact rate of 60% displacement and 3% to 5% mortality causing a population decline. However, as stated, the CPGR is considered a more robust metric compared to the CPS in this analysis due to the models being conducted with density independence, in line with NatureScot (2023k) guidance. The PVA model predicted that the CPGR was between 0.967 to 0.945 (Table 11.48:) which translates to a median reduction of 3.30% to 5.50% in population growth rate after 35 years. Such a decrease indicates that this level of impact would adversely affect the population. However, as noted earlier within section 11.11, research examining the displacement effects on guillemots indicates that a 50% displacement rate is more reflective, with this rate still regarded as precautionary (RoyalHaskoning, 2013; Peschko *et al.* 2020; APEM, 2022; MacArthur Green, 2023). Consequently, it is anticipated that the Applicant's approach (incorporating a 50% displacement rate alongside a 1% mortality rate) leads to an estimate that aligns more closely with actual conditions. If the Applicant's approach is followed, the increase in baseline mortality would be 0.55%. This level of impact would likely remain undetectable against natural population fluctuations. Furthermore, it would not significantly alter the background mortality rate.

Table 11.48: Guillemot 35 Year Cumulative PVA Results for Displacement Impacts Including Berwick Bank during the Breeding Season

Scenario	Predicted Mortality (Original Impact) (no. of birds)	Growth Rate (Annual GR)	Median CPGR	Median CPS	U=50%I
NatureScot Approach - 60% displacement, 3% mortality	2,406	0.9915	0.9670	0.2986	0
NatureScot Approach - 60% displacement, 5% mortality	4,010	0.9689	0.9450	0.1303	0

419. When considering the impact during the non-breeding season on the regional population defined for the non-breeding season, using the NatureScot approach (60% displacement and 1% to 3% mortality) and with Berwick Bank included, the PVA predicted that the CPS was 0.904 to 0.739 (Table 11.49). The median population size was therefore projected to be between 9.58% to 26.15% smaller than the unimpacted population over a 35 year time period, with a 50th centile value of 32.92 to 8.32. In terms of the population size, this implies that the median of the impacted population fell within the 32nd and 8th percentile of the unimpacted population (a value of 50 would indicate that they are the same). This suggests that, if a 60% displacement and 3% mortality rate was applied, this level of impact could have an adverse effect on the population. However, as stated, the CPGR is considered a more robust metric compared to the CPS in this analysis due to the models being conducted with density independence, in line with NatureScot (2023k) guidance. The PVA model predicted that the CPGR was between 0.997 to 0.992 (Table 11.49) which translates to a median reduction of 0.28% to 0.84% in population growth rate after 35 years. Such a decrease indicates that this level of impact would not adversely affect the population and would likely remain undetectable against natural population fluctuations. Furthermore, it is not expected to significantly alter the background mortality rate. Additionally, as stated above, it is anticipated that the Applicant's approach (incorporating a 50% displacement rate alongside a 1% mortality rate) leads to an estimate that aligns more closely with actual conditions. If the Applicant's approach is followed, the increase in baseline mortality would be 0.93%. In addition, the guillemot population in the UK North Sea & Channel waters BDMPS is observed to be growing and the population is still expected to continue to grow and will be larger after 35 years than that which is currently recorded, even in the event of the largest impact.

Table 11.49: Guillemot 35 Year Cumulative PVA Results for Displacement Impacts Including Berwick Bank during the Non-breeding Season

Scenario	Predicted Mortality (Original Impact) (no. of birds)	Growth Rate (Annual GR)	Median CPGR	Median CPS	U=50%I
NatureScot Approach - 60% displacement, 1% mortality	2,395	1.0224	0.9972	0.9042	32.92
NatureScot Approach - 60% displacement, 3% mortality	7,184	1.0167	0.9916	0.7385	8.32

420. When considering the annual impact on the annual regional population, under the NatureScot Approach (60% displacement and 1% to 3% mortality) and with Berwick Bank included, the PVA predicted that the CPS was 0.817 to 0.623 (Table 11.50). The median population size was therefore projected to be between 18.31% to 37.71% smaller than the unimpacted population over a 35 year time period, with a 50th centile value of 17.72 to 1.52. In terms of the population size, this implies that the median of the impacted population fell within the 17th and 1st percentile of the unimpacted population (a value of 50 would indicate that they are the same). This suggests that, if a 60% displacement and 3% mortality rate was applied, this level of impact could have an adverse effect on the population. However, as stated, the CPGR is considered a more robust metric compared to the CPS in this analysis due to the models being conducted with density independence, in line with NatureScot (2023) guidance. The PVA model predicted that the CPGR was between 0.994 to 0.987 (Table 11.50) which translates to a median reduction of 0.56% to 1.31% in population growth rate after 35 years. Such a decrease indicates that this level of impact could adversely affect the population. As stated previously, it is anticipated that the Applicant's approach (incorporating a 50% displacement rate alongside a 1% mortality rate) leads to an estimate that aligns more closely with actual conditions. In addition, the guillemot population in the UK North Sea & Channel waters BDMPS is observed to be growing and the population is still expected to continue to grow and will be larger after 35 years than that which is currently recorded, even in the event of the largest impact.

421. When following the Applicant's Approach, the PVA predicted that the CPS was 0.894 (Table 11.50). The median population size was therefore projected to be 10.60% smaller than the unimpacted population over a 35 year time period, with a 50th centile value of 31.04. In terms of the population size, this implies that the median of the impacted population fell within the 31st percentile of the unimpacted population (a value of 50 would indicate that they are the same). This suggests that the impacted scenario was still within the margin of error of the non-impacted scenario, and therefore there would likely be no adverse effect to the population. As stated the CPGR is considered a more robust metric compared to the CPS in this analysis due to the models being conducted with density independence, in line with NatureScot (2023) guidance. The PVA model predicted that the CPGR was 0.997 (Table 11.50) which translates to a median reduction of 0.31% in population growth rate after 35 years. Such a decrease indicates that this level of impact would not adversely affect the population and would not trigger a risk of population decline and would only result in a slight reduction in the growth rate currently seen in the BDMPS population and would therefore be undetectable against natural population fluctuations. Furthermore, it is not expected to significantly alter the background mortality rate. In addition, the guillemot population in the UK North Sea & Channel waters BDMPS is observed to be growing and the population is still expected to continue to grow and will be larger after 35 years than that which is currently recorded, even in the event of the largest impact.

Table 11.50: Guillemot 35 Year Cumulative PVA Results for Displacement Impacts Including Berwick Bank on an Annual Basis

Scenario	Predicted Mortality (Original Impact) (no. of birds)	Growth Rate (Annual GR)	Median CPGR	Median CPS	U=50%I
NatureScot Approach - 60% displacement, 1% mortality	4,801	1.0195	0.9944	0.8169	17.72
NatureScot Approach - 60% displacement, 3% mortality	11,194	1.0119	0.9869	0.6229	1.52
Applicant's Approach - 50% displacement, 1% mortality	2,664	1.0221	0.9969	0.8940	31.04

PVA Assessment Excluding Berwick Bank

422. When considering the impact during the breeding season on the regional population defined for the breeding season, using the NatureScot approach (60% displacement and 5% mortality) and with Berwick Bank excluded, the PVA predicted that the CPS was 0.409 (Table 11.51). The median population size was therefore projected to be 59.08% smaller than the unimpacted population over a 35 year time period, with a 50th centile value of 0. In terms of the population size, this implies that the median of the impacted population falls outside the percentile range of the unimpacted population (a value of 50 would indicate that they are the same). This suggests that this level of impact would have an adverse effect on the population, with an impact rate of 60% displacement and 5% mortality causing a population decline. However, as outlined within volume 3, appendix 11.5, the CPGR is considered a more robust metric compared to the CPS in this analysis due to the models being conducted with density independence, in line with NatureScot (2023k) guidance. The PVA model predicted that the CPGR was 0.976 (Table 11.51) which translates to a median reduction of 2.45% in population growth rate after 35 years. Such a decrease indicates that this level of impact would adversely affect the population. However, as noted earlier within section 11.11, it is anticipated that the Applicant's approach (incorporating a 50% displacement rate alongside a 1% mortality rate) leads to an estimate that aligns more closely with actual conditions. If the Applicant's approach is followed, the increase in baseline mortality would be 0.25%. This level of impact would likely remain undetectable against natural population fluctuations. Furthermore, it would not significantly alter the background mortality rate.

Table 11.51: Guillemot 35 Year Cumulative PVA Results for Displacement Impacts Excluding Berwick Bank during the Breeding Season

Scenario	Predicted Mortality (Original Impact) (no. of birds)	Growth Rate (Annual GR)	Median CPGR	Median CPS	U=50%I
NatureScot Approach - 60% displacement, 5% mortality	1,786	1.0001	0.9755	0.4092	0

423. When considering the impact during the non-breeding season on the regional population defined for the non-breeding season, using the NatureScot approach (60% displacement and 3% mortality) and with Berwick Bank excluded, the PVA predicted that the CPS was 0.749 (Table 11.52). The median population size was therefore projected to be 25.06% smaller than the unimpacted population over a 35 year time period, with a 50th centile value of 9.00. In terms of the population size, this implies that the median of the impacted population fell within the 9th percentile of the unimpacted population (a value of 50 would indicate that they are the same). This level of impact could have an adverse effect on the population. However, as stated, the CPGR is considered a more robust metric compared to the CPS in this analysis due to the models being conducted with density independence, in line with NatureScot (2023k) guidance. The PVA model predicted that the CPGR was 0.992 (Table 11.52) which translates to a median reduction of 0.80% in population growth rate after 35 years. Such a decrease indicates that this level of impact would not adversely affect the population and would not trigger a risk of population decline and would only result in a slight reduction in the growth rate currently seen in the BDMPS population and would therefore be undetectable against natural population fluctuations. Furthermore, it is not expected to significantly alter the background mortality rate. As stated, it is anticipated that the Applicant's approach (incorporating a 50% displacement rate alongside a 1% mortality rate) leads to an estimate that aligns more closely with actual conditions. If the Applicant's approach is followed, the increase in baseline mortality would be 0.83%. In addition, the guillemot population in the UK North Sea & Channel waters BDMPS is observed to be growing and the population is still expected to continue to grow and will be larger after 35 years than that which is currently recorded, even in the event of the largest impact.

Table 11.52: Guillemot 35 Year Cumulative PVA Results for Displacement Impacts Excluding Berwick Bank during the Non-breeding Season

Scenario	Predicted Mortality (Original Impact) (no. of birds)	Growth Rate (Annual GR)	Median CPGR	Median CPS	U=50%I
NatureScot Approach - 60% displacement, 3% mortality	6,389	1.0171	0.9920	0.7494	9.00

424. When considering the annual impact on the annual regional population, under the range of scenarios considered (60% displacement, 1% to 3% mortality) and with Berwick Bank excluded, the PVA predicted that the CPS was 0.874 to 0.708 (Table 11.53). The median population size was therefore projected to be between 12.60% to 29.19% smaller than the unimpacted population over a 35 year time period, with a 50th centile value of 27.56 to 5.04. In terms of the population size, this implies that the median of the impacted population fell within the 27th and 5th percentile of the unimpacted population (a value of 50 would indicate that they are the same). This suggests that, if a 60% displacement and 3% mortality rate was applied, this level of impact could have an adverse effect on the population. However, as outlined within volume 3, appendix 11.5, the CPGR is considered a more robust metric compared to the CPS in this analysis due to the models being conducted with density independence, in line with NatureScot (2023) guidance. The PVA model predicted that the CPGR was between 0.996 to 0.991 (Table 11.53) which translates to a median reduction of 0.37% to 0.95% in population growth rate after 35 years. Such a decrease indicates that this level of impact would not adversely affect the population and would not trigger a risk of population decline and would only result in a slight reduction in the growth rate currently seen in the BDMPS population and would therefore be undetectable against natural population fluctuations. Furthermore, it is not expected to significantly alter the background mortality rate. As stated, it is anticipated that the Applicant's approach (incorporating a 50% displacement rate alongside a 1% mortality rate) leads to an estimate that aligns more closely with actual conditions. If the Applicant's approach is followed, the increase in baseline mortality would be 0.97%. In addition, the guillemot population in the UK North Sea & Channel waters BDMPS is observed to be growing and the population is still expected to continue to grow and will be larger after 35 years than that which is currently recorded, even in the event of the largest impact.

Table 11.53: Guillemot 35 Year Cumulative PVA Results for Displacement Impacts Excluding Berwick Bank on an Annual Basis

Scenario	Predicted Mortality (Original Impact) (no. of birds)	Growth Rate (Annual GR)	Median CPGR	Median CPS	U=50%I
NatureScot Approach - 60% displacement, 1% mortality	3,201	1.0214	0.9963	0.8740	27.56
NatureScot Approach - 60% displacement, 3% mortality	8,175	1.0155	0.9905	0.7081	5.04

Magnitude of impact

425. The estimated mortality resulting from displacement during operation and maintenance was assessed for each season, and also on an annual basis by combining seasonal impacts and comparing them against the largest regional seasonal population (as set out in volume 3, appendix 11.3, and summarised in Table 11.21).

426. Based on the PVA results for the breeding season with Berwick Bank included and following the NatureScot Approach using the 60% displacement, 5% mortality rate, the magnitude of impact on the guillemot population during the breeding season is considered to be of medium magnitude.

427. Based on the PVA results for the breeding season with Berwick Bank included and following the NatureScot Approach using the 60% displacement, 3% mortality rate the magnitude of impact on the guillemot population during the breeding season is considered to be of medium magnitude.

428. Based on the displacement assessment, for the breeding season with Berwick Bank included and following the Applicant Approach using a 50% displacement and 1% mortality rate, the cumulative impact was perceived as low magnitude.

429. Based on the PVA results for the non-breeding season with Berwick Bank included and following the NatureScot Approach using the 60% displacement, 3% mortality rate, the magnitude of impact on the guillemot population during the non-breeding season is considered to be of low magnitude.

430. Based on the PVA results for the non-breeding season with Berwick Bank included and following the NatureScot Approach using the 60% displacement, 1% mortality rate, the magnitude of impact on the guillemot population during the non-breeding season is considered to be of low magnitude.

431. Based on the displacement assessment, for the non-breeding season with Berwick Bank included and following the Applicant Approach using a 50% displacement and 1% mortality rate, the cumulative impact was perceived as low magnitude.

432. Based on the PVA results using the 60% displacement and 3% mortality rate of the NatureScot Approach and with Berwick Bank included the magnitude of impact on the guillemot population on an annual basis is considered to be of low magnitude.

433. Based on the PVA results using the 60% displacement and 1% mortality rate of the NatureScot Approach and with Berwick Bank included the magnitude of impact on the guillemot population on an annual basis is considered to be of low magnitude.

434. Based on the PVA results using the Applicant's Approach of 50% displacement and 1% mortality and with Berwick Bank included the magnitude of impact on guillemot population on an annual basis is considered to be of low magnitude.

435. Based on the PVA results for the breeding season with Berwick Bank excluded and following the NatureScot Approach using the 60% displacement, 5% mortality rate, the magnitude of impact on the guillemot population during the breeding season is considered to be of medium magnitude.

436. Based on the displacement assessment for the breeding season with Berwick Bank excluded and following the NatureScot Approach using the 60% displacement and 3% mortality, the magnitude of impact on guillemot population during the breeding season is considered to be of low magnitude.

437. Based on the displacement assessment, for the breeding season with Berwick Bank excluded and following the Applicant Approach using a 50% displacement and 1% mortality rate, the cumulative impact was perceived as low magnitude.

438. Based on the PVA results for the non-breeding season with Berwick Bank excluded and following the NatureScot Approach using the 60% displacement, 3% mortality rate, the magnitude of impact on the guillemot population during the non-breeding season is considered to be of low magnitude.

439. Based on the displacement assessment for the non-breeding season with Berwick Bank excluded and following the NatureScot Approach using the 60% displacement and 1% mortality, the magnitude of impact on guillemot population during the non-breeding season is considered to be of low magnitude.

440. Based on the displacement assessment, for the non-breeding season with Berwick Bank and following the Applicant Approach using a 50% displacement and 1% mortality rate, the cumulative impact was perceived as low magnitude.

441. Based on the PVA results using the 60% displacement and 3% mortality rate of the NatureScot Approach and with Berwick Bank excluded, the magnitude of impact on the guillemot population on an annual basis is considered to be of low magnitude.

442. Based on the PVA results using the 60% displacement and 1% mortality rate of the NatureScot Approach and with Berwick Bank excluded, the magnitude of impact on the guillemot population on an annual basis is considered to be of low magnitude.

443. Based on the displacement assessment using the Applicant's Approach of 50% displacement and 1% mortality and with Berwick Bank excluded, the magnitude of impact on guillemot population on an annual basis is considered to be of low magnitude.

444. For all seasons, the Applicant Approach is regarded as informative, particularly because the rates utilised are derived from post-construction studies conducted over multiple years (see paragraph 144 to 147). The impact is considered to be of low magnitude, irrespective of whether Berwick Bank is included or excluded from the analysis.

445. Due to the minimal level of change to baseline conditions, the cumulative effect is predicted to be of national spatial extent, long-term duration, continuous and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be low.

Sensitivity of the receptor

446. Guillemot are considered to be moderately vulnerable to disturbance (Wade *et al.*, 2016). Whilst there is evidence from studies that guillemot respond adversely to vessel traffic (Rojek *et al.*, 2007), behavioural response to underwater and airborne sounds resulting from construction activities are unknown. Although guillemot are likely to respond to visual stimuli during the construction phase, the impacts of disturbance/displacement are short-term and guillemot have the ability to return to the baseline abundance and distribution after construction.

447. Guillemot raise a single chick per year and breed from the age of six onwards, typically living on average for 23 years (Burnell *et al*., 2023). Guillemot have undergone decreases of approximately 31% in Scotland since the early 2000s. Surveys managed by the RSPB in 2023 have recorded indicative decreases of 6% across a number of sites in Britain in 2023 when compared against a pre-HPAI baseline (Tremlett *et al*., 2024). Overall, Guillemot is deemed to have low recoverability.

448. Guillemot is a qualifying interest for several SPAs likely to be connected to the Array (within the mean-max + SD foraging range), with several non-SPA colonies also within range and so the species is considered to be of international value. The population recorded during baseline surveys of the Array was found to be of regional importance. Therefore, guillemot is considered to be of international value.

449. Guillemot is deemed to be of medium vulnerability, low recoverability and international value. The sensitivity of the receptor is therefore, considered to be high.

Significance of the effect

450. Overall, the magnitude of the impact is deemed to be low and the sensitivity of the receptor is considered to be high. The effect will, therefore, be of minor to moderate adverse significance. However, due to the PVA results concluding there to be a low impact both with and without Berwick Bank and following the Applicant's Approach (the approach deemed more in line with displacement effects observed by the

species based on evidence; Dierschke *et al*., 2016; APEM, 2022; MacArthur Green, 2023; RoyalHaskoning, 2013; Leopold and Verdaat, 2018; Peschko *et al*., 2020) it is considered that **minor** adverse significance is appropriate, which is not significant in EIA terms.

Further mitigation and residual effect

451. No offshore ornithology mitigation is considered necessary because the likely effect in the absence of further mitigation (beyond the designed in measures outlined in section 11.10) is not significant in EIA terms.

Puffin

452. The estimated abundance of puffin for the purpose of estimating displacement impacts is given in Table 11.54. Estimated abundances for projects are those presented by Berwick Bank (SSE Renewables, 2022), for which NatureScot has not raised any concerns or noted any errors. In addition, estimates have been obtained from Green Volt Offshore Wind Farm (Green Volt, 2023), Pentland Floating Offshore Wind (Pentland Floating Offshore Wind Farm, 2022), West of Orkney (Offshore Wind Power Limited, 2023), North Falls (North Falls, 2023), Five Estuaries (Five Estuaries, 2023) and Outer Dowsing (Outer Dowsing, 2023) offshore wind farms, as those projects had not published their estimates at the time of the Berwick Bank application. As puffin disperse rapidly and widely in the non-breeding season, only the breeding season is considered for the puffin cumulative assessment.

Table 11.54: Puffin Cumulative Abundance Estimates

Project	Season Breeding
Aberdeen	42
Beatrice	2,858
Blyth Demo Phase 1	235
Blyth Demo Phase 2 and 3	-
Dogger Bank (Creyke Beck) A	37
Dogger Bank (Creyke Beck) B	102
Dogger Bank C (Teesside A)	34
Dogger Bank Sofia (Teesside B)	35
Dudgeon	N/A (outside foraging range)
Dudgeon Extension and Sheringham Shoal Extension	N/A (outside foraging range)
East Anglia ONE	N/A (outside foraging range)
East Anglia ONE North	N/A (outside foraging range)
East Anglia THREE	N/A (outside foraging range)
East Anglia TWO	N/A (outside foraging range)
Five Estuaries	N/A (outside foraging range)
Forthwind Demonstration Project	-
Galloper	N/A (outside foraging range)
Gunfleet Sands 3 Demonstration Project	N/A (outside foraging range)
Green Volt Offshore Wind Farm	250
Hornsea Project One	N/A (outside foraging range)
Hornsea Project Two	N/A (outside foraging range)
Hornsea Project Three	N/A (outside foraging range)
Hornsea Project Four	N/A (outside foraging range)
Humber Gateway	N/A (outside foraging range)
Hywind	119
Inch Cape Offshore Wind Farm	2,956
Kentish Flats and Extension	N/A (outside foraging range)
Kincardine Offshore Wind Farm	19
London Array	N/A (outside foraging range)
Moray East	2,795
Moray West	1,115
Neart na Gaoithe	2,562
Norfolk Boreas	N/A (outside foraging range)
North Falls (PEIR)	N/A (outside foraging range)
Norfolk Vanguard	N/A (outside foraging range)
Outer Dowsing	N/A (outside foraging range)
Pentland Floating Offshore Wind	N/A (outside foraging range)
Race Bank	N/A (outside foraging range)
Rampion	N/A (outside foraging range)
Rampion 2	N/A (outside foraging range)
Seagreen 1 and 1A Offshore Wind Farm	6,154
Sheringham Shoal	N/A (outside foraging range)
Teesside	35
Thanet	N/A (outside foraging range)
Triton Knoll	N/A (outside foraging range)
West of Orkney	N/A (outside foraging range)
Westermost Rough	N/A (outside foraging range)
Total	**19,348**
Berwick Bank	4,513
Ossian	1,928
Total (including Berwick Bank)	**25,789**
Total (excluding Berwick Bank)	**21,276**

453. The cumulative displacement mortality is given in Table 11.55: (with Berwick Bank included) and Table 11.47 (with Berwick Bank excluded). Mortality is calculated using 60% displacement and a range of 3% to 5% mortality in the breeding season, in line with guidance (NatureScot, 2023h). Additionally, the Applicant's Approach which utilises a 50% displacement rate and 1% mortality rate are presented.

Table 11.55: Puffin Cumulative Displacement Mortality Estimates Inclusive of Berwick Bank

Season	Regional Baseline		Cumulative displacement mortality (Applicant's Approach)	Cumulative displacement mortality (NatureScot Approach)	Increase in baseline mortality (Applicant's Approach) (%)	Increase in baseline mortality (NatureScot Approach) (%)
	Population	Baseline mortality				
Breeding	279,803	49,357	129	464 to 774	0.261	0.940 to 1.567

454. With Berwick Bank, the estimated displacement mortality for puffin, following the NatureScot Approach, is 464 to 774 individuals in the breeding season. This is equivalent to an increase in baseline mortality of 0.94% to 1.57% in the breeding season (Table 11.55:).

455. When following the Applicant's Approach, the estimated displacement mortality with Berwick Bank, for puffin is 129 individuals in the breeding season. This is equivalent to an increase in baseline mortality of 0.26% in the breeding season.

Table 11.56: Puffin Cumulative Displacement Mortality Estimates Exclusive of Berwick Bank

Season	Regional Baseline		Cumulative displacement mortality (Applicant's Approach)	Cumulative displacement mortality (NatureScot Approach)	Increase in baseline mortality (Applicant's Approach) (%)	Increase in baseline mortality (NatureScot Approach) (%)
	Population	Baseline mortality				
Breeding	279,803	49,357	106	383 to 638	0.216	0.776 to 1.293

456. Without Berwick Bank, the estimated displacement mortality for puffin, following the NatureScot Approach, is 383 to 638 individuals in the breeding season. This is equivalent to an increase in baseline mortality of 0.78% to 1.29% in the breeding season (Table 11.56:).

457. When following the Applicant's Approach, the estimated displacement mortality without Berwick Bank, for puffin is 106 individuals in the breeding season. This is equivalent to an increase in baseline mortality of 0.22% in the breeding season.

458. The estimated cumulative displacement mortality therefore represents an increase in mortality of over 1% of baseline mortality when applying the upper end of NatureScot's Approach, both with and without Berwick Bank during the breeding season. Therefore, to further assess the significance of this effect, a PVA has been carried out for puffin as described in volume 3, appendix 11.5.

PVA Assessment Including Berwick Bank

459. During the breeding season, using the NatureScot approach (60% displacement and 5% mortality) and under the most extreme scenario with Berwick Bank included, the PVA predicted that the CPS was 0.807 (Table 11.57). The median population size was therefore projected to be 19.30% smaller than the unimpacted population over a 35 year time period, with a 50th centile value of 34.96. In terms of the population size, this implies that the median of the impacted population fell within the 34th percentile of the unimpacted population (a value of 50 would indicate that they are the same). This suggests that the impacted scenario was still within the margin of error of the non-impacted scenario, and therefore there would likely be no adverse effect to the population. However, as stated, the CPGR is considered a more robust metric compared to the CPS in this analysis due to the models being conducted with density independence, in line with NatureScot (2023k) guidance. The PVA model predicted that the CPGR was 0.994 (Table 11.57) which translates to a median reduction of 0.59% in population growth rate after 35 years. Such a decrease indicates that this level of impact would not adversely affect the population and would only result in a slight reduction in the growth rate currently seen in the BDMPS population and would therefore be undetectable against natural population fluctuations. However, as noted earlier within section 11.11, research examining the displacement effects on puffin indicates that a 50% displacement rate is more reflective (MacArthur Green, 2019; 2023). Consequently, it is anticipated that the Applicant's approach (incorporating a 50% displacement rate alongside a 1% mortality rate) leads to an estimate that aligns more closely with actual conditions. If the Applicant's approach is followed, the increase in baseline mortality would be 0.26%. This level of impact would likely remain undetectable against natural population fluctuations. Furthermore, it would not significantly alter the background mortality rate.

Table 11.57: Puffin 35 Year Cumulative PVA Results for Displacement Impacts Including Berwick Bank during the Breeding Season

Scenario	Predicted Mortality (Original Impact) (no. of birds)	Growth Rate (Annual GR)	Median CPGR	Median CPS	U=50%I
NatureScot Approach - 60% displacement, 5% mortality	774	0.9740	0.9941	0.8070	34.96

PVA Assessment Excluding Berwick Bank

460. During the breeding season, using the NatureScot approach (60% displacement and 5% mortality) and under the most extreme scenario with Berwick Bank excluded, the PVA predicted that the CPS was 0.838 (Table 11.58). The median population size was therefore projected to be 16.18% smaller than the unimpacted population over a 35 year time period, with a 50th centile value of 38. In terms of the population size, this implies that the median of the impacted population fell within the 38th percentile of the unimpacted population (a value of 50 would indicate that they are the same). This suggests that the impacted scenario was still within the margin of error of the non-impacted scenario, and therefore there would likely be no adverse effect to the population. However, as stated, the CPGR is considered a more robust metric compared to the CPS in this analysis due to the models being conducted with density independence, in line with NatureScot (2023k) guidance. The PVA model predicted that the CPGR was 0.995 (Table 11.58) which translates to a median reduction of 0.49% in population growth rate after 35 years. Such a decrease indicates that this level of impact would not adversely affect the population and would only result in a slight reduction in the growth rate currently seen in the BDMPS population and would therefore be undetectable against natural population fluctuations. As noted earlier, it is anticipated that the Applicant's approach (incorporating a 50% displacement rate alongside a 1% mortality rate) leads to an estimate that aligns more closely with actual conditions. If the Applicant's approach is followed, the increase in baseline mortality would be 0.22%. This level of impact would likely remain undetectable against natural population fluctuations. Furthermore, it would not significantly alter the background mortality rate.

Table 11.58: Puffin 35 Year Cumulative PVA Results for Displacement Impacts Excluding Berwick Bank during the Breeding Season

Scenario	Predicted Mortality (Original Impact) (no. of birds)	Growth Rate (Annual GR)	Median CPGR	Median CPS	U=50%I
NatureScot Approach - 60% displacement, 5% mortality	638	0.9750	0.9951	0.8382	38

Magnitude of impact

461. The estimated mortality resulting from displacement during operation and maintenance was assessed for each season, and also on an annual basis by combining seasonal impacts and comparing them against the largest regional seasonal population (as set out in volume 3, appendix 11.3, and summarised in Table 11.23).

462. Based on the PVA results using a 60% displacement and 5% mortality rate of the NatureScot Approach with Berwick Bank included the magnitude of impact on the puffin population during the breeding season is considered to be of low magnitude.

463. Based on the displacement assessment using a 60% displacement and 3% mortality rate of the NatureScot Approach with Berwick Bank included the magnitude of impact on the puffin population during the breeding season is considered to be of low magnitude.

464. Based on the displacement assessment using a 50% displacement and 1% mortality rate of the Applicant Approach with Berwick Bank included the magnitude of impact on the puffin population during the breeding season is considered to be of low magnitude.

465. Based on the PVA results using a 60% displacement and 5% mortality rate of the NatureScot Approach with Berwick Bank excluded, the magnitude of impact on the puffin population during the breeding season is considered to be of low magnitude.

466. Based on the displacement assessment using a 60% displacement and 3% mortality rate of the NatureScot Approach with Berwick Bank excluded, the magnitude of impact on the puffin population during the breeding season is considered to be of low magnitude.

467. Based on the displacement assessment using a 50% displacement and 1% mortality rate of the Applicant Approach with Berwick Bank excluded, the magnitude of impact on the puffin population during the breeding season is considered to be of low magnitude.

468. During the breeding season, the Applicant Approach is regarded as informative, particularly because the rates utilised are derived from post-construction studies conducted over multiple years (see paragraph 144 to 147). However, even under the NatureScot Approach and incorporating the most extreme scenario of 60% displacement and 5% mortality, the impact is considered to be of low magnitude, irrespective of whether Berwick Bank is included or excluded from the analysis.

469. The cumulative effect is predicted to be of national spatial extent, long-term duration, continuous and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be low.

Sensitivity of the receptor

470. Puffin are considered to be moderately vulnerable to disturbance (Wade *et al.*, 2016). Behavioural responses to underwater and airborne sounds resulting from construction activities are unknown. Although puffin are likely to respond to visual stimuli during the construction phase, the impacts of disturbance/displacement are short-term and puffin have the ability to return to the baseline abundance and distribution after construction (MacArthur Green, 2023).

471. Puffin have a low reproductive potential (i.e. typically laying only one egg and not breeding until five years old) (Robinson, 2005). Given puffin nest in burrows, and often in inaccessible locations, abundance estimates are relatively infrequent. The long-term pattern indicates a population increase since the counts conducted for Operation Seafarer (1969/70) but small declines in recent years (JNCC, 2021; Burnell, 2023). Puffin is therefore assessed as having low recoverability.

472. Puffin is a qualifying interest for several SPAs likely to be connected to the Array (within the mean-max + SD foraging range), with several non-SPA colonies also within range and so the species is considered to be of international value. The population recorded during baseline surveys of the Array was found to be of regional importance. Therefore, puffin is considered to be of international value.

473. Puffin is deemed to be of medium vulnerability, limited potential recoverability and international value. The sensitivity of the receptor is therefore considered to be high.

Significance of the effect

474. Overall, the magnitude of the impact is deemed to be low and the sensitivity of the receptor is considered to be high. The effect will, therefore, be of minor to moderate adverse significance. However, due to the PVA results concluding there to be a low impact both with and without Berwick Bank and following both the NatureScot and Applicant's Approach, it is considered that **minor** adverse significance is appropriate, which is not significant in EIA terms.

Further mitigation and residual effect

475. No offshore ornithology mitigation is considered necessary because the likely effect in the absence of further mitigation (beyond the designed in measures outlined in section 11.10) is not significant in EIA terms.

Razorbill

476. The estimated abundance of razorbill for the purpose of estimating displacement impacts is given in Table 11.59:. Estimated abundances for projects are those presented by Berwick Bank (SSE Renewables, 2022), for which NatureScot has not raised any concerns or noted any errors. In addition, estimates have been obtained from Green Volt Offshore Wind Farm (Green Volt, 2023), Pentland Floating Offshore Wind (Pentland Floating Offshore Wind Farm, 2022), West of Orkney (Offshore Wind Power Limited, 2023), North Falls (North Falls, 2023), Five Estuaries (Five Estuaries, 2023) and Outer Dowsing (Outer Dowsing, 2023) offshore wind farms, as those projects had not published their estimates at the time of the Berwick Bank application.

Table 11.59: Razorbill Cumulative Abundance Estimates

Project	Season			
	Breeding	Post-breeding	Winter	Pre-breeding
Aberdeen	161	64	7	26
Beatrice	N/A (outside foraging range)	833	555	833
Blyth Demo Phase 1	N/A (outside foraging range)	91	61	91
Blyth Demo Phase 2 and 3	N/A (outside foraging range	-	-	-
Dudgeon Extension and Sheringham Shoal Extension	N/A (outside foraging range)	4,500	1,531	464
Dogger Bank (Creyke Beck) A	N/A (outside foraging range)	1,576	1,728	4,149
Dogger Bank (Creyke Beck) B	N/A (outside foraging range)	2,097	2,143	5,119
Dogger Bank C (Teesside A)	N/A (outside foraging range)	310	959	1,919
Dogger Bank Sofia (Teesside B)	N/A (outside foraging range)	592	1,426	2,953
Dudgeon	N/A (outside foraging range)	346	745	346
East Anglia ONE	N/A (outside foraging range)	26	155	336
East Anglia ONE North	N/A (outside foraging range)	85	54	207
East Anglia THREE	N/A (outside foraging range)	1,122	1,499	1,524
East Anglia TWO	N/A (outside foraging range)	44	136	230
Five Estuaries	N/A (outside foraging range)	284	1,046	756

Project	Season			
	Breeding	Post-breeding	Winter	Pre-breeding
Forthwind Demonstration Project	-	-	-	-
Galloper	N/A (outside foraging range)	43	106	394
Gunfleet Sands 3 Demonstration Project	N/A (outside foraging range)	-	-	-
Green Volt Offshore Wind Farm	457	56	15	28
Hornsea Project Four	N/A (outside foraging range)	3,590	474	371
Hornsea Project One	N/A (outside foraging range)	4,812	1,518	1,803
Hornsea Project Three	N/A (outside foraging range)	2,020	3,649	2,105
Hornsea Project Two	N/A (outside foraging range)	4,221	720	1,668
Humber Gateway	N/A (outside foraging range)	20	13	20
Hywind	30	719	10	N/A
Inch Cape Offshore Wind Farm	1,436	2,870	651	N/A
Kentish Flats and Extension	N/A (outside foraging range)	-	-	-
Kincardine Offshore Wind Farm	22	-	-	-
London Array	N/A (outside foraging range)	20	14	21
Moray East	N/A (outside foraging range)	1,103	30	168
Moray West	N/A (outside foraging range)	3,544	184	3,585
Neart na Gaoithe	331	5,492	508	
Norfolk Boreas	N/A (outside foraging range)	263	1,065	345
North Falls (PEIR)	N/A (outside foraging range)	266	2,565	1,860
Norfolk Vanguard	N/A (outside foraging range)	866	839	924
Outer dowsing	N/A (outside foraging range)	2339	2570	5299
Pentland Floating Offshore Wind	N/A (outside foraging range)	N/A (outside BDMPS)	N/A (outside BDMPS)	N/A (outside BDMPS)
Race Bank	N/A (outside foraging range)	42	28	42
Rampion	N/A (outside foraging range)	66	1,244	3,327
Rampion 2	N/A (outside foraging range)	26	1,193	6,303
Seagreen 1 and 1A Offshore Wind Farm	9,574	assessed as breeding and non-breeding season	2,375	assessed as breeding and non-breeding season
Sheringham Shoal	N/A (outside foraging range)	1,343	211	30
Teesside	N/A (outside foraging range)	61	2	20
Thanet	N/A (outside foraging range)	-	14	21
Triton Knoll	N/A (outside foraging range)	254	855	117
West of Orkney	N/A (outside foraging range)	N/A (outside BDMPS)	N/A (outside BDMPS)	N/A (outside BDMPS)
Westermost Rough	N/A (outside foraging range)	121	152	91
Total	**12,011**	**46,127**	**33,050**	**47,495**
Berwick Bank	4,040	8,849	1,399	7,480
Ossian	2,608	1,493	138	224

Project	Season			
	Breeding	Post-breeding	Winter	Pre-breeding
Total (including Berwick Bank)	**18,659**	**56,469**	**34,587**	**55,199**
Total (excluding Berwick Bank)	**14,619**	**47,620**	**33,188**	**47,719**

477. The cumulative displacement mortality is given in Table 11.60 (with Berwick Bank included) and Table 11.61 with Berwick Bank excluded). Mortality is calculated using 60% displacement and a range of 3% to 5% mortality in the breeding season and 1% to 3% mortality in the non-breeding seasons, in line with guidance (NatureScot, 2023h). Additionally, the Applicant's Approach which utilises a 50% displacement rate and 1% mortality rate is presented.

Table 11.60: Razorbill Cumulative Displacement Mortality Estimates Inclusive of Berwick Bank

Season	Regional Baseline		Cumulative Displacement Mortality (Developer Approach)	Cumulative Displacement Mortality (NatureScot Approach)	Increase in Baseline Mortality (Applicant's Approach) (%)	Increase in Baseline Mortality (NatureScot Approach) (%)
	Population	Baseline Mortality				
Pre-breeding	591,874	101,980	276	331 to 994	0.271	0.325 to 0.974
Breeding	54,552	9,399	93	336 to 560	0.993	3.573 to 5.956
Post-breeding	591,874	101,980	282	339 to 1,016	0.277	0.332 to 0.997
Non-breeding	218,622	37,669	173	208 to 623	0.459	0.551 to 1.653
Annual	**591,874**	**101,980**	**825**	**1,213 to 3,192**	**0.809**	**1.190 to 3.130**

478. With Berwick Bank, the estimated displacement mortality for razorbill, following the NatureScot Approach, is 331 to 994 individuals in the pre-breeding season, 336 to 560 individuals in the breeding season, 339 to 1,016 individuals in the post-breeding season and 208 to 623 individuals in the non-breeding season. This is equivalent to an increase in baseline mortality of 0.33% to 0.97% in the pre-breeding season, 3.57% to 5.96% in the breeding season, 0.33% to 1.00% in the post-breeding season and 0.55% to 1.65% in the non-breeding season. On an annual basis, the number of mortalities is estimated as 1,213 to 3,192 individuals, which equates to an increase in baseline mortality of 1.19% to 3.13% (Table 11.60).

479. When following the Applicant's Approach, the estimated displacement mortality with Berwick Bank, for razorbill is 276 individuals in the pre-breeding season, 93 individuals in the breeding season, 282 individuals in the post-breeding season and 173 individuals in the non-breeding season. This is equivalent to an increase in baseline mortality of 0.27% in the pre-breeding season, 0.99% in the breeding season, 0.28% in the post-breeding season and 0.46% in the non-breeding season. On an annual basis, the number of mortalities is estimated as 825 individuals, which equates to an increase in baseline mortality of 0.81%.

Table 11.61: Razorbill Cumulative Displacement Mortality Estimates Exclusive of Berwick Bank

Season	Regional Baseline		Cumulative Displacement Mortality (Applicant's Approach)	Cumulative Displacement Mortality (NatureScot Approach)	Increase in Baseline Mortality (Applicant's Approach) (%)	Increase in Baseline Mortality (NatureScot Approach) (%)
	Population	Baseline Mortality				
Pre-breeding	591,874	101,980	239	286 to 859	0.234	0.281 to 0.842
Breeding	54,552	9,399	73	263 to 439	0.778	2.800 to 4.666
Post-breeding	591,874	101,980	238	286 to 857	0.233	0.280 to 0.841
Non-breeding	218,622	37,669	166	199 to 597	0.441	0.529 to 1.586
Annual	**591,874**	**101,980**	**716**	**1,034 to 2,752**	**0.702**	**1.014 to 2.699**

480. Without Berwick Bank and using the NatureScot rates, the estimated displacement mortality for razorbill is 286 to 859 individuals in the pre-breeding season, 263 to 439 individuals in the breeding season, 286 to 857 individuals in the post-breeding season and 199 to 597 individuals in the non-breeding season. This is equivalent to an increase in baseline mortality of 0.28% to 0.84% in the pre-breeding season, 2.80% to 4.67% in the breeding season, 0.28% to 0.84% in the post-breeding season and 0.53% to 1.59% in the non-breeding season. On an annual basis, the number of mortalities is estimated as 1,034 to 2,752 individuals, which equates to an increase in baseline mortality of 1.01% to 2.70% (Table 11.61).

481. When following the Applicant's Approach, the estimated displacement mortality without Berwick Bank, for razorbill is 239 individuals in the pre-breeding season, 73 individuals in the breeding season, 238 individuals in the post-breeding season and 166 individuals in the non-breeding season. This is equivalent to an increase in baseline mortality of 0.23% in the pre-breeding season, 0.78% in the breeding season, 0.23% in the post-breeding season and 0.44% in the non-breeding season. On an annual basis, the number of mortalities is estimated as 716 individuals, which equates to an increase in baseline mortality of 0.70%.

482. The estimated cumulative displacement mortality therefore represents an increase in mortality of over 1% of baseline mortality when applying the NatureScot Approach range with Berwick Bank, as well as the upper range of the NatureScot Approach without Berwick Bank during the breeding season and on an annual basis. Therefore, to further assess the significance of this effect, a PVA has been carried out for razorbill as described in volume 3, appendix 11.5.

PVA Assessment Including Berwick Bank

483. When considering the impact during the breeding season on the regional population defined for the breeding season, using the NatureScot approach (60% displacement and 3% to 5% mortality) and with Berwick Bank included, the PVA predicted that the CPS was 0.397 to 0.212 (Table 11.62). The median population size was therefore projected to be between 60.27% to 78.81% smaller than the unimpacted population over a 35 year time period, with a 50th centile value of 1.76 to 0. In terms of the population size, this implies that a rate of 60% displacement and 3% mortality would result in a medium impacted population that fell within the 1st percentile of the unimpacted population, with a rate of 60% displacement and 5% mortality resulting in median of the impacted population falling outside the percentile range of the unimpacted population (a value of 50 would indicate that they are the same). This suggests that this level of impact would have an adverse effect on the population. However, as stated, the CPGR is considered a more robust metric compared to the CPS in this analysis due to the models being conducted with density independence, in line with NatureScot (2023k) guidance. The PVA model predicted that the CPGR was between 0.975 to 0.958 (Table 11.62) which translates to a median reduction of 2.53% to 4.22% in population growth rate after 35 years. Such a decrease indicates that this level of impact would adversely affect the population. As noted earlier within section 11.11, research examining the displacement effects on razorbill indicates that a 50% displacement rate is more reflective, with this rate still regarded as precautionary (RoyalHaskoning, 2013; Peschko *et al*. 2020; APEM, 2022; MacArthur Green, 2023). Consequently, it is anticipated that the Applicant's approach (incorporating a 50% displacement rate alongside a 1% mortality rate) leads to an estimate that aligns more closely with actual conditions. If the Applicant's approach is followed, the increase in baseline mortality would be 0.99% which is below the 1% threshold and therefore would not adversely affect the population or alter background mortality rates. In addition, under the unimpacted scenario, within the PVA model, razorbill population was estimated to decline. However, the recent published Seabirds Count (Burnell *et al*. 2023) highlighted that overall, razorbill populations within the UK have increased by 21%, with colonies in Scotland experiencing population change of between -89% to +393% and colonies within England changing by between +64% to +230%. It's worth noting that the population models utilised in this analysis were not density dependent (to follow NatureScot guidance). As a result, population size predictions are not constrained by the model and can be predicted to grow, or decline, in unrealistic ways. While the PVA models indicate a decline in population regardless of impact, this contradicts the recently published results from the Seabirds Census (Burnell *et al*., 2023), which demonstrate an increase in razorbill populations despite the model predictions.

Table 11.62: Razorbill 35 Year Cumulative PVA Results for Displacement Impacts Including Berwick Bank during the Breeding Season

Scenario	Predicted Mortality (Original Impact) (no. of birds)	Growth Rate (Annual GR)	Median CPGR	Median CPS	U=50%I
NatureScot Approach - 60% displacement, 3% mortality	336	0.9520	0.9747	0.3973	1.76
NatureScot Approach - 60% displacement, 5% mortality	560	0.9354	0.9578	0.2119	0

484. When considering the impact during the non-breeding season on the regional population defined for the non-breeding season, using the NatureScot approach (60% displacement and 3% mortality) and with Berwick Bank included, the PVA predicted that the CPS was 0.780 (Table 11.63). The median population size was therefore projected to be 22.00% smaller than the unimpacted population over a 35 year time period, with a 50th centile value of 27.4. In terms of the population size, this implies that the median of the impacted population fell within the 27th percentile of the unimpacted population (a value of 50 would indicate that they are the same). This suggests that the impacted scenario was still within the margin of error of the non-impacted scenario, and therefore there would likely be no adverse effect to the population. However, as stated, the CPGR is considered a more robust metric compared to the CPS in this analysis due to the models being conducted with density independence, in line with NatureScot (2023) guidance. The PVA model predicted that the CPGR was 0.993 (Table 11.63) which translates to a median reduction of 0.69% in population growth rate after 35 years. Such a decrease indicates that this level of impact would not adversely affect the population and would only result in a slight reduction in the growth rate currently seen in the BDMPS population and would therefore be undetectable against natural population fluctuations. As stated previously, it is anticipated that the Applicant's approach (incorporating a 50% displacement rate alongside a 1% mortality rate) leads to an estimate that aligns more closely with actual conditions. If the Applicant's approach is followed, the increase in baseline mortality would be 0.46%.

Table 11.63: Razorbill 35 Year Cumulative PVA Results for Displacement Impacts Including Berwick Bank during the Non-breeding Season

Scenario	Predicted Mortality (Original Impact) (no. of birds)	Growth Rate (Annual GR)	Median CPGR	Median CPS	U=50%I
NatureScot Approach - 60% displacement, 3% mortality	623	0.9702	0.9931	0.7800	27.40

485. When considering the annual impact on the annual regional population, under the range of scenarios considered (60% displacement and 1% to 3% mortality) and with Berwick Bank included, the PVA predicted that the CPS was 0.844 to 0.638 (Table 11.64). The median population size was therefore projected to be between 15.63% to 36.18% smaller than the unimpacted population over a 35 year time period, with a 50th centile value of 34.16 to 14.60. In terms of the population size, this implies that the median of the impacted population fell within the 34th and 14th percentile of the unimpacted population (a value of 50 would indicate that they are the same). This suggests that the if a 60% displacement and 3% mortality rate was applied, there could be an adverse effect to the population. However, as outlined within volume 3, appendix 11.5, the CPGR is considered a more robust metric compared to the CPS in this analysis due to the models being conducted with density independence, in line with NatureScot (2023) guidance. The PVA model predicted that the CPGR was between 0.995 to 0.988 (Table 11.64) which translates to a median reduction of 0.47% to 1.24% in population growth rate after 35 years. Such a decrease indicates that the level of impact from a 60% displacement and 3% mortality rate could adversely affect the population. However, as stated it is anticipated that the Applicant's approach (incorporating a 50% displacement rate alongside a 1% mortality rate) leads to an estimate that aligns more closely with actual conditions. If the Applicant's approach is followed, the increase in baseline mortality would be 0.81%. This level of impact would not trigger a risk of population decline and would only result in a slight reduction in the growth rate currently seen in the BDMPS population and would therefore be undetectable against natural population fluctuations. Furthermore, it is not expected to significantly alter the background mortality rate.

Table 11.64: Razorbill 35 Year Cumulative PVA Results for Displacement Impacts Including Berwick Bank on an Annual Basis

Scenario	Predicted Mortality (Original Impact) (no. of birds)	Growth Rate (Annual GR)	Median CPGR	Median CPS	U=50%I
NatureScot Approach - 60% displacement, 1% mortality	1,213	0.9724	0.9953	0.8437	34.16
NatureScot Approach - 60% displacement, 3% mortality	3,192	0.9649	0.9876	0.6382	14.60

PVA Assessment Excluding Berwick Bank

486. When considering the impact during the breeding season on the regional population defined for the breeding season, using the NatureScot approach (60% displacement and 3% to 5% mortality) and with Berwick Bank excluded, , the PVA predicted that the CPS was 0.487 to 0.298 (Table 11.65). The median population size was therefore projected to be between 51.35% to 70.19% smaller than the unimpacted population over a 35 year time period, with a 50th centile value of 4.48 to 0.32 In terms of the population size, this implies that a rate of 60% displacement and 3% mortality would result in a medium impacted population that fell within the 4th percentile of the unimpacted population, with a rate of 60% displacement and 5% mortality resulting in median of the impacted population falling outside the percentile range of the unimpacted population (a value of 50 would indicate that they are the same). This suggests that this level of impact would have an adverse effect on the population. However, as stated, the CPGR is considered a more robust metric compared to the CPS in this analysis due to the models being conducted with density independence, in line with NatureScot (2023k) guidance. The PVA model predicted that the CPGR was between 0.980 to 0.967 (Table 11.65) which translates to a median reduction of 1.98% to 3.31% in population growth rate after 35 years. Such a decrease indicates that this level of impact would adversely affect the population. However, as noted earlier within section 11.11, research examining the displacement effects on razorbill indicates that a 50% displacement rate is more reflective, with this rate still regarded as precautionary (Royal Haskoning, 2013; Peschko *et al*. 2020; APEM, 2022; MacArthur Green, 2023). Consequently, it is anticipated that the Applicant's approach (incorporating a 50% displacement rate alongside a 1% mortality rate) leads to an estimate that aligns more closely with actual conditions. If the Applicant's approach is followed, the increase in baseline mortality would be 0.78% which is below the 1% threshold and therefore would therefore not adversely affect the population or alter background mortality rates. In addition, as stated previously, under the unimpacted scenario, within the PVA model, razorbill population was estimated to decline. However, the recent published Seabirds Count (Burnell *et al*. 2023) highlighted that overall, razorbill populations within the UK have increased by 21%, with colonies in Scotland experiencing population change of between -89% to +393% and colonies within England changing by between +64% to +230%. It's worth noting that the population models utilised in this analysis were not density dependent (to follow NatureScot guidance). As a result, population size predictions are not constrained by the model and can be predicted to grow, or decline, in unrealist ways like the population trend predicted for razorbill. While the PVA models indicate a decline in population regardless of impact, this contradicts the recently published results from the Seabirds Census (Burnell *et al*., 2023), which anticipate an increase in razorbill populations despite the model predictions.

Table 11.65: Razorbill 35 Year Cumulative PVA Results for Displacement Impacts Excluding Berwick Bank during the Breeding Season

Scenario	Predicted Mortality (Original Impact) (no. of birds)	Growth Rate (Annual GR)	Median CPGR	Median CPS	U=50%I
NatureScot Approach - 60% displacement, 3% mortality	263	0.9574	0.9802	0.4865	4.48
NatureScot Approach - 60% displacement, 5% mortality	439	0.9445	0.9669	0.2981	0.32

487. When considering the impact during the non-breeding season on the regional population defined for the non-breeding season, using the NatureScot approach (60% displacement and 3% mortality) and with Berwick Bank excluded, the PVA predicted that the CPS was 0.809 (Table 11.66). The median population size was therefore projected to be 19.07% smaller than the unimpacted population over a 35 year time period, with a 50th centile value of 31.04. In terms of the population size, this implies that the median of the impacted population fell within the 31st percentile of the unimpacted population (a value of 50 would indicate that they are the same). This suggests that the impacted scenario was still within the margin of error of the non-impacted scenario, and therefore there would likely be no adverse effect to the population. However, as stated, the CPGR is considered a more robust metric compared to the CPS in this analysis

due to the models being conducted with density independence, in line with NatureScot (2023) guidance. The PVA model predicted that the CPGR was 0.994 (Table 11.66) which translates to a median reduction of 0.58% in population growth rate after 35 years. Such a decrease indicates that this level of impact would not adversely affect the population and would only result in a slight reduction in the growth rate currently seen in the BDMPS population and would therefore be undetectable against natural population fluctuations. As stated previously, it is anticipated that the Applicant's approach (incorporating a 50% displacement rate alongside a 1% mortality rate) leads to an estimate that aligns more closely with actual conditions. If the Applicant's approach is followed, the increase in baseline mortality would be 0.44%.

Table 11.66: Razorbill 35 Year Cumulative PVA Results for Displacement Impacts Excluding Berwick Bank during the Non-breeding Season

Scenario	Predicted Mortality (Original Impact) (no. of birds)	Growth Rate (Annual GR)	Median CPGR	Median CPS	U=50%I
NatureScot Approach - 60% displacement, 3% mortality	597	0.9711	0.9942	0.8093	31.04

488. When considering the annual impact on the annual regional population, under the NatureScot scenarios (60% displacement, 1% to 3% mortality) and with Berwick Bank excluded, the PVA predicted that the CPS was between 0.865 to 0.679 (Table 11.67). The median population size was therefore projected to be 13.49% to 32.11% smaller than the unimpacted population over a 35 year time period, with a 50th centile value of 36.40 to 18.04. In terms of the population size, this implies that the median of the impacted population fell within the 36th and 18th percentile of the unimpacted population (a value of 50 would indicate that they are the same). This suggests that the impacted scenario under the lower rate was still within the margin of error of the non-impacted scenario. Under the most extreme scenario, it fell near the lower percentile of the unimpacted population and therefore could indicate that there was an adverse effect to the population. However, as stated, the CPGR is considered a more robust metric compared to the CPS in this analysis due to the models being conducted with density independence, in line with NatureScot (2023) guidance. The PVA model predicted that the CPGR was 0.996 to 0.989 (Table 11.67) which translates to a median reduction of 0.40% to 1.07% in population growth rate after 35 years. Such a decrease indicates that this level of impact would not adversely affect the population and would not trigger a risk of population decline and would only result in a slight reduction in the growth rate currently seen in the BDMPS population and would therefore be undetectable against natural population fluctuations. Furthermore, it is not expected to significantly alter the background mortality rate. As stated, it is anticipated that the Applicant's approach (incorporating a 50% displacement rate alongside a 1% mortality rate) leads to an estimate that aligns more closely with actual conditions. If the Applicant's approach is followed, the increase in baseline mortality would be 0.70%.

Table 11.67: Razorbill 35 Year Cumulative PVA Results for Displacement Impacts Excluding Berwick Bank on an Annual Basis

Scenario	Predicted Mortality (Original Impact) (no. of birds)	Growth Rate (Annual GR)	Median CPGR	Median CPS	U=50%I
NatureScot Approach - 60% displacement, 1% mortality	1,034	0.9730	0.9960	0.8651	36.40
NatureScot Approach - 60% displacement, 3% mortality	2,752	0.9665	0.9893	0.6789	18.04

Magnitude of impact

489. The estimated mortality resulting from displacement during operation and maintenance was assessed for each season, and also on an annual basis by combining seasonal impacts and comparing them against the largest regional seasonal population (as set out in volume 3, appendix 11.3, and summarised in Table 11.22).

490. Based on the displacement assessment, for the pre-breeding and post-breeding season with Berwick Bank included and following the NatureScot Approach using a 60% displacement and 5% mortality rate, the cumulative impact was perceived to be of low magnitude.

491. Based on the displacement assessment, for the pre-breeding and post-breeding season with Berwick Bank included and following the NatureScot Approach using a 60% displacement and 3% mortality rate, the cumulative impact was perceived to be of low magnitude.

492. Based on the displacement assessment, for the pre-breeding and post-breeding season with Berwick Bank included and following the Applicant Approach using a 50% displacement and 1% mortality rate, the cumulative impact was perceived to be of low magnitude.

493. Based on the PVA results using the 60% displacement and 5% mortality rate of the NatureScot Approach and with Berwick Bank included the magnitude of impact on the razorbill population during the breeding season is considered to be of medium magnitude.

494. Based on the PVA results using the 60% displacement and 3% mortality rate of the NatureScot Approach and with Berwick Bank included the magnitude of impact on the razorbill population during the breeding season is considered to be of medium magnitude.

495. Based on the displacement assessment, for the breeding season with Berwick Bank included and following the Applicant Approach using a 50% displacement and 1% mortality rate, the impact from the cumulative assessment was perceived to be of low magnitude.

496. Based on the PVA results using the 60% displacement and 3% mortality rate of the NatureScot Approach and with Berwick Bank included the magnitude of impact on razorbill population in the non-breeding season is considered to be of low magnitude.

497. Based on the PVA results using the 60% displacement and 1% mortality rate of the NatureScot Approach and with Berwick Bank included the magnitude of impact on razorbill population in the non-breeding season is considered to be of low magnitude.

498. Based on the displacement assessment, using the 50% displacement and 1% mortality rate of the Applicant Approach and with Berwick Bank included the magnitude of impact on razorbill population in the non-breeding season is considered to be of low magnitude.

499. Based on the PVA results, on an annual basis with Berwick Bank included and following the NatureScot Approach using a 60% displacement and 3% mortality rate, the impact from the cumulative assessment is considered to be of low magnitude.

500. Based on the PVA results, on an annual basis with Berwick Bank included and following the NatureScot Approach using a 60% displacement and 3% mortality rate, the impact on the razorbill population from the cumulative assessment is considered to be of low magnitude.

501. Based on the displacement assessment, on an annual basis with Berwick Bank included and following the Applicant Approach using a 50% displacement and 1% mortality rate, the impact on the razorbill population from the cumulative assessment is considered to be of low magnitude.

502. Based on the displacement assessment, for the pre-breeding and post-breeding season with Berwick Bank excluded and following the NatureScot Approach using a 60% displacement and 5% mortality rate, the cumulative impact was perceived to be of low magnitude.

503. Based on the displacement assessment, for the pre-breeding and post-breeding season with Berwick Bank excluded and following the NatureScot Approach using a 60% displacement and 3% mortality rate, the cumulative impact was perceived to be of low magnitude.

504. Based on the displacement assessment, for the pre-breeding and post-breeding season with Berwick Bank excluded and following the Applicant Approach using a 50% displacement and 1% mortality rate, the cumulative impact was perceived to be of low magnitude.

505. Based on the PVA results using the 60% displacement and 5% mortality rate of the NatureScot Approach and with Berwick Bank excluded, the magnitude of impact on the razorbill population during the breeding season is considered to be of medium magnitude.

506. Based on the PVA results using the 60% displacement and 3% mortality rate of the NatureScot Approach and with Berwick Bank excluded, the magnitude of impact on the razorbill population during the breeding season is considered to be of medium magnitude.

507. Based on the displacement assessment, for the breeding season with Berwick Bank excluded and following the Applicant Approach using a 50% displacement and 1% mortality rate, the impact from the cumulative assessment was perceived to be of low magnitude.

508. Based on the PVA results using the 60% displacement and 3% mortality rate of the NatureScot Approach and with Berwick bank excluded, the magnitude of impact on razorbill population in the non-breeding season is considered to be of low magnitude.

509. Based on the displacement assessment, using the 60% displacement and 1% mortality rate of the NatureScot Approach and with Berwick Bank excluded, the magnitude of impact on razorbill population in the non-breeding season is considered to be of low magnitude.

510. Based on the displacement assessment, using the 50% displacement and 1% mortality rate of the Applicant Approach and with Berwick Bank excluded, the magnitude of impact on razorbill population in the non-breeding season is considered to be of low magnitude.

511. Based on the PVA results, on an annual basis with Berwick Bank excluded and following the NatureScot Approach using a 60% displacement and 3% mortality rate, the impact from the cumulative assessment was perceived as low.

512. Based on the displacement assessment, on an annual basis with Berwick Bank excluded and following the NatureScot Approach using a 60% displacement and 1% mortality rate, the impact on the razorbill population from the cumulative assessment is considered to be of low magnitude.

513. Based on the displacement assessment, on an annual basis with Berwick Bank excluded and following the Applicant Approach using a 50% displacement and 1% mortality rate, the impact on the razorbill population from the cumulative assessment is considered to be of low magnitude.

514. For the breeding season, non-breeding season and annually, the Applicant Approach is regarded as informative, particularly because the rates utilised are derived from post-construction studies conducted over multiple years (see paragraph 144 to 147). The impact is therefore considered to be of low magnitude, irrespective of whether Berwick Bank is included or excluded from the analysis.

515. The cumulative effect is predicted to be of national spatial extent, long-term duration, continuous and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be low.

Sensitivity of the receptor

516. As with guillemot, razorbill are deemed to be moderately vulnerable to disturbance from vessels and helicopters at offshore wind farms (Wade *et al.,* 2016). Although razorbill are likely to respond to visual stimuli during the construction phase, the impacts of disturbance/displacement are short-term and razorbill have the ability to return to the baseline conditions after construction.

517. Although the species has a low reproductive potential (only laying one egg) and does not breed until four years old (Robinson, 2005), razorbill are deemed to have a medium recoverability given their increasing trend in abundance in the UK (JNCC, 2020).

518. The Array is within the foraging range of razorbill from two SPAs at which the species is a qualifying feature (Fowlsheugh SPA and Troup, Pennan and Lion's Heads SPA). In addition, there are a number of smaller colonies within foraging range. The numbers of razorbills recorded during baseline surveys of the Array are considered to be of national importance. Therefore, razorbill is considered to be of international conservation value.

519. Razorbill is deemed to be of medium vulnerability, medium recoverability and international value. The sensitivity of the receptor is therefore, considered to be high.

Significance of the effect

520. Overall, the magnitude of the impact is deemed to be low and the sensitivity of the receptor is considered to be high. The effect will, therefore, be of minor to moderate adverse significance. However, considering both the pre-breeding season and post-breeding season mortality rates fell below 1%, along with the PVA results indicating a low impact with and without Berwick Bank, following both the NatureScot and Applicant's Approach the impact is considered minor. Additionally, the Applicant's Approach aligns more closely with displacement effects observed in guillemot populations, as evidenced by Dierschke *et al*. (2016), APEM (2022), MacArthur Green (2023), Royal Haskoning (2013), Leopold and Verdaat (2018), and Peschko *et al*. (2020 It is therefore deemed appropriate to categorise the impact as having **minor** adverse significance, which is not significant in EIA terms.

Further mitigation and residual effect

521. No offshore ornithology mitigation is considered necessary because the likely effect in the absence of further mitigation (beyond the designed in measures outlined in section 11.10) is not significant in EIA terms.

Gannet

522. The estimated abundance of gannet for the purpose of estimating displacement impacts is given in Table 11.68. Estimated abundances for projects are those presented by Berwick Bank (SSE Renewables, 2022), for which NatureScot has not raised any concerns or noted any errors. In addition, estimates have been obtained from Green Volt Offshore Wind Farm (Green Volt, 2023), Pentland Floating Offshore Wind (Pentland Floating Offshore Wind Farm, 2022), West of Orkney (Offshore Wind Power Limited, 2023), North Falls (North Falls, 2023), Five Estuaries (Five Estuaries, 2023) and Outer Dowsing (Outer Dowsing,

2023) offshore wind farms, as those projects had not published their estimates at the time of the Berwick Bank application.

Table 11.68: Gannet Cumulative Abundance Estimates

Project	Season		
	Breeding	Post-breeding	Pre-breeding
Aberdeen	35	5	0
Beatrice	151	0	0
Blyth Demo Phase 1	-	0	0
Blyth Demo Phase 2 and 3	-	-	-
Dogger Bank A and B	1,155	2,048	394
Dogger C and Sofia	2,250	887	464
Dudgeon	53	25	11
Dudgeon Extension and Sheringham Shoal Extension	440	638	57
East Anglia 1 North	149	468	44
East Anglia 2	192	891	192
East Anglia 3	412	1,269	524
East Anglia One	161	3,638	76
Five Estuaries	N/A (outside foraging range)	640	67
Forthwind Demonstration Project	-	-	-
Galloper	N/A (outside foraging range)	907	276
Gunfleet Sands 3 Demonstration Project	-	-	-
Green Volt Offshore Wind Farm	198	24	102
Hornsea Project Four	791	854	235
Hornsea Project One	671	694	250
Hornsea Project Three	1,333	984	527
Hornsea Project Two	457	1,140	124
Humber Gateway	-	0	0
Hywind	10	0	4
Inch Cape Offshore Wind Farm	2,398	703	212
Kentish Flats + Extension	N/A (outside foraging range)	13	0
Kincardine Offshore Wind Farm	120	0	0
Lincs	-	0	0
London Array	N/A (outside foraging range)	0	0
Moray East	564	292	27
Moray West	2,827	439	144
Neart na Gaoithe	1,987	552	281
Norfolk Boreas	1,229	1,723	526
North Falls (PEIR)	N/A (outside foraging range)	453	245
Norfolk Vanguard	N/A (outside foraging range)	2,453	437
Outer Dowsing	635	496	91
Pentland Floating Offshore Wind	166	N/A (outside BDMPS)	N/A (outside BDMPS)
Race Bank	92	32	29
Rampion	N/A (outside foraging range)	590	0
Rampion 2	N/A (outside foraging range	102	123
Scroby Sands	N/A (outside foraging range)	0	0
Seagreen 1 and 1A Offshore Wind Farm	2,956	664	332
Sheringham Shoal	47	31	2
Teesside	1	0	0
Thanet	-	0	0
Triton Knoll	211	15	24
West of Orkney	1,226	N/A (outside BDMPS)	N/A (outside BDMPS)
Westermost Rough	-	-	-
Total	**22,917**	**23,670**	**5,820**
Berwick Bank	4,735	1,500	269
Ossian	1,393	775	42
Total (including Berwick Bank)	**29,045**	**25,945**	**6,131**
Total (excluding Berwick Bank)	**24,310**	**24,445**	**5,862**

523. The cumulative displacement mortality is given in Table 11.69 (with Berwick Bank included) and Table 11.70 with Berwick Bank excluded. Mortality is calculated using 70% displacement and a range of 1% to 3% mortality in all seasons, in line with guidance (NatureScot, 2023h). Additionally, the Applicant’s Approach which utilises a 70% displacement rate and 1% mortality rate is presented.

524. With Berwick Bank, the estimated displacement mortality for gannet, following the NatureScot Approach, is 43 to 129 individuals in the pre-breeding season, 203 to 610 individuals in the breeding season and 182 to 545 individuals in the post-breeding season. This equates to an increase in baseline mortality of 0.09% to 0.27% in the pre-breeding season, 0.14% to 0.42% in the breeding season and 0.21% to 0.62% in the post-breeding season. On an annual basis, the number of mortalities is estimated as 428 to 1,284, which equates to an increase in baseline mortality of 0.29% to 0.87% (Table 11.69).

525. When following the Applicant’s Approach, the estimated displacement mortality with Berwick Bank, for gannet is 43 individuals in the pre-breeding season, 203 individuals in the breeding season and 182 individuals in the post-breeding season. This is equivalent to an increase in baseline mortality of 0.09% in the pre-breeding season, 0.14% in the breeding season and 0.21% in the post-breeding season. On an annual basis, the number of mortalities is estimated as 428 individuals, which equates to an increase in baseline mortality of 0.29%.

Table 11.69: Gannet Cumulative Displacement Mortality Estimates Inclusive of Berwick Bank

Season	Regional Baseline		Cumulative Displacement Mortality (Applicant’s Approach)	Cumulative Displacement Mortality (NatureScot Approach)	Increase in Baseline Mortality (Applicant’s Approach) (%)	Increase in Baseline Mortality (NatureScot Approach) (%)
	Population	Baseline Mortality				
Pre-breeding	248,385	47,864	43	43 to 129	0.090	0.090 to 0.269
Breeding	763,577	147,141	203	203 to 610	0.138	0.138 to 0.415
Post-breeding	456,298	87,945	182	182 to 545	0.207	0.207 to 0.620
Annual	**763,577**	**147,141**	**428**	**428 to 1,284**	**0.291**	**0.291 to 0.872**

526. Without Berwick Bank, the estimated displacement mortality for gannet, following the NatureScot Approach, is 41 to 123 individuals in the pre-breeding season, 170 to 511 individuals in the breeding season and 171 to 513 individuals in the post-breeding season. This is equivalent to an increase in baseline mortality of 0.09% to 0.26% in the pre-breeding season, 0.12% to 0.35% in the breeding season and 0.20% to 0.58% in the post-breeding season. On an annual basis, the number of mortalities is estimated as 382 to 1,147, which equates to an increase in baseline mortality of 0.26% to 0.78% (Table 11.70).

527. When following the Applicant’s Approach, the estimated displacement mortality without Berwick Bank, for gannet is 41 individuals in the pre-breeding season,170 individuals in the breeding season and 171 individuals in the post-breeding season. This is equivalent to an increase in baseline mortality of 0.09% in the pre-breeding season, 0.12% in the breeding season and 0.20% in the post-breeding season. On an

annual basis, the number of mortalities is estimated as 382 individuals, which equates to an increase in baseline mortality of 0.26%.

528. The estimated cumulative displacement mortality therefore represents an increase in mortality of less than 1% of baseline mortality when applying the Applicant's Approach and NatureScot's Approach range, both with and without Berwick Bank. Therefore, there is no cumulative effect of displacement on gannet, and PVA is not required.

Table 11.70: Gannet Cumulative Displacement Mortality Estimates Exclusive of Berwick Bank

Season	Regional Baseline		Cumulative Displacement Mortality (Applicant's Approach)	Cumulative Displacement Mortality (NatureScot Approach)	Increase in Baseline Mortality (Applicant's Approach) (%)	Increase in Baseline Mortality (NatureScot Approach) (%)
	Population	Baseline Mortality				
Pre-breeding	248,385	47,864	41	41 to 123	0.086	0.086 to 0.257
Breeding	763,577	147,141	170	170 to 511	0.116	0.116 to 0.347
Post-breeding	456,298	87,945	171	171 to 513	0.195	0.195 to 0.584
Annual	**763,577**	**147,141**	**382**	**382 to 1,147**	**0.260**	**0.260 to 0.779**

Magnitude of Impact

529. The estimated mortality resulting from displacement during operation and maintenance was assessed for each season, and also on an annual basis by combining seasonal impacts and comparing them against the largest regional seasonal population (as set out in volume 3, appendix 11.3, and summarised in Table 11.25).

530. Under all seasons considered, the cumulative impact is predicted to be of low magnitude both following the NatureScot and Applicant Approach and both with and without Berwick Bank. The cumulative effect is predicted to be of national spatial extent, long-term duration, continuous and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be low.

Sensitivity of the receptor

531. Gannet are considered to have a very low vulnerability to other sources of disturbance such as vessel and helicopter traffic (Wade *et al.*, 2016), and so gannet are considered to be of very low vulnerability.

532. Gannet have low reproductive potential given a typical age of first breeding of five years and typically laying only a single egg per breeding season. However, although gannet has a low reproductive potential, the species has demonstrated a consistent increasing trend in abundance since the 1990s (JNCC, 2020). It is of note that the species has suffered from the outbreak of HPAI during the 2022 breeding season (Pearce-Higgins *et al*., 2023), with declines of 25% recorded at certain sites in Britain in 2023 when compared against a pre-HPAI baseline (Tremlett *et al*., 2024). Therefore, whilst the overall population has shown steady growth, HPAI has led to some short-term declines. Therefore, overall gannet is deemed to have low recoverability.

533. Due to the large foraging range, gannet is a qualifying interest for several SPAs likely to be connected to the Array (within the mean-max + SD foraging range), including the UK's largest gannet colony at Bass Rock. Bass Rock, which falls within the Outer Firth of Forth and St Andrews Bay Complex SPA, located 106.4 km south-west of the Array. The species is therefore considered to be of international value. Refer to volume 3, appendix 11.1 (Table 6.30) for details of SPAs with connectivity to the Array with regards to gannet.

534. Gannet is deemed to be of very low vulnerability, low recoverability and international value. The sensitivity of the receptor is therefore considered to be high.

Significance of the effect

535. Overall, the magnitude of the impact is deemed to be low and the sensitivity of the receptor is considered to be high. The effect will, therefore, be of minor to moderate adverse significance. However, considering all seasonal impacts fell below 1%, the impact is considered to be of **minor** adverse significance, which is not significant in EIA terms.

Further mitigation and residual effect

536. No offshore ornithology mitigation is considered necessary because the likely effect in the absence of further mitigation (beyond the designed in measures outlined in section 11.10) is not significant in EIA terms.

COLLISION WITH WIND TURBINES

537. The Array, together with other offshore wind farms in the North Sea, may contribute to cumulative collision risk, in the event the operations and maintenance phases of different projects overlap.

538. As stated, data used within the assessing cumulative collision risk is based on published information produced by the respective project developers. As such, the input parameters (e.g. avoidance rates) and the collision risk model used (e.g. deterministic) may vary from those put forward in this chapter.

539. The species assessed for cumulative collision impacts were kittiwake, gannet and herring gull. The predicted impact for lesser black-backed gull and fulmar from the Array represented less than 0.01% of the baseline mortality of all seasonal and annual regional populations. It is therefore considered that the Array will not materially contribute to any existing cumulative collision impacts on these species.

540. Additionally, the impact to migratory species was deemed to be negligible from the Array and it is therefore concluded that the Array will not materially contribute to any existing cumulative collision impacts on these species.

541. There is no cumulative collision impact from the Proposed onshore application.

Tier 1 and Tier 2

Kittiwake

542. The estimated collision mortalities of kittiwake for the purpose of estimating cumulative collisions impacts are given in Table 11.71. Estimated collisions for projects are those presented by Berwick Bank (SSE Renewables, 2022), for which NatureScot has not raised any concerns or noted any errors. In addition, estimates have been obtained from Green Volt Offshore Wind Farm (Green Volt, 2023), Pentland Floating Offshore Wind (Pentland Floating Offshore Wind Farm, 2022), West of Orkney (Offshore Wind Power Limited, 2023), North Falls (North Falls, 2023), Five Estuaries (Five Estuaries, 2023) and Outer Dowsing (Outer Dowsing, 2023) offshore wind farms, as those projects had not published their estimates at the time of the Berwick Bank application.

Table 11.71: Kittiwake Cumulative Collision Mortalities

Project	Avoidance Rate used in Assessment	Season		
		Breeding	Post-breeding	Pre-breeding
Aberdeen	98.9%	9.02	4.44	0.84
Beatrice	98.9%	52.11	5.89	21.90
Blyth Demo Phase 1	98.9%	1.70	2.30	1.40
Blyth Demo Phase 2 and 3	unknown	-	-	-
Dogger Bank A and B	98.9%	288.60	135.00	295.40
Dogger C and Sofia	98.9%	136.90	90.70	216.90
Dudgeon	98.9%	N/A (outside foraging range)	0.00	0.00
Dudgeon Extension and Sheringham Shoal Extension	99.2%	N/A (outside foraging range)	4.30	0.90
East Anglia 1 North	98.9%	N/A (outside foraging range)	8.10	3.50
East Anglia 2	98.9%	N/A (outside foraging range)	5.40	7.40
East Anglia 3	98.9%	N/A (outside foraging range)	56.60	30.70
East Anglia One	98.9%	N/A (outside foraging range)	108.21	31.57
Five Estuaries	99.3%	N/A (outside foraging range)	7.88	5.52
Forthwind Demonstration Project	-	-	-	-
Galloper	98.9%	N/A (outside foraging range)	11.69	13.37
Gunfleet Sands 3 Demonstration Project	unknown	N/A (outside foraging range)	-	-
Green Volt Offshore Wind Farm	99.2%	5.65	5.95	3.55
Hornsea Project Four	98.9%	75.50	13.90	4.60
Hornsea Project One	98.9%	N/A (outside foraging range)	9.72	3.63
Hornsea Project Three	98.9%	N/A (outside foraging range)	38.47	30.66
Hornsea Project Two	98.9%	N/A (outside foraging range)	9.00	3.00
Humber Gateway	98.9%	N/A (outside foraging range)	1.37	0.81
Hywind	98.9%	16.60	0.90	0.90
Inch Cape Offshore Wind Farm	98.9%	40.00	26.00	6.00
Kentish Flats	unknown	N/A (outside foraging range)	0.90	0.70
Kentish Flats + Extension	98.9%	N/A (outside foraging range)	0.00	1.60
Kincardine Offshore Wind Farm	98.9%	22.00	9.00	1.00
Lincs	98.9%	N/A (outside foraging range)	1.20	0.70
London Array	98.9%	N/A (outside foraging range)	0.88	0.69
Moray East	98.9%	24.00	2.00	5.00
Moray West	98.9%	77.00	23.00	7.00
Neart na Gaoithe	98.9%	8.00	17.00	2.00
Norfolk Boreas	98.9%	N/A (outside foraging range)	32.20	11.90
North Falls (PEIR)	98.9%	N/A (outside foraging range)	19.10	19.10
Norfolk Vanguard	98.9%	N/A (outside foraging range)	16.40	19.30
Outer Dowsing	99.3%	N/A (outside foraging range)	2.80	2.60
Pentland Floating Offshore Wind	98.9%	N/A (outside foraging range)	1.00	0.00
Race Bank	98.9%	1.12	14.08	3.30
Rampion	98.9%	N/A (outside foraging range)	N/A (outside BDMPS)	N/A (outside BDMPS)
Rampion 2	99.3%	N/A (outside foraging range)	N/A (outside BDMPS)	N/A (outside BDMPS)
Seagreen 1 and 1A Offshore Wind Farm	98.9%	62.00	70.00	38.00
Sheringham Shoal	unknown	N/A (outside foraging range)	0.00	0.00
Teesside	98.9%	32.42	20.27	2.11
Thanet	98.9%	N/A (outside foraging range)	0.23	0.18
Triton Knoll	98.9%	N/A (outside foraging range)	50.48	16.49
West of Orkney	99.3%	16.59	15.34	21.05
Westermost Rough	98.9%	0.10	0.20	0.10
Total	**-**	**869.31**	**841.89**	**835.38**
Berwick Bank	98.9%	617.00	190.00	179.00
Ossian	99.3%	28.13	5.35	6.24
Total (including Berwick Bank)	**-**	**1514.44**	**1037.24**	**1020.62**
Total (excluding Berwick Bank)	**-**	**897.44**	**847.24**	**841.62**

543. The cumulative collision mortality is given in Table 11.72 (with Berwick Bank included) and Table 11.73 (with Berwick Bank excluded).

Table 11.72: Kittiwake Cumulative Collision Mortality Estimates Inclusive of Berwick Bank

Season	Regional Baseline		Cumulative Collision Mortality	Increase in Baseline Mortality (%)
	Population	Baseline Mortality		
Pre-breeding	627,816	98,065	1,020.62	1.041
Breeding	261,047	40,776	1,514.44	3.712
Post-breeding	829,937	129,636	1,037.24	0.800
Annual	**829,937**	**129,636**	**3,572.30**	**2.756**

544. With Berwick Bank, the estimated collision mortality for kittiwake is 1,021 individuals in the pre-breeding season, 1,514 in the breeding season and 1,037 in the post-breeding season. This is equivalent to an increase in baseline mortality of 1.04% in the pre-breeding season, 3.71% in the breeding season and 0.80% in the post-breeding season. On an annual basis, the number of mortalities is estimated as 3,572, which equates to an increase in baseline mortality of 2.76% (Table 11.72).

Table 11.73: Kittiwake Cumulative Collision Mortality Estimates Exclusive of Berwick Bank

Season	Regional Baseline		Cumulative Collision Mortality	Increase in Baseline Mortality (%)
	Population	Baseline Mortality		
Pre-breeding	627,816	98,065	841.62	0.858
Breeding	261,047	40,776	897.44	2.201
Post-breeding	829,937	129,636	847.24	0.654
Annual	**829,937**	**129,636**	**2,586.30**	**1.995**

545. Without Berwick Bank, the estimated collision mortality for kittiwake is 842 individuals in the pre-breeding season, 897 in the breeding season and 847 in the post-breeding season. This is equivalent to an increase in baseline mortality of 0.86% in the pre-breeding season, 2.20% in the breeding season and 0.65% in the post-breeding season. On an annual basis, the number of mortalities is estimated as 2,586 individuals, which equates to an increase in baseline mortality of 2.00% (Table 11.73).

546. The cumulative collision mortality therefore represents an increase in mortality of over 1% of baseline mortality during the pre-breeding, breeding season and annually with Berwick Bank and the breeding season and annually excluding Berwick Bank. Therefore, to further assess the significance of this effect, a PVA has been carried out for kittiwake as described in volume 3, appendix 11.5.

PVA Assessment Including Berwick Bank

547. When considering the impact during the pre-breeding season on the regional population defined for the pre-breeding season, using the NatureScot avoidance rates (0.993 avoidance) and with Berwick Bank included, the PVA predicted that the CPS was 0.891 (Table 11.74). The median population size was

therefore projected to be 10.94% smaller than the unimpacted population over a 35 year time period, with a 50th centile value of 42.92. In terms of the population size, this means that the median of the impacted population fell within the 42nd percentile of the unimpacted population (a value of 50 would indicate that they are the same). This suggests that the impacted scenario was still within the margin of error of the non-impacted scenario, and therefore there would likely be no adverse effect to the population. However, as outlined within volume 3, appendix 11.5, the CPGR is considered a more robust metric compared to the CPS in this analysis due to the models being conducted with density independence, in line with NatureScot (2023k) guidance. The PVA model predicted that the CPGR was 0.997 (Table 11.74) which translates to a median reduction of 0.32% in population growth rate after 35 years. Such a decrease indicates that this level of impact would not adversely affect the population and would likely remain undetectable against natural population fluctuations. Furthermore, it is not expected to significantly alter the background mortality rate.

Table 11.74: Kittiwake 35 Year Cumulative PVA Results for Collision Impacts Including Berwick Bank during the Pre-breeding Season

Scenario	Predicted Mortality (Original Impact) (no. of birds)	Growth Rate (Annual GR)	Median CPGR	Median CPS	U=50%I
NatureScot Approach – 0.993 avoidance rate	1,020.62	0.9918	0.9968	0.8906	42.92

548. When considering the impact during the breeding season on the regional population defined for the breeding season, using the NatureScot avoidance rates (0.993 avoidance) and with Berwick Bank included, the PVA predicted that the CPS was 0.626 (Table 11.75). The median population size was therefore projected to be 37.38% smaller than the unimpacted population over a 35 year time period, with a 50th centile value of 21.76 In terms of the population size, this means that the median of the impacted population fell within the 21st percentile of the unimpacted population (a value of 50 would indicate that they are the same). This suggests that the impacted scenario was still within the margin of error of the non-impacted scenario, and therefore there would likely be no adverse effect to the population. However, as stated, the CPGR is considered a more robust metric compared to the CPS in this analysis due to the models being conducted with density independence, in line with NatureScot (2023k) guidance. The PVA model predicted that the CPGR was 0.987 (Table 11.75) which translates to a median reduction of 1.29% in population growth rate after 35 years. Such a decrease indicates that this level of impact would not adversely affect the population and would likely remain undetectable against natural population fluctuations. Furthermore, it is not expected to significantly alter the background mortality rate.

Table 11.75: Kittiwake 35 Year Cumulative PVA Results for Collision Impacts Including Berwick Bank during the Breeding Season

Scenario	Predicted Mortality (Original Impact) (no. of birds)	Growth Rate (Annual GR)	Median CPGR	Median CPS	U=50%I
NatureScot Approach – 0.993 avoidance rate	1,514.44	0.9823	0.9871	0.6262	21.76

549. When considering the annual impact on the annual regional population, using the NatureScot avoidance rates (0.993 avoidance) and with Berwick Bank included, the PVA predicted that the CPS was 0.728 (Table 11.76). The median population size was therefore projected to be 27.25% smaller than the unimpacted population over a 35 year time period, with a 50th centile value of 30.92. In terms of the population size, this means that the median of the impacted population fell within the 30th percentile of the unimpacted population (a value of 50 would indicate that they are the same). This suggests that the impacted scenario was still within the margin of error of the non-impacted scenario, and therefore there would likely be no adverse effect to the population. However, as stated, the CPGR is considered a more robust metric compared to the CPS in this analysis due to the models being conducted with density independence, in line with NatureScot (2023k) guidance. The PVA model predicted that the CPGR was 0.991 (Table 11.76) which translates to a median reduction of 0.88% in population growth rate after 35 years. Such a decrease indicates that this level of impact would not adversely affect the population and would only result in a slight reduction in the growth rate currently seen in the BDMPS population and would therefore be undetectable against natural population fluctuations. Furthermore, it is not expected to significantly alter the background mortality rate.

Table 11.76: Kittiwake 35 Year Cumulative PVA Results for Displacement Impacts Including Berwick Bank on an Annual Basis

Scenario	Predicted Mortality (Original Impact) (no. of birds)	Growth Rate (Annual GR)	Median CPGR	Median CPS	U=50%I
NatureScot Approach – 0.993 avoidance rate	3,572.30	0.9863	0.9912	0.7275	30.92

PVA Assessment Excluding Berwick Bank

550. When considering the impact during the breeding season on the regional population defined for the breeding season, using the NatureScot avoidance rates (0.993 avoidance) and with Berwick Bank excluded, the PVA predicted that the CPS was 0.759 (Table 11.77). The median population size was therefore projected to be 24.13% smaller than the unimpacted population over a 35 year time period, with a 50th centile value of 33.0. In terms of the population size, this means that the median of the impacted population fell within the 33rd percentile of the unimpacted population (a value of 50 would indicate that they are the same). This suggests that the impacted scenario was still within the margin of error of the non-impacted scenario, and therefore there would likely be no adverse effect to the population. However, as stated, the CPGR is considered a more robust metric compared to the CPS in this analysis due to the models being conducted with density independence, in line with NatureScot (2023k) guidance. The PVA model predicted that the CPGR was 0.992 (Table 11.77) which translates to a median reduction of 0.76% in population growth rate after 35 years. Such a decrease indicates that this level of impact would not adversely affect the population and would likely remain undetectable against natural population fluctuations. Furthermore, it is not expected to significantly alter the background mortality rate.

Table 11.77: Kittiwake 35 Year Cumulative PVA Results for Collision Impacts Excluding Berwick Bank during the Breeding Season

Scenario	Predicted Mortality (Original Impact) (no. of birds)	Growth Rate (Annual GR)	Median CPGR	Median CPS	U=50%I
NatureScot Approach – 0.993 avoidance rate	897.44	0.9875	0.9924	0.7587	33.0

551. When considering the annual impact on the annual regional population, using the NatureScot avoidance rates (0.993 avoidance) and with Berwick Bank excluded, the PVA predicted that the CPS was 0.795 (Table 11.78). The median population size was therefore projected to be 20.53% smaller than the unimpacted population over a 35 year time period, with a 50th centile value of 36.32. In terms of the population size, this means that the median of the impacted population fell within the 36th percentile of the unimpacted population (a value of 50 would indicate that they are the same). This suggests that the impacted scenario was still within the margin of error of the non-impacted scenario, and therefore there would likely be no adverse effect to the population. However, as stated, the CPGR is considered a more robust metric compared to the CPS in this analysis due to the models being conducted with density independence, in line with NatureScot (2023k) guidance. The PVA model predicted that the CPGR was 0.994 (Table 11.78) which translates to a median reduction of 0.64% in population growth rate after 35 years. Such a decrease indicates that this level of impact would not adversely affect the population and would only result in a slight reduction in the growth rate currently seen in the BDMPS population and would therefore be undetectable against natural population fluctuations. Furthermore, it is not expected to significantly alter the background mortality rate.

Table 11.78: Kittiwake 35 Year Cumulative PVA Results for Displacement Impacts Excluding Berwick Bank on an Annual Basis

Scenario	Predicted Mortality (Original Impact) (no. of birds)	Growth Rate (Annual GR)	Median CPGR	Median CPS	U=50%I
NatureScot Approach – 0.993 avoidance rate	2,586.30	0.9888	0.9936	0.7947	36.32

Magnitude of impact

552. The estimated mortality resulting from collision during operation and maintenance was assessed for each season, and also on an annual basis by combining seasonal impacts and comparing them against the largest regional seasonal population (as set out in volume 3, appendix 11.2).

553. Based on the PVA results for the pre-breeding season with Berwick Bank included and following the NatureScot Approach using a 0.993 avoidance rate, the impact from the cumulative assessment on the kittiwake population was perceived as low.

554. Based on the PVA results for the breeding season with Berwick Bank included and following the NatureScot Approach using a 0.993 avoidance rate, the impact from the cumulative assessment on the kittiwake population was perceived as low.

555. Based on the collision assessment, with Berwick Bank included and following the NatureScot Approach using a 0.993 avoidance rate, for the post-breeding season the magnitude of impact on the kittiwake population is considered to be of low magnitude.

556. Based on the PVA results, on an annual basis with Berwick Bank included and following the NatureScot Approach using a 0.993 avoidance rate, the impact from the cumulative assessment on kittiwake populations is considered to be of low magnitude.

557. Based on the collision assessment for the pre-breeding season with Berwick Bank excluded and following the NatureScot Approach using a 0.993 avoidance rate, the impact from the cumulative assessment on the kittiwake population was perceived as low.

558. Based on the PVA results for the breeding season with Berwick Bank excluded and following the NatureScot Approach using a 0.993 avoidance rate, the impact from the cumulative assessment was perceived as low.

559. Based on the collision assessment, with Berwick Bank excluded and following the NatureScot Approach using a 0.993 avoidance rate, for the post-breeding season the magnitude of impact on the kittiwake population is considered to be of low magnitude.

560. Based on the PVA results, on an annual basis with Berwick Bank excluded and following the NatureScot Approach using a 0.993 avoidance rate, the impact from the cumulative assessment on kittiwake populations is considered to be of low magnitude.

561. Kittiwake populations have been declining within the UK with Burnell *et al.* (2023) reporting that the population has decreased by 21%. However, it is evident that this decline is attributed to the presence of other pressures such as poor prey resources which can impact productivity (Furness and Tasker, 2000; Frederiksen *et al*., 2008; Carroll *et al*., 2017) and challenges from climate change (Heath *et al*, 2012). The PVA indicates that cumulative mortality attributed to offshore wind farms would have a minimal impact on the overall population trajectory.

562. The cumulative effect is predicted to be of national spatial extent, long-term duration, continuous and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be low.

Sensitivity of the receptor

563. Kittiwake was rated as highly vulnerable to collision impacts by Wade *et al.* (2016), due to the proportion of flights likely to occur at potential risk height and percentage of time in flight. In terms of nocturnal activity rate, kittiwake are considered to have a medium rate of activity at night with a score of three (out of five) (Wade *et al.* 2016).

564. Kittiwake lay two eggs and breed from the age of three onwards, typically living on average for 12 years (Burnell *et al*., 2023). Kittiwake have undergone decreases of approximately 57% in Scotland since the early 2000s. Surveys managed by the RSPB in 2023 have recorded indicative increases of 8% across a number of sites in Britain in 2023 when compared against a pre-HPAI baseline (Tremlett *et al*., 2024). Overall, kittiwake is deemed to have low recoverability.

565. Kittiwake is a qualifying interest for several SPAs likely to be connected to the Array (within the mean-max + SD foraging range), with several non-SPA colonies also within range and so the species is considered to be of international conservation value. Refer to table 6.2 of volume 3, appendix 11.1 for details of SPAs with connectivity to the Array with regards to kittiwake.

566. Kittiwake is deemed to be of high vulnerability, low recoverability and international value. The sensitivity of the receptor is therefore considered to be high.

Significance of the effect

567. Overall, the magnitude of the impact is deemed to be low and the sensitivity of the receptor is considered to be high. The effect will, therefore, be of minor to moderate adverse significance. However, considering pre-breeding season mortality rates fell below 1%, along with the PVA results indicating a low impact with and without Berwick Bank, the impact is considered minor. It is therefore deemed appropriate to categorise the impact as having a **minor** adverse significance, which is not significant in EIA terms.

Further mitigation and residual effect

568. No offshore ornithology mitigation is considered necessary because the likely effect in the absence of further mitigation (beyond the designed in measures outlined in section 11.10) is not significant in EIA terms.

Herring Gull

569. The estimated collision mortalities of herring gull for the purpose of estimating cumulative collisions impacts are given in Table 11.79. Estimated collisions for projects are those presented by Berwick Bank (SSE Renewables, 2022), for which NatureScot has not raised any concerns or noted any errors. In addition, estimates have been obtained from Green Volt Offshore Wind Farm (Green Volt, 2023), Pentland Floating Offshore Wind (Pentland Floating Offshore Wind Farm, 2022), West of Orkney (Offshore Wind Power Limited, 2023), North Falls (North Falls, 2023), Five Estuaries (Five Estuaries, 2023) and Outer Dowsing (Outer Dowsing, 2023) offshore wind farms, as those projects had not published their estimates at the time of the Berwick Bank application.

Table 11.79: Herring Gull Cumulative Collision Mortalities

Project	Avoidance Rate used in Assessment	Season	
		Breeding	Non-breeding
Aberdeen	99.5%	4.8	0
Beatrice	99.5%	N/A (outside foraging range)	197.4
Blyth Demo Phase 1	99.5%	N/A (outside foraging range)	2.2
Blyth Demo Phase 2 and 3	unknown	N/A (outside foraging range)	-
Dogger Bank A and B	unknown	N/A (outside foraging range)	-
Dogger C and Sofia	unknown	N/A (outside foraging range)	-
Dudgeon	unknown	N/A (outside foraging range)	-
East Anglia ONE	99.5%	N/A (outside foraging range)	28
East Anglia ONE North	99.5%	N/A (outside foraging range)	0
East Anglia THREE	99.5%	N/A (outside foraging range)	23
East Anglia TWO	99.5%	N/A (outside foraging range)	0.5
Five Estuaries	99.4%	N/A (outside foraging range)	1.52
Forthwind Demonstration Project	uknown	-	-
Galloper	unknown	N/A (outside foraging range)	-
Gunfleet Sands 3 Demonstration Project	unknown	N/A (outside foraging range)	-
Green Volt Offshore Wind Farm	99.4%	N/A (outside foraging range)	5.8
Hornsea Project Four	99.5%	N/A (outside foraging range)	0.9
Hornsea Project One	99.5%	N/A (outside foraging range)	11.6
Hornsea Project Three	99.5%	N/A (outside foraging range)	4
Hornsea Project Two	unknown	N/A (outside foraging range)	-
Hywind	99.5%	0.6	7.8
Inch Cape	99.5%	N/A (outside foraging range)	13.5
Kentish Flats + Extension	99.5%	N/A (outside foraging range)	1.7
Kincardine	99.5%	1	0
Lincs	99.5%	N/A (outside foraging range)	-
London Array	99.5%	N/A (outside foraging range)	-
Moray East	99.5%	N/A (outside foraging range)	-
Moray West	99.5%	N/A (outside foraging range)	1
Neart na Gaoithe	99.5%	5	12.5
N North Falls (PEIR)	99.5%	N/A (outside foraging range)	0.91
Norfolk Boreas	99.5%	N/A (outside foraging range)	5.4
Norfolk Vanguard	99.0%	N/A (outside foraging range)	7.1
Outer Dowsing	99.4%	N/A (outside foraging range)	0.2
Pentland Floating Offshore Wind	unknown	N/A (outside foraging range)	0
Race Bank	99.5%	N/A (outside foraging range)	-
Rampion 1	99.5%	N/A (outside foraging range)	0
Rampion 2	99.5%	N/A (outside foraging range)	28.1
Seagreen 1 and 1A Offshore Wind Farm	unknown	10	21
Sheringham Shoal	99.5%	N/A (outside foraging range)	-
Teesside	99.5%	N/A (outside foraging range)	34.5
Thanet	unknown	N/A (outside foraging range)	19.6
Triton Knoll	unknown	N/A (outside foraging range)	-
West of Orkney	99.5%	N/A (outside foraging range)	-
Westermost Rough	99.5%	N/A (outside foraging range)	0
Total	-	**21.4**	**427.23**
Berwick Bank	99.4%	43	7
Ossian	99.5%	0	2.7
Total (including Berwick Bank)	**-**	**64.4**	**436.93**
Total (excluding Berwick Bank)	**-**	**21.4**	**429.93**

570. The cumulative collision mortality is given in Table 11.80 (with Berwick Bank included) and Table 11.81 (with Berwick Bank excluded).

Table 11.80: Herring Gull Cumulative Collision Mortality Estimates Inclusive of Berwick Bank

Season	Regional Baseline Population	Baseline Mortality	Cumulative Collision Mortality	Increase in Baseline Mortality (%)
Breeding	13,836	2,363	64.4	2.725
Non-breeding	466,511	79,680	436.93	0.548
Annual	**466,511**	**79,680**	**501.33**	**0.629**

571. With Berwick Bank, the estimated cumulative collision mortality for herring gull is 64 individuals in the breeding season and 437 individuals in the non-breeding season. This is equivalent to an increase in baseline mortality of 2.73% in the breeding season and 0.55% in the non-breeding season. On an annual basis, the number of mortalities is estimated as 501, which equates to an increase in baseline mortality of 0.63% (Table 11.80).

Table 11.81: Herring Gull Cumulative Collision Mortality Estimates Exclusive of Berwick Bank

Season	Regional Baseline Population	Baseline Mortality	Cumulative Collision Mortality	Increase in Baseline Mortality (%)
Breeding	13,836	2,363	21.4	0.906
Non-breeding	466,511	79,680	429.93	0.540
Annual	**466,511**	**79,680**	**451.33**	**0.566**

572. Without Berwick Bank, the estimated collision mortality for herring gull is 21 individuals in the breeding season and 430 in the non-breeding season. This is equivalent to an increase in baseline mortality of 0.91% in the breeding season and 0.54% in the non-breeding season. On an annual basis, the number of mortalities is estimated as 451 individuals, which equates to an increase in baseline mortality of 0.57% (Table 11.81).

573. The cumulative collision mortality represents an increase in mortality of over 1% of baseline mortality in the breeding season only, and only when including Berwick Bank. Therefore, to further assess the significance of this effect, a PVA has been carried out for herring gull as described in volume 3, appendix 11.5.

PVA Assessment Including Berwick Bank

574. When considering the impact during the breeding season on the regional population defined for the breeding season, using the NatureScot avoidance rates (0.994 avoidance) and with Berwick Bank included, the PVA predicted that the CPS was 0.815 (Table 11.82). The median population size was therefore projected to be 18.34% smaller than the unimpacted population over a 35 year time period, with a 50th centile value of 33.32. In terms of the population size, this means that the median of the impacted population fell within the 33rd percentile of the unimpacted population (a value of 50 would indicate that they are the same). This suggests that the impacted scenario was still within the margin of error of the non-impacted scenario, and therefore there would likely be no adverse effect to the population. However, as stated, the CPGR is considered a more robust metric compared to the CPS in this analysis due to the models being conducted with density independence, in line with NatureScot (2023k) guidance. The PVA model predicted that the CPGR was 0.994 (Table 11.82) which translates to a median reduction of 0.57% in population growth rate after 35 years. Such a decrease indicates that this level of impact would not adversely affect the population and would likely remain undetectable against natural population fluctuations. Furthermore, it is not expected to significantly alter the background mortality rate.

Table 11.82: Herring gull 35 Year Cumulative PVA Results for Collision Impacts Including Berwick Bank during the Breeding Season

Scenario	Predicted Mortality (Original Impact) (no. of birds)	Growth Rate (Annual GR)	Median CPGR	Median CPS	U=50%l
NatureScot Approach - 0.994 avoidance rate	64.4	0.9443	0.9943	0.8153	33.32

Magnitude of impact

575. The estimated mortality resulting from collision during operation and maintenance was assessed for each season, and also on an annual basis by combining seasonal impacts and comparing them against the largest regional seasonal population (as set out in volume 3, appendix 11.2).

576. Based on the PVA results for the breeding season with Berwick Bank included and following the NatureScot Approach using a 0.994 avoidance rate, the impact from the cumulative assessment on the herring gull population was perceived as low.

577. Based on the collision assessment, with Berwick Bank included and following the NatureScot Approach using a 0.994 avoidance rate, for the non-breeding season the magnitude of impact on the herring gull population is considered to be of low magnitude

578. Based on the collision assessment, with Berwick Bank included and following the NatureScot Approach using a 0.994 avoidance rate, on an annual basis the magnitude of impact on the herring gull population is considered to be of low magnitude

579. Based on the collision assessment results for the breeding season with Berwick Bank excluded and following the NatureScot Approach using a 0.994 avoidance rate, the impact from the cumulative assessment on the herring gull population was perceived as low.

580. Based on the collision assessment, with Berwick Bank excluded and following the NatureScot Approach using a 0.994 avoidance rate, for the non-breeding season the magnitude of impact on the herring gull population is considered to be of low magnitude

581. Based on the collision assessment, with Berwick Bank excluded and following the NatureScot Approach using a 0.994 avoidance rate, on an annual basis the magnitude of impact on the herring gull population is considered to be of low magnitude

582. Herring gull populations have been declining within the UK with Burnell et al. (2023) reporting that the population has decreased by around 30%, with colonies within Scotland down 44% (NatureScot, 2024). However it is evident that this decline is attributed to the presence of other pressures such as food availability, bycatch, disease and pollution (Gorski et al. 1977; Zydelis et al. 2013). The PVA indicates that cumulative mortality attributed to offshore wind farms would have a minimal impact on the overall population trajectory.

583. Due to the minimal level of change to baseline conditions, the cumulative effect is predicted to be of national spatial extent, long-term duration, continuous and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be low.

Sensitivity of the receptor

584. Herring gull was rated as one of the most vulnerable seabird species to collision impacts by Wade *et al.* (2016), due to the proportion of flights likely to occur at potential risk height and percentage of time in

flight. In terms of nocturnal activity rate, herring gull are considered to have a medium rate of activity at night with a score of three (out of five) (Wade *et al.* 2016).

585. As herring gull is a qualifying interest for two SPAs likely to be connected to the Array (within the mean-max + SD foraging range of Fowlsheugh SPA and Buchan Ness to Collieston Coast SPA) with multiple non-SPA colonies within range, the species is considered to be of international value. Refer to Table 6.7 of volume 3, appendix 11.1 for details of SPAs with connectivity to the Array with regards to herring gull.

586. Herring gull lay up to three eggs and breed from the age of four onwards, typically living on average for 12 years (Burnell *et al*., 2023). Natural nesting colonies of herring gull have undergone decreases of approximately 44% in Scotland since the early 2000s, whereas urban-nesting populations have increased considerably. Given that the urban population is small compared to the natural population (Burnell *et al.*, 2023), the overall trend is likely to be a decline. Surveys managed by the RSPB in 2023 have recorded indicative declines of 7% across a number of sites in Britain in 2023 when compared against a pre-HPAI baseline (Tremlett *et al*., 2024). Overall herring gull is considered to have low recoverability.

587. Herring gull is deemed to be of very high vulnerability, low recoverability and international value. The sensitivity of the receptor is therefore, considered to be high.

Significance of the effect

588. Overall, the magnitude of the impact is deemed to be low and the sensitivity of the receptor is considered to be high. The effect will, therefore, be of minor to moderate adverse significance. However, considering the non-breeding season and annual mortality rates are below 1% of baseline mortality, along with the PVA results indicating a low impact with and without Berwick Bank, the effect should be considered minor. It is therefore deemed appropriate to categorise the impact as having a **minor** adverse significance, which is not significant in EIA terms.

Further mitigation and residual effect

589. No offshore ornithology mitigation is considered necessary because the likely effect in the absence of further mitigation (beyond the designed in measures outlined in section 11.10) is not significant in EIA terms.

Gannet

590. The estimated collision mortalities of gannet for the purpose of estimating cumulative collisions impacts are given in Table 11.83. Estimated collisions for projects are those presented by Berwick Bank (SSE Renewables, 2022), for which NatureScot has not raised any concerns or noted any errors. In addition, estimates have been obtained from Green Volt Offshore Wind Farm (Green Volt, 2023), Pentland Floating Offshore Wind (Pentland Floating Offshore Wind Farm, 2022), West of Orkney (Offshore Wind Power Limited, 2023), North Falls (North Falls, 2023), Five Estuaries (Five Estuaries, 2023) and Outer Dowsing (Outer Dowsing, 2023) offshore wind farms, as those projects had not published their estimates at the time of the Berwick Bank application.

Table 11.83: Gannet Cumulative Collision Mortalities

Project	Avoidance Rate used in Assessment	Season		
		Breeding	Post-breeding	Pre-breeding
Aberdeen	98.9%	3.48	4.22	0.08
Beatrice	98.9%	37.4	48.8	9.5
Blyth Demo Phase 1	98.9%	3.5	2.1	2.8
Blyth Demo Phase 2 and 3	unknown	-	-	-
Dogger Bank A and B	98.9%	81.1	83.5	54.4
Dogger C and Sofia	98.9%	14.8	10.1	10.8
Dudgeon	98.9%	22.3	38.9	19.1
Dudgeon Extension and Sheringham Shoal Extension	99.2%	0.4	0.6	0
East Anglia ONE	98.9%	3.4	131	6.3
East Anglia ONE North	98.9%	12.4	11	1.1
East Anglia THREE	98.9%	4.8	28.5	8.4
East Anglia TWO	98.9%	12.5	23.1	4
Five Estuaries	99.3%	2.01	1.14	0.61
Forthwind Demonstration Project	unknown	-	-	-
Galloper	98.9%	N/A (outside foraging range)	30.9	12.6
Gunfleet Sands 3 Demonstration Project	unknown	-	-	-
Green Volt Offshore Wind Farm	99.3%	14.9	0.6	2.4
Hornsea Project One	98.9%	2.61	7.27	5.11
Hornsea Project Two	98.9%	7	14	6
Hornsea Project Three	98.9%	9.77	4.51	4.93
Hornsea Project Four	98.9%	15.8	5.2	1.3
Humber Gateway	98.9%	1.9	1.1	1.5
Hywind	98.9%	5.6	0.8	0.8
Inch Cape Offshore Wind Farm	98.9%	108	5	4
Kentish Flats	98.9%	N/A (outside foraging range)	0.8	1.1
Kentish Flats Extension	unknown	N/A (outside foraging range)	-	-
Kincardine Offshore Wind Farm	98.9%	3	0	0
Lincs	98.9%	2.1	1.3	1.7
London Array	98.9%	N/A (outside foraging range)	1.4	1.8
Moray East	98.9%	80.6	35.4	8.9
Moray West	98.9%	9.8	1.5	0.7
Neart na Gaoithe	98.9%	89	7	7
Norfolk Boreas	98.9%	14.1	12.7	3.9
North Falls (PEIR)	98.9%	6.5	8.1	4.7
Norfolk Vanguard	98.9%	8.2	18.6	5.3
Outer Dowsing	99.3%	1.05	0.36	0.07
Pentland Floating Offshore Wind	98.9%	N/A (outside foraging range)	0	0
Race Bank	98.9%	33.7	11.7	4.1

Project	Avoidance Rate used in Assessment	Breeding	Season Post-breeding	Pre-breeding
Rampion 1	98.9%	N/A (outside foraging range)	13.9	0.5
Rampion 2	99.3%	N/A (outside foraging range)	1.4	0.61
Seagreen 1 and 1A Offshore Wind Farm	98.9%	159	8	9
Sheringham Shoal	unknown	14.1	3.5	0
Teesside	98.9%	4.9	1.7	0
Thanet	98.9%	N/A (outside foraging range)	0	0
Triton Knoll	98.9%	26.8	64.1	30.1
West of Orkney	99.3%	37.78	7.65	2.05
Westermost Rough	98.9%	N/A	N/A	N/A
Total	-	**854.3**	**651.45**	**237.26**
Berwick Bank	98.9%	170	18	3
Ossian	99.3%	28.18	3.76	0.24
Total (including Berwick Bank)	-	**1052.48**	**673.21**	**240.5**
Total (excluding Berwick Bank)	-	**882.48**	**655.21**	**237.5**

591. The cumulative collision mortality is given in Table 11.84 (with Berwick Bank included) and Table 11.85 (with Berwick Bank excluded).

Table 11.84: Gannet Cumulative Collision Mortality Estimates Inclusive of Berwick Bank

Season	Regional Baseline Population	Baseline Mortality	Cumulative Collision Mortality	Increase in Baseline Mortality (%)
Pre-breeding	248,385	47,864	240.5	0.502
Breeding	763,577	147,141	673.21	0.458
Post-breeding	456,298	87,929	1052.48	1.197
Annual	**763,577**	**147,141**	**1,966.19**	**1.336**

592. With Berwick Bank, the estimated collision mortality for gannet is 241 individuals in the pre-breeding season, 673 individuals in the breeding season and 1,052 in the post-breeding season. This is equivalent to an increase in baseline mortality of 0.50% in the pre-breeding season, 0.46% in the breeding season and 1.20% in the post-breeding season. On an annual basis, the number of mortalities is estimated as 1,966, which equates to an increase in baseline mortality of 1.34% (Table 11.84).

Table 11.85: Gannet Cumulative Collision Mortality Estimates Exclusive of Berwick Bank

Season	Regional Baseline Population	Baseline Mortality	Cumulative Collision Mortality	Increase in Baseline Mortality (%)
Pre-breeding	248,385	47,864	237.09	0.485
Breeding	763,577	147,141	882.48	0.592
Post-breeding	456,298	87,929	655.21	0.745
Annual	**763,577**	**147,141**	**1,774.78**	**1.206**

593. Without Berwick Bank, the estimated collision mortality for gannet is 237 individuals in the pre-breeding season, 882 individuals in the breeding season and 655 in the post-breeding season. This is equivalent to an increase in baseline mortality of 0.49% in the pre-breeding season, 0.59% in the breeding season and 0.75% in the post-breeding season. On an annual basis, the number of mortalities is estimated as 1,775 individuals, which equates to an increase in baseline mortality of 1.20% (Table 11.85).

594. The cumulative collision mortality therefore represents an increase in annual mortality of over 1% of baseline mortality, both with Berwick Bank included for the post-breeding season and on an annual basis. With Berwick Bank excluded, the 1% threshold is surpassed on an annual basis only. Therefore, to further assess the significance of this effect, a PVA has been carried out for gannet as described in volume 3, appendix 11.5.

PVA Assessment Including Berwick Bank

595. When considering the impact on the post-breeding regional population, using the NatureScot avoidance rates (0.993 avoidance) and with Berwick Bank included, the PVA predicted that the CPS was 0.831 (Table 11.87Table 11.87). The median population size was therefore projected to be 16.89% smaller than the unimpacted population over a 35 year time period, with a 50th centile value of 22.16. In terms of the population size, this means that the median of the impacted population fell within the 22nd percentile of the unimpacted population (a value of 50 would indicate that they are the same). This suggests that the impacted scenario was still within the margin of error of the non-impacted scenario, and therefore there would likely be no adverse effect to the population. However, as stated, the CPGR is considered a more robust metric compared to the CPS in this analysis due to the models being conducted with density independence, in line with NatureScot (2023k) guidance. The PVA model predicted that the CPGR was 0.995 (Table 11.87) which translates to a median reduction of 0.51% in population growth rate after 35 years. Such a decrease indicates that this level of impact would not adversely affect the population and would only result in a slight reduction in the growth rate currently seen in the BDMPS population and would therefore be undetectable against natural population fluctuations. Furthermore, it is not expected to significantly alter the background mortality rate.

Table 11.86: Gannet 35 Year Cumulative PVA Results for Collision Impacts Including Berwick Bank during the Post-breeding Season

Scenario	Predicted Mortality (Original Impact) (no. of birds)	Growth Rate (Annual GR)	Median CPGR	Median CPS	U=50%I
NatureScot Approach – 0.993 avoidance rate	1,052.48	1.0069	0.9949	0.8311	22.16

596. When considering the annual impact on the annual regional population, using the NatureScot avoidance rates (0.993 avoidance) and with Berwick Bank included, the PVA predicted that the CPS was 0.820 (Table 11.87). The median population size was therefore projected to be 18.0% smaller than the unimpacted population over a 35 year time period, with a 50th centile value of 20.76. In terms of the population size, this means that the median of the impacted population fell within the 20th percentile of the unimpacted population (a value of 50 would indicate that they are the same). This suggests that the impacted scenario was still within the margin of error of the non-impacted scenario, and therefore there would likely be no adverse effect to the population. However, as stated, the CPGR is considered a more robust metric compared to the CPS in this analysis due to the models being conducted with density independence, in line with NatureScot (2023k) guidance. The PVA model predicted that the CPGR was 0.995 (Table 11.87)

which translates to a median reduction of 0.55% in population growth rate after 35 years. Such a decrease indicates that this level of impact would not adversely affect the population and would only result in a slight reduction in the growth rate currently seen in the BDMPS population and would therefore be undetectable against natural population fluctuations. Furthermore, it is not expected to significantly alter the background mortality rate.

Table 11.87: Gannet 35 Year Cumulative PVA Results for Collision Impacts Including Berwick Bank on an Annual Basis

Scenario	Predicted Mortality (Original Impact) (no. of birds)	Growth Rate (Annual GR)	Median CPGR	Median CPS	U=50%I
NatureScot Approach – 0.993 avoidance rate	1,966.19	1.0066	0.9945	0.8200	20.76

PVA Assessment Excluding Berwick Bank

597. When considering the annual impact on the annual regional population, using the NatureScot avoidance rates (0.993 avoidance) and with Berwick Bank excluded, the PVA predicted that the CPS was 0.836 (Table 11.88). The median population size was therefore projected to be 16.38% smaller than the unimpacted population over a 35 year time period, with a 50th centile value of 22.56. In terms of the population size, this means that the median of the impacted population fell within the 22nd percentile of the unimpacted population (a value of 50 would indicate that they are the same). This suggests that the impacted scenario was still within the margin of error of the non-impacted scenario, and therefore there would likely be no adverse effect to the population. However, as stated, the CPGR is considered a more robust metric compared to the CPS in this analysis due to the models being conducted with density independence, in line with NatureScot (2023k) guidance. The PVA model predicted that the CPGR was 0.995 (Table 11.88) which translates to a median reduction of 0.50% in population growth rate after 35 years. Such a decrease indicates that this level of impact would not adversely affect the population and would only result in a slight reduction in the growth rate currently seen in the BDMPS population and would therefore be undetectable against natural population fluctuations. Furthermore, it is not expected to significantly alter the background mortality rate.

Table 11.88: Gannet 35 Year Cumulative PVA Results for Collision Impacts Excluding Berwick Bank on an Annual Basis

Scenario	Predicted Mortality (Original Impact) (no. of birds)	Growth Rate (Annual GR)	Median CPGR	Median CPS	U=50%I
NatureScot Approach – 0.993 avoidance rate	1,774.78	1.0071	0.9950	0.8362	22.56

Magnitude of impact

598. The estimated mortality resulting from collision during operation and maintenance was assessed for each season, and also on an annual basis by combining seasonal impacts and comparing them against the largest regional seasonal population (as set out in volume 3, appendix 11.2).

599. Based on the collision assessment for the pre-breeding season with Berwick Bank included and following the NatureScot Approach using a 0.993 avoidance rate, the impact from the cumulative assessment on the gannet population was perceived as low.

600. Based on the collision assessment for the breeding season with Berwick Bank included and following the NatureScot Approach using a 0.993 avoidance rate, the impact from the cumulative assessment on the gannet population was perceived as low.

601. Based on the PVA results for the post-breeding season with Berwick Bank included and following the NatureScot Approach using a 0.993 avoidance rate, the impact from the cumulative assessment on the gannet population is considered to be of low magnitude

602. Based on the PVA results, with Berwick Bank included and following the NatureScot Approach using a 0.993 avoidance rate, on an annual basis the magnitude of impact on the gannet population is considered to be of low magnitude

603. Based on the collision assessment for the pre-breeding season with Berwick Bank excluded and following the NatureScot Approach using a 0.993 avoidance rate, the impact from the cumulative assessment on the gannet population was perceived as low.

604. Based on the collision assessment for the breeding season with Berwick Bank excluded and following the NatureScot Approach using a 0.993 avoidance rate, the impact from the cumulative assessment on the gannet population was perceived as low.

605. Based on the collision assessment for the post-breeding season with Berwick Bank excluded and following the NatureScot Approach using a 0.993 avoidance rate, the impact from the cumulative assessment on the gannet population was perceived as low.

606. Based on the PVA results, with Berwick Bank excluded and following the NatureScot Approach using a 0.993 avoidance rate, on an annual basis the magnitude of impact on the gannet population is considered to be of low magnitude.

607. The cumulative effect is predicted to be of national spatial extent, long-term duration, continuous and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be low.

Sensitivity of the receptor

608. Although the latest scientific guidance showed the species to display a high level of macro-avoidance (Peschko *et al.*, 2020), the species is rated as relatively vulnerable to collision impacts by Wade *et al.* (2016).

609. Gannet is a qualifying interest for several SPAs likely to be connected to the Array (within the mean-max + SD foraging range). The species is therefore considered to be of international value. Refer to Table 6.30 of volume 3, appendix 11.1 for details of SPAs with connectivity to the Array with regards to gannet.

610. Gannet have low reproductive potential given a typical age of first breeding of five years and typically laying only a single egg per breeding season. However, although gannet has a low reproductive potential, the species has demonstrated a consistent increasing trend in abundance since the 1990's (JNCC, 2020).. It is of note that the species has suffered from the outbreak of avian flu during the 2022 breeding season (Pearce-Higgins *et al.*, 2023), with declines of 25% recorded at certain sites in Britain in 2023 when compared against a pre-HPAI baseline (Tremlett *et al.*, 2024). Therefore, whilst the overall population has

shown steady growth, HPAI has led to some short-term declines. Therefore, overall gannet is deemed to have low recoverability.

611. Gannet is deemed to be of high vulnerability, low recoverability and international value. The sensitivity of the receptor is therefore considered to be high.

Significance of the effect

612. Overall, the magnitude of the impact is deemed to be low and the sensitivity of the receptor is considered to be high. The effect will, therefore, be of minor to moderate adverse significance. However, considering the pre-breeding, breeding and post-breeding season mortality rates fell below 1%, along with the PVA results indicating a low impact with and without Berwick Bank, the impact is considered minor. It is therefore deemed appropriate to categorise the impact as having a **minor** adverse significance, which is not significant in EIA terms.

Further mitigation and residual effect

613. No offshore ornithology mitigation is considered necessary because the likely effect in the absence of further mitigation (beyond the designed in measures outlined in section 11.10) is not significant in EIA terms.

COMBINED DISPLACEMENT AND COLLISION WITH WIND TURBINES

614. There is no cumulative displacement and/or collision impact from the Proposed onshore application. Whilst there may be a displacement resulting from maintenance/repair activities associated with the Proposed offshore export cable(s), any such displacement would be highly localised and temporary in nature, and is therefore expected to be negligible.

615. There is potential for combined cumulative displacement and collision with regards to kittiwake and gannet, as a result of construction and operational activities associated with the Array cumulatively with other developments.

616. Combined collision and displacement mortality has been calculated using an additive approach as advised by NatureScot in their representation in response to the Ossian Array Scoping Report (refer to section 11.5).

617. It is recognised that assessing these two potential impacts together could amount to double counting, as birds that are subject to displacement could not be subject to potential collision risk as they are already assumed to have not entered the Array. Equally, birds estimated to be subject to collision risk mortality would not be subjected to displacement mortality as well. The results presented in this section are therefore considered highly precautionary, especially gannet due to high displacement rates.

618. Currently, no more refined method to consider displacement and collision together has been agreed with NatureScot and therefore the precautionary and highly unlikely additive approach is presented in this assessment.

Tier 1 and Tier 2

Kittiwake

619. The combined cumulative displacement and collision mortality is given in Table 11.89 (with Berwick Bank included) and Table 11.90 (with Berwick Bank excluded). Displacement mortality is calculated using 30% displacement and a range of 1% to 3% mortality in all seasons, in line with guidance (NatureScot, 2023h). Additionally, the Applicant's Approach which utilises a 30% displacement rate and 1% mortality rate is presented.

Table 11.89: Kittiwake Combined Cumulative Displacement and Collision Mortality Estimates Inclusive of Berwick Bank

Season	Regional Baseline		Cumulative Displacement Mortality (Applicant's Approach)	Cumulative Displacement Mortality (NatureScot Approach)	Increase in Baseline Mortality (Applicant's Approach) (%)	Increase in Baseline Mortality (NatureScot Approach) (%)
	Population	Baseline Mortality				
Pre-breeding	627,816	98,065	1,225	1,225 to 1,634	1.249	1.249 to 1.666
Breeding	261,047	40,776	1,703	1,703 to 2,080	4.176	4.176 to 5.101
Post-breeding	829,937	129,636	1,285	1,285 to 1,781	0.991	0.991 to 1.374
Annual	**829,937**	**129,636**	4,213	**4,213 to 5,495**	**3.250**	**3.250 to 4.239**

620. With Berwick Bank, the estimated combined displacement and collision mortality for kittiwake, following the NatureScot Approach, is 1,225 to 1,634 individuals in the pre-breeding season, 1,703 to 2,080 individuals in the breeding season and 1,285 to 1,781 individuals in the post-breeding season. This is equivalent to an increase in baseline mortality of 1.25% to 1.67% in the pre-breeding season, 4.18% to 5.10% in the breeding season and 0.99% to 1.37% in the post-breeding season. On an annual basis, the number of mortalities is estimated as 4,213 to 5,495 individuals, which equates to an increase in baseline mortality of 3.25% to 4.24% (Table 11.89).

621. When following the Applicant's Approach, the estimated combined displacement and collision mortality with Berwick Bank, for kittiwake is 1,225 individuals in the pre-breeding season, 1,703 individuals in the breeding season and 1,285 individuals in the post-breeding season. This is equivalent to an increase in baseline mortality of 1.25% in the pre-breeding season, 4.18% in the breeding season and 0.99% in the post-breeding season. On an annual basis, the number of mortalities is estimated as 4,213 individuals, which equates to an increase in baseline mortality of 3.25%.

Table 11.90: Kittiwake Combined Cumulative Displacement and Collision Mortality Estimates Exclusive of Berwick Bank

Season	Regional Baseline		Cumulative Displacement Mortality (Applicant's Approach)	Cumulative Displacement Mortality (NatureScot Approach)	Increase in Baseline Mortality (Applicant's Approach) (%)	Increase in Baseline Mortality (NatureScot Approach) (%)
	Population	Baseline Mortality				
Pre-breeding	627,816	98,065	1,005	1,005 to 1,331	1.025	1.025 to 1.357
Breeding	261,047	40,776	1,023	1,023 to 1,273	2.508	2.508 to 3.121
Post-breeding	829,937	129,636	1,062	1,062 to 1,490	0.819	0.819 to 1.150
Annual	**829,937**	**129,636**	**3,089**	**3,089 to 4,094**	**2.383**	**2.383 to 3.158**

622. Without Berwick Bank, the estimated combined displacement and collision mortality for kittiwake is 1,005 to 1,331 individuals in the pre-breeding season, 1,023 to 1,273 in the breeding season and 1,062 to 1,490 in the post-breeding season. This is equivalent to an increase in baseline mortality of 1.03% to 1.36% in the pre-breeding season, 2.51% to 3.12% in the breeding season and 0.82% to 1.15% in the post-breeding

season. On an annual basis, the number of mortalities is estimates as 3,089 to 4,094 individuals, which equates to an increase in baseline mortality of 2.38% to 3.16% (Table 11.90Table 11.90).

623. When following the Applicant's Approach, the estimated combined displacement and collision mortality without Berwick Bank, for kittiwake is 1,005 individuals in the pre-breeding season, 1,023 individuals in the breeding season and 1,062 individuals in the post-breeding season. This is equivalent to an increase in baseline mortality of 1.03% in the pre-breeding season, 2.51% in the breeding season and 0.82% in the post-breeding season. On an annual basis, the number of mortalities is estimated as 3,089 individuals, which equates to an increase in baseline mortality of 2.38%.

624. The cumulative combined displacement and collision mortality represents an increase in mortality of over 1% of baseline mortality, both with and without Berwick Bank, across all seasons when applying NatureScot displacement rates. When following the Applicant's Approach, the 1% threshold was surpassed in the pre-breeding season, breeding season and on an annual basis. Therefore, to further assess the significance of this effect, a PVA has been carried out for kittiwake as described in volume 3, appendix 11.5.

PVA Assessment Including Berwick Bank

625. When considering the impact during the pre-breeding season on the regional population defined for the pre-breeding season, using the NatureScot avoidance rates (0.993 avoidance, 30% displacement and 1% to 3% mortality) and with Berwick Bank included, the PVA predicted that the CPS was between 0.870 to 0.831 (Table 11.91). The median population size was therefore projected to be 12.97% to 16.93% smaller than the unimpacted population over a 35 year time period, with a 50th centile value of 41.40 to 38.76. In terms of the population size, this means that the median of the impacted population fell within the 41st and 38th percentile of the unimpacted population (a value of 50 would indicate that they are the same). This suggests that the impacted scenario was still within the margin of error of the non-impacted scenario, and therefore there would likely be no adverse effect to the population. However, as stated, the CPGR is considered a more robust metric compared to the CPS in this analysis due to the models being conducted with density independence, in line with NatureScot (2023k) guidance. The PVA model predicted that the CPGR was between 0.996 to 0.995 (Table 11.91) which translates to a median reduction of 0.39% to 0.51% in population growth rate after 35 years. Such a decrease indicates that this level of impact would not adversely affect the population and would likely remain undetectable against natural population fluctuations. Furthermore, it is not expected to significantly alter the background mortality rate.

626. When considering the impact during the pre-breeding season on the regional population defined for the pre-breeding season, using the Applicant's displacement rates and the NatureScot avoidance rates (0.993 avoidance, 30% displacement and 1% mortality) and with Berwick Bank included, the PVA predicted that the CPS was 0.870 (Table 11.91). The median population size was therefore projected to be 12.98% smaller than the unimpacted population over a 35 year time period, with a 50th centile value of 41.16. In terms of the population size, this means that the median of the impacted population fell within the 41st percentile of the unimpacted population (a value of 50 would indicate that they are the same). This suggests that the impacted scenario was still within the margin of error of the non-impacted scenario, and therefore there would likely be no adverse effect to the population. However, as stated, the CPGR is considered a more robust metric compared to the CPS in this analysis due to the models being conducted with density independence, in line with NatureScot (2023k) guidance. The PVA model predicted that the CPGR was 0.996 (Table 11.91) which translates to a median reduction of 0.39% in population growth rate after 35 years. Such a decrease indicates that this level of impact would not adversely affect the population and would likely remain undetectable against natural population fluctuations. Furthermore, it is not expected to significantly alter the background mortality rate.

Table 11.91: Kittiwake 35 Year Cumulative PVA Results for Combined Displacement and Collision Impacts Including Berwick Bank during the Pre-breeding Season

Scenario	Predicted Mortality (Original Impact) (no. of birds)	Growth Rate (Annual GR)	Median CPGR	Median CPS	U=50%I
NatureScot Approach - 0.993 avoidance rate, 30% displacement, 1% mortality	1,225	0.9912	0.9961	0.8703	41.40
NatureScot Approach - 0.993 avoidance rate, 30% displacement, 3% mortality	1,634	0.9899	0.9949	0.8307	38.76
Applicant's Approach - 0.993 avoidance rate, 30% displacement, 1% mortality	1,225	0.9912	0.9961	0.8702	41.16

627. When considering the impact during the breeding season on the regional population defined for the breeding season, using the NatureScot Approach (0.993 avoidance, 30% displacement and 1% to 3% mortality) and with Berwick Bank included, the PVA predicted that the CPS was between 0.591 to 0.525 (Table 11.92). The median population size was therefore projected to be 40.90% to 47.46% smaller than the unimpacted population over a 35 year time period, with a 50th centile value of 19.52 to 15.40. In terms of the population size, this means that the median of the impacted population fell within the 19th and 15th percentile of the unimpacted population (a value of 50 would indicate that they are the same). Notably, the median of the impacted population fell close to the lower boundary, between the 19th and 15th percentiles of the unimpacted population. Whilst this is within the margin of error, this proximity suggests there could be an adverse effect to the population. As outlined within volume 3, appendix 11.5, the CPGR is considered a more robust metric compared to the CPS in this analysis due to the models being conducted with density independence, in line with NatureScot (2023k) guidance. The PVA model predicted that the CPGR was between 0.986 to 0.982 (Table 11.92) which translates to a median reduction of 1.45% to 1.77% in population growth rate after 35 years. Such a decrease indicates that this level of impact would adversely affect the population.

628. When considering the impact during the breeding season on the regional population defined for the breeding season, using the Applicant's displacement rates and the NatureScot avoidance rates (0.993 avoidance, 30% displacement and 1% mortality) and with Berwick Bank Included, the PVA predicted that the CPS was 0.591 (Table 11.92). The median population size was therefore projected to be 40.90% smaller than the unimpacted population over a 35 year time period, with a 50th centile value of 19.56. In terms of the population size, this means that the median of the impacted population fell within the 19th percentile of the unimpacted population (a value of 50 would indicate that they are the same). Notably, the median of the impacted population fell close to the lower boundary, between the 19th percentile of the unimpacted population. Whilst this is within the margin of error, this proximity suggests there could be an adverse effect to the population. As stated, the CPGR is considered a more robust metric compared to the CPS in this analysis due to the models being conducted with density independence, in line with NatureScot (2023k) guidance. The PVA model predicted that the CPGR was 0.986 (Table 11.92) which translates to a median reduction of 1.45% in population growth rate after 35 years. Such a decrease indicates that this level of impact would adversely affect the population.

Table 11.92: Kittiwake 35 Year Cumulative PVA Results for Combined Displacement and Collision Impacts Including Berwick Bank during the Breeding Season

Scenario	Predicted Mortality (Original Impact) (no. of birds)	Growth Rate (Annual GR)	Median CPGR	Median CPS	U=50%I
NatureScot Approach - 0.993 avoidance rate, 30% displacement, 1% mortality	1,703	0.9807	0.9855	0.5910	19.52
NatureScot Approach - 0.993 avoidance rate, 30% displacement, 3% mortality	2,080	0.9774	0.9823	0.5254	15.40
Applicant's Approach - 0.993 avoidance rate, 30% displacement, 1% mortality	1,703	0.9806	0.9855	0.5910	19.56

629. When considering the impact during the post-breeding season on the regional population defined for the post-breeding season, using the most extreme NatureScot scenario (0.993 avoidance, 30% displacement and 3% mortality) and with Berwick Bank included, the PVA predicted that the CPS was 0.854 (Table 11.93). The median population size was therefore projected to be 14.64% smaller than the unimpacted population over a 35 year time period, with a 50th centile value of 40.20. In terms of the population size, this means that the median of the impacted population fell within the 40th percentile of the unimpacted population (a value of 50 would indicate that they are the same). This suggests that the impacted scenario was still within the margin of error of the non-impacted scenario, and therefore there would likely be no adverse effect to the population. However, as stated, the CPGR is considered a more robust metric compared to the CPS in this analysis due to the models being conducted with density independence, in line with NatureScot (2023k) guidance. The PVA model predicted that the CPGR was 0.996 (Table 11.93) which translates to a median reduction of 0.44% in population growth rate after 35 years. Such a decrease indicates that this level of impact would not adversely affect the population and would likely remain undetectable against natural population fluctuations. Furthermore, it is not expected to significantly alter the background mortality rate.

Table 11.93: Kittiwake 35 Year Cumulative PVA Results for Combined Displacement and Collision Impacts Including Berwick Bank during the Post-breeding Season

Scenario	Predicted Mortality (Original Impact) (no. of birds)	Growth Rate (Annual GR)	Median CPGR	Median CPS	U=50%I
NatureScot Approach - 0.993 avoidance rate, 30% displacement, 3% mortality	1,781	0.9907	0.9956	0.8536	40.2

630. When considering the annual impact on the annual regional population, using the NatureScot Approach (0.993 avoidance, 30% displacement and 1% to 3% mortality) and with Berwick Bank included, the PVA predicted that the CPS was between 0.687 to 0.612 (Table 11.94). The median population size was therefore projected to be between 31.28% to 38.78% smaller than the unimpacted population over a 35 year time period, with a 50th centile value of 28.12 to 22.92. In terms of the population size, this means that the median of the impacted population fell within the 28th and 22nd percentile of the unimpacted population (a value of 50 would indicate that they are the same). This suggests that the impacted scenario was still within the margin of error of the non-impacted scenario, and therefore there would likely be no adverse effect to the population. However, as stated, the CPGR is considered a more robust metric compared to the CPS in this analysis due to the models being conducted with density independence, in line with NatureScot (2023k) guidance. The PVA model predicted that the CPGR was between 0.990 to 0.987 (Table 11.94) which translates to a median reduction of 1.04% to 1.35% in population growth rate after 35 years. Under the most extreme NatureScot scenario of 30% displacement and 3% mortality alongside collision, this level of impact indicates that there could be an adverse affect on the population.

631. When considering the annual impact on the annual regional population, using the Applicant's displacement rate and the NatureScot avoidance rates (0.993 avoidance, 30% displacement and 1% mortality) and with Berwick Bank included, the PVA predicted that the CPS was 0.687 (Table 11.94). The median population size was therefore projected to be 31.28% smaller than the unimpacted population over a 35 year time period, with a 50th centile value of 28.08 In terms of the population size, this means that the median of the impacted population fell within the 28th percentile of the unimpacted population (a value of 50 would indicate that they are the same). This suggests that the impacted scenario was still within the margin of error of the non-impacted scenario, and therefore there would likely be no adverse effect to the population. However, as stated, the CPGR is considered a more robust metric compared to the CPS in this analysis due to the models being conducted with density independence, in line with NatureScot (2023k) guidance. The PVA model predicted that the CPGR was 0.990 (Table 11.94) which translates to a median reduction of 1.04% in population growth rate after 35 years. Such a decrease indicates that this level of impact would not adversely affect the population and would only result in a slight reduction in the growth rate currently seen in the BDMPS population and would therefore be undetectable against natural population fluctuations. Furthermore, it is not expected to significantly alter the background mortality rate.

Table 11.94: Kittiwake 35 Year Cumulative PVA Results for Combined Displacement and Collision Impacts Including Berwick Bank on an Annual Basis

Scenario	Predicted Mortality (Original Impact) (no. of birds)	Growth Rate (Annual GR)	Median CPGR	Median CPS	U=50%I
NatureScot Approach - 0.993 avoidance rate, 30% displacement, 1% mortality	4,213	0.9847	0.9896	0.6872	28.12
NatureScot Approach - 0.993 avoidance rate, 30% displacement, 3% mortality	5,495	0.9816	0.9865	0.6122	22.92
Applicant's Approach - 0.993 avoidance rate, 30% displacement, 1% mortality	4,213	0.9847	0.9896	0.6872	28.08

PVA Assessment Excluding Berwick Bank

632. When considering the impact during the pre-breeding season on the regional population defined for the pre-breeding season, using the NatureScot Approach (0.993 avoidance, 30% displacement and 1% to 3% mortality) and with Berwick Bank excluded, the PVA predicted that the CPS was between 0.892 to 0.860

(Table 11.95). The median population size was therefore projected to be 10.79% to 14.02% smaller than the unimpacted population over a 35 year time period, with a 50th centile value of 43.04 to 40.68. In terms of the population size, this means that the median of the impacted population fell within the 43rd and 40th percentile of the unimpacted population (a value of 50 would indicate that they are the same). This suggests that the impacted scenario was still within the margin of error of the non-impacted scenario, and therefore there would likely be no adverse effect to the population. However, as stated, the CPGR is considered a more robust metric compared to the CPS in this analysis due to the models being conducted with density independence, in line with NatureScot (2023k) guidance. The PVA model predicted that the CPGR was between 0.997 to 0.996 (Table 11.95) which translates to a median reduction of 0.32% to 0.42% in population growth rate after 35 years. Such a decrease indicates that this level of impact would not adversely affect the population and would likely remain undetectable against natural population fluctuations. Furthermore, it is not expected to significantly alter the background mortality rate.

633. When considering the impact during the pre-breeding season on the regional population defined for the pre-breeding season, using the Applicant's displacement rates and the NatureScot avoidance rates (0.993 avoidance, 30% displacement and 1% mortality) and with Berwick Bank excluded, the PVA predicted that the CPS was 0.892 (Table 11.95). The median population size was therefore projected to be 10.77% smaller than the unimpacted population over a 35 year time period, with a 50th centile value of 43.24. In terms of the population size, this means that the median of the impacted population fell within the 43rd percentile of the unimpacted population (a value of 50 would indicate that they are the same). This suggests that the impacted scenario was still within the margin of error of the non-impacted scenario, and therefore there would likely be no adverse effect to the population. However, as stated, the CPGR is considered a more robust metric compared to the CPS in this analysis due to the models being conducted with density independence, in line with NatureScot (2023k) guidance. The PVA model predicted that the CPGR was 0.997 (Table 11.95) which translates to a median reduction of 0.32% in population growth rate after 35 years. Such a decrease indicates that this level of impact would not adversely affect the population and would likely remain undetectable against natural population fluctuations. Furthermore, it is not expected to significantly alter the background mortality rate.

Table 11.95: Kittiwake 35 Year Cumulative PVA Results for Combined Displacement and Collision Impacts Excluding Berwick Bank during the Pre-breeding Season

Scenario	Predicted Mortality (Original Impact) (no. of birds)	Growth Rate (Annual GR)	Median CPGR	Median CPS	U=50%I
NatureScot Approach - 0.993 avoidance rate, 30% displacement, 1% mortality	1,005	0.9919	0.9968	0.8921	43.04
NatureScot Approach - 0.993 avoidance rate, 30% displacement, 3% mortality	1,331	0.9909	0.9958	0.8598	40.68
Applicant's Approach - 0.993 avoidance rate, 30% displacement, 1% mortality	1,005	0.9919	0.9968	0.8923	43.24

634. When considering the impact during the breeding season on the regional population defined for the breeding season, using the NatureScot Approach (0.993 avoidance, 30% displacement and 1% to 3% mortality) and with Berwick Bank excluded, the PVA predicted that the CPS was between 0.730 to 0.675 (Table 11.96). The median population size was therefore projected to be 27.02% to 32.46% smaller than the unimpacted population over a 35 year time period, with a 50th centile value of 30.04 to 26.00. In terms of the population size, this means that the median of the impacted population fell within the 30th and 26th percentile of the unimpacted population (a value of 50 would indicate that they are the same). This suggests that the impacted scenario was still within the margin of error of the non-impacted scenario, and therefore there would likely be no adverse effect to the population. As outlined within volume 3, appendix 11.5, the CPGR is considered a more robust metric compared to the CPS in this analysis due to the models being conducted with density independence, in line with NatureScot (2023k) guidance. The PVA model predicted that the CPGR was between 0.991 to 0.989 (Table 11.96) which translates to a median reduction of 0.87% to 1.08% in population growth rate after 35 years. Such a decrease indicates that this level of impact would not adversely affect the population and would only result in a slight reduction in the growth rate currently seen in the BDMPS population and would therefore be undetectable against natural population fluctuations. Furthermore, it is not expected to significantly alter the background mortality rate.

635. When considering the impact during the breeding season on the regional population defined for the breeding season, using the Applicant's displacement rates and the NatureScot avoidance rates (0.993 avoidance, 30% displacement and 1% mortality) and with Berwick Bank excluded, the PVA predicted that the CPS was 0.730 (Table 11.96). The median population size was therefore projected to be 26.99% smaller than the unimpacted population over a 35 year time period, with a 50th centile value of 30.12. In terms of the population size, this means that the median of the impacted population fell within the 30th percentile of the unimpacted population (a value of 50 would indicate that they are the same). This suggests that the impacted scenario was still within the margin of error of the non-impacted scenario, and therefore there would likely be no adverse effect to the population. As stated, the CPGR is considered a more robust metric compared to the CPS in this analysis due to the models being conducted with density independence, in line with NatureScot (2023k) guidance. The PVA model predicted that the CPGR was 0.991 (Table 11.96) which translates to a median reduction of 0.87% in population growth rate after 35 years. Such a decrease indicates that this level of impact would not adversely affect the population and would only result in a slight reduction in the growth rate currently seen in the BDMPS population and would therefore be undetectable against natural population fluctuations. Furthermore, it is not expected to significantly alter the background mortality rate.

Table 11.96: Kittiwake 35 Year Cumulative PVA Results for Combined Displacement and Collision Impacts Excluding Berwick Bank during the Breeding Season

Scenario	Predicted Mortality (Original Impact) (no. of birds)	Growth Rate (Annual GR)	Median CPGR	Median CPS	U=50%I
NatureScot Approach - 0.993 avoidance rate, 30% displacement, 1% mortality	1,023	0.9863	0.9913	0.7298	30.04
NatureScot Approach - 0.993 avoidance rate, 30% displacement, 3% mortality	1,273	0.9843	0.9892	0.6754	26.00
Applicant's Approach - 0.993 avoidance rate, 30% displacement, 1% mortality	1,023	0.9864	0.9913	0.7301	30.12

636. When considering the impact during the post-breeding season on the regional population defined for the post-breeding season, using the most extreme NatureScot scenario (0.993 avoidance, 30% displacement and 3% mortality) and with Berwick Bank excluded, the PVA predicted that the CPS was 0.876 (Table

11.97). The median population size was therefore projected to be 12.37% smaller than the unimpacted population over a 35 year time period, with a 50th centile value of 42.20. In terms of the population size, this means that the median of the impacted population fell within the 42nd percentile of the unimpacted population (a value of 50 would indicate that they are the same). This suggests that the impacted scenario was still within the margin of error of the non-impacted scenario, and therefore there would likely be no adverse effect to the population. However, as stated, the CPGR is considered a more robust metric compared to the CPS in this analysis due to the models being conducted with density independence, in line with NatureScot (2023k) guidance. The PVA model predicted that the CPGR was 0.996 (Table 11.97) which translates to a median reduction of 0.37% in population growth rate after 35 years. Such a decrease indicates that this level of impact would not adversely affect the population and would likely remain undetectable against natural population fluctuations. Furthermore, it is not expected to significantly alter the background mortality rate.

Table 11.97: Kittiwake 35 Year Cumulative PVA Results for Combined Displacement and Collision Impacts Excluding Berwick Bank during the Post-breeding Season

Scenario	Predicted Mortality (Original Impact) (no. of birds)	Growth Rate (Annual GR)	Median CPGR	Median CPS	U=50%I
NatureScot Approach - 0.993 avoidance rate, 30% displacement, 3% mortality	1,490	0.9914	0.9963	0.8763	42.20

637. When considering the annual impact on the annual regional population, using the NatureScot Approach (0.993 avoidance, 30% displacement and 1% to 3% mortality) and with Berwick Bank excluded, the PVA predicted that the CPS was between 0.760 to 0.694 (Table 11.98). The median population size was therefore projected to be between 24.02% to 30.56% smaller than the unimpacted population over a 35 year time period, with a 50th centile value of 33.60 to 28.68. In terms of the population size, this means that the median of the impacted population fell within the 33rd and 28th percentile of the unimpacted population (a value of 50 would indicate that they are the same). This suggests that the impacted scenario was still within the margin of error of the non-impacted scenario, and therefore there would likely be no adverse effect to the population. However, as stated, the CPGR is considered a more robust metric compared to the CPS in this analysis due to the models being conducted with density independence, in line with NatureScot (2023k) guidance. The PVA model predicted that the CPGR was between 0.992 to 0.990 (Table 11.98) which translates to a median reduction of 0.76% to 1.01% in population growth rate after 35 years. Such a decrease indicates that this level of impact would not adversely affect the population and would only result in a slight reduction in the growth rate currently seen in the BDMPS population and would therefore be undetectable against natural population fluctuations. Furthermore, it is not expected to significantly alter the background mortality rate.

638. When considering the annual impact on the annual regional population, using the Applicant's displacement rate and the NatureScot avoidance rates (0.993 avoidance, 30% displacement and 1% mortality) and with Berwick Bank excluded, the PVA predicted that the CPS was 0.760 (Table 11.98). The median population size was therefore projected to be 24.02% smaller than the unimpacted population over a 35 year time period, with a 50th centile value of 33.12. In terms of the population size, this means that the median of the impacted population fell within the 33rd percentile of the unimpacted population (a value of 50 would indicate that they are the same). This suggests that the impacted scenario was still within the margin of error of the non-impacted scenario, and therefore there would likely be no adverse effect to the population. However, as stated, the CPGR is considered a more robust metric compared to the CPS in this analysis due to the models being conducted with density independence, in line with NatureScot (2023k) guidance. The PVA model predicted that the CPGR was 0.992 (Table 11.98) which translates to a median reduction of 0.76% in population growth rate after 35 years. Such a decrease indicates that this level of impact would not adversely affect the population and would only result in a slight reduction in the growth rate currently seen in the BDMPS population and would therefore be undetectable against natural population fluctuations. Furthermore, it is not expected to significantly alter the background mortality rate.

Table 11.98: Kittiwake 35 Year Cumulative PVA Results for Combined Displacement and Collision Impacts Including Berwick Bank on an Annual Basis

Scenario	Predicted Mortality (Original Impact) (no. of birds)	Growth Rate (Annual GR)	Median CPGR	Median CPS	U=50%I
NatureScot Approach - 0.993 avoidance rate, 30% displacement, 1% mortality	3,089	0.9875	0.9924	0.7598	33.60
NatureScot Approach - 0.993 avoidance rate, 30% displacement, 3% mortality	4,094	0.9850	0.9899	0.6944	28.68
Applicant's Approach - 0.993 avoidance rate, 30% displacement, 1% mortality	3,089	0.9875	0.9924	0.7598	33.12

Magnitude of impact

639. When considering both displacement and collision impacts in line with NatureScot guidance, there's a potential for double counting as a bird that is displaced cannot simultaneously experience collision. Therefore, it is likely that impacts provided within Table 11.89 to Table 11.90 are overestimates. As kittiwake experience around 30% displacement, collision numbers should be reduced by around 30%.

640. Information surrounding kittiwake displacement is also limited and so it is unclear if kittiwake do indeed experience displacement effects and hence the numbers within Table 11.89 to Table 11.90 could be overestimates. If displacement is not included within the cumulative impacts or if displacement is accounted for (thus then reducing density within the wind farm and therefore reduce the number of collision), the magnitude of the impact is said to be low.

641. Given the decline in kittiwake populations within the UK reported by Burnell *et al*. (2023), attributed to various pressures such as diminished prey resources impacting productivity (Furness and Tasker, 2000; Frederiksen *et al*., 2008; Carroll *et al*., 2017), and challenges from climate change (Heath *et al*., 2012), it is imperative that offshore wind farms do not exacerbate this decline further.

642. Based on the PVA results for the pre-breeding season with Berwick Bank included and following the NatureScot Approach using a 0.993 avoidance rate and a 30% displacement and 3% mortality rate, the impact from the cumulative assessment on the kittiwake population is considered to be of low magnitude

643. Based on the PVA results for the pre-breeding season with Berwick Bank included and following the NatureScot Approach using a 0.993 avoidance rate and a 30% displacement and 1% mortality rate, the impact from the cumulative assessment on the kittiwake population is considered to be of low magnitude.

644. Based on the PVA results for the pre-breeding season with Berwick Bank included and following the Applicant Approach using a 30% displacement and 1% mortality rate and using the NatureScot avoidance

rate of 0.993, the impact from the cumulative assessment on the kittiwake population is considered to be of low magnitude.

645. Based on the PVA results for the breeding season with Berwick Bank included and following the NatureScot Approach using a 0.993 avoidance rate and a 30% displacement and 3% mortality rate, the impact from the cumulative assessment on the kittiwake population is considered to be of medium magnitude

646. Based on the PVA results for the breeding season with Berwick Bank included and following the NatureScot Approach using a 0.993 avoidance rate and a 30% displacement and 1% mortality rate, the impact from the cumulative assessment on the kittiwake population is considered to be of medium magnitude.

647. Based on the PVA results for the breeding season with Berwick Bank included and following the Applicant Approach using a 30% displacement and 1% mortality rate and using the NatureScot avoidance rate of 0.993, the impact from the cumulative assessment on the kittiwake population is considered to be of medium magnitude.

648. Based on the PVA results for the post-breeding season with Berwick Bank included and following the NatureScot Approach using a 0.993 avoidance rate and a 30% displacement and 3% mortality rate, the impact from the cumulative assessment on the kittiwake population is considered to be of low magnitude.

649. Based on the combined displacement and collision assessment for the post-breeding season with Berwick Bank included and following the NatureScot Approach using a 0.993 avoidance rate and a 30% displacement and 1% mortality rate, the impact from the cumulative assessment on the kittiwake population is considered to be of low magnitude.

650. Based on the combined displacement and collision assessment for the post-breeding season with Berwick Bank included and following the Applicant Approach using a 30% displacement and 1% mortality rate and using the NatureScot avoidance rate of 0.993, the impact from the cumulative assessment on the kittiwake population is considered to be of low magnitude.

651. Based on the PVA results, on an annual basis with Berwick Bank included and following the NatureScot Approach using a 0.993 avoidance rate and a 30% displacement and 3% mortality rate, the impact from the cumulative assessment on the kittiwake population is considered to be of medium magnitude.

652. Based on the PVA results, on an annual basis with Berwick Bank included and following the NatureScot Approach using a 0.993 avoidance rate and a 30% displacement and 1% mortality rate, the impact from the cumulative assessment on the kittiwake population is considered to be of low magnitude.

653. Based on the PVA results, on an annual basis with Berwick Bank included and following the Applicant Approach using a 30% displacement and 1% mortality rate and using the NatureScot avoidance rate of 0.993, the impact from the cumulative assessment on the kittiwake population is considered to be of low magnitude.

654. Based on the PVA results for the pre-breeding season with Berwick Bank excluded and following the NatureScot Approach using a 0.993 avoidance rate and a 30% displacement and 3% mortality rate, the impact from the cumulative assessment on the kittiwake population is considered to be of low magnitude

655. Based on the PVA results for the pre-breeding season with Berwick Bank excluded and following the NatureScot Approach using a 0.993 avoidance rate and a 30% displacement and 1% mortality rate, the impact from the cumulative assessment on the kittiwake population is considered to be of low magnitude.

656. Based on the PVA results for the pre-breeding season with Berwick Bank excluded and following the Applicant Approach using a 30% displacement and 1% mortality rate and using the NatureScot avoidance rate of 0.993, the impact from the cumulative assessment on the kittiwake population is considered to be of low magnitude.

657. Based on the PVA results for the breeding season with Berwick Bank excluded and following the NatureScot Approach using a 0.993 avoidance rate and a 30% displacement and 3% mortality rate, the impact from the cumulative assessment on the kittiwake population is considered to be of low magnitude.

658. Based on the PVA results for the breeding season with Berwick Bank excluded and following the NatureScot Approach using a 0.993 avoidance rate and a 30% displacement and 1% mortality rate, the impact from the cumulative assessment on the kittiwake population is considered to be of low magnitude.

659. Based on the PVA results for the breeding season with Berwick Bank excluded and following the Applicant Approach using a 30% displacement and 1% mortality rate and using the NatureScot avoidance rate of 0.993, the impact from the cumulative assessment on the kittiwake population is considered to be of low magnitude.

660. Based on the PVA results for the post-breeding season with Berwick Bank excluded and following the NatureScot Approach using a 0.993 avoidance rate and a 30% displacement and 3% mortality rate, the impact from the cumulative assessment on the kittiwake population is considered to be of low magnitude.

661. Based on the combined displacement and collision assessment for the post-breeding season with Berwick Bank excluded and following the NatureScot Approach using a 0.993 avoidance rate and a 30% displacement and 1% mortality rate, the impact from the cumulative assessment on the kittiwake population is considered to be of low magnitude.

662. Based on the combined displacement and collision assessment for the post-breeding season with Berwick Bank excluded and following the Applicant Approach using a 30% displacement and 1% mortality rate and using the NatureScot avoidance rate of 0.993, the impact from the cumulative assessment on the kittiwake population is considered to be of low magnitude.

663. Based on the PVA results, on an annual basis with Berwick Bank excluded and following the NatureScot Approach using a 0.993 avoidance rate and a 30% displacement and 3% mortality rate, the impact from the cumulative assessment on the kittiwake population is considered to be of low magnitude.

664. Based on the PVA results, on an annual basis with Berwick Bank excluded and following the NatureScot Approach using a 0.993 avoidance rate and a 30% displacement and 1% mortality rate, the impact from the cumulative assessment on the kittiwake population is considered to be of low magnitude.

665. Based on the PVA results, on an annual basis with Berwick Bank excluded and following the Applicant Approach using a 30% displacement and 1% mortality rate and using the NatureScot avoidance rate of 0.993, the impact from the cumulative assessment on the kittiwake population is considered to be of low magnitude.

666. The predicted impact with Berwick Bank included during the breeding season, using both the NatureScot and Applicant's Approach, would result in a medium magnitude of impact, which is significant in EIA terms. However, if Berwick Bank is excluded, the cumulative impact on kittiwake populations from the remaining surrounding wind farms would result in a low magnitude of impact, deemed not significant in EIA terms.

667. The cumulative effect is predicted to be of national spatial extent, long-term duration, continuous and high reversibility. It is predicted that the impact will affect the receptor directly. With Berwick Bank included, the magnitude is considered to be medium. With Berwick Bank excluded, the magnitude is considered to be low.

Sensitivity of the receptor

668. Kittiwake were assessed as having low vulnerability to displacement impacts but higher vulnerability to collision impacts, and therefore considered to have medium vulnerability to the combined impact of displacement and collision.

669. Kittiwake lay two eggs and breed from the age of three onwards, typically living on average for 12 years (Burnell *et al*., 2023). Kittiwake have undergone decreases of approximately 57% in Scotland since the early 2000s. Surveys managed by the RSPB in 2023 have recorded indicative increases of 8% across a number of sites in Britain in 2023 when compared against a pre-HPAI baseline (Tremlett *et al*., 2024). Overall, kittiwake is deemed to have low recoverability.

670. Kittiwake is a qualifying interest for several SPAs likely to be connected to the Array (within the mean-max + SD foraging range), with several non-SPA colonies also within range and so the species is considered to be of international conservation value. Refer to table 6.2 of volume 3, appendix 11.1 for details of SPAs with connectivity to the Array with regards to kittiwake.

671. Kittiwake is deemed to be of medium vulnerability, low recoverability and international value. The sensitivity of the receptor is therefore considered to be high.

Significance of the effect

672. Overall, the magnitude of the impact with Berwick Bank included is deemed to be medium and the sensitivity of the receptor is considered to be high. The effect will, therefore, be of moderate to major adverse significance, which is significant in EIA terms. However, as the PVA results indicated that the magnitude was medium, the impact is considered moderate. It is therefore deemed appropriate to categorise the impact as having a **moderate** adverse significance, which is significant in EIA terms.

673. The magnitude of the impact with Berwick Bank excluded is deemed to be low and the sensitivity of the receptor is considered to be high. The effect will, therefore, be of minor to moderate adverse significance. However, as PVA results indicated a low impact without Berwick Bank, the impact is considered minor. It is therefore deemed appropriate to categorise the impact as having a **minor** adverse significance, which is not significant in EIA terms.

Further mitigation and residual effect

674. No offshore ornithology mitigation is considered necessary because the likely effect in the absence of further mitigation (beyond the designed in measures outlined in section 11.10) is not significant in EIA terms.

Gannet

675. The combined cumulative collision and displacement mortality is given in Table 11.99 (with Berwick Bank included) and Table 11.100 (with Berwick Bank excluded). Displacement mortality is calculated using 70% displacement and a range of 1% to 3% mortality in all seasons, in line with guidance (NatureScot, 2023h). Additionally, the Applicant's Approach which utilises a 70% displacement rate and 1% mortality rate is presented.

Table 11.99: Gannet Combined Cumulative Displacement and Collision Mortality Estimates Inclusive of Berwick Bank

Season	Regional Baseline		Cumulative Displacement and Collision Mortality (Applicant's Approach)	Cumulative Displacement and Collision Mortality (NatureScot Approach)	Increase in Baseline Mortality (Applicant's Approach) (%)	Increase in Baseline Mortality (NatureScot Approach) (%)
	Population	Baseline Mortality				
Pre-breeding	248,385	47,864	283	283 to 369	0.591	0.591 to 0.771
Breeding	763,577	147,141	1,256	1,256 to 1,662	0.853	0.853 to 1.130
Post-breeding	456,298	87,945	855	855 to 1,218	0.972	0.972 to 1.385
Annual	**763,577**	**147,141**	**2,394**	**2,394 to 3,249**	**1.627**	**1.627 to 2.208**

676. With Berwick Bank, the estimated combined displacement and collision mortality for gannet, following the NatureScot Approach, is 283 to 369 individuals in the pre-breeding season, 1,256 to 1,662 individuals in the breeding season and 855 to 1,218 individuals in the post-breeding season. This is equivalent to an increase in baseline mortality of 0.59% to 0.77% in the pre-breeding season, 0.85% to 1.13% in the breeding season and 0.97% to 1.39% in the post-breeding season. On an annual basis, the number of mortalities is estimated as 2,394 to 3,249 individuals, which equates to an increase in baseline mortality of 1.63% to 2.21% (Table 11.99).

677. When following the Applicant's Approach, the estimated combined displacement and collision mortality with Berwick Bank, for gannet is 283 individuals in the pre-breeding season, 1,256 individuals in the breeding season and 855 individuals in the post-breeding season. This is equivalent to an increase in baseline mortality of 0.59% in the pre-breeding season, 0.85% in the breeding season and 0.97% in the post-breeding season. On an annual basis, the number of mortalities is estimated as 2,394 individuals, which equates to an increase in baseline mortality of 1.63%.

Table 11.100: Gannet Combined Cumulative Displacement and Collision Mortality Estimates Exclusive of Berwick Bank

Season	Regional Baseline		Cumulative Displacement and Collision Mortality (Applicant's Approach)	Cumulative Displacement and Collision Mortality (NatureScot Approach)	Increase in Baseline Mortality (Applicant's Approach) (%)	Increase in Baseline Mortality (NatureScot Approach) (%)
	Population	Baseline Mortality				
Pre-breeding	248,385	47,864	278	278 to 360	0.581	0.581 to 0.753
Breeding	763,577	147,141	1,053	1,053 to 1,393	0.715	0.715 to 0.947
Post-breeding	456,298	87,945	826	826 to 1,169	0.940	0.940 to 1.329
Annual	**763,577**	**147,141**	**2,157**	**2,157 to 2,922**	**1.466**	**1.466 to 1.986**

678. Without Berwick Bank, the estimated combined displacement and collision mortality for gannet, following the NatureScot Approach, is 278 to 360 individuals in the pre-breeding season, 1,053 to 1,393 individuals in the breeding season and 826 to 1,169 individuals in the post-breeding season. This is equivalent to an increase in baseline mortality of 0.58% to 0.75% in the pre-breeding season, 0.72% to 0.95% in the breeding season and 0.94% to 1.33% in the post-breeding season. On an annual basis, the number of mortalities is estimated as 1,466 to 1,986 individuals, which equates to an increase in baseline mortality of 1.47% to 1.99% (Table 11.100).

679. The cumulative combined displacement and collision mortality represents an increase in mortality of over 1% of baseline mortality, both with and without Berwick Bank. Therefore, to further assess the significance of this effect, a PVA has been carried out for gannet as described in volume 3, appendix 11.5.

PVA Assessment Including Berwick Bank

680. When considering the impact during the breeding season on the regional population defined for the breeding season, using the most extreme NatureScot scenario (0.993 avoidance, 70% displacement and 3% mortality) and with Berwick Bank included, the PVA predicted that the CPS was 0.846 (Table 11.101). The median population size was therefore projected to be 15.43% smaller than the unimpacted population over a 35 year time period, with a 50th centile value of 23.76. In terms of the population size, this means that the median of the impacted population fell within the 23rd percentile of the unimpacted population (a value of 50 would indicate that they are the same). This suggests that the impacted scenario was still

within the margin of error of the non-impacted scenario, and therefore there would likely be no adverse effect to the population. However, as stated, the CPGR is considered a more robust metric compared to the CPS in this analysis due to the models being conducted with density independence, in line with NatureScot (2023k) guidance. The PVA model predicted that the CPGR was 0.995 (Table 11.101) which translates to a median reduction of 0.46% in population growth rate after 35 years. Such a decrease indicates that this level of impact would not adversely affect the population and would likely remain undetectable against natural population fluctuations. Furthermore, it is not expected to significantly alter the background mortality rate.

Table 11.101: Gannet 35 Year Cumulative PVA Results for Combined Displacement and Collision Impacts Including Berwick Bank during the Breeding Season

Scenario	Predicted Mortality (Original Impact) (no. of birds)	Growth Rate (Annual GR)	Median CPGR	Median CPS	U=50%I
NatureScot Approach – 0.993 avoidance rate, 70% displacement, 3% mortality	1,662	1.0074	0.9954	0.8457	23.76

681. When considering the impact during the post-breeding season on the regional population defined for the post-breeding season, using the NatureScot scenarios (0.993 avoidance, 70% displacement and 1% to 3% mortality) and with Berwick Bank included, the PVA predicted that the CPS was 0.807 (Table 11.102). The median population size was therefore projected to be 19.26% smaller than the unimpacted population over a 35 year time period, with a 50th centile value of 19.72. In terms of the population size, this means that the median of the impacted population fell within the 19th percentile of the unimpacted population (a value of 50 would indicate that they are the same). This suggests that under a 70% displacement and 1% mortality rate alongside collision, the impacted scenario was still within the margin of error of the non-impacted scenario, and therefore there would likely be no adverse effect to the population. A percentile of 19 suggests that an adverse effect could occur. However, as stated, the CPGR is considered a more robust metric compared to the CPS in this analysis due to the models being conducted with density independence, in line with NatureScot (2023k) guidance. The PVA model predicted that the CPGR was 0.994 (Table 11.102) which translates to a median reduction of between 0.59% in population growth rate after 35 years. Such a decrease indicates that this level of impact would not adversely affect the population and would likely remain undetectable against natural population fluctuations. Furthermore, it is not expected to significantly alter the background mortality rate.

Table 11.102: Gannet 35 Year Cumulative PVA Results for Combined Displacement and Collision Impacts Including Berwick Bank during the Post-breeding Season

Scenario	Predicted Mortality (Original Impact) (no. of birds)	Growth Rate (Annual GR)	Median CPGR	Median CPS	U=50%I
NatureScot Approach – 0.993 avoidance rate, 70% displacement, 3% mortality	1,218	1.0061	0.9941	0.8074	19.72

682. When considering the annual impact on the annual regional population, using the NatureScot Approach (0.993 avoidance, 70% displacement and 1% to 3% mortality) and with Berwick Bank included, the PVA predicted that the CPS was between 0.785 to 0.720 (Table 11.103). The median population size was therefore projected to be between 21.46% to 27.98% smaller than the unimpacted population over a 35 year time period, with a 50th centile value of 15.80 to 9.64. In terms of the population size, this means that the median of the impacted population fell within the 15th and 9th percentile of the unimpacted population (a value of 50 would indicate that they are the same). Notably, the median of the impacted population fell close to the lower boundary, between the 15th and 9th percentiles of the unimpacted population. Whilst this is within the margin of error, this proximity suggests there could be an adverse effect to the population. However, as stated, the CPGR is considered a more robust metric compared to the CPS in this analysis due to the models being conducted with density independence, in line with NatureScot (2023k) guidance. The PVA model predicted that the CPGR was between 0.993 to 0.991 (Table 11.103) which translates to a median reduction of 0.67% to 0.91% in population growth rate after 35 years. Such a decrease indicates that this level of impact would not adversely affect the population and would only result in a slight reduction in the growth rate currently seen in the BDMPS population and would therefore be undetectable against natural population fluctuations. Furthermore, it is not expected to significantly alter the background mortality rate.

683. When considering the annual impact on the annual regional population, using the Applicant's displacement rate and the NatureScot avoidance rates (0.993 avoidance, 70% displacement and 1% mortality) and with Berwick Bank included, the PVA predicted that the CPS was 0.785 (Table 11.103). The median population size was therefore projected to be 21.47% smaller than the unimpacted population over a 35 year time period, with a 50th centile value of 15.88. In terms of the population size, this means that the median of the impacted population fell within the 15th percentile of the unimpacted population (a value of 50 would indicate that they are the same). Notably, the median of the impacted population fell close to the lower boundary of the 15th percentile of the unimpacted population. Whilst this is within the margin of error, this proximity suggests there could be an adverse effect to the population. However, as stated, the CPGR is considered a more robust metric compared to the CPS in this analysis due to the models being conducted with density independence, in line with NatureScot (2023k) guidance. The PVA model predicted that the CPGR was 0.993 (Table 11.103) which translates to a median reduction of 0.67% in population growth rate after 35 years. Such a decrease indicates that this level of impact would not adversely affect the population and would only result in a slight reduction in the growth rate currently seen in the BDMPS population and would therefore be undetectable against natural population fluctuations. Furthermore, it is not expected to significantly alter the background mortality rate.

Table 11.103: Gannet 35 Year Cumulative PVA Results for Combined Displacement and Collision Impacts Including Berwick Bank on an Annual Basis

Scenario	Predicted Mortality (Original Impact) (no. of birds)	Growth Rate (Annual GR)	Median CPGR	Median CPS	U=50%I
NatureScot Approach – 0.993 avoidance rate, 70% displacement, 1% mortality	2,394	1.0054	0.9933	0.7854	15.80
NatureScot Approach – 0.993 avoidance rate, 70% displacement, 3% mortality	3,249	1.0029	0.9909	0.7202	9.64
Applicant's Approach - NatureScot Approach – 0.993 avoidance rate,	2,394	1.0054	0.9933	0.7853	15.88

Scenario	Predicted Mortality (Original Impact) (no. of birds)	Growth Rate (Annual GR)	Median CPGR	Median CPS	U=50%I
70% displacement, 1% mortality					

PVA Assessment Excluding Berwick Bank

684. When considering the impact during the post-breeding season on the regional population defined for the post-breeding season, using the most extreme NatureScot scenario (0.993 avoidance, 70% displacement and 3% mortality) and with Berwick Bank excluded, the PVA predicted that the CPS was 0.814 (Table 11.104). The median population size was therefore projected to be 18.58% smaller than the unimpacted population over a 35 year time period, with a 50th centile value of 20.56. In terms of the population size, this means that the median of the impacted population fell within the 20th percentile of the unimpacted population (a value of 50 would indicate that they are the same). This suggests that the impacted scenario was still within the margin of error of the non-impacted scenario, and therefore there would likely be no adverse effect to the population. However, as stated, the CPGR is considered a more robust metric compared to the CPS in this analysis due to the models being conducted with density independence, in line with NatureScot (2023k) guidance. The PVA model predicted that the CPGR was 0.994 (Table 11.104) which translates to a median reduction of 0.57% in population growth rate after 35 years. Such a decrease indicates that this level of impact would not adversely affect the population and would likely remain undetectable against natural population fluctuations. Furthermore, it is not expected to significantly alter the background mortality rate.

Table 11.104: Gannet 35 Year Cumulative PVA Results for Combined Displacement and Collision Impacts Excluding Berwick Bank during the Post-breeding Season

Scenario	Predicted Mortality (Original Impact) (no. of birds)	Growth Rate (Annual GR)	Median CPGR	Median CPS	U=50%I
NatureScot Approach – 0.993 avoidance rate, 70% displacement, 3% mortality	1,169	1.0063	0.9943	0.8142	20.56

685. When considering the annual impact on the annual regional population, using the Applicant's Approach (0.993 avoidance, 70% displacement and 1% mortality) and with Berwick Bank excluded, the PVA predicted that the CPS was between 0.804 to 0.739 (Table 11.105). The median population size was therefore projected to be between 19.56% to 26.08% smaller than the unimpacted population over a 35 year time period, with a 50th centile value of 18.56 to 11.08. In terms of the population size, this means that the median of the impacted population fell within the 18th and 11th percentile of the unimpacted population (a value of 50 would indicate that they are the same). Notably, the median of the impacted population fell close to the lower boundary, between the 18th and 11th percentiles of the unimpacted population. Whilst this is within the margin of error, this proximity suggests there could be an adverse effect to the population. However, as stated, the CPGR is considered a more robust metric compared to the CPS in this analysis due to the models being conducted with density independence, in line with NatureScot (2023k) guidance. The PVA model predicted that the CPGR was between 0.994 to 0.992 (Table 11.105) which translates to a median reduction of 0.60% to 0.84% in population growth rate after 35 years. Such a decrease indicates that this level of impact would not adversely affect the population and would only result in a slight reduction in the growth rate currently seen in the BDMPS population and would therefore be undetectable against natural population fluctuations. Furthermore, it is not expected to significantly alter the background mortality rate.

686. When considering the annual impact on the annual regional population, using the Applicant's displacement rate and the NatureScot avoidance rates (0.993 avoidance, 70% displacement and 1% mortality) and with Berwick Bank excluded, the PVA predicted that the CPS was 0.804 (Table 11.105). The median population size was therefore projected to be 19.57% smaller than the unimpacted population over a 35 year time period, with a 50th centile value of 18.44. In terms of the population size, this means that the median of the impacted population fell within the 18th percentile of the unimpacted population (a value of 50 would indicate that they are the same). Notably, the median of the impacted population fell close to the lower boundary of the 18th percentile of the unimpacted population. Whilst this is within the margin of error, this proximity suggests there could be an adverse effect to the population. However, as stated, the CPGR is considered a more robust metric compared to the CPS in this analysis due to the models being conducted with density independence, in line with NatureScot (2023k) guidance. The PVA model predicted that the CPGR was 0.994 (Table 11.105) which translates to a median reduction of 0.60% in population growth rate after 35 years. Such a decrease indicates that this level of impact would not adversely affect the population and would only result in a slight reduction in the growth rate currently seen in the BDMPS population and would therefore be undetectable against natural population fluctuations. Furthermore, it is not expected to significantly alter the background mortality rate.

Table 11.105: Gannet 35 Year Cumulative PVA Results for Combined Displacement and Collision Impacts Including Berwick Bank on an Annual Basis

Scenario	Predicted Mortality (Original Impact) (no. of birds)	Growth Rate (Annual GR)	Median CPGR	Median CPS	U=50%I
NatureScot Approach – 0.993 avoidance rate, 70% displacement, 1% mortality	2,157	1.0060	0.9940	0.8044	18.56
NatureScot Approach – 0.993 avoidance rate, 70% displacement, 3% mortality	2,922	1.0036	0.9916	0.7392	11.08
Applicant's Approach - NatureScot Approach – 0.993 avoidance rate, 70% displacement, 1% mortality	2,157	1.0060	0.9940	0.8043	18.44

Magnitude of impact

687. When considering both displacement and collision impacts in line with NatureScot guidance, there's a potential for double counting as a bird that is displaced cannot simultaneously experience collision. Therefore, it is likely that impacts provided within Table 11.99 to Table 11.100 are overestimates. As gannet experience around 70% displacement, collision numbers should be reduced by around 70%.

688. Based on the combined displacement and collision assessment for the pre-breeding season with Berwick Bank included and following the NatureScot Approach using a 0.993 avoidance rate and a 70%

displacement and 3% mortality rate, the impact from the cumulative assessment on the gannet population is considered to be of low magnitude

689. Based on the combined displacement and collision assessment for the pre-breeding season with Berwick Bank included and following the NatureScot Approach using a 0.993 avoidance rate and a 70% displacement and 1% mortality rate, the impact from the cumulative assessment on the gannet population is considered to be of low magnitude.

690. Based on the combined displacement and collision assessment for the pre-breeding season with Berwick Bank included and following the Applicant Approach using a 70% displacement and 1% mortality rate and using the NatureScot avoidance rate of 0.993, the impact from the cumulative assessment on the gannet population is considered to be of low magnitude.

691. Based on the PVA results for the breeding season with Berwick Bank included and following the NatureScot Approach using a 0.993 avoidance rate and a 70% displacement and 3% mortality rate, the impact from the cumulative assessment on the gannet population is considered to be of low magnitude.

692. Based on the combined displacement and collision assessment for the breeding season with Berwick Bank included and following the NatureScot Approach using a 0.993 avoidance rate and a 70% displacement and 1% mortality rate, the impact from the cumulative assessment on the gannet population is considered to be of low magnitude.

693. Based on the combined displacement and collision assessment for the breeding season with Berwick Bank included and following the Applicant Approach using a 70% displacement and 1% mortality rate and using the NatureScot avoidance rate of 0.993, the impact from the cumulative assessment on the gannet population is considered to be of low magnitude.

694. Based on the PVA results for the post-breeding season with Berwick Bank included and following the NatureScot Approach using a 0.993 avoidance rate and a 70% displacement and 3% mortality rate, the impact from the cumulative assessment on the gannet population is considered to be of low magnitude.

695. Based on the combined displacement and collision assessment for the post-breeding season with Berwick Bank included and following the NatureScot Approach using a 0.993 avoidance rate and a 70% displacement and 1% mortality rate, the impact from the cumulative assessment on the gannet population is considered to be of low magnitude.

696. Based on the combined displacement and collision assessment for the post-breeding season with Berwick Bank included and following the Applicant Approach using a 70% displacement and 1% mortality rate and using the NatureScot avoidance rate of 0.993, the impact from the cumulative assessment on the gannet population is considered to be of low magnitude.

697. Based on the PVA results, on an annual basis with Berwick Bank included and following the NatureScot Approach using a 0.993 avoidance rate and a 70% displacement and 3% mortality rate, the impact from the cumulative assessment on the gannet population is considered to be of low magnitude.

698. Based on the PVA results, on an annual basis with Berwick Bank included and following the NatureScot Approach using a 0.993 avoidance rate and a 70% displacement and 1% mortality rate, the impact from the cumulative assessment on the gannet population is considered to be of low magnitude.

699. Based on the PVA results, on an annual basis with Berwick Bank included and following the Applicant Approach using a 70% displacement and 1% mortality rate and using the NatureScot avoidance rate of 0.993, the impact from the cumulative assessment on the gannet population is considered to be of low magnitude.

700. Based on the combined displacement and collision assessment for the pre-breeding season with Berwick Bank excluded and following the NatureScot Approach using a 0.993 avoidance rate and a 70% displacement and 3% mortality rate, the impact from the cumulative assessment on the gannet population is considered to be of low magnitude

701. Based on the combined displacement and collision assessment for the pre-breeding season with Berwick Bank excluded and following the NatureScot Approach using a 0.993 avoidance rate and a 70% displacement and 1% mortality rate, the impact from the cumulative assessment on the gannet population is considered to be of low magnitude.

702. Based on the combined displacement and collision assessment for the pre-breeding season with Berwick Bank excluded and following the Applicant Approach using a 70% displacement and 1% mortality rate and using the NatureScot avoidance rate of 0.993, the impact from the cumulative assessment on the gannet population is considered to be of low magnitude.

703. Based on the combined displacement and collision assessment for the breeding season with Berwick Bank excluded and following the NatureScot Approach using a 0.993 avoidance rate and a 70% displacement and 3% mortality rate, the impact from the cumulative assessment on the gannet population is considered to be of low magnitude.

704. Based on combined displacement and collision assessment results for the breeding season with Berwick Bank excluded and following the NatureScot Approach using a 0.993 avoidance rate and a 70% displacement and 1% mortality rate, the impact from the cumulative assessment on the gannet population is considered to be of low magnitude.

705. Based on the combined displacement and collision assessment for the breeding season with Berwick Bank excluded and following the Applicant Approach using a 70% displacement and 1% mortality rate and using the NatureScot avoidance rate of 0.993, the impact from the cumulative assessment on the gannet population is considered to be of low magnitude.

706. Based on the PVA results for the post-breeding season with Berwick Bank excluded and following the NatureScot Approach using a 0.993 avoidance rate and a 70% displacement and 3% mortality rate, the impact from the cumulative assessment on the gannet population is considered to be of low magnitude.

707. Based on the combined displacement and collision assessment for the post-breeding season with Berwick Bank excluded and following the NatureScot Approach using a 0.993 avoidance rate and a 70% displacement and 1% mortality rate, the impact from the cumulative assessment on the gannet population is considered to be of low magnitude.

708. Based on the combined displacement and collision assessment for the post-breeding season with Berwick Bank excluded and following the Applicant Approach using a 70% displacement and 1% mortality rate and using the NatureScot avoidance rate of 0.993, the impact from the cumulative assessment on the gannet population is considered to be of low magnitude.

709. Based on the PVA results, on an annual basis with Berwick Bank excluded and following the NatureScot Approach using a 0.993 avoidance rate and a 70% displacement and 3% mortality rate, the impact from the cumulative assessment on the gannet population is considered to be of low magnitude.

710. Based on the PVA results, on an annual basis with Berwick Bank excluded and following the NatureScot Approach using a 0.993 avoidance rate and a 70% displacement and 1% mortality rate, the impact from the cumulative assessment on the gannet population is considered to be of low magnitude.

711. Based on the PVA results, on an annual basis with Berwick Bank excluded and following the Applicant Approach using a 70% displacement and 1% mortality rate and using the NatureScot avoidance rate of 0.993, the impact from the cumulative assessment on the gannet population is considered to be of low magnitude.

712. Results from the PVA for the breeding, post-breeding season and annually concluded that the impact from the cumulative assessment with Berwick Bank included and excluded and following both the NatureScot and Applicant's Approach was perceived as low.

713. The cumulative effect is predicted to be of national spatial extent, long-term duration, continuous and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be low.

Sensitivity of the receptor

714. Gannet were assessed as having low vulnerability to displacement impacts but higher vulnerability to collision impacts, and therefore considered to have medium vulnerability to the combined impact of displacement and collision.

715. Gannet is a qualifying interest for several SPAs likely to be connected to the Array (within the mean-max + SD foraging range), with several non-SPA colonies also within range and so the species is considered to be of international value. Refer to Table 6.30 of volume 3, appendix 11.1 for details of SPAs with connectivity to the Array with regards to gannet.

716. Gannet have low reproductive potential given a typical age of first breeding of five years and typically laying only a single egg per breeding season. However, although gannet has a low reproductive potential, the species has demonstrated a consistent increasing trend in abundance since the 1990's (JNCC, 2020). It is of note that the species has suffered from the outbreak of HPAI during the 2022 breeding season (Pearce-Higgins *et al*., 2023), with declines of 25% recorded at certain sites in Britain in 2023 when compared against a pre-HPAI baseline (Tremlett *et al*., 2024). Therefore, whilst the overall population has shown steady growth, HPAI has led to some short-term declines. Therefore, overall gannet is deemed to have low recoverability.

717. Gannet is deemed to be of medium vulnerability, medium recoverability and international value. The sensitivity of the receptor is therefore considered to be high.

Significance of the effect

718. Overall, the magnitude of the impact is deemed to be low and the sensitivity of the receptor is considered to be high. The effect will, therefore, be of minor to moderate adverse significance. However, considering the pre-breeding, season mortality rates fell below 1%, along with the PVA results concluding there to be a low impact both with and without Berwick Bank and following both the NatureScot and Applicant's Approach, it is considered that **minor** adverse significance is appropriate, which is not significant in EIA terms.

Further mitigation and residual effect

719. No offshore ornithology mitigation is considered necessary because the likely effect in the absence of further mitigation (beyond the designed in measures outlined in section 11.10) is not significant in EIA terms.

11.13. PROPOSED MONITORING

720. It is not appropriate to propose specific monitoring measures at this stage. Instead, the Applicant will engage with MD-LOT, NatureScot, and other relevant key stakeholders to identify and contribute to targeted and proportionate regional or strategic monitoring to better understand the environmental effects of offshore wind taking account of known evidence gaps. This may involve engaging and contributing to ongoing strategic initiatives from ScotMER forum (Scottish Government, 2024b). These measures will be agreed with key stakeholders and will be set out in a Project Environmental Monitoring Programme (PEMP).

11.14. TRANSBOUNDARY EFFECTS

721. A screening of transboundary impacts has been carried out and any potential for significant transboundary effects with regard to offshore ornithology from the Array upon the interests of European Economic Area (EEA) states has been assessed as part of the EIA. The potential transboundary impacts are summarised below:

- Disturbance and displacement from the physical presence of wind turbines and maintenance activities.
- Collision with wind turbines.

DISTURBANCE AND DISPLACEMENT FROM THE PHYSICAL PRESENCE OF WIND TURBINES AND MAINTENANCE ACTIVITIES

722. For all other species, disturbance and displacement was determined to result in minor adverse effect at worst case. As such, transboundary impacts, which encompass wider populations and those more distant from the Array, are not expected to occur. Therefore, transboundary impacts from disturbance and displacement from the physical presence of wind turbines and maintenance activities are determined to be **negligible**, which is not significant in EIA terms.

COLLISION WITH WIND TURBINES

723. For all species, collision with wind turbines was determined to result in minor adverse effect at worst case. As such, transboundary impacts, which encompass wider populations and those more distant from the Array, are not expected to occur. Therefore, transboundary impacts from collision with wind turbines are determined to be **negligible**, which is not significant in EIA terms.

COMBINED IMPACTS – DISPLACEMENT AND COLLISION WITH WIND TURBINES

724. For kittiwake, a potentially significant effect was identified as a result of the combined impact of displacement and collision. This potentially significant effect occurred during the breeding season when most birds found within the Array would be expected to be UK-breeding birds associated with colonies on the Scottish coast and Scottish islands. The impact caused to the annual population under the NatureScot extreme scenario is a direct result of breeding season impacts. However, it is important to note that there is likely doubling up of impacts, as displaced birds will not suffer collisions. Therefore, the impacts on kittiwake populations are overestimated. On that basis, this potentially significant impact has no potential to lead to a significant transboundary effect. For gannet, the combined impact was deemed to be minor at worst case. Therefore, transboundary impacts from combined impacts from displacement and collision with wind turbines are determined to be **negligible**, which is not significant in EIA terms.

11.15. INTER-RELATED EFFECTS (AND ECOSYSTEM ASSESSMENT)

725. A description of the likely inter-related effects arising from the Array on offshore ornithology is provided in volume 2, chapter 20.

726. For offshore ornithology, the following potential impacts have been considered within the inter-related assessment:

- temporary habitat loss and disturbance;
- indirect impacts from construction/decommissioning noise;
- indirect impacts from UXO clearance;
- disturbance and displacement from the physical presence of wind turbines and maintenance activities;
- barrier to movement;
- collision with wind turbines;
- changes to prey availability; and
- entanglement.

727. Table 11.106 lists the inter-related effects (project lifetime effects) that are predicted to arise during the construction, operation and maintenance, and decommissioning phases of the Array and also the inter-related effects (receptor-led effects) that are predicted to arise for offshore ornithology receptors.

728. Effects on offshore ornithology are not expected to have secondary effects on other receptors.

Table 11.106: Summary of Potential Impacts for Offshore Ornithology from Individual Effects Occurring Across the Construction, Operation and Maintenance and Decommissioning Phases of the Array (Array Lifetime Effects) and From Multiple Effects Interacting Across all Phases (Receptor-led Effects)

Description of Impact	Phase[26] C	O	D	Likely Significant Inter-Related Effects
Array Lifetime Effects				
Temporary habitat loss and disturbance	✓	×	✓	The majority of the disturbance during construction and decommissioning will be highly localised and the habitats affected are predicted to recover quickly following completion of maintenance activities with prey species for seabirds recovering into the affected areas. Therefore, across the lifetime of the Array, the effects on seabird receptors are not anticipated to interact in such a way as to result in inter-related effects of greater significance than the assessments presented for each individual phase. As a result, the inter-related in effects are of minor adverse significance which is not significant in EIA terms.
Indirect impacts from construction/decommissioning noise	✓	×	✓	The majority of the indirect impacts during construction and decommissioning will be highly localised and temporary. Therefore, across the lifetime of the Array, the effects on seabird receptors are not anticipated to interact in such a way as to result in inter-related effects of greater significance than the assessments presented for each individual phase. As a result, the inter-related in effects are of minor adverse significance which is not significant in EIA terms.
Indirect impacts from UXO clearance	✓	×	×	The impacts from UXO clearance will be highly localised and temporary. Therefore, across the lifetime of the Array, the effects on seabird receptors are not anticipated to interact in such a way as to result in inter-related effects of greater significance than the assessments presented for each individual phase. As a result, the inter-related in effects are of minor adverse significance which is not significant in EIA terms.
Disturbance and displacement from the physical presence of wind turbines and maintenance activities	×	✓	×	This effect will only arise during the operation and maintenance phase only, therefore no likely significant inter-related effects are anticipated across the lifetime of the Array.
Barrier to movement	×	✓	×	This effect will only arise during the operation and maintenance phase only, therefore no likely significant inter-related effects are anticipated across the lifetime of the Array.
Collision with wind turbines	×	✓	×	This effect will only arise during the operation and maintenance phase only, therefore no likely significant inter-related effects are anticipated across the lifetime of the Array.
Changes to prey availability	✓	×	✓	The changes to prey availability during construction and decommissioning are expected to be temporary, with prey availability recovering rapidly. Therefore, across the lifetime of the Array, the effects on seabird receptors are not anticipated to interact in such a way as to result in inter-related effects of greater significance than the assessments presented for each individual phase. As a result, the inter-related in effects are of minor adverse significance which is not significant in EIA terms.
Entanglement	×	✓	×	This effect will arise during the operation and maintenance phase only, therefore no likely significant inter-related effects are anticipated across the lifetime of the Array.
Receptor-led effects				
For species at risk of both displacement and collision, an assessment has been included in volume 2, chapter 11. It is not expected that there is any other potential for impacts to interact to cause an additive/synergistic/antagonistic effects that may lead to a significant effect. Indirect impacts from construction/decommissioning noise, indirect impacts from UXO clearance and changes to prey availability take into account the effects on other prey receptors (i.e. shellfish, fish and benthic invertebrates) as part of their assessment. As a result, the receptor-led effects are of minor adverse significance which is not significant in EIA terms.				

[26] C = Construction, O = Operation and maintenance, D = Decommissioning

11.16. SUMMARY OF IMPACTS, MITIGATION, LIKELY SIGNIFICANT EFFECTS AND MONITORING

729. Information on offshore ornithology within the offshore ornithology study area was collected through a desktop study and site-specific DAS. An assessment of the impacts resulting from the Array has been carried out using the methodology set out in section 11.9, in line with the guidance policy and legislation set out in section 11.4 and informed through the consultation process as described in section 11.5. This information is summarised in Table 11.107 and Table 11.108

730. Table 11.107 presents a summary of the potential impacts, designed in measures and the conclusion of the magnitude of impacts in EIA terms in respect to offshore ornithology. The impacts assessed include:

- temporary habitat loss and disturbance;
- indirect impacts from construction/decommissioning noise;
- indirect impacts from UXO clearance;
- disturbance and displacement from the physical presence of wind turbines and maintenance activities;
- barrier to movement;
- collision with wind turbines;
- changes to prey availability; and
- entanglement.

731. Overall, it is concluded that there will be no significant effects arising from the Array alone during the construction, operation and maintenance or decommissioning phase.

732. Table 11.107 presents a summary of the potential impacts for the Array alone, designed in measures and the conclusion of LSE[1] on offshore ornithology in EIA terms.

733. The cumulative effects assessed include:

- disturbance and displacement from the physical presence of wind turbines and maintenance activities; and
- collision with wind turbines

734. Overall, it is concluded that there will be the following significant cumulative effects from the Array alongside other projects/plans.

- significant adverse effect on kittiwake resulting from the combined displacement and collision with wind turbines impact when Berwick Bank is included.

735. Table 11.108 presents a summary of the potential impacts from the Array cumulatively with other plans and projects, designed in measures and the conclusion of LSE[1] on offshore ornithology in EIA terms.

736. No likely significant transboundary effects have been identified in regard to effects of the Array.

Table 11.107: Summary of Likely Significant Environmental Effects, Secondary Mitigation and Monitoring of the Array Alone

Description of Impact	Phase			Magnitude of Impact	Sensitivity of Receptor	Significance of Effect	Additional Measures	Significance Residual Effect	of Proposed Monitoring
	C	O	D						
Temporary habitat loss and disturbance	✓	×	✓	Kittiwake C: Negligible D: Negligible Guillemot C: Low D: Low Razorbill C: Negligible D: Negligible Puffin C: Negligible D: Negligible Fulmar C: Negligible D: Negligible Gannet C: Negligible D: Negligible	Kittiwake C: Medium D: Medium Guillemot C: High D: High Razorbill C: Medium D: Medium Puffin C: High D: High Fulmar C: Medium D: Medium Gannet C: Medium D: Medium	Kittiwake C: Negligible to minor adverse D: Negligible to minor adverse Guillemot C: Minor adverse D: Minor adverse Razorbill C: Negligible to minor adverse D: Negligible to minor adverse Puffin C: Minor adverse D: Minor adverse Fulmar C: Negligible to minor adverse D: Negligible to minor adverse Gannet C: Negligible to minor adverse D: Negligible to minor adverse	None required	Kittiwake C: Not significant D: Not significant Guillemot C: Not significant D: Not significant Razorbill C: Not significant D: Not significant Puffin C: Not significant D: Not significant Fulmar C: Not significant D: Not significant Gannet C: Not significant D: Not significant	N/A
Indirect impacts from construction/decommissioning noise	✓	×	✓	All receptors: C: Negligible D: Negligible	All receptors: C: High D: High	All receptors: C: Minor adverse D: Minor adverse	None required	N/A	N/A
Indirect impacts from UXO clearance	✓	×	x	All receptors: C: Negligible	All receptors: C: High	All receptors: C: Minor adverse	None required	N/A	N/A
Disturbance and displacement from the physical presence of wind turbines and maintenance activities	×	✓	×	Kittiwake O: Negligible Guillemot O: Low Razorbill O: Low Puffin O: Negligible Fulmar O: Negligible	Kittiwake O: Medium Guillemot O: High Razorbill O: High Puffin O: High Fulmar O: Medium	Kittiwake O: Negligible to minor adverse Guillemot O: Minor adverse Razorbill O: Minor adverse Puffin O: Minor adverse Fulmar	None required	Kittiwake O: Not significant Guillemot O: Not significant Razorbill O: Not significant Puffin O: Not significant Fulmar O: Not significant	Post-construction monitoring will be detailed within the PEMP

Description of Impact	Phase C	Phase O	Phase D	Magnitude of Impact	Sensitivity of Receptor	Significance of Effect	Additional Measures	Significance of Residual Effect	Proposed Monitoring
				Gannet O: Negligible	Gannet O: Medium	O: Negligible to minor adverse Gannet O: Negligible to minor adverse		Gannet O: Not significant	
Barrier to movement	×	✓	×	Migratory receptors O: Negligible	Migratory receptors O: Low to high	Migratory receptors O: Negligible to minor adverse	None required	Migratory receptors O: Not significant	N/A
Collision with wind turbines	×	✓	×	Kittiwake O: Negligible Herring gull O: Negligible Lesser black-backed gull O: Negligible Fulmar O: Negligible Gannet O: Negligible Migratory birds O: Negligible	Kittiwake O: High Herring gull O: High Lesser black-backed gull O: High Fulmar O: High Gannet O: High Migratory birds O: Low to high	Kittiwake O: Minor adverse Herring gull O: Minor adverse Lesser black-backed gull O: Minor adverse Fulmar O: Minor adverse Gannet O: Minor adverse Migratory birds O: Negligible to minor adverse	None required	Kittiwake O: Not significant Herring gull O: Not significant Lesser black-backed gull O: Not significant Fulmar O: Not significant Gannet O: Not significant Migratory birds O: Not significant	Post-construction monitoring will be detailed within the PEMP
Changes to prey availability	✓	×	✓	All receptors: C: Negligible O: Negligible D: Negligible	All receptors: C: Low to High O: Low to High D: Low to High	All receptors: C: Negligible to minor adverse O: Negligible to minor adverse D: Negligible to minor adverse	None required	N/A	N/A
Entanglement	×	✓	×	All diving seabirds present in the Array O: Negligible	All diving seabirds present in the Array O: Medium	All diving seabirds present in the Array O: Negligible to minor adverse	None required	All diving seabirds present in the Array O: Not significant	N/A
Combined impact – collision and displacement	×	✓	×	Kittiwake O: Negligible Fulmar O: Negligible Gannet O: Negligible	Kittiwake O: Medium Fulmar O: Medium Gannet O: Medium	Kittiwake O: Negligible to minor adverse Fulmar O: Negligible to minor averse Gannet O: Negligible to minor adverse	None required	Kittiwake O: Not significant Fulmar O: Not significant Gannet O: Not significant	N/A

Table 11.108: Summary of Likely Significant Cumulative Environment Effects, Mitigation and Monitoring

Description of Impact	Phase	Cumulative Effects Assessment Tier	Magnitude of Impact	Sensitivity of Receptor	Significance of Effect	Additional Measures	Significance of Residual Effect	Proposed Monitoring
Disturbance and displacement from the physical presence of wind turbines and maintenance activities	O	Tier 1 and Tier 2	With Berwick Bank Kittiwake O: Low Guillemot O: low Razorbill O: Low Puffin O: Low Gannet O: Low Without Berwick Bank Kittiwake O: Low Guillemot O: Low Razorbill O: Low Puffin O: Low Gannet O: Low	Kittiwake O: High Guillemot O: high Razorbill O: High Puffin O: High Gannet O: High	With Berwick Bank Kittiwake O: Minor adverse Guillemot O: Minor adverse Razorbill O: Minor adverse Puffin O: Minor adverse Gannet O: Minor adverse Without Berwick Bank Kittiwake O: Minor adverse Guillemot O: Minor adverse Razorbill O: Minor adverse Puffin O: Minor adverse Gannet O: Minor adverse	None required	With Berwick Bank Kittiwake O: Not significant Guillemot O: Not significant Razorbill O: Not significant Puffin O: Not significant Gannet O: Not significant Without Berwick Bank Kittiwake O: Not significant Guillemot O: Not significant Razorbill O: Not significant Puffin O: Not significant Gannet O: Not significant	Post-construction monitoring will be detailed within the PEMP
Collision with wind turbines	O	Tier 1 and Tier 2	With Berwick Bank Kittiwake O: Low Herring gull O: Low Gannet O: Low Without Berwick Bank Kittiwake O: Low Herring gull O: Low Gannet O: Low	Kittiwake O: High Herring gull O: High Gannet O: High	With Berwick Bank Kittiwake O: Minor adverse Herring gull O: Minor adverse Gannet O: Minor adverse Without Berwick Bank Kittiwake O: Minor adverse Herring gull O: Minor adverse Gannet O: Minor adverse	None required	With Berwick Bank Kittiwake O: Not significant Herring gull O: Not significant Gannet O: Not significant Without Berwick Bank Kittiwake O: Not significant Herring gull O: Not significant Gannet O: Not significant	Post-construction monitoring will be detailed within the PEMP

Description of Impact	Phase	Cumulative Effects Assessment Tier	Magnitude of Impact	Sensitivity of Receptor	Significance of Effect	Additional Measures	Significance of Residual Effect	Proposed Monitoring
Combined impact – collision and displacement	O	Tier 1 and Tier 2	With Berwick Bank Kittiwake O: Medium Gannet O: Low Without Berwick Bank Kittiwake O: Low Gannet O: Low	Kittiwake O: High Gannet O: Low	With Berwick Bank Kittiwake O: Moderate Gannet O: Minor adverse Without Berwick Bank Kittiwake O: Minor adverse Gannet O: Minor adverse	None required	With Berwick Bank Kittiwake O: Significant adverse effect Gannet O: Not significant Without Berwick Bank Kittiwake O: Not significant Gannet O: Not significant	Post-construction monitoring will be detailed within the PEMP

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