MONA OFFSHORE WIND PROJECT

Environmental Statement

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Image of an offshore wind farm

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Annexes

Volume 6, Annex 5.1: Offshore ornithology baseline characterisation of the Environmental Statement
Volume 6; Annex 5.2: Offshore ornithology displacement technical report of the Environmental Statement
Volume 6, Annex 5.3: Offshore ornithology collision risk modelling technical report of the Environmental Statement
Volume 6, Annex 5.4: Offshore ornithology migratory bird collision risk modelling technical report of the Environmental Statement
Volume 6, Annex 5.5: Offshore ornithology apportioning technical report of the Environmental Statement
Volume 6, Annex 5.6: Offshore ornithology population viability analysis technical report of the Environmental Statement
Volume 6, Annex 5.7: Offshore Ornithology Assessment of Pen y Gogarth/Great Orme's Head SSSI Technical Report

Glossary

Term	Meaning
Avoidance	Probability that a bird takes successful evasive action to avoid collision with a wind turbine.
Air draught	Distance between sea level and lowest blade tip.
Bio-season	Bird behaviour and abundance is recognised to differ across a calendar year, with particular months recognised as being part of different seasons. The biologically defined minimum population scales (BDMPS) bio-seasons used in this report are based on those in Furness (2015), hereafter referred to as bio-seasons. Separate bio-seasons are recognised in this chapter in order to establish the level of importance any seabird species has within the study area during any particular period of time.
Biologically Defined Minimum Population Scales	Seasonal subdivision of bird population size. The rationale behind these subdivisions is that the likely origin of a bird in a particular location depends on the time of year.
Collision risk	Risk of a bird lethally colliding with a wind turbine within a wind farm.
Collision risk model (CRM)	A model that calculates collision risk for a species within a wind farm based on a set of wind farm and bird species specific parameters. Collision risk models can be run deterministically or stochastically.
Confidence Interval	A confidence interval displays the probability that a parameter will fall between a pair of values around the mean.
Design-based Abundance Estimates	An estimated total abundance of birds within a given area. The design-based method is based on the premise that the portion of the study area that is surveyed is representative of the remainder of the study area.
Disturbance sensitivity	Disturbance by wind farm structures, ship and helicopter traffic factor used scores from 1 (limited escape behaviour and a very short flight distance when approached), to 5 (strong escape behaviour, at a large response distance).
Habitat specialisation	The habitat specialisation factor represents the range of habitats species are able to use and whether they use these as specialists or generalists. Species habitat specialisation scores used in this Technical Report have been compiled by Bradbury *et al*. (2014). This score classifies species into categories from 1 (tend to forage over large marine areas with little known association with particular marine features) to 5 (tend to feed on very specific habitat features, such as shallow banks with bivalve communities, or kelp beds).
Light Detection and Ranging (LiDAR)	A remote sensing method using pulsed lasers to measure distances to the earth.
Lowest Astronomical Tide (LAT)	The lowest level of the sea surface with respect to the land.
Maximum Design Scenario (MDS)	The wind farm design scenario that is considered the worst case from the perspective of collision risk.
MRSea	Statistical package to model spatial count data and predict spatial abundances. Package has been developed by the Centre for Research into Ecological and Environmental Modelling (CREEM) specifically for dealing with data collected for offshore wind farm projects.
Ornithology	Ornithology is a branch of zoology that concerns the study of birds.

Term	Meaning
Parameter	Parameters are the input elements of a model that together affect the output of a model. In collision risk models, examples of parameters are the number of wind turbines and the length of the bird.
Section 42 of the Planning Act (2008)	Under Section 42 of the Planning Act, the applicant is required to undertake formal and statutory consultation with a prescribed list of bodies, local authorities and those people with an interest in the land, or whose properties may potentially be affected by the operation of the proposed Project.
Significant effect	The significance of an effect is determined by considering the overall importance of the receptor and the magnitude of the effect using a matrix-based approach and applying professional judgement as to whether the integrity of an SPA feature will be affected.
Stochastic model	Model where the input parameters that go into the model are allowed to vary, leading to a range of output.

Acronyms

Acronym	Description
BDMPS	Biologically Defined Minimum Population Scales
BoCC	Birds of Conservation Concern
BTO	British Trust for Ornithology
CEA	Cumulative Effects Assessment
CRM	Collision Risk Modelling
DAS	Digital Aerial Surveys
DCO	Development Consent Order
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
ES	Environmental Statement
EWG	Expert Working Group
HPAI	Highly Pathogenic Avian Influenza
HRA	Habitat Regulations Assessment
IEF	Important ecological features
IEMA	The Institute of Environmental Management and Assessment
ISAA	Information to Support Appropriate Assessment
JNCC	Joint Nature Conservation Committee
LAT	Lowest Astronomical Tide
LCI	Lower Confidence Interval
LiDAR	Light Detection and Ranging
LSE	Likely Significant Effects
MPCP	Marine Pollution Contingency Plan

Acronym	Description
MDS	Maximum Design Scenario
MLWS	Mean Low Water Springs
MNR	Marine Nature Reserves
MPA	Marine Protected Area
MRSea	Marine Renewables Strategic Environmental Assessment
NPS	National Policy Statements
NRW	Natural Resources Wales
OSP	Offshore Substation Platform
OWES	Offshore Wind Environmental Standards
PEIR	Preliminary Environmental Information Report
PVA	Population Viability Analysis
RSPB	Royal Society for the Protection of Birds
SAC	Special Areas of Conservation
sCRM	Stochastic Collision Risk Model
SD	Standard Deviation
SMP	Seabird Monitoring Programme
SNCB	Statutory Nature Conservation Body
SOSSMAT	Strategic Ornithological Support Services Migration Assessment Tool
SPAs	Special Protection Areas
SSCs	Suspended Sediment Concentrations
SSSI	Site of Special Scientific Interest
TWT	The Wildlife Trusts
UCI	Upper Confidence Interval
UK	United Kingdom
ZOI	Zone of Influence

Units

Unit	Description
%	Percentage
kJ	Kilojoules
km^2	Square kilometres
km	Kilometres
m	Metres
MW	Megawatts

Unit	Description
nm	Nautical mile
rpm	Rotations per minute

5 Offshore ornithology

5.1 Introduction

5.1.1 Overview

5.1.1.1 This updated chapter of the Environmental Statement presents the assessment of the potential impact of the Mona Offshore Wind Project on offshore ornithology incorporating all relevant material submitted as part of the Mona Offshore Wind Project DCO examination. Specifically, this chapter considers the potential impact of the Mona Offshore Wind Project seaward of Mean Low Water Springs (MLWS) during the construction, operations and maintenance, and decommissioning phases. Those impacts of the Mona Offshore Wind Project landward of MLWS are addressed in Volume 3, Chapter 4: Onshore and intertidal ornithology of the Environmental Statement.

5.1.1.2 The assessment presented is informed by the following technical reports:

- Volume 6, Annex 5.1: Offshore Ornithology Baseline Characterisation of the Environmental Statement (Document Reference F6.5.1)
- Volume 6; Annex 5.2: Offshore Ornithology Displacement Technical Report of the Environmental Statement (Document Reference F6.5.2)
- Volume 6, Annex 5.3: Offshore Ornithology Collision Risk Modelling Technical Report of the Environmental Statement (Document Reference F6.5.3)
- Volume 6 Annex 5.4: Offshore Ornithology Migratory Bird Collision Risk Modelling Technical Report of the Environmental Statement (Document Reference F6.5.4)
- Volume 6, Annex 5.5: Offshore Ornithology Apportioning Technical Report of the Environmental Statement (Document Reference F6.5.5)
- Volume 6, Annex 5.6: Offshore Ornithology Population Viability Analysis Technical Report of the Environmental Statement (Document Reference F6.5.6) – it should be noted that this document has been superseded and all PVA input and output parameters required are within the respective documents rather than this Annex
- Volume 6, Annex 5.7: Offshore Ornithology Assessment of Pen y Gogarth/Great Orme’s Head Site of Special Scientific Interest Technical Report of the Environmental Statement (Document Reference F6.5.7)

5.1.1.3 The updated offshore ornithology chapter (Document Reference F2.5) considers any seabirds that are present at some point in their life cycle in the study areas and non-seabird species using the study areas during migratory flights. The overarching term ‘seabird’ is used to refer to species that depend on the marine environment for survival at some point in their life cycle. Therefore, in addition to the true seabirds, seaducks, divers and grebes are also included because of their additional reliance on marine areas, especially in the non-breeding season. The study areas are defined in section 5.3.4.

5.1.1.4 The document has been updated at Deadline 7 to take account of additional information provided during the Mona DCO examination. This document supersedes the application submission (Document Reference F2.5 F01) and subsequent versions submitted during examination at Deadline 2 (Document Reference F2.5 F02) and

Deadline 4 (Document Reference F2.5 F03). A summary of the comments received and the consequential updates is provided in section 5.2.3. The key updates from previous versions relate to the consideration of the quantitative impacts of historical offshore wind projects (using a gap-filling approach) in the CEA presented in section 5.9, in line with the SNCB advice note (which is presented in Section D.6.13 of Appendix D of Technical Engagement Plan (Document Reference E4.1)). The Applicant has also updated the Morgan Generation Assets, the Morecambe Generation Assets and Llŷr 1 to Tier 1 projects in the CEA presented in section 5.9.

5.1.2 Purpose of chapter

5.1.2.1 The primary purpose of the Environmental Statement is outlined in Volume 1, Chapter 1: Introduction of the Environmental Statement (Document Reference F1.1). In summary, the primary purpose of an Environmental Statement is to support the Development Consent Order (DCO) application for Mona Offshore Wind Project under the Planning Act 2008 (the 2008 Act). The Environmental Impact Assessment (EIA) has been finalised following completion of pre-application consultation and the Environmental Statement will accompany the application to the Secretary of State for Development Consent. This Environmental Statement chapter is based upon advice, guidance and policy available at the time of DCO application submission (February 2024).

5.1.2.2 In particular, this Environmental Statement chapter:

1. Presents the existing environmental baseline established from desk studies, site-specific surveys and consultation
2. Identifies any assumptions and limitations encountered in compiling the environmental information
3. Presents the potential environmental effects on offshore ornithology arising from the Mona Offshore Wind Project, based on the information gathered and the analysis and assessments undertaken
4. Highlights any necessary monitoring and/or mitigation measures which could prevent, minimise, reduce or offset the possible environmental effects of the Mona Offshore Wind Project on offshore ornithology.

5.1.3 National Policy Statements

5.1.3.1 There are currently six energy National Policy Statements (NPSs), two of which contain policy relevant to offshore wind development and the Mona Offshore Wind Project, specifically:

- NPS for Energy (NPS EN-1) which sets out the United Kingdom (UK) Government's policy for the delivery of major energy infrastructure (Department for Energy Security & Net Zero, 2024a)
- NPS for Renewable Energy Infrastructure (NPS EN-3) (Department for Energy Security & Net Zero, 2024b).

5.1.3.2 NPS EN-1 and NPS EN-3 include guidance on what matters are to be considered in the assessment. These are summarised in Table 5-1. NPS EN-1 and NPS EN-3 also highlight a number of factors relating to the determination of an application and in relation to mitigation. These are summarised in Table 5-2.

Table 5-1: Summary of the NPS EN-1 and NPS EN-3 provisions relevant to offshore ornithology.

Summary of NPS EN-1 and EN-3 provision	How and where considered in the Environmental Statement
NPS-EN1	
All proposals for projects that are subject to the Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 (the EIA Regulations) must be accompanied by an Environmental Statement (ES) describing the aspects of the environment likely to be significantly affected by the project. (NPS EN1 paragraph 4.3.1). The Regulations require an assessment of the Likely Significant Effects (LSE) of the proposed project on the environment, covering the direct effects and any indirect, secondary, cumulative, transboundary, short, medium, and long-term, permanent and temporary, positive and negative effects at all stages of the project, and also of the measures envisaged for avoiding or mitigating significant adverse effects. (NPS EN1 paragraph 4.3.3).	Assessment of the potential effects of the Mona Offshore Wind Project relevant to offshore ornithology is considered in section 5.7. The approach to mitigation is discussed in section 5.6.
For the purposes of this NPS and the technology specific NPSs the ES should cover the environmental, social and economic effects arising from pre-construction, construction, operation and decommissioning of the project. (NPS EN-1 paragraph 4.3.5)	Construction, operations and maintenance and decommissioning effects of the Mona Offshore Wind Project relevant to offshore ornithology are assessed in section 5.7.
Where some details are still to be finalised, the ES should, to the best of the applicant's knowledge, assess the likely worst-case environmental, social and economic effects of the proposed development to ensure that the impacts of the project as it may be constructed have been properly assessed. (NPS EN-1 paragraph 4.3.12)	The maximum design scenario (MDS) is shown in Table 5-21. The MDS has been selected as those scenarios having the potential to result in the greatest effect on an identified receptor or receptor group. The assessment of effects is contained in section 5.7.
The highest level of biodiversity protection is afforded to sites identified through international conventions. The Habitats Regulations set out sites for which a Habitat Regulations Assessment (HRA) will assess the implications of a plan or project, including Special Areas of Conservation (SAC) and Special Protection Areas (SPA). (NPS EN-1 paragraph 5.4.4)	Internationally designated sites are identified in Table 5-11 and Table 5-12, and are described in Volume 6, Annex 5.1: Offshore ornithology baseline characterisation of the Environmental Statement (Document Reference F6.5.1).
As a matter of policy, the following should be given the same protection as sites covered by the Habitats Regulations and an HRA will also be required: (a) potential SPA and possible SAC; (b) listed or proposed Ramsar sites; and (c) sites identified, or required, as compensatory measures for adverse effects on any of the other sites covered by this paragraph. (NPS EN-1, paragraph 5.4.5)	Internationally designated sites are identified in Table 5-11 described in Volume 6, Annex 5.1: Offshore ornithology baseline characterisation of the Environmental Statement (Document Reference F6.5.1). The findings of the HRA process are reported in an Information to Support Appropriate Assessment (ISAA) report (Document Reference E1.1 – E1.3) and supporting Annexes (Document References E1.3.1 and E1.3.2), which assesses the impact specifically on all European sites and is submitted alongside the Environmental Statement.

Summary of NPS EN-1 and EN-3 provision	How and where considered in the Environmental Statement
Many Sites of Special Scientific Interest (SSSIs) are also designated as sites of international importance and will be protected accordingly. Those that are not, or those features of SSSIs not covered by an international designation, should be given a high degree of protection. Most National Nature Reserves are notified as SSSIs. (NPS EN-1 paragraph 5.4.7)	All relevant SSSIs are identified in Table 5-12 and described in Volume 6, Annex 5.1: Offshore ornithology baseline characterisation of the Environmental Statement (Document Reference F6.5.1). The assessment of impacts takes account all impacts on all designated sites (including SSSIs) within the Mona offshore ornithology study areas as defined in section 5.3.4.
Many individual species receive statutory protection under a range of legislative provisions. Other species and habitats have been identified as being of principal importance for the conservation of biodiversity in England and Wales, as well as for their continued benefit for climate mitigation and adaptation and thereby requiring conservation action. (NPS EN-1 paragraph 5.4.16)	Assessment of the potential effects of the Mona Offshore Wind Project relevant to offshore ornithology are considered in section 5.7. The approach to mitigation is discussed in section 5.6.
Where the development is subject to EIA, the applicant should ensure that the ES clearly sets out any effects on internationally, nationally, and locally designated sites of ecological or geological conservation importance (including those outside England), on protected species and on habitats and other species identified as being of principal importance for the conservation of biodiversity, including irreplaceable habitats. (NPS EN-1 paragraph, 5.4.17)	The baseline ornithological environment is described in section 5.4. As part of this chapter, the process of identifying designated sites has been undertaken and results are presented in Table 5-9 and Table 5-10. The specific bird species that may be impacted by the potential effects of the Mona Offshore Wind Project are identified in Table 5-11 and an assessment of the potential effects for these specific species are identified and considered in section 5.7.
Applicants should include appropriate avoidance, mitigation, compensation and enhancement measures as an integral part of the proposed development. In particular, the applicant should demonstrate that: • During construction, they will seek to ensure that activities will be confined to the minimum areas required for the works • The timing of construction has been planned to avoid or limit disturbance • During construction and operation best practice will be followed to ensure that risk of disturbance or damage to species or habitats is minimised, including as a consequence of transport access arrangements • Habitats will, where practicable, be restored after construction works have finished • Opportunities will be taken to enhance existing habitats rather than replace them, and where practicable, create new habitats of value within the site landscaping proposals. Where habitat creation is required as mitigation, compensation, or enhancement, the location and quality will be of key importance. In this regard habitat creation should be focused on areas where the most ecological and ecosystems benefits can be realised • Mitigations required as a result of legal protection of habitats or species will be complied with. (NPS EN-1 paragraph 5.4.35)	The approach taken to mitigation is described in section 5.6.

Summary of NPS EN-1 and EN-3 provision	How and where considered in the Environmental Statement
NPS-EN3	
As part of the Offshore Wind Environmental Improvement Package set out in the British Energy Security Strategy, government committed to establishing Offshore Wind Environmental Standards (OWES; previously referred to as Nature Based Design Standards) to accelerate deployment whilst offering greater protection of the marine environment. OWES aim to support developers to take a more consistent approach to avoiding, reducing, and mitigating the impacts of an offshore wind farm and/or offshore transmission infrastructure. The measures could apply to the design, construction, operation and decommissioning of offshore wind farms and offshore transmission (as defined in EN-5 at section 2.12). Defra will consult on a series of OWES before drafting clear OWES Guidance, which sets out where and how Defra expects each measure to be applied to a development. Once the OWES Guidance is issued, the Secretary of State will expect applicants to have applied the relevant measures to their applications. Applicants should explain how their proposals comply with the guidance or, alternatively, the grounds on which a departure from them is justified. Any reasons for departure from the OWES should be fully detailed within the application documents, with details of any agreements made with statutory consultees. (NPS EN-3 paragraphs 2.8.90 to 2.8.92)	The project is aware of the requirements in NPS EN3 to apply the guidance on Environmental Standards once the final guidance is issued. The project will review the guidance once available and determine how the project complies with the guidance, and where, if relevant, the project departs from them.
Applicants should consult at an early stage of pre-application with relevant statutory consultees and energy not-for profit organisations/non governmental organisations as appropriate, on the assessment methodologies, baseline data collection, and potential avoidance, mitigation and compensation options which should be undertaken. (NPS EN-3 paragraph 2.8.104)	Throughout the Mona Offshore Wind Project consultations with relevant statutory and non-statutory stakeholders have been carried out (e.g. via the Evidence Plan Process Expert Working Groups (EWG)) and are presented in section 5.2. A Scoping Report was submitted to the Planning Inspectorate and a Scoping Opinion was received, discussed in section 5.2. Furthermore, Section S42 responses from the relevant statutory and non-statutory stakeholders were received following submission of the Preliminary Environmental Information Report (PEIR) technical annexes and chapter. All the responses provided, and changes suggested by the stakeholders are presented in the consultation report (Document Reference E.3).

Summary of NPS EN-1 and EN-3 provision	How and where considered in the Environmental Statement
Offshore wind farms have the potential to impact on birds through: • Collisions with rotating blades • Direct habitat loss • Disturbance from construction activities such as the movement of construction/decommissioning/maintenance vessels and piling • Displacement during the operational phase, resulting in loss of foraging/roosting area • Impacts on bird flight lines (i.e. barrier effect) and associated increased energy use by birds for commuting flights between roosting and foraging areas • Impacts upon prey species and prey habitat; and • Impacts on protected sites. (NPS EN-3 paragraph 2.8.136)	Assessment of the potential effects of the Mona Offshore Wind Project relevant to offshore ornithology are discussed in section 5.7.
Applicants should discuss the scope, effort and methods required for ornithological surveys with the relevant statutory advisor, taking into consideration baseline and monitoring data from operational windfarms. (NPS EN-3 paragraph 2.8.143)	Baseline survey methods have been discussed with Natural Resources Wales (NRW), Natural England, the Joint Nature Conservation Committee (JNCC) and the Royal Society for the Protection of Birds (RSPB) through the Evidence Plan Process. Relevant data from other operational offshore wind farms has been considered to inform the assessment of potential significant effects of the Mona Offshore Wind Project and the Cumulative Effects Assessment (CEA) in section 5.9.
Applicants must undertake collision risk modelling (CRM), as well as displacement and population viability assessments for certain species of birds. Applicants are expected to seek advice from Statutory Nature Conservation Bodies (SNCBs). (NPS EN-3 paragraph 2.8.144)	CRM, displacement assessment, population viability assessment has been undertaken for birds using parameters that have been agreed with SNCBs through the Evidence Plan process. Potential effects from collision risk and displacement are presented and assessed in section 5.7.
The assessment should be undertaken for all stages of the lifespan of the proposed wind farm in accordance with the appropriate policy and guidance for offshore wind farm EIAs. (NPS EN-3 paragraph 2.8.198)	The construction, operations and maintenance and decommissioning phases of Mona Offshore Wind Project have been assessed in section 5.7.
The Secretary of State should consider the effects of a proposed development on marine ecology and biodiversity, considering all relevant information made available by the applicant. (NPS EN-3 paragraph 2.8.302)	Section 5.7 presents the assessment of effects of the Mona Offshore Wind Project on offshore ornithology receptors.

Table 5-2: Summary of NPS EN-1 and NPS EN-3 policy on decision making relevant to offshore ornithology.

Summary of NPS EN-1 and EN-3 provision	How and where considered in the Environmental Statement
NPS EN-1	
In the 25 Year Environment Plan, the government set out its vision for a quarter-of-a-century action to help the natural world regain and retain good health. A commitment to review the plan every 5 years was set into law in the Environment Act 2021. The Environmental Improvement Plan was published in 2023, which reinforces the intent of the 25 Year Environment Plan and sets out a plan to deliver on its framework and vision. The government's policy for biodiversity in England is set out in the Environmental Improvement Plan 2023, the National Pollinator Strategy and the UK Marine Strategy. The aim is to halt overall biodiversity loss in England by 2030 and then reverse loss by 2042, support healthy well-functioning ecosystems and establish coherent ecological networks, with more and better places for nature for the benefit of wildlife and people. This aim needs to be viewed in the context of the challenge presented by climate change. Healthy, naturally functioning ecosystems and coherent ecological networks will be more resilient and adaptable to climate change effects. Failure to address this challenge will result in significant adverse impact on biodiversity and the ecosystem services it provides. (NPS EN-1 paragraph 5.4.2).	Assessment of the potential effects of the Mona Offshore Wind Project and associated mitigation for specific species are identified and discussed in section 5.7 and 5.6 respectively.

5.1.4 The Welsh National Marine Plan and its relevance to offshore ornithology

5.1.4.1 The assessment of potential changes to offshore ornithology has also been made with consideration to the specific policies set out in the Welsh National Marine Plan (Welsh Government, 2019).

5.1.4.2 The Welsh National Marine Plan was published on 12 November 2019 and sets out the policy for the next 20 years for the sustainable use of Welsh seas. It includes sector objectives for renewable energy to support the decarbonisation of the Welsh economy and the use of marine renewable energy, including offshore wind farms.

5.1.4.3 Key provisions are set out in Table 5-3 along with details as to how these have been addressed within the assessment.

Table 5-3: Welsh National Marine Plan and its relevance to offshore ornithology.

Policy	Key provisions	How and where considered in the Environmental Statement
ENV_01: Resilient marine ecosystems	Proposals should demonstrate how potential impacts on marine ecosystems have been taken into consideration and should, in order of preference: • Avoid adverse impacts; and/or • Minimise impacts where they cannot be avoided; and/or • Mitigate impacts where they cannot be minimised. If significant adverse impacts cannot be avoided, minimised or mitigated, proposals must present a clear and convincing case for proceeding. Proposals that contribute to the protection, restoration and/or enhancement of marine ecosystems are encouraged.	The potential impacts on Important Ecological Features (IEFs) have been assessed in section 5.7 and measures adopted as part of the Mona Offshore Wind Project are summarised in section 5.6.
ENV_02: Marine Protected Areas (MPA)	Proposals should demonstrate how they: • Avoid adverse impacts on individual MPAs and the coherence of the network as a whole • Have regard to the measures to manage MPAs; and • Avoid adverse impacts on designated sites that are not part of the MPA network.	Designated sites supporting IEFs that have been identified as appropriate are outlined in section 5.3.8, and any potential impacts to features and the site network will be assessed in the Habitats Regulations Assessment Stage 2 Information to Support an Appropriate Assessment (ISAA) – Part Three: Special Protection Areas and Ramsar sites Assessments (Document Reference E1.3) and supporting Annexes (Document References E1.3.1 and E1.3.2).
ENV_05: Underwater sound.	Proposals should demonstrate that they have considered man-made noise impacts on the marine environment and, in order of preference: • Avoid adverse impacts; and/or • Minimise impacts where they cannot be avoided; and/or • Mitigate impacts where they cannot be minimised. If significant adverse impacts cannot be avoided, minimised or mitigated, proposals must present a clear and convincing case for proceeding.	Section 5.7 assesses the impact of underwater and airborne sound on seabirds.

Policy	Key provisions	How and where considered in the Environmental Statement
ENV_07: Fish species and Habitats	Proposals potentially affecting important feeding, breeding (including spawning and nursery) and migration areas or habitats for key fish and shellfish species of commercial or ecological importance should demonstrate how they, in order of preference: • Avoid adverse impacts on those areas; and/or • Minimise adverse impacts where they cannot be avoided; and/or • Mitigate adverse impacts where they cannot be minimised. If significant adverse impacts cannot be avoided, minimised or mitigated, proposals must present a clear and convincing case for proceeding.	The potential effects on fish species and their habitats have been assessed in full in Volume 2, Chapter 3: Fish and shellfish ecology of the Environmental Statement (Document Reference F2.3). Section 5.7 of this chapter assesses the potential effects on seabirds in the context of how seabird prey species may be impacted.

5.1.5 North West Inshore and North West Offshore Coast Marine Plans

5.1.5.1 The assessment of potential changes to offshore ornithology has also been made with consideration to the specific policies set out in the North West Inshore and North West Offshore Coast Marine Plans (MMO, 2021). Key provisions are set out in Table 5-4 along with details as to how these have been addressed within the assessment.

Table 5-4: North West Inshore and North West Offshore Marine Plan policies of relevant to offshore ornithology.

Policy	Key provisions	How and where considered in the Environmental Statement
NW-SCP-1	Proposals within or relatively close to nationally designated areas should have regard to the specific statutory purposes of the designated area. Great weight should be given to conserving and enhancing landscape and scenic beauty in National Parks and Areas of Outstanding Natural Beauty.	As part of this chapter (as well as Volume 6, Annex 5.1: Offshore ornithology baseline characterisation of the Environmental Statement (Document Reference F6.5.1)), designated sites with mobile features connected to the Mona Offshore Wind Project have been identified. This is to ensure that all features and species of conservation importance were considered, where relevant, in this assessment. The HRA Stage 1 Screening Report (Document Reference E1.4) considers the direct or indirect effects on features of relevant SPA sites, and where relevant will be included in the ISAA (Document Reference E1.3) and supporting Annexes (Document References E1.3.1 and E1.3.2).

Policy	Key provisions	How and where considered in the Environmental Statement
NW-MPA-1	Proposals that support the objectives of MPAs and the ecological coherence of the MPA network will be supported.	As part of this chapter (as well as Volume 6, Annex 5.1: Offshore ornithology baseline characterisation of the Environmental Statement (Document Reference F6.5.1)), designated sites with mobile features connected to the Mona Offshore Wind Project have been identified (section 5.3.8). This is to ensure that all features and species of conservation importance were considered, where relevant, in this assessment. The HRA Stage 1 Screening Report (Document Reference E1.4) considers the direct or indirect effects on features of relevant SPA sites, and where relevant will be included in the ISAA (Document Reference E1.3) and supporting Annexes (Document References E1.3.1 and E1.3.2).
NW-BIO-1	NW-BIO-1 encourages and supports proposals that enhance the distribution of priority habitats and priority species.	The Mona Offshore Wind Project will aim to conserve habitats and species as far as reasonably practicable through a number of measures adopted to reduce the impact of the Mona Offshore Wind Project (section 5.6).
NW-BIO-2	NW-BIO-2 requires proposals to manage negative effects which may significantly adversely impact the functioning of healthy, resilient and adaptable marine ecosystems.	In addition to measures adopted as part of the Mona Offshore Wind Project and sensitive project design, secondary mitigation will be considered if an impact is considered to be significant in EIA terms in section 5.7.
NW-CE-1	Proposals which may have adverse cumulative effects with other existing, authorised, or reasonably foreseeable proposals must demonstrate that they will avoid, minimise and mitigate.	Cumulative effects have been quantified and their significance assessed in section 5.9.

5.2 Consultation

5.2.1 Overview

5.2.1.1 A summary of the key issues raised during consultation activities undertaken to date specific to offshore ornithology is presented in Table 5-5 below, together with how these issues have been considered in the production of this Environmental Statement chapter. Further detail is presented in the following Annexes:

- Volume 6, Annex 5.1: Offshore ornithology Baseline Characterisation of the Environmental Statement (Document Reference F6.5.1)
- Volume 6; Annex 5.2: Offshore Ornithology Displacement Technical Report of the Environmental Statement (Document Reference F6.5.2)
- Volume 6, Annex 5.3: Offshore Ornithology Collision Risk Modelling Technical Report of the Environmental Statement (Document Reference F6.5.3)
- Volume 6, Annex 5.4: Offshore Ornithology Migratory Bird Collision Risk Modelling Technical Report of the Environmental Statement (Document Reference F6.5.4)

- Volume 6, Annex 5.5: Offshore Ornithology Apportioning Technical Report of the Environmental Statement (Document Reference F6.5.5)
- Volume 6, Annex 5.6: Offshore Ornithology Population Viability Analysis Technical Report of the Environmental Statement (Document Reference F6.5.6) – this document has been superseded and all PVA input and output parameters required are included within the respective documents.
- Volume 6, Annex 5.7: Offshore Ornithology Assessment of Pen y Gogarth/Great Orme's Head Site of Special Scientific Interest Technical Report of the Environmental Statement (Document Reference F6.5.7)

5.2.2 Evidence Plan process

5.2.2.1 The purpose of the Evidence Plan process is to agree the information the Mona Offshore Wind Project needs to supply to the Secretary of State, as part of a DCO application for the Mona Offshore Wind Project. The Evidence Plan seeks to ensure compliance with the HRA and EIA Regulations. The development and monitoring of the Evidence Plan and its subsequent progress is being undertaken by the Steering Group. The Steering Group is comprised of the Planning Inspectorate, the Applicant, NRW, Natural England, JNCC and the MMO. To inform the EIA and HRA process during the pre-application stage of the Mona Offshore Wind Project, EWGs were also set up to discuss and agree topic specific issues with the relevant stakeholders. Consultation was undertaken via the Offshore Ornithology EWG, with meetings held in February 2022, July 2022, November 2022, February 2023, June 2023, October 2023 and December 2023 (Table 5-5).

5.2.2.2 The responses provided and changes suggested by the stakeholders through the EWG are summarised in Table 5-5 together with changes implemented in the chapter of the Environmental Statement.

Table 5-5: Summary of key topics and issues raised during consultation activities undertaken for the Mona Offshore Wind Project relevant to offshore ornithology.

Date	Consultee and type of response	Topics and issues raised	Response to issue raised and/or where considered in this chapter
February 2022	**Offshore Ornithology Expert Working Group 1** **Attended by:** Natural England, JNCC, The Wildlife Trusts (TWT), MMO, RSPB (apologies given by NRW)	The EWG agreed on broad approach to baseline characterisation (including digital aerial survey) and characterisation for the Mona Offshore Cable Corridor using desktop data sources only.	Methodology presenting the approach to baseline using site-specific surveys and desktop studies is summarised and presented in section 5.3 of this chapter.
	Scoping Opinion IOM Department of Infrastructure	The Isle of Man Department of Infrastructure noted that Manx shearwater *Puffinus puffinus*, common guillemot *Uria aalge*, razorbill *Alca torda* and black-legged kittiwake *Rissa tridactyla* were numerous in previous surveys of the generation assets study area. These are all within foraging range of their Isle of Man breeding colonies.	Abundance at breeding colonies on the Isle of Man (using the Seabird Monitoring Programme (SMP) database (JNCC (2023)) are considered in section 5.3 of this chapter.
		The Isle of Man government requested that the national bird statuses and conservation concerns of the Isle of Man are taken into account by reference to the recently published Manx Birds of Conservation Concern and had a current concern regarding severe declines in many seabird populations on the Isle of Man (See Hill *et al.,* 2019). Schedule 1 of the Wildlife Act 1990 lists the specially protected birds. Both of these are relevant to the status of these species in the vicinity of this development and in particular, the considerations of potential impacts on Manx populations.	The conservation value of Isle of Man birds has been included in section 5.3.8 of this chapter.
June 2022	**Scoping Opinion** The Planning Inspectorate	Where possible, the Applicant should seek to agree the magnitude of impact or sensitivity of receptors with relevant consultees through the PEIR and pre-application process. Where differences in opinion remain, these should be identified within the Environmental Statement with justification given for the Applicant's choice.	The description of the magnitude of each impact and sensitivity of each receptor, or each receptor group considered in the EIA (see sections 5.7 to 5.12 of this chapter). Comments note that where differences in opinion remain, these will be identified, and justification given for the Applicant's choice.

Date	Consultee and type of response	Topics and issues raised	Response to issue raised and/or where considered in this chapter
		The Environmental Statement should define what a 'reasonable timescale' or 'short time period' would be within which recovery could occur so that an impact would be reversible/not permanent.	For each impact where recovery is considered, the timescales for recovery has been stated in section 5.4 of this chapter.
		A number of mitigation plans have been referred to in aspect chapters. Where plans are relied upon to avoid significant environmental effects, outline or in-principle plans should be submitted as part of the DCO application.	Where a significant environmental effect has been identified, further mitigation has been proposed in section 5.6 of this chapter.
		The Applicant proposed to assess the effects of underwater sound on marine life due to jacket or monopile cutting and removal during decommissioning. The Scoping Report does not propose to assess this potential impact within the fish and shellfish ecology, marine mammals or offshore ornithology Environmental Statement chapters. The outcomes of this assessment should be presented within the relevant chapters.	The indirect impact of underwater sound on prey species relevant to ornithological receptors has been assessed for the construction, operations and maintenance, and decommissioning phases, as detailed in section 5.7.3 of this chapter.
		Direct disturbance and displacement impacts from underwater sound during the operations and maintenance and decommissioning phases.	Disturbance and displacement from airborne noise, underwater sound, and presence of vessels and infrastructure has been assessed in-combination across all phases, as detailed in section 5.7 of this chapter.
		The Inspectorate agreed that collision risk to birds from the offshore booster station structures is unlikely and is therefore content to scope this matter from the Environmental Statement.	The Offshore Booster Substation is no longer in the design for the Mona Offshore Wind Project and is therefore not included in the impact assessments presented in section 5.7 of this chapter.

Date	Consultee and type of response	Topics and issues raised	Response to issue raised and/or where considered in this chapter
		The Planning Inspectorate proposes a range (4 km to 10 km) within the study area proposed for the offshore ornithology aspect chapter. The Environmental Statement should clearly state and provide justification for the final study area adopted in the impact assessment. It should also be supported by a figure(s) clearly presenting the extent of the buffer and where these buffer distances differ. The study area should be based on the Zone of Influence (ZOI) for the Proposed Development. The Applicant's attention is directed to the recent issue of the 'Joint SNCB1 Interim Advice on the treatment of displacement for red-throated diver (2022)' with regards to revised guidance for red-throated diver displacement. The Inspectorate advises that the marine ornithology study area should include the array area and a minimum 10 km buffer. Where the buffer does not consistently reach 10 km, the Environmental Statement should clearly justify the approach.	There are three study areas adopted for the offshore ornithology assessment presented in section 5.3.4 of this chapter, with justifications.
		The Environmental Statement should consider those birds listed on Schedule 1 of the Wildlife Act 1990 (Isle of Man) and refer to the Manx Birds of Conservation Concern (2021) when considering conservation status of Manx birds (where relevant).	The conservation value of Isle of Man birds has been included 5.3.8 of this chapter.
		The Applicant's attention is directed to the response of the Isle of Man Government at Appendix 2 to this Opinion with regards to designated sites and in particular the Calf of Man National Bird Observatory.	The importance of the National Bird Observatory for monitoring, research and recreational activities is acknowledge (see Table 5-12 in section 5.3.8 of this chapter). However, the status of the Bird Observatory is of limited relevance to the assessment of ornithological receptors.
		The Scoping Report proposes to determine connectivity between breeding seabird colonies at designated sites and the Proposed Development through the application of the metric 'mean maximum (plus one standard deviation)'. Until the site-specific surveys are complete, and the data analysis finalised, it may be prudent to scope in all SPAs, Ramsar sites, and SSSIs with marine or estuarine bird qualifying features to the impact assessment. The Applicant should seek to agree the appropriate metric with relevant consultation bodies, including NRW and Natural England.	Best practice (i.e. using the mean-max + 1 standard deviation (SD) foraging range from Woodward *et al.*, (2019)) guidelines were followed to determine connectivity between sites and the ZOI of the Mona Offshore Wind Project. Designated sites connected to the Mona Offshore Wind Project are presented in section 5.3.8 of this chapter.

Date	Consultee and type of response	Topics and issues raised	Response to issue raised and/or where considered in this chapter
		The Scoping Report states that the displacement matrix approach for the transmission assets may be modified (in terms of the appropriate displacement and mortality rates) to assess the potential temporary impact of disturbance during installation of the offshore export cables. If fundamental disagreements remain regarding the assessment methods and modelling for assessing effects from displacement and collision-related mortality, the Environmental Statement should include assessments based on the Applicant's preferred method and those advocated by NRW and Natural England. The Applicant is advised to agree the detailed assessment methodologies with relevant stakeholders represented on the ornithology EWG.	The Mona Offshore Cable Corridor assessment has been agreed with the Offshore Ornithology EWG and the findings are presented in section 5.7 of this chapter.
	Scoping Opinion **JNCC**	Clarity is required as to how impacts from operational developments will be included within a cumulative assessment. If built and operational projects are classed as part of the baseline conditions, then the project alone assessment needs to consider whether it brings 'baseline mortality' (including the mortality contributed from baseline projects) above a level that is unacceptable. Mortality that can be attributed to projects that were built and operational at the time that survey data were collected do need to be considered alongside predicted mortality from the Mona proposal. We would suggest that, given the difficulties in assessing 'actual' mortality or population consequences for mobile species such as marine birds, from existing built and operational infrastructure (such as windfarms), then in practice this means that the assessment is based on a combined 'predicted' mortality across built, operational, under construction, consented and otherwise identified infrastructure projects. The Scoping Report appears to suggest that operational project/plans will be included within a cumulative assessment, which contracts with the list of developments in stated elsewhere in the document. Please clarify whether and how the impact operational developments will be incorporated in a cumulative assessment.	The impact of operational developments has been included in the cumulative assessment (section 5.9 of this chapter). The approach to assessing cumulative impact is based on obtaining collision risk estimates where available. If unavailable for historic projects, a qualitative assessment of collision will be undertaken. For displacement, the approach follows standard methodology obtaining, where possible, abundance data from each project (or using Marine Ecosystem Research Programme (MERP) data if unavailable) and scaling this to relevant areas/seasons.

Date	Consultee and type of response	Topics and issues raised	Response to issue raised and/or where considered in this chapter
	Scoping Opinion Natural England	Identification of receptors and the sensitivity of receptors to impact scale definitions should be discussed and agreed as part of the Evidence Plan process with the relevant EWG. These definitions should be set out within the Environmental Statement.	The definition of sensitivity for receptors and receptor groups is included in section 5.4.2 of this chapter.
		A matrix for assessment of significance is provided as an example, demonstrating how the sensitivity of receptor against magnitude of impact can determine the significance of effect. As with above comments, sensitivity of receptor, magnitude of impact and the matrix of significance of effect should be discussed and agreed through the Evidence Planning process. Discuss and agree with the relevant EWGs and definitions should be provided in the Environmental Statement.	The matrix for assessment of significance has been included in section 5.4.2 of this chapter.
		We understand that at the current stage this is a high-level definition, however, all definitions will require refining. Discussion and agreement should be sought through the Evidence Plan process with the relevant EWG.	The definition if significance levels will be included in section 5.4.2 of this chapter.
		Consideration of climate change impacts over the operational period of Mona offshore wind farm should be considered. These impacts will become important if they cause an alteration in the baseline conditions and become detectable above natural inter-annual variations.	An assessment of the future baseline scenario including the impact of climate change is presented in section 5.3.10 of this chapter.

Date	Consultee and type of response	Topics and issues raised	Response to issue raised and/or where considered in this chapter
February 2022	**Offshore Ornithology Expert Working Group 1** – **Attended by:** Natural England, JNCC, NRW, TWT,	Agreed on ways of working document, including timescales. Agreed on broad approach to digital aerial surveys (DAS). Agreed on broad approach to characterisation for the Mona Offshore Cable Corridor using desktop data sources only.	The Mona digital aerial area includes a buffer of 7-16 km from the Mona Array Area. The Mona digital aerial survey area does not extend fully to 10 km in all directions around the Mona Array Area, as this area was refined following commencement of the DAS. The uneven buffer around the Mona Array Area is a result of the surveys being designed on the basis of an array area that differed to the final boundary. The use of Light Detection and Ranging (LiDAR) as a method for collecting flight height data to parameterise collision risk models was not endorsed by Natural England; as such it has not been progressed and flight heights are based on existing literature. The approach to characterisation of the Mona Offshore Cable Corridor is to rely on available desktop data for the Mona Offshore Cable Corridor. This approach is standard for offshore wind farm transmission assets
13 July 2022	**Offshore Ornithology Expert Working Group 2** **Attended by:** Natural England, JNCC, NRW, RSPB, TWT, MMO	The second EWG meeting provided an update on the approach used to characterise the baseline conditions and assess the effects on ornithological receptors. • JNCC advised that the assessment of displacement during construction and decommissioning should include for 50% of the displacement during operation.	The EWG agreed on the approach to baseline characterisation as summarised and presented in section 5.3 of this chapter. A summary of the methodology presenting the approach to baseline using site-specific surveys and desktop studies is presented in section 5.3.3 Assessment during construction and decommissioning is presented in section 5.7of the Environmental Statement chapter
November 2022	**Offshore Ornithology Expert Working Group 3** **Attended by:** Natural England, JNCC, NRW, RSPB TWT, MMO, Isle of Man Government	The third EWG meeting provided an update on the results of the baseline characterisation, displacement assessment, migratory and non-migratory collision assessment, apportioning and approach to LSE screening under for the Preliminary Environmental Information Report (PEIR). • NRW and JNCC advised on displacements rates and mortality rates to be used for Manx shearwater • Request for sabbaticals to be included as adult birds.	As recommended, auk species displacement and mortality rates have been used in the assessment of effect presented in section of the 5.7 of the Environmental Statement chapter. Sabbaticals are included in adult impacts in the assessment of effect presented in section of the 5.7 of this chapter.

Date	Consultee and type of response	Topics and issues raised	Response to issue raised and/or where considered in this chapter
February 2023	**Offshore Ornithology Expert Working Group 4** **Attended by:** Natural England, JNCC, NRW, RSPB TWT, MMO	The fourth EWG meeting provided an update on the Highly Pathogenic Avian Influenza (HPAI) and discuss the result of the assessment for the Mona Offshore Cable Corridor on seaducks and divers, overview of the new conservation advice package for Liverpool Bay SPA, and approach to LSE screening. • NRW/JNCC/Natural England suggested timing restrictions during cable laying across the Liverpool Bay SPA to avoid disturbance and displacement impacts on red-throated divers and common scoter.	Timing restrictions of work will be followed and implemented during cable laying across the Liverpool Bay SPA. Mitigation measures adopted are presented in section 5.6 of this chapter.
June 2023	**Offshore Ornithology Expert Working Group 5** **Attended by:** Natural England, JNCC, NRW, RSPB TWT, Isle of Man Government, MMO, Niras	Presentation of Power Analysis results and discussion of Section 42 comments. The fifth EWG meeting (June 2023) discussed Section 42 responses and provided an update on the power analysis carried out to demonstrate the adequacy of the survey design and sampling regime.	A summary of the key Section 42 responses with changes implemented in the Environmental Statement chapter are presented in this table below.
June 2023	**S42 Consultation** NRW, JNCC, Natural England	Consultees do not agree with the use of stable age structures for age-class apportioning or the removal of sabbaticals from impacts in the PEIR.	Sabbaticals are included in adult impacts in the assessment of effect presented in section 5.7 of Volume 2, Chapter 5: Offshore ornithology of the Environmental Statement (Document Reference F2.5).
	S42 Consultation NRW, JNCC, Natural England	Consultees do not consider it appropriate to base the cumulative (and hence also in-combination) assessments on so many unknowns for impacts from many of the relevant other projects. Whilst these historic projects may not have undertaken quantitative assessments, or assessments using current approaches, estimates will need to be generated for these unknown projects in order to undertake meaningful assessments.	The impact of historic projects for which collision and assessment were unknown have been included in the cumulative assessment (section 5.9 of this chapter). In the absence of quantitative assessment for historical projects, qualitative assessment has been presented where the information was available.
	S42 Consultation NRW and Natural England	Consultees query why Manx shearwater has not been assessed for cumulative displacement impacts both during construction and operation/maintenance, as we consider this should be assessed.	Cumulative and in-combination assessments have been undertaken for Manx shearwater and the results are presented in this chapter.
	S42 Consultation NRW and Natural England	Consultees suggest that cumulative collision assessments of migrant species are also undertaken.	Cumulative collision assessment of migrant species is included in the CEA presented in this chapter.

Date	Consultee and type of response	Topics and issues raised	Response to issue raised and/or where considered in this chapter
	S42 Consultation NRW, JNCC, Natural England	The combined impact of displacement plus collision risk for the Mona project alone should be undertaken for black-legged kittiwake and northern gannet.	The combined cumulative displacement and collision for northern gannet and black-legged kittiwake for the Mona project alone is included in the CEA presented in this chapter.
	S42 Consultation Orsted	To assess the impacts of project alone and cumulative projects on Whooper swan.	Project alone and cumulative collision assessment of Whopper swan is included in the CEA presented in this chapter.
October 2023	**Offshore Ornithology Expert Working Group 6** Attended by: Natural England, JNCC, NRW, RSPB TWT, Isle of Man Government, MMO, Niras	Project updates that affect the assessment were presented to the EWG (e.g., a reduction in the array area and no. of turbines). The EWG were asked to agree whether or not up to 8 vessel movements at the landfall would not be subject to seasonal restrictions. The EWG were notified that due to a number of project changes the baseline characterisation presented in the ES will differ slightly from that of the PEIR and that the regional population estimates used had been revised. It was also noted that precautionary regional breeding estimates as explored with the EWG would be used for assessment. It was noted that the impacts assessed in the ES will be the same as those assessed in the PEIR.	The SNCBs disagreed with the approach taken surrounding the revision of population estimates and the inclusion of immatures within the breeding population and suggested that the discussion would need more clarification. Following the EWG meeting, a technical note detailing the approach to calculating the reference breeding population for project alone and cumulative effect assessment has been circulated to the SNCBs. Agreement on approach detailed under the December EWG meeting below,
December 2023	**Offshore Ornithology Expert Working Group 7** Attended by: Natural England, JNCC, NRW, RSPB, TWT, Isle of Man Government, MMO, Niras	Methodology updates that affect the assessment were presented to the EWG (e.g., project alone and CEA breeding regional population approach and avoidance rates for gull species). Following presentation of the Applicant's approach to calculating regional breeding population against NRW approach (as agreed with JNCC and NE), NRW/JNCC/NE requested that the impacts in the context of the smallest regional breeding population for project alone should also be presented. Following discussion on data sources on avoidance rates, NRW/JNCC/NE requested that the Natural England avoidance rates should be used when assessing collision risk to gull species. The applicant presented an update to the Mona HRA outlining method of screening SPAs for LSE and concluded that there are likely no adverse effects on integrity of any SPAs and a derogation case would likely not be required.	Following discussion with SNCBs, the applicant has presented for project alone the impacts in the context of the smallest regional breeding population. The NRW approach (as agreed with JNCC and Natural England) shows a smaller regional population for northern gannet and Manx shearwater and the Applicant has u presented these values alongside the foraging range populations. The impacts are presented in section 5.7.

5.2.3 Post-application and Examination Consultation

5.2.3.1 Table 5-6 outlines the key comments received from NRW (Advisory) (NRW (A)) and the JNCC post-application and during examination and how the Applicant has updated the chapter in light of the feedback received.

Table 5-6: Post-application consultation and the Applicant's response.

Consultee and form of consultation	Comment summary	Response to issue raised and/or were considered in this document
The JNCC Written Representations at Deadline 1	JNCC do not agree that single values of displacement and mortality should be used for analysis of population impacts. JNCC advises that a range of displacement mortality values are taken through to the assessment of population impacts (SNCBs, 2022)	The Applicant has presented a range of impacts for displacement assessments for both the Mona Offshore Wind Project alone assessment (within section 5.7.2) and cumulatively (within section 5.9.2).
NRW (A)'s and the JNCC's Written Representations at Deadline 1	Request for the Applicant to undertake gap-filling for historical offshore wind projects in the eastern Irish Sea, in line with the SNCB advice note.	The Applicant's response to NRW (A)'s and the JNCC's written representations confirmed that a 'gap-filling' exercise was being undertaken in line with the SNCB advice (which is presented in Section D.6.13 of Appendix D of Technical Engagement Plan (Document Reference E4.1)) to generate indicative estimates for impacts from historical projects that were unquantified at application. The indicative estimates for impacts from historical projects (using a gap-fill approach) are presented in section 5.9 and in Volume 6, Annex 5.7: Offshore Ornithology Assessment of Pen y Gogarth/Great Orme's Head Site of Special Scientific Interest Technical Report of the Environmental Statement (Document Reference F6.5.7).
JNCC's written feedback following a meeting on 4 September 2024 (received via email on 10 September 2024)	The JNCC recommended that the presentation of collision impacts within the EIA include the following information: – Site – Population – Baseline mortality – Mean collision mortality (lower confidence interval (LCI) and upper confidence interval (UCI) (per bio-season) – Increase in baseline mortality mean (LCI, UCI) (per bio-season)	These parameters are presented in section 5.7.5.

Consultee and form of consultation	Comment summary	Response to issue raised and/or were considered in this document
Meeting with NRW, the JNCC and Natural England on 29 August 2024 and in written advice at Deadline 5 (see row below).	Request from Natural England for the project to consider the updated reference populations and parameters in the NRW and Natural England interim advice note (advice letter provided to the Morgan Offshore Wind Project: Generation Assets (hereafter referred to as the Morgan Generation Assets) by Natural England and NRW on 21 March 2024, post submission of the Mona Offshore Wind Project DCO application), particularly in relation to great black-backed gull.	As shown in section 5.7.5, the Applicant has presented the increase in baseline in mortality for the Mona Offshore Wind Project alone using the largest regional population which is the south-west and Channel Biologically Defined Minimum Population Scales (BDMPS) great black-backed gull non-breeding season figure of 17,742 from Furness (2015) as advised by SNCBs in their interim advice regarding demographic rates, EIA scale mortality rates and reference populations for use in offshore wind impact assessments (SNCBs, 2024).
Natural Resources Wales - Deadline 5 Submission - paragraph 8.	Conclusion of cumulative effects on great black-backed gull. The great black-backed gull cumulative collision assessments presented in Volume 2, Chapter 5: Offshore Ornithology (Document Reference eference F2.5 F03) are based on the original advised breeding season reference population, and hence largest seasonal BDMPS population of 44,753 individuals. The revised south-west and Channel BDMPS great black-backed gull breeding season reference population is now 13,424 (interim advice regarding demographic rates, EIA scale mortality rates and reference populations for use in offshore wind impact assessments (SNCBs, 2024)), meaning that the largest BDMPS to use for EIA annual impact assessment is the non-breeding season figure of 17,742 from Furness (2015). NRW (A) advised that the cumulative assessment in Volume 2, Chapter 5: Offshore Ornithology (Document Reference F2.5 F04) be updated to account for this change to the advised great black-backed gull breeding (13,424) and largest seasonal population (17,742) and include the PVA undertaken for this starting population.	As shown in section 5.9, the Applicant has included a CEA for great-black backed gull using the updated population. The results of the PVA using the updated population are presented in section 5.9.3. The PVA revealed that the population is predicted to increase in size under the two impact scenarios considered (species-group avoidance rate (0.9939) or species-specific avoidance rate (0.9991)).
Natural Resources Wales - Deadline 5 Submission - paragraphs 2, 7,19, 27 and 41.	Consideration of new information for other projects and plans made available after submission of the Mona Offshore Wind Project application. The cumulative assessments in Volume 2, Chapter 5: Offshore ornithology (Document Reference F2.5 F04) should include the application numbers from the Morgan Generation Assets, Morecambe Generation Assets and Llŷr 1 Floating Wind Farm,	The Applicant has updated the Morgan Generation Assets, the Morecambe Generation Assets and Llŷr 1 Floating Wind Farm to Tier 1 projects in the CEA presented in section 5.9. The Applicant has updated the Morgan Generation Assets and the Morecambe Generation Assets figures to the application submissions in the CEA presented in section 5.9.

Consultee and form of consultation	Comment summary	Response to issue raised and/or were considered in this document
Natural Resources Wales - Deadline 5 Submission - paragraphs 7 and 18.	Consideration in the CEA and in-combination assessment of historical projects for which quantitative analyses were not presented in the project's specific application documents. The cumulative assessments in Volume 2, Chapter 5: Offshore ornithology (Document Reference F2.5 F04) should include the impacts of these historical projects using a gap-filling method to generate indicative numbers for displacement and collision.	An 'Offshore Ornithology Cumulative Effects Assessment and In-combination Gap-filling Historical Projects Technical Note' (Document Reference S_D3_12) was submitted at Deadline 4 of the Mona Offshore Wind Project examination, which follows the SNCB methodology for quantifying impacts from historical projects. The Applicant subsequently reached an agreement with NRW (A) and the JNCC on the approach and indicative estimates for the gap-filled historical projects have been included in the CEA (see section 5.9 and Appendix A).
Natural Resources Wales - Deadline 5 Submission - paragraph 10	Paragraph 5.9.3.2 of Volume 2, Chapter 5: Offshore Ornithology (Document Reference F2.5 F03) incorrectly references the Ozsanlav-Harris et al. report as dated 2015, when this reference is actually dated 2023	The Applicant has updated the reference in paragraph 5.9.3.2.
Ørsted IPs Comments on the Mona Offshore Wind Project examination Deadline 4 Submissions	The Ørsted IPs outlined that their understanding is that no additional consents are required to continue operating Barrow Offshore Windfarm beyond 2026. The Applicant previous excluded Barrow Offshore Windfarm the from the CEA as the marine licence is due to expire before 2026.	In light of Ørsted IP's comment and for completeness, the Applicant has updated the CEA assessment in section 5.9 to include an indicative impact estimate for Barrow Offshore Wind Farm as well as North Hoyle Offshore Wind Farm due to the potential for these projects to repower.

5.3 Baseline methodology

5.3.1 Relevant guidance

5.3.1.1 The baseline characterisation has followed methodologies and approaches set out in the following guidance documents:

- Offshore Wind Marine Environmental Assessments: Best Practice Advice for Evidence and Data Standards. Phase I: Expectations for pre-application baseline data for designated nature conservation and landscape receptors to support offshore wind applications (Natural England, 2022a)
- Offshore Wind Marine Environmental Assessments: Best Practice Advice for Evidence and Data Standards. Phase II: Expectations for pre-application engagement and best practice guidance for the evidence plan process (Natural England, 2022b)
- Offshore Wind Marine Environmental Assessments: Best Practice Advice for Evidence and Data Standards. Phase III: Expectations for data analysis and presentation at examination for offshore wind applications (Natural England, 2022c).

5.3.2 Scope of the assessment

5.3.2.1 The scope of this Environmental Statement has been developed in consultation with relevant statutory and non-statutory consultees as detailed in Table 5-5

5.3.2.2 Taking into account the scoping and consultation process, Table 5-7 summarises the issues considered as part of this assessment.

Table 5-7: Issues considered within this assessment.

Activity	Potential effects scoped into the assessment
Construction phase	
	• Disturbance and displacement from airborne noise, underwater sound, and presence of vessels and infrastructure • Indirect impacts from underwater sound affecting prey species • Temporary habitat loss/disturbance and increased suspended sediment concentrations (SSCs).
Operation and maintenance	
	• Disturbance and displacement from airborne noise, underwater sound, and presence of vessels and infrastructure • Temporary habitat loss/disturbance and increased SSCs • Presence of operational wind turbines may lead to collision risk. Additional mortality may cause a decrease in seabird populations • Presence of operational wind turbines may result in additional energy expenditure as migrating or commuting birds fly longer distances around the offshore wind farm.
Decommissioning	
	• Disturbance and displacement from airborne noise, underwater sound, and presence of vessels and infrastructure • Indirect impacts from underwater sound affecting prey species • Temporary habitat loss/disturbance and increased SSCs.

5.3.2.3 On the basis of the baseline environment and the description of development outlined in Volume 1, Chapter 3: Project description of the Environmental Statement, a number of impacts have been scoped out of the assessment at the scoping stage for offshore ornithology. These impacts are outlined, together with a justification for scoping them out, in Table 5-8.

Table 5-8: Impacts scoped out of the assessment for offshore ornithology.

Potential impact	Justification
Direct disturbance and displacement impacts from underwater sound during the operations and maintenance phase.	Underwater sound as a result of operation of the wind turbines is extremely unlikely to result in sound levels that would harm birds. In the unlikely event that such low levels of sound emission result in displacement of birds away from wind turbines, this impact would already be accounted for by the above-water operational displacement assessment.

Potential impact	Justification
Accidental pollution during all phases of the Mona Offshore Wind Project.	Pollution impacts (accidental oil/fuel spills) during all phases of the Mona Offshore Wind Project relating to the generation assets are scoped out on the basis that the implementation of a Marine Pollution Contingency Plan (MPCP) will avoid the risk of significant pollution events. Consequently, seabirds and shorebirds are extremely unlikely to be significantly affected by any such pollution impacts.
Indirect impact from underwater sound from wind turbine operation on prey fish species during the operations and maintenance phase.	Sound generated by operational wind turbines is of a very low frequency and low sound pressure level (Andersson, 2011). Studies have found that sound levels are only high enough to possibly cause a behavioural reaction within metres from a wind turbine (Sigray and Andersson, 2011) and therefore such levels are not considered to have potentially significant effects on fish. The Marine Management Organisation (MMO, 2014) review of post-consent monitoring at offshore wind farms found that available data on the operational wind turbine sound, from the UK and abroad, in general showed that sound levels from operational wind turbines are low and the spatial extent of the potential impact of the operational sound is low. This is supported by project specific modelling which indicated that effects on fish (e.g., injury or behavioural effects) are unlikely to occur for the modelled operations wind turbines. See Volume 5, Annex 3.1: Underwater sound technical report of the Environmental Statement (Document Reference F5.3.1) for further details.

5.3.3 Methodology to inform baseline

5.3.3.1 In order to inform the Environmental Statement, 24 months of DAS were undertaken between March 2020 and February 2022. The DAS aim to characterise the distribution and abundance of seabirds within the Mona Offshore Ornithology Array Area study area (Figure 5.1).

5.3.3.2 Furthermore, information on offshore ornithology within the Mona Offshore Ornithology Array Area study area and the Mona Offshore Ornithology Offshore Cable Corridor study area was collected through a detailed desktop review of existing studies and datasets.

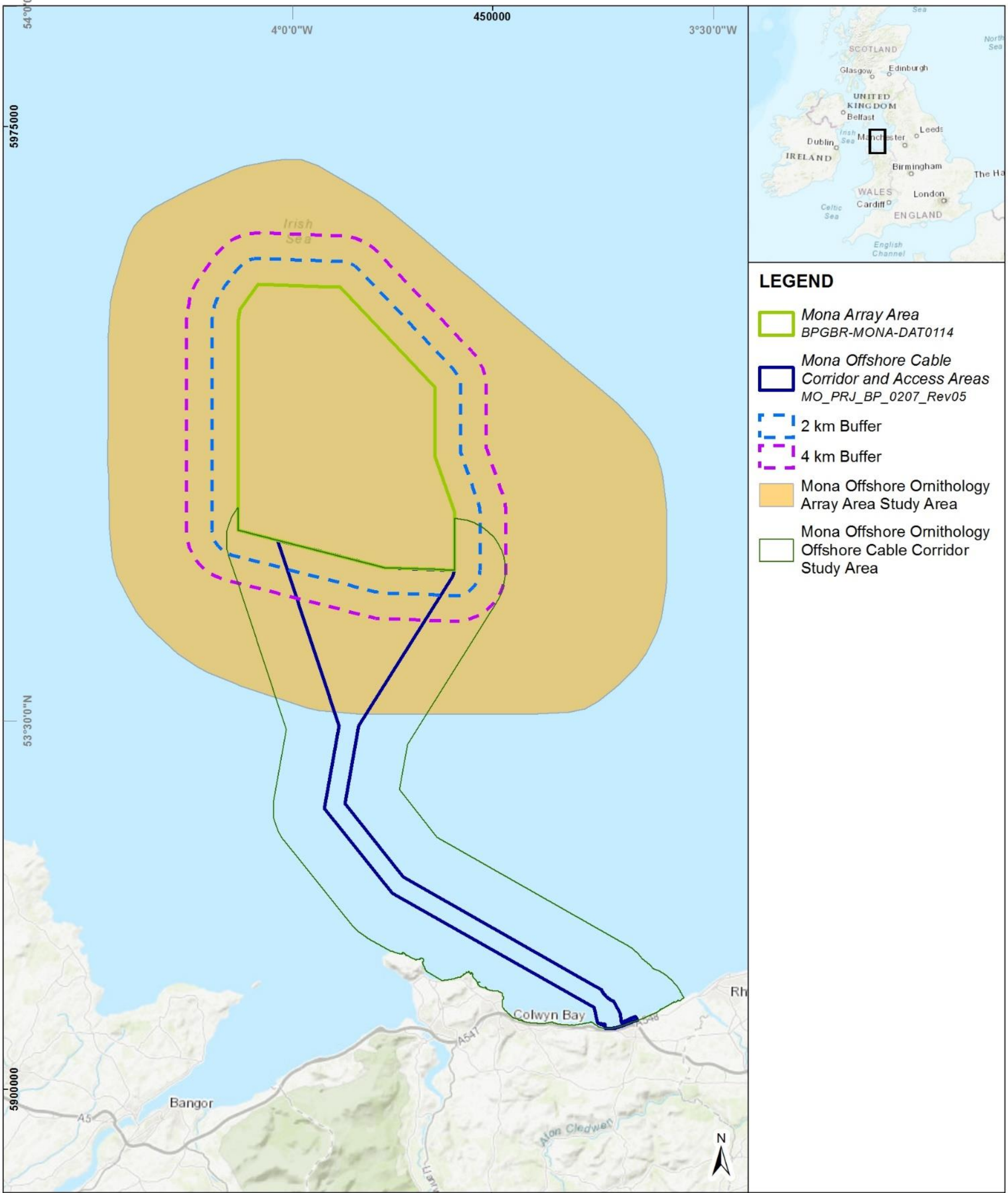
5.3.3.3 The full details of both the site-specific surveys and desktop review methodology are presented in Volume 6, Annex 5.1: Offshore ornithology baseline characterisation technical report of the Environmental Statement (Document Reference F6.5.1).

5.3.4 Study areas

5.3.4.1 There are three study areas for the Mona Offshore Ornithology EIA. These are:

- The Mona Offshore Ornithology Array Area study area: this includes the Mona Array Area plus a buffer extending between 7 km and 16.5 km (Figure 5.1). This area was defined by the extent of the digital aerial bird surveys. Due to the changes in the proposed Mona Array Area since the design of the digital aerial survey in spring 2020, the Mona Offshore Ornithology Array Area study area does not extend equally in all directions around the Mona Array Area assessed in this Environmental Statement

- The Mona Offshore Ornithology Offshore Cable Corridor study area: this encompasses the Mona Offshore Cable Corridor and Access Areas running between the landfall area on the Welsh Coast and the Mona Array Area, plus a 4 km buffer (Figure 5.1). Part of the Mona Offshore Ornithology Offshore Cable Corridor study area has been covered by the digital aerial bird surveys. The areas outside the digital bird surveys are covered by the regional studies of Liverpool Bay (Bradbury *et al*., 2014, Lawson *et al.*, 2016 and HiDef Aerial Surveying Limited., 2023)
- The Cumulative Mona Offshore Ornithology study area: this was identified by consideration of the foraging ranges of seabird species recorded within the Mona Offshore Ornithology Array Area study area and the relevant Biologically Defined Minimum Population Scales (BDMPS) region (Furness, 2015). The Cumulative Mona Offshore Ornithology study correlates to the relevant BDMPS (e.g. 'UK Western Waters'). The Cumulative Mona Offshore Ornithology study area varies dependent upon different species foraging ranges (See Volume 6, Annex 5.1: Offshore ornithology baseline characterisation technical report of the Environmental Statement (Document Reference F6.5.1) for a list of mean maximum foraging ranges plus one standard definition as reported by Woodward, *et al*. (2019)).



Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community	**Data Sources:** Client	
Project Name: MONA OFFSHORE WIND PROJECT	0 2.5 5 nm / 0 5 10 km	**Drawing Number:** RPSE-MN-ES-ORN-001-03
Drawing Title: OFFSHORE ORNITHOLOGY STUDY AREA	**Geodetic Information:** Datum: ETRS 1989; Projection: ETRS 1989 UTM Zone 30N; Scale@160mmx220mm: 1:500,000	

VER	DATE	DETAILS	BY	CHECK
00	24/07/23	First Issue	MJ	AN
03	03/10/23	Revision	MJ	AM

Figure 5.1: The Mona Offshore Ornithology Array Area study area and the Mona Offshore Ornithology Offshore Cable Corridor study area.

5.3.5 Desktop study

5.3.5.1 Information on offshore ornithology within the Mona Offshore Ornithology Array Area study area and the Mona Offshore Ornithology Offshore Cable Corridor study area was collected through a detailed desktop review of existing studies and datasets. These are summarised in Table 5-9 with full details presented in Volume 6, Annex 5.1: Offshore ornithology baseline characterisation technical report of the Environmental Statement (Document Reference F6.5.1).

Table 5-9: Summary of key desktop reports reviewed to inform baseline.

Title	Reference
Identifying important at-sea areas for seabirds using species distribution models and hotspot mapping.	Cleasby *et al*., 2020
Distribution maps of cetacean and seabird populations in the northeast Atlantic.	Waggitt *et al*., 2020
Mapping seabird sensitivity to offshore wind farms.	Bradbury et al., 2014
Non-breeding season populations of seabirds in UK waters: Population sizes for Biologically Defined Minimum Population Scales (BDMPS).	Furness, 2015
All Wales Common Scoter survey: report on 2002/03 work programme.	Cranswick *et al*., 2004
An assessment of the numbers and distributions of inshore aggregations of waterbirds using Liverpool Bay during the non-breeding season in support of possible SPA identification.	Webb *et al*., 2006
An assessment of the numbers and distribution of wintering waterbirds and seabirds in Liverpool Bay/Bae Lerpwl area of search.	Lawson *et al*., 2016
SEA678 Data Report for Offshore Seabird Populations.	Mackey and Giménez, 2006
Seabird Tracking Database.	BirdLife International, 2022
Morgan Offshore Wind Project Preliminary Environmental Information Report (Volume 2, Chapter 10: Offshore Ornithology)	Morgan Offshore Wind Ltd, 2023
Morecambe Offshore Wind Project Preliminary Environmental Information Report (Volume 1, Chapter 12: Offshore Ornithology)	Morecambe Offshore Wind Ltd, 2023
Densities of qualifying species within Liverpool Bay Bae Lerpwl SPA: 2015 to 2020	HiDef Aerial Surveying Limited, 2023

5.3.6 Identification of designated sites

5.3.6.1 All designated sites within the three study areas with qualifying interest features that could be affected by the construction, operations and maintenance and decommissioning phases of the Mona Offshore Wind Project were identified.

5.3.6.2 All designated sites of international (e.g. SPAs or Ramsar sites) and national (e.g. SSSIs or Marine Nature Reserves (MNR) within the Isle of Man) importance which directly overlap one of the three study areas or have features which connect to the study areas were identified. The main sources for identifying these sites were the

JNCC's online resource on the SPAs network (JNCC, 2022), the Ramsar Sites Information Service (RSIS, n.d.) and the Isle of Man's website (The Official Isle of Man Government Website, 2023).

5.3.6.3 Connectivity was established during the breeding season if a site (for which a species is a qualifying feature) is within foraging range of one of the study areas (using mean maximum + 1 SD (Woodward *et al*., 2019).

5.3.6.4 Additional designated sites are included within the HRA for the non-breeding period (migration and winter) but are not specifically mentioned within the chapter. Impacts to populations are felt more profoundly during the breeding season due to its significance in life cycles and therefore to reduce the length of baseline description within this Environmental Statement chapter, only sites connected to the Mona Offshore Wind Project during the breeding season are described in section 5.3.8. During the non-breeding season, species are no longer spatially restricted and undertake much larger movements than during the breeding season (Furness, 2015).

Site-specific surveys

5.3.6.5 In order to inform the Environmental Statement, site-specific surveys were undertaken as agreed with the statutory bodies. A summary of the surveys undertaken to inform the offshore ornithology impact assessment is outlined in Table 5-10.

Table 5-10: Summary of site-specific survey data.

Title	Extent of survey	Overview of survey	Survey contractor	Date	Reference to further information
DAS	Mona Array Area with buffer extending 7 km to 16.5 km	DAS to characterise the distribution and abundance of seabirds within the Mona Offshore Ornithology Array Area study area.	APEM	March 2020 to February 2022 (24 months)	Volume 6, Annex 5.1: Offshore ornithology baseline characterisation technical report of the Environmental Statement (Document Reference F6.5.1).

5.3.7 Baseline environment

Desktop study findings

5.3.7.1 The Mona Array Area is situated in the central part of the Irish Sea. The Irish Sea separates the islands of Ireland and Great Britain and is linked to the Celtic Sea in the south by St George's Channel, and to the Inner Seas off the West Coast of Scotland in the north by the North Channel (also known as the Straits of Moyle).

5.3.7.2 21 species of seabird have been reported as regularly nesting on beaches or cliffs around the Irish Sea (Mitchell *et al.,* 2004).

5.3.7.3 A large proportion of the Manx shearwater biogeographic population is found breeding on offshore islands around the Irish Sea. Most of the world's Manx shearwater population is found in the UK and over 90% of the UK population is found on the Islands of Rum, Eigg (Scotland), Skomer and Skokholm (Wales) (Mitchell *et al*., 2004; JNCC, 2020).

5.3.7.4 During the non-breeding season, large populations of common scoter *Melanitta nigra* and red-throated diver use the shallow waters of Liverpool Bay (Lawson *et al*., 2016).

5.3.7.5 For the most widespread and abundant seabirds of the central Irish Sea, namely northern gannet, common guillemot, European herring gull *Larus argentatus*, black-legged kittiwake, lesser black-backed gull *Larus fuscus*, Manx shearwater and razorbill, there are a number of breeding colonies within the species-specific foraging ranges (mean-maximum foraging ranges compiled by Woodward *et al.* (2019)) from the Mona Array Area.

5.3.7.6 During the desktop study a review of boat-based and aerial survey data analysed by Waggitt *et al*. (2020) and Bradbury *et al*. (2014) revealed key patterns of temporal and spatial use in the Mona Offshore Ornithology Array Area study area. These are summarised below with full details presented in Volume 6, Annex 5.1: Offshore ornithology baseline characterisation of the Environmental Statement (Document Reference F6.5.1).

5.3.7.7 Both studies showed that black-legged kittiwake have a patchy seasonal distribution, an overall lower abundance during the breeding season (March to August) and relative low densities in the Mona Offshore Ornithology Array Area study area. It is also apparent from both studies that the Mona Array Area did not overlap with hotspots of abundance of common guillemot and razorbill, which were located further inshore or offshore during the non-breeding and breeding seasons respectively. It is also evident from Waggitt *et al*. (2020) and Bradbury *et al*. (2014) that lesser black-backed gull and European herring gull have a very restricted coastal distribution during the breeding season (April to August) owing to their small foraging range (Woodward *et al*., 2019).

5.3.7.8 Both Bradbury *et al*. (2014) and Waggitt *et al*. (2020) showed densities of Manx shearwater to be relatively low during the breeding season (April to August) with less than one bird per km^2 in the Mona Offshore Ornithology Array Area study area. The work by Waggitt *et al*. (2020), based on aerial and boat-based survey data collected between 1980 to 2018, also indicated that northern gannet were found in the highest densities to the west of the Mona Offshore Ornithology Array Area study area during the breeding season (March to September) whilst Bradbury *et al*. (2014) found the highest densities to be southeast of the Mona Offshore Ornithology Array Area study area during the breeding season.

Site-specific survey findings

5.3.7.9 Design-based abundance estimates of all species are presented in Volume 6, Annex 5.1: Offshore Ornithology Baseline Characterisation Technical Report of the Environmental Statement (Document Reference F6.5.1), alongside model-based abundance (using the Marine Renewables Strategic Environmental Assessment (MRSea) package) for the most abundant seabird species. MRSea modelling is unable to calculate estimated abundance for species with low counts.

5.3.7.10 Common guillemot was the most abundant seabird species recorded during the DAS, with most birds found on the sea. Common guillemot distribution was heterogeneous depending on year and month. Within the Mona Array Area study area plus 2 km, the highest MRSea modelled estimates were recorded in March 2020 and February 2021, with 5,739 and 4,415 individuals, respectively.

5.3.7.11 Black-legged kittiwake were most abundant in March at the start of the breeding season. Thereafter, the predicted abundance varied greatly for the rest of the breeding season (April to August) and the predicted distribution within the Mona Array Area appeared to be variable, with high inter-month variability recorded. Black-legged kittiwake were also present in moderate numbers throughout the non-breeding season. MRSea modelled estimates for monthly black-legged kittiwake numbers in the Mona Array Area plus 2 km peaked at 907 individuals in March 2021.

5.3.7.12 Within the Mona Array Area plus 2 km, the highest MRSea estimate of Manx shearwater was recorded in June 2021, with an estimated 2,173 individuals. The presence of Manx shearwater in the breeding season suggested that these birds might be associated with the Welsh colonies and thus forage within the Mona Offshore Ornithology Array Area study area.

5.3.7.13 Razorbill was recorded in the highest MRSea estimates in February 2021 with 2,305 individuals in the Mona Array Area plus 2 km. At this time of the year, the species starts gathering at sea in the vicinity of breeding colonies. Outside the pre-breeding period (February to March), population estimates were very low.

5.3.7.14 The distribution of northern gannet during the breeding months was patchy, and the highest densities were found outside the Mona Array Area. In Year 1, the highest MRSea estimate in the Mona Array Area plus 2 km was recorded in July and August, with 209 and 144 individuals respectively. In contrast the highest MRSea estimate was recorded at the end of the breeding season in Year 2 with 293 individuals (in September 2022. The low abundances and high inter-annual variability during the breeding season suggests that the Mona Array Area is not favoured by foraging northern gannet.

5.3.8 Designated sites

International sites (European sites and Ramsar sites)

5.3.8.1 Internationally designated sites identified for the offshore ornithology assessment are described in Table 5-11. Sites are ordered according to distance from the Mona Array Area within two broad categories of site: marine SPAs and breeding seabird colony SPAs. All relevant designated sites are assessed with the HRA (HRA Stage 1 Screening Report (Document Reference E1.4) and HRA Stage 2 Information to Support an Appropriate Assessment Part Three: Special Protection Areas and Ramsar sites Assessments (Document Reference E1.3)).

Table 5-11: International designated sites and relevant qualifying interests for the offshore ornithology assessment.

Designated site	Closest distance to the Mona Array Area (km)	Closest distance to the Mona Offshore Cable Corridor and Access Areas (km)	Relevant qualifying interest (i.e. the site is within connectivity distance (mean max foraging range + 1 SD) to the Mona Array Area or Cable Corridor and Access Areas)
Marine SPAs and Ramsar sites (designated for aggregations of seabirds within the marine environment)			
Liverpool Bay SPA	10.0	0.0	Red-throated diver
			Little gull
			Common scoter
			Little tern *Sternula albifrons*
			Common tern
			Waterbird assemblage
Mersey Narrows and North Wirral Foreshore SPA/Ramsar	44.9	26.2	Little gull

Designated site	Closest distance to the Mona Array Area (km)	Closest distance to the Mona Offshore Cable Corridor and Access Areas (km)	Relevant qualifying interest (i.e. the site is within connectivity distance (mean max foraging range + 1 SD) to the Mona Array Area or Cable Corridor and Access Areas)
Irish Seafront SPA	57.2	61.4	Manx shearwater
Breeding seabird colony SPAs and Ramsar sites (designated for breeding seabirds)			
Dee Estuary SPA/Ramsar	39.2	13.1	Common tern
			Sandwich tern
			Cormorant
Ribble and Alt Estuaries SPA/Ramsar	37.2	39.3	Lesser black-backed gull
Morecambe Bay and Duddon Estuary SPA/Ramsar	47.0	58.7	Lesser black-backed gull
			European herring gull
			Sandwich tern
Bowland Fells SPA	76.2	80.1	Lesser-black backed gull
Aberdaron Coast and Bardsey Island SPA	98.9	83.0	Manx shearwater
Lambay Island SPA	128.9	132.5	Lesser black-backed gull
			European herring gull
			Black-legged kittiwake
			Razorbill
			Northern fulmar
			Atlantic puffin
Howth Head Coast SPA	134.4	137.7	Black-legged kittiwake
Ireland's Eye SPA	134.7	138.0	Black-legged kittiwake
Copeland Islands SPA	136.1	152.1	Manx shearwater
Wicklow Head SPA	148.8	146.2	Black-legged kittiwake
Ailsa Craig SPA	166.9	193.0	Northern gannet
			Black-legged kittiwake
			Lesser black-backed gull
Rathlin Island SPA	207.7	230.3	Black-legged kittiwake
			Seabird assemblage (breeding) including the components: • Atlantic puffin • Lesser black-backed gull
Skomer, Skokholm and the Seas off Pembrokeshire SPA	220.6	201.1	European storm-petrel *Hydrobates pelagicus*
			Manx shearwater
			Lesser black-backed gull
			Atlantic puffin

Designated site	Closest distance to the Mona Array Area (km)	Closest distance to the Mona Offshore Cable Corridor and Access Areas (km)	Relevant qualifying interest (i.e. the site is within connectivity distance (mean max foraging range + 1 SD) to the Mona Array Area or Cable Corridor and Access Areas)
			Seabird assemblage (breeding) including the components: • Black-legged kittiwake • Common guillemot • Razorbill
Grassholm SPA	229.4	211.4	Northern gannet
			Northern fulmar
Saltee Islands SPA	236.8	228.2	Northern gannet
			Lesser black-backed gull
			Black-legged kittiwake
			Northern fulmar
			Atlantic puffin
North Colonsay and Western Cliffs SPA	281.7	307.0	Black-legged kittiwake
Helvick Head to Ballyquin SPA	292.4	286.6	Black-legged kittiwake
Rum SPA	365.5	391.8	Black-legged kittiwake
Old Head of Kinsale SPA	377.7	371.9	Black-legged kittiwake
Canna and Sanday SPA	384.5	410.7	Black-legged kittiwake
Cruagh Island SPA	407.31	410.7	Manx shearwater
Isles of Scilly SPA/Ramsar	433.3	411.1	Great-black backed gull
			Lesser black-backed gull
Blasket Islands SPA	465.5	465.9	Manx shearwater
Deenish Island and Scariff Island SPA	466.5	464.6	Northern fulmar
			Manx shearwater
Shiant Isles SPA	467.5	494.3	Seabird assemblage including the components: • Northern fulmar
Puffin Island SPA	472.6	471.5	Northern fulmar
Skelligs SPA	481.9	480.5	Northern gannet
Handa SPA	505.1	532.5	Seabird assemblage including the components: • Northern fulmar
St Kilda SPA	514.2	538.9	Northern gannet
			Northern fulmar
Cape Wrath SPA	527.1	554.6	Northern fulmar
Flannan Isles SPA	535.5	561.6	Northern fulmar

National sites (SSSI and MNRs)

5.3.8.2 Nationally designated sites (seabird colonies within SSSI and MNR sites) identified for the offshore ornithology assessment are described in Table 5-12. Sites are ordered according to distance from the Mona Array Area within each category of site.

Table 5-12: Nationally designated sites and relevant qualifying interests for the offshore ornithology assessment.

Designated Site	Closest Distance to the Mona Array Area (km)	Closest Distance to the Mona Offshore Cable Corridor and Access Areas (km)	Relevant Qualifying Interest
SSSI (seabird colonies)			
Creigiau Rhiwledyn/Little Orme's Head SSSI	31.3	2.3	Common guillemot
			Razorbill
			Black-legged kittiwake
			Great cormorant
Pen y Gogarth/Great Orme's Head SSSI	29.8	3.3	Common guillemot
			Razorbill
			Black-legged kittiwake
			Great cormorant
Arfordir Gogleddol Penmon SSSI	34.7	13.8	Northern fulmar
Penrhynoedd Llangadwaladr SSSI	57.3	43.5	Lesser black-backed gull
			Herring gull
Ribble Estuary SSSI	58.7	48.3	Black-headed gull
			Common tern
St. Bees Head SSSI	77.8	97.3	Common guillemot
			Northern fulmar
			Black-legged kittiwake
			Razorbill
			Herring gull
Abbey Burn Foot to Balcary Point SSSI	108.0	127.9	Northern fulmar
			Black-legged kittiwake
			Razorbill
Sanda Islands SSSI	191.2	209.5	Northern fulmar
			Black-legged kittiwake
St. Margaret's Island SSSI	226.0	197.6	Black-legged kittiwake
			Atlantic puffin
			Lesser black-backed gull
Grassholm / Ynys Gwales SSSI	232.6	213.6	Northern gannet
MNRs			
Langness MNR	40.9	56.6	Northern fulmar
			Herring gull
			Lesser black-backed gull

Designated Site	Closest Distance to the Mona Array Area (km)	Closest Distance to the Mona Offshore Cable Corridor and Access Areas (km)	Relevant Qualifying Interest
Little Ness MNR	44.6	62.2	Northern fulmar
			Lesser black-backed gull
Laxey Bay MNR	48.8	67.8	Herring gull
			Lesser black-backed gull
			Northern fulmar
Baie ny Carrickey MNR	49.9	64.7	Razorbill
			Common guillemot
			Northern fulmar
			Black-legged kittiwake
			Atlantic puffin
Calf of Man and Wart Bank MNR	53.2	66.6	Lesser black-backed gull
			Herring gull
			Manx shearwater
			Atlantic puffin
			Black-legged kittiwake
Port Erin Bay MNR	56.5	70.8	Northern fulmar
			Northern gannet
			Herring gull
Ramsey Bay MNR	57.0	76.7	Northern fulmar
			Northern gannet
			Atlantic puffin
			Black-legged kittiwake
			Herring gull
Niarbyl Bay MNR	57.5	72.2	Northern fulmar
			Lesser black-backed gull
West Coast MNR	60.7	76.4	Black-legged kittiwake
			Northern fulmar
			Common guillemot
			Atlantic puffin
			Razorbill
			Manx shearwater
			Lesser black-backed gull
			Herring gull

5.3.9 Important Ecological Features (IEFs)

5.3.9.1 The IEFs included within the assessment are those species recorded during the site-specific surveys and identified in the desktop study that could be potentially affected by the Mona Offshore Wind Project during the construction, operations and maintenance or decommissioning phases. In addition, statutory consultees requested additional species also be included within the assessment (highlighted within Table 5-13).

5.3.9.2 The offshore ornithology IEFs have been selected (Table 5-13) based on the conservation status of the ornithological receptor, their sensitivity to impact (for each impact which has been scoped in for the assessment) and known abundance from site specific surveys and desktop studies (Volume 6, Annex 5.1: Offshore ornithology baseline characterisation of the Environmental Statement (Document Reference F6.5.1)).

5.3.9.3 For each IEF identified, it has been stated in Table 5-13 whether the identified species are listed on Annex I of the European Commission ('EC') Directive 2009/147/EC (codified version of 79/409/EC) on the Conservation of Wild Birds (the 'Birds Directive'). Within the UK, the Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019 (known as the 'Habitats Regulations') provide amendments to the 2017 Habitats Regulations. The 2017 Habitats Regulations transpose aspects of the Birds Directive into national law, covering all environments out to 12 nm.

5.3.9.4 The level of conservation concern is presented from the Birds of Conservation Concern 5 (BoCC) (Stanbury *et al*., 2021), which uses quantitative assessments against standardised criteria to allocate species to red, amber, or green lists depending on their level of conservation concern.

5.3.9.5 Furthermore, species of principal importance for the conservation of biodiversity in England (priority species) were included in the assessment as listed under Section 41 of the Natural Environment and Rural Communities Act 2006. A number of species of conservation importance, i.e., BoCC 5 (Stanbury *et al*., 2021) and BoCC 5 Addendum (Stanbury *et al*., 2024) and Section 41 (Natural England, 2022d), are also interest features of UK SSSI sites and MNR on the Isle of Man.

5.3.9.6 Following the evaluation, the IEFs identified in Table 5-13 were taken forward for consideration in the impact assessment. Species that were recorded in very low numbers or very infrequently during the site-specific surveys and the desktop study are excluded because a population-level effect would be undetectable and thus negligible.

Table 5-13: Evaluation of IEFs showing species assessed for significance of effect from the Mona Offshore Wind Project.

Important ecological features	Conservation status	Observed within the Mona Array Area plus 2 km buffer (or 4 km buffer if appropriate for the species)	Vulnerable to disturbance and displacement	Vulnerable to collision risk	Assessed for significance of effects for the Mona Offshore Wind Project
Arctic skua	Red list	Yes – peak abundance of 11 birds during one survey.	Very low	High	Yes for collision, the species risk of collision was considered during the migration periods using the WWT Consulting and MacArthur Green (2014) approach for migratory species. However, as Arctic skua are assumed to migrate within a band of no more than 20 km from shore, there was no risk of collision during the migration period using the WWT Consulting and MacArthur Green (2014) approach.
Arctic tern	Annex 1, Red list	No	Low	Moderate	No, no birds were present within array area
Atlantic puffin	**Red list**	**Yes – peak abundance of 44 birds during one survey.**	**Moderate**	**Very low**	**Yes, for disturbance and displacement**
Black-headed gull	**Amber list**	**Yes – peak abundance of 7 birds during one survey.**	**Low**	**Moderate**	**Yes, for migratory collision risk**
Black-legged kittiwake	**Red list**	**Yes – peak abundance of 907 birds during one survey.**	**Low**	**High**	**Yes, for disturbance and displacement, and collision risk**
Common guillemot	**Amber list**	**Yes – peak abundance of 5,739 birds during one survey.**	**Moderate**	**Very low**	**Yes, for disturbance and displacement**
Common gull	Red list	Yes – peak abundance of 20 birds during one survey.	Low	High	Yes for collision during migration periods, the species risk of collision was considered using the WWT Consulting and MacArthur Green (2014) approach for migratory species. However, as common gull are assumed to migrate within a band of no more than 20 km from shore, there was no risk of collision during the migration period using the WWT Consulting and MacArthur Green (2014) approach.
Common scoter	**Red list, Section 41 species**	**No**	**High**	Very low	**Yes, for disturbance and displacement due to higher abundances within the Cable Corridor and Access Areas.**

Important ecological features	Conservation status	Observed within the Mona Array Area plus 2 km buffer (or 4 km buffer if appropriate for the species)	Vulnerable to disturbance and displacement	Vulnerable to collision risk	Assessed for significance of effects for the Mona Offshore Wind Project
Common tern	Annex 1, Amber list	Yes – peak abundance of 7 birds during one survey.	Low	Moderate	No, for collision during breeding season, the species was not considered as the Mona Array Area is beyond the mean maximum plus one standard deviation for foraging common tern at breeding colonies. Yes, for collision during migration periods, the species risk of collision was considered using the WWT Consulting and MacArthur Green (2014) approach for migratory species. However, as common tern are assumed to migrate within a band of no more than 20 km from shore, there was no risk of collision during the migration period using the WWT Consulting and MacArthur Green (2014) approach.
European shag	Amber list	No	Moderate	Moderate	No, no birds were present within the Mona Array Area
Great black-backed gull	**Red list**	**Yes – peak abundance of 174 birds during one survey.**	Low	**Very high**	**Yes, for collision risk**
Great cormorant	Green list	Yes – peak abundance of 6 birds during one survey.	High	Low	No, the species is of low conservation status and low numbers of birds were present and therefore, the risk of collision and displacement was not considered.
Great skua	**Red list**	**Yes – peak abundance of 7 birds during one survey.**	**Very Low**	**Moderate**	**Yes, for migratory collision risk**
Herring gull	**Red list, Section 41 species**	**Yes – peak abundance of 68 birds during one survey.**	Low	**Very high**	**Yes, for collision risk**
Lesser black-backed gull	**Amber list**	**Yes – peak abundance of 27 birds during one survey.**	Low	**Very high**	**Yes, for collision risk**
Little gull	Annex 1, Green list	Yes – peak abundance of 14 birds during one survey.	Low	Low	No, species is of low risk to displacement and/or collision risk. In addition, low numbers of birds were present compared to regional populations and therefore, the species was not assessed.

Important ecological features	Conservation status	Observed within the Mona Array Area plus 2 km buffer (or 4 km buffer if appropriate for the species)	Vulnerable to disturbance and displacement	Vulnerable to collision risk	Assessed for significance of effects for the Mona Offshore Wind Project
Manx shearwater	**Amber list**	**Yes – peak abundance of 2,173 birds during one survey.**	**Very Low**	**Very low**	**Yes, for disturbance and displacement and collision risk. Requested by the EWG even though the species is very low vulnerability.**
Northern fulmar	**Amber list**	**Yes – peak abundance of 149 birds during one survey.**	Very Low	**Very low**	**Yes, for collision risk. Requested by the EWG even though the species is very low vulnerability.**
Northern gannet	**Amber list**	**Yes – peak abundance of 293 birds during one survey.**	**Low**	**High**	**Yes, for disturbance and displacement, and collision risk.**
Razorbill	**Amber list**	**Yes – peak abundance of 2,305 birds during one survey.**	**Moderate**	Very low	**Yes, for disturbance and displacement.**
Red-throated diver	**Annex 1, Green list**	**No**	**High**	Moderate	**Yes, for disturbance and displacement. Requested by the EWG even though the species was not recorded during the Array Area surveys.**
Sandwich tern	Annex 1, Amber list	Yes – peak abundance of 15 birds during one survey.	Moderate	Moderate	No, for disturbance and displacement during breeding season, the species was not considered as the Mona Array Area is beyond the mean maximum plus one standard deviation for foraging common tern at breeding colonies. Yes for collision, the species risk of collision was considered during the migration periods using the WWT Consulting and MacArthur Green (2014) approach for migratory species. However, sandwich tern are assumed to migrate within a band of no more than 20 km from shore, there was no risk of collision during the migration period using the WWT Consulting and MacArthur Green (2014) approach.

Seasonality

5.3.9.7 The behaviour and abundance of bird populations vary throughout the calendar year, contingent on the biological seasons relevant to different seabird species. The IEFs included in the assessment showed seasonality in their distribution and abundance during the site-specific surveys, which reflected the timing of the breeding and non-breeding seasons and migratory periods (i.e. pre- and post-breeding). These distinct biological seasons (bio-seasons) are acknowledged in order to assess the significance of each bird species within the Mona Offshore Wind Project during each specific time period. The BDMPS seasons used within the assessment are based on those in Furness (2015).

5.3.9.8 The seasonal definitions in Furness (2015) include overlapping months in some instances due to variation in the timing of migration for birds which breed at different latitudes (i.e. individuals from breeding sites in the north of the species' range may still be on spring migration when individuals farther south have already commenced breeding).

5.3.9.9 Bio-seasons used within the assessment were defined according to the breeding, non-breeding and migratory periods (autumn and spring migration) from Furness (2015) are shown in Table 5-14. Common Scoter was not included within Furness (2015) and so was based on Cramp and Simmons (1983). The Migration-free breeding season was not used in the assessment as advised by JNCC in the second EWG (held on 13/07/2022).

Table 5-14: Seasonal definitions as the basis for assessment, from Furness (2015).

Species	Pre-breeding season/spring migration	Migration-free breeding season	Full breeding Season	Post breeding Season/autumn migration	Migration-free non-breeding/ winter season
Red-throated diver	February to April	May to August	March to August	September to November	December to January
Common Scoter	N/A	N/A	May to August	N/A	September to April
Common guillemot	December to February	March to June	March to July	July to October	November
Razorbill	January to March	April to June	April to July	August to October	November to December
Atlantic puffin	March to April	May to June	April to early August	Late July to August	September to February
Northern fulmar	December to March	April to August	January to August	September to October	November
Northern gannet	December to March	April to August	March to September	September to November	N/A
Manx shearwater	Late March to May	June to July	April to August	August to early October	November to February
Black-legged kittiwake	January to April	May to July	March to August	August to December	N/A
European herring gull	January to April	May to July	March to August	August to November	December

Species	Pre-breeding season/spring migration	Migration-free breeding season	Full breeding Season	Post breeding Season/autumn migration	Migration-free non-breeding/ winter season
Lesser black-backed gull	March to April	May to July	April to August	August to October	November to February
Great black-backed gull	January to April	May to July	Late March to August	August to November	December

Reference populations

5.3.9.10 Regional population estimates for the non-breeding, wintering and autumn and spring migration periods have been defined and calculated using the BDMPS relevant for each species (Furness, 2015). Population estimates for the breeding population were based on SPA and non-SPA sites (including SSSIs and MNR sites) located within the species' mean-maximum plus one standard deviation foraging range (using Woodward *et al.,* 2019) of the Mona Offshore Wind Project. Regional breeding colony counts were extracted from the SMP online database (JNCC, 2023), with the most recent colony count for each colony utilised (up to the year 2023)

5.3.9.11 In addition to breeding adult birds associated with the breeding colonies, there will be immature and juvenile seabirds present within the region. Population counts therefore must be adjusted to account for these seabirds.

5.3.9.12 As outlined in Volume 6, Annex 5.1 Offshore ornithology baseline characterisation technical report of the Environmental Statement (Document Reference F6.5.1), calculation of the total regional breeding population was explored collaboratively with the Offshore Ornithology EWG due to their being little evidence to support the calculation of the number of juveniles, immatures and non-breeding birds that remain in their wintering areas into the breeding season. During the seventh EWG meeting (held 08 December 2023), it was agreed that for the project alone assessment, foraging range populations could be used, however if the foraging range population is greater than the regional seas populations (BDMPS from Furness, 2015) then impacts would also be assessed against this population. This specifically occurs for northern gannet and Manx shearwater. For precaution, the lowest breeding season population is presented in assessment.

5.3.9.13 In the non-breeding season, seabirds are not constrained by colony location and can, depending on individual species, range widely within UK seas and beyond. The ZOI for seabird species where an assessment in the non-breeding season and migratory periods is deemed to be required is based on either the 'UK Western Waters', 'UK Western Waters and Channel' or 'UK south-west and Channel waters' depending on the species (Furness, 2015). The total regional breeding population (adult plus juveniles and immatures) are presented in Table 5-15 alongside the non-breeding and migration periods BDMPS. Non-breeding populations for common scoter and red-throated diver were derived from HiDef Aerial Surveying Limited (2023).

5.3.9.14 As shown in Table 5-15, only certain seasons have been taken forward to the assessment. Furness (2015) provides under each species account the appropriate seasons to be used within assessments and hence why not all seasons in Table 5-14 have been utilised. These seasons were agreed with the EWG during the second meeting.

Table 5-15: Bio-seasons, monthly breakdown and population sizes used within the assessment.

Bio-season population sizes of species taken from Furness, 2015.
[1]HiDef. (2023) – Latest population for the Liverpool Bay/Lerpwl Bae Area of Search.

Species	Pre-Breeding Season/Spring Migration	Foraging Range Breeding Season	Regional Seas Breeding Season	Post Breeding Season/Autumn Migration	Non-breeding/Winter Season
Red-throated diver	February to April (4,373)	N/A	N/A	September to November (4,373)	December to January (2,073)[1]
Common scoter	N/A	N/A	N/A	N/A	September to April (95,931)[1]
Common guillemot	N/A	March to July (136,680)	March to July (1,145,528)	N/A	August to February (1,139,220)
Razorbill	January to March (606,914)	April to July (18,345)	April to July (198,969)	August to October (606,914)	November to December (341,422)
Atlantic puffin	N/A	April to August (203,302)	April to August (1,482,791)	N/A	September to March (304,557)
Northern fulmar	December (828,194)	January to August (54,403)	January to August (629,594)	September to October (828,194)	November (556,367)
Northern gannet	December to February (661,888)	March to September (682,989)	March to September (522,888)	October to November (545,954)	N/A
Manx shearwater	March (1,580,895)	April to August (2,372,485)	April to August (1,821,544)	September to October (1,580,895)	N/A
Black-legged kittiwake	January to February (691,526)	March to August (156,679)	March to August (245,234)	September to December (911,586)	N/A
European herring gull	N/A	March to August (31,214)	March to August (217,167)	N/A	September to February (173,299)
Lesser black-backed gull	March (163,304)	April to August (109,785)	April to August (240,750)	September to October (163,304)	November to February (41,159)
Great black-backed gull	N/A	March to August (1,496)	March to August (13,424)	N/A	September to February (17,742)

Baseline mortality rates

5.3.9.15 The impact of additional mortality due to offshore wind farm effects is assessed in terms of the change in the baseline mortality rate which could result. 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. Therefore, a weighted average baseline mortality rate has been calculated which is appropriate for all age classes for use in assessments, calculated for those species screened in for assessment.

5.3.9.16 Age specific survival rates for each species from Horswill and Robinson (2015) were entered into a matrix population model. Updated productivity values were provided by JNCC/British Trust for Ornithology (BTO) (SMP, 2023), with the UK average over the course of 2010 to 2019 calculated and used. Not all species and colonies had updated counts after 2014, and so the national average from Horswill and Robinson (2015) was used if no updated rates from JNCC/BTO were made available. Productivity values were used to calculate the expected proportions in each age class. Each age class survival rate was multiplied by its proportion and the total for all ages summed to give the average survival rate for all ages. The average mortality rate was subsequently calculated by subtracting the survival rate from 1. The demographic rates, age class proportions and average mortality rates calculated are presented in Table 5-16.

Table 5-16: Demographic rates from JNCC/BTO for productivity (SMP, 2023) and Horswill and Robinson (2015) for survival and mortality rates and population age ratios calculated from population models used to estimate average mortality for use in impact assessment.

Species	Parameter	Age Class						Adult	Productivity	Average mortality
		0 to 1	1 to 2	2 to 3	3 to 4	4 to 5	5 to 6			
Red-throated diver	Survival	0.600	0.620	N/A	N/A	N/A	N/A	0.840	0.571	0.233
	Proportion in population	0.196	0.118	N/A	N/A	N/A	N/A	0.686	N/A	N/A
Common scoter	Survival	0.749	0.749	N/A	N/A	N/A	N/A	0.783	1.838	0.238
	Proportion in population	0.352	0.264	N/A	N/A	N/A	N/A	0.384	N/A	N/A
Common guillemot	Survival	0.560	0.792	0.917	0.939	0.939	N/A	0.939	0.583	0.133
	Proportion in population	0.153	0.084	0.065	0.058	0.053	N/A	0.587	N/A	N/A
Razorbill	Survival	0.630	0.630	0.895	0.895	N/A	N/A	0.895	0.532	0.172
	Proportion in population	0.155	0.099	0.064	0.059	N/A	N/A	0.623	N/A	N/A
Atlantic puffin	Survival	0.709	0.709	0.709	0.760	0.805	N/A	0.906	0.555	0.176
	Proportion in population	0.155	0.113	0.082	0.060	0.046	N/A	0.544	N/A	N/A
Northern fulmar	Survival	0.260	N/A	N/A	N/A	N/A	N/A	0.936	0.410	0.221
	Proportion in population	0.233	N/A	N/A	N/A	N/A	N/A	0.767	N/A	N/A
Manx shearwater	Survival	0.870	0.870	0.870	0.870	0.870	N/A	0.870	0.600	0.130
	Proportion in population	0.140	0.120	0.103	0.089	0.077	N/A	0.471	N/A	N/A
Northern gannet	Survival	0.424	0.829	0.891	0.895	0.895	N/A	0.919	0.766	0.193
	Proportion in population	0.201	0.084	0.069	0.061	0.054	N/A	0.531	N/A	N/A
	Survival	0.790	0.854	0.854	0.854	N/A	N/A	0.854	0.619	0.156

Species	Parameter	Age Class						Adult	Productivity	Average mortality
		0 to 1	1 to 2	2 to 3	3 to 4	4 to 5	5 to 6			
Black-legged kittiwake	Proportion in population	0.160	0.126	0.107	0.090	N/A	N/A	0.517	N/A	N/A
European herring gull	Survival	0.798	0.834	0.834	0.834	0.834	N/A	0.834	0.498	0.171
	Proportion in population	0.132	0.110	0.096	0.084	0.073	N/A	0.505	N/A	N/A
Lesser black-backed gull	Survival	0.820	0.885	0.885	0.885	0.885	N/A	0.885	0.438	0.121
	Proportion in population	0.120	0.099	0.088	0.079	0.069	N/A	0.547	N/A	N/A
Great black-backed gull	Survival	0.798	0.930	0.930	0.930	0.930	N/A	0.930	1.061	0.095
	Proportion in population	0.188	0.134	0.112	0.094	0.078	N/A	0.394	N/A	N/A

5.3.10 Future baseline scenario

5.3.10.1 The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 requires that "an outline of the likely evolution thereof without implementation of the development 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 Environmental Statement. In the event that the Mona Offshore Wind Project does not come forward, an assessment of the future baseline conditions has been carried out and is described within this section.

5.3.10.2 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).

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

5.3.10.4 Most seabird species in the UK are at the southern limit of their range in the northeast Atlantic and therefore an increase in global temperatures could result in a 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). On current predictions it is anticipated that sea surface temperatures will continue to rise (see Volume 4, Chapter 2: Climate Change of the Environmental Statement (Document Reference F4.2)).

5.3.10.5 Fisheries management will also likely impact on future seabird populations in the UK and Ireland. For many years, seabird species have benefitted from bycatch and fisheries discards; for scavenging species such as European herring gull, black-legged 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.

5.3.11 Data limitations

5.3.11.1 Baseline characterisation of the Mona Offshore Ornithology Array Area study area and resulting assessments of significance use site-specific data (DAS) conducted over a period of 24 months (March 2020 to February 2022). 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 at the Mona Offshore Wind Project is identical to other baseline characterisation surveys at offshore wind farms projects which have been previously agreed by SNCBs as suitable for baseline characterisation.

5.3.11.2 The level of precision of the abundance estimates is crucial as reliable abundance underpins the robustness of the predictions and the assessment of the effects on the

IEFs. To characterise the baseline conditions, model-based estimates using the MRSea) package were produced in order to predict numbers across the survey area alongside 95% confidence intervals to provide a level of uncertainty. Design based estimates for bird numbers and densities in each month were also generated and compared to the MRSea estimates to provide additional validation of the MRSea outputs and provide estimates for months where low raw abundances prevented the use of the MRSea model. Flight heights for the Stochastic Collision Risk Model (sCRM) were derived from the published literature rather than site-specific data. Generic flight height distributions published by Johnston *et al*. (2014a, 2014b) were therefore used in sCRM for this assessment. The application of site-specific flight height data collected by LiDAR survey was considered during the survey programme but was not undertaken following consultation with the EWG in 2021. At the time of consultation, the EWG did not endorse the use of LiDAR as a method for collecting flight height data to parameterise CRMs due to the lack of an established body of scientific evidence. Other methods to collect site-specific flight height data (e.g. derived from aerial imagery) were not currently considered to be sufficiently robust or precise in their estimates and have associated issues with the application of appropriate avoidance rates. The use of generic flight heights conforms to current best practice and has been agreed through the Evidence Plan Process as presented in section 5.2.

5.3.11.3 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 but emerging (Grémillet *et al*., 2023, Burke *et al*, 2024, Jeglinsk *et al*., 2024; Birkhead and Hatchwell, 2025). The disease has affected 61 bird species, including species such as northern gannet, razorbill, common guillemot, Atlantic puffin, Manx shearwater, northern fulmar and small and large gull species (Pearce-Higgens *et al*., 2022; Tremlett *et al*, 2024). The impact has affected northern gannet and great skua colonies profoundly, with both species now facing increased risk of global extinction (Pearce-Higgens *et al*., 2022; Tremlett *et al*, 2024) (the UK supports 55.6% of the global northern gannet population and 60% of the global great skua population; JNCC, 2021). However, as determined by recent Natural England guidance on HPAI in relation to baseline characterisation of offshore renewable projects (Natural England, 2022d), as the baseline data for the Mona Offshore Ornithology Array Area study area were all collected prior to summer 2022 (surveys commenced in March 2020 and were completed in February 2022), the assessments within this report remain a valid representation of typical seabird distribution and density.

5.4 Impact assessment methodology

5.4.1 Overview

5.4.1.1 The offshore ornithology impact assessment has followed the methodology set out in Volume 1, Chapter 5: EIA methodology of the Environmental Statement (Document Reference F1.5). Specific to the offshore ornithology impact assessment, the following guidance documents have been considered:

- Offshore Wind Marine Environmental Assessments: Best Practice Advice for Evidence and Data Standards. Phase I: Expectations for pre-application baseline data for designated nature conservation and landscape receptors to support offshore wind applications (Natural England, 2022a)
- Offshore Wind Marine Environmental Assessments: Best Practice Advice for Evidence and Data Standards. Phase II: Expectations for pre-application

engagement and best practice guidance for the evidence plan process (Natural England, 2022b)

- Offshore Wind Marine Environmental Assessments: Best Practice Advice for Evidence and Data Standards. Phase III: Expectations for data analysis and presentation at examination for offshore wind applications (Natural England, 2022c)
- Chartered Institute of Ecology and Environmental Management (CIEEM) (2018) Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal and Marine
- EIA for Offshore Renewable Energy projects (British Standards Institute (BSI) (2015); and
- UK Planning Inspectorate Advice Note Twelve: Transboundary Impacts (PINS, 2015); and Advice Note Seventeen: Cumulative Effects Assessment (PINS, 2019).

5.4.1.2 In addition, the offshore ornithology impact assessment has considered the legislative framework as defined by:

- The Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019 and the 2017 Habitats Regulations
- European Commission ('EC') Directive 2009/147/EC (codified version of 79/409/EC) on the Conservation of Wild Birds (the 'Birds Directive')
- Ramsar Convention on Wetlands of International Importance 1971
- Wildlife and Countryside Act 1981 (as amended).

5.4.2 Impact assessment criteria

5.4.2.1 Determination of significance of effects is a two-stage process that involves defining the magnitude of the 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 5: EIA methodology of the Environmental Statement (Document Reference F1.5).

5.4.2.2 The criteria for defining magnitude in this chapter are outlined in Table 5-17 below. This set of definitions has been determined on the basis of changes to bird populations.

Table 5-17: Definition of terms relating to the magnitude of an impact.

Magnitude of impact	Definition
High	A change in the size or extent of distribution of the relevant biogeographic population or the population that is the interest feature of a specific protected site that is predicted to irreversibly alter the population in the short to long term and to alter the long-term viability of the population and/or the integrity of the protected site. Impacts felt long-term. Impacts predicted to be reversed in the long-term (i.e. more than five years) following cessation of the project activity.
Medium	A change in the size or extent of distribution of the relevant biogeographic population or the population that is the interest feature of a specific protected site that occurs in the short and long-term, but which is not predicted to alter the long-term viability of the population and/or the integrity of the protected site. Impacts felt medium to long-term. Impacts predicted to be reversed in the medium-term (i.e. no more than five years) following cessation of the project activity.

Magnitude of impact	Definition
Low	A change in the size or extent of distribution of the relevant biogeographic population or the population that is the interest feature of a specific protected site that is sufficiently small-scale or of short duration to cause no long-term harm to the feature/population. Impacts present for a short to medium duration. Impacts predicted to be reversed in the short-term (i.e. no more than one year) following cessation of the project activity.
Negligible	Very slight or no change from the size or extent of distribution of the relevant biogeographic population or the population that is the interest feature of a specific protected site. Impacts present for a short duration. Impacts predicted to be reversed rapidly (i.e. no more than circa six months) following cessation of the project related activity.

5.4.2.3 The criteria for defining recoverability and sensitivity in this chapter are outlined in Table 5-18 below.

Table 5-18: Definition of recoverability of the receptor.

Recoverability	Definition
High	A species with a low to medium reproductive success and a stable or increasing UK trend in breeding abundance and productivity.
Medium	A species with a low reproductive success and a stable or increasing UK long-term trend in breeding abundance and productivity.
Low	A species with a low reproductive success and a declining UK long-term trend in breeding abundance and productivity or uncertainty regarding the long-term trend (due to data availability).

5.4.2.4 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. Using this approach, the conservation importance of a species seen at different times of year may fall into any of the defined categories (Table 5-19).

Table 5-19: Definition of conservation importance of the receptor.

Conservation Importance	Definition
High	A species for which individuals at risk can be clearly connected to a particular SPA and is listed as a qualifying feature of a designated site
Medium	A species for which individuals at risk are probably drawn from particular SPA populations, although other colonies (both SPA and non-SPA) may also contribute to individuals observed on the Mona Offshore Wind Project. The species is listed as a feature of a national designated site (e.g SSSI)
Low	A species for which it is not possible to identify the SPAs from which individuals on the Mona Offshore Wind Project have been drawn, or for which no SPAs are designated (includes SPAS, Ramsar sites and SSSIs).

5.4.2.5 The definition of sensitivity considers the vulnerability and recoverability of a receptor as well as taking into account the conservation importance of each receptor (outlined in Table 5-19).

5.4.2.6 It should be noted that high vulnerability and/or low recoverability are not necessarily linked with high conservation value within a particular impact. A receptor could be categorised as being of high conservation value (e.g. an interest feature of a SPA) but have a low or negligible physical/ecological vulnerability to an effect and vice versa. Determination of sensitivity takes these differing aspects into consideration.

Table 5-20: Definition of sensitivity of the receptor.

Sensitivity	Definition
Very High	Bird species has high conservation value, very high vulnerability to impact and has no ability to recover
High	Bird species has high conservation value, medium vulnerability to impact and has low recoverability
	Bird species has medium conservation value, high vulnerability to impact and has low recoverability
Medium	Bird species has high conservation value, low vulnerability to impact and has medium recoverability
	Bird species has high conservation value, low vulnerability to impact and has low recoverability
	Bird species has medium conservation value, high vulnerability to impact and has medium recoverability
	Bird species has medium conservation value, medium vulnerability to impact and has medium recoverability
	Bird species has medium conservation value, low vulnerability to impact and has medium recoverability
Low	Bird species has medium conservation value, medium vulnerability to impact and high recoverability
	Bird species has low conservation value, medium to high vulnerability to impact and medium to high recoverability
Negligible	Bird species has low conservation value, low vulnerability to impact and medium to high recoverability
	Bird species is not vulnerable to impacts.

5.4.2.7 The significance of the effect upon offshore ornithology is determined by correlating the magnitude of the impact and the sensitivity of the receptor. The method employed for this assessment is presented in Table 5-21. Where a range of significance of effect is presented in section 5.7, the final assessment for each effect is based upon expert judgement and a precautionary approach.

5.4.2.8 For the purposes of this assessment, any effects with a significance level of ‘moderate’ or ‘major’ have been concluded to be significant in terms of The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017.

Table 5-21: Matrix used for the assessment of the significance of the effect.

Sensitivity of Receptor	Magnitude of Impact			
	Negligible	**Low**	**Medium**	**High**
Negligible	Negligible	Negligible or Minor	Negligible or Minor	Minor
Low	Negligible or Minor	Negligible or Minor	Minor	Minor or Moderate

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

5.4.3 Designated sites

5.4.3.1 Where National Site Network sites (i.e. internationally designated sites) are considered, this chapter summarises the assessments made on the interest features of internationally designated sites as described within section 5.3.8 of this chapter (with the assessment on the site itself deferred to the ISAA (Document Reference E.1.1 – E1.3)). With respect to nationally and locally designated sites, where these sites fall within the boundaries of an internationally designated site (e.g. SSSIs which have not been assessed within the ISAA (Document Reference E.1.1 – E1.3)), only the international site has been taken forward for assessment. This is because potential effects on the integrity and conservation status of the nationally designated site are assumed to be inherent within the assessment of the internationally designated site (i.e. a separate assessment for the national site is not undertaken).

5.4.3.2 The ISAA (Document Reference E.1.1 – E1.3) has been prepared in accordance with Advice Note Ten: Habitats Regulations Assessment Relevant to Nationally Significant Infrastructure Projects (Planning Inspectorate, 2022) and has been submitted alongside the Environmental Statement.

5.5 Key parameters for assessment

5.5.1 Maximum design scenario

5.5.1.1 The MDS identified in Table 5-22 have been selected as those having the potential to result in the greatest effect on an identified receptor or receptor group. These scenarios have been selected from the Project Design Envelope provided in Volume 1, Chapter 3: Project description of the Environmental Statement (Document Reference F1.3). Effects of greater adverse significance are not predicted to arise should any other development scenario, based on details within the Project Design Envelope (e.g. different infrastructure layout), to that assessed here be taken forward in the final design scheme.

Table 5-22: Maximum design scenario considered for the assessment of potential impacts on offshore ornithology.

[a] C=construction, O=operations and maintenance, D=decommissioning

Potential impact	Phase[a]			Maximum Design Scenario	Justification
	C	O	D		
Disturbance and displacement from airborne noise, underwater sound, and presence of vessels and infrastructure	✓	✓	✓	**Construction phase** Installation of wind turbines, offshore substation platforms (OSPs), inter-array and interconnector cables in the Mona Array Area of up to 300 km², and offshore export cables within the Mona Offshore Cable Corridor and Access Areas. - Wind turbines: installation of up to 96 wind turbines - Up to 64 with four-legged jacket foundations. This will require one pile per leg with a maximum diameter of each pile of 3.8 m) installed by impact piling - Up to 32 with gravity base foundations, with up to 10 requiring piling, leading to up to 150 piles, with 15 piles per foundation (maximum diameter of 4 m per pile) - OSPs: installation of up to four OSPs - OSP foundations consisting of up to four-legged jacket foundations, with three piles per leg (48 piles, maximum diameter of 5 m per pile) installed by impact piling - Maximum hammer energy of up to 4,400 kJ - Up to two vessels piling wind turbines concurrently with a maximum hammer energy of 3,000 kJ each (minimum distance 1.4 km, maximum distance 15 km, between piling vessels) - Maximum of up to 4.5 hours of piling for a wind turbine foundation with a cumulative total of up to 1,152 hours, with a maximum of one foundation (four piles) per day. - Consecutive piling to take place over a maximum of 24 hoursper foundation. - Up to four piles installed per 24 hours per vessel = up to 159 days (up to 64 four legged jacket foundations for wind turbines, up to 37.5 days for the 10 gravity base foundations that require piling, 12 days for OSP foundation piles) for a single vessel (maximum temporal) or 57 days for two vessels (maximum spatial) - Total piling phase (foundation installation) of up to two years within a four-year construction programme	Represents the maximum density of wind turbines and structures across the maximum Mona Array Area and the Mona Offshore Cable Corridor and Access Areas that would cause greatest extent of disturbance and displacement to birds or the greatest duration of impact. Represents the maximum underwater sound impacts from impact piling for each of the relevant infrastructure foundation options. Represents the maximum number of vessel and helicopter movements that would cause greatest visual and noise disturbance and displacement to birds from the Mona Array Area and the Mona Offshore Cable Corridor and Access Areas.

Potential impact	Phase[a] C	O	D	Maximum Design Scenario	Justification
				- Burial of up to 325 km of inter-array cables, 50 km of interconnector cables and 360 km of export cable via ploughing, trenching and jetting; cable burial and rock dumping • Mona Array Area - Up to 1,929 installation vessel movements (return trips) during construction (521 main installation and support vessels, 74 tug/anchor handlers, 56 cable lay installation and support vessels, 50 guard vessel, 31 survey vessels, 19 seabed preparation vessels, 1,135 CTVs, 41 scour protection installation vessels and 2 cable protection installation vessels) - Up to a total of 69 construction vessels on site at any one time - Up to 1,095 helicopter movements with up to 7 helicopters on site at any one time • Mona Offshore Cable Corridor and Access Areas - Up to a total of 17 construction vessels on site at any one time including; ○ 2 cable lay installation and support vessels ○ 2 trench supporting vessels for export cable route ○ 2 installation support vessels for export cable route ○ 1 guard vessel for export cable route ○ 2 survey vessels for pre or post survey works for export cable route ○ 1 Out of Service cable removal vessel for export cable route ○ 1 boulder clearance vessel for export cable route ○ 1 dredging vessel for export cable route ○ 2 crew transport / installation support vessels ○ 1 rock dumping vessel for export cable route ○ 1 construction support vessel for concrete mattress installation for export cable route - Up to 126 installation vessel movements (return trips) during construction (10 cable lay installation cycles, 10 TSV rotations and 20 ISV rotations (support vessels), 18 guard vessel, 4 survey vessels, 24 seabed preparation vessels, 20 CTVs, and 20 cable protection installation vessels)	

Potential impact	Phase[a] C	O	D	Maximum Design Scenario	Justification

				Operations and maintenance phase
				Disturbance and displacement from presence of operational wind turbines and associated operations and maintenance activity, including increased vessel, helicopter and inspection drone activity:
				- Presence of up to 96 operating turbines and up to four OSPs occupying the Mona Array Area of up to 300 km^2
				- Minimum spacing of 1400 m between wind turbines
				- Up to a total of 21 operations and maintenance vessels on site at any one time
				  ○ Up to 6 crew transfer vessels
				  ○ Up to 3 Jack-up vessels
				  ○ Up to 4 cable repair vessels
				  ○ Up to 4 other vessels
				  ○ Up to 4 excavator or backhoe dredger
				  ○ Up to 8 helicopters
				  ○ Up to 5 inspection drones (operated from vessel). Up to five inspections per wind turbine per year as a maximum.
				- Up to 849 operations and maintenance vessel movements (return trips) each year
				  ○ Up to 730 crew transfer vessels return trips
				  ○ Up to 25 Jack-up vessel trips return trips
				  ○ Up to 8 cable repair vessel return trips
				  ○ Up to 78 other vessel return trips
				  ○ Up to 8 excavator or backhoe dredger return trips
				  ○ Up to 730 helicopter return trips
				  ○ Up to 214 inspection drone return trips (operated from vessel).
				- Routine inspectons once per year
				  ○ max 2 repairs every 5 years per export cable with max 4 km per repair = 6.4 km per year
				  ○ estimated 1 reburial event every 5 years with approx 15 km cable length per reburial event
				- Operational lifetime of up to 35 years.	

Potential impact	Phase[a] C	O	D	Maximum Design Scenario	Justification
				Decommissioning phase - Vessels used for a range of decommissioning activities such as removal of foundations - Noise from vessels assumed to be as per vessel activity described for the construction phase above.	
Indirect impacts from underwater sound affecting prey species	✓	×	✓	**Construction phase** • As described in Volume 2, Chapter 3: Fish and shellfish ecology of the Environmental Statement (Document Reference F2.3) for: – Underwater sound during the construction phase impacting fish and shellfish receptors. **Decommissioning phase** • As described in Volume 2, Chapter 3: Fish and shellfish ecology of the Environmental Statement (Document Reference F2.3) for: – Underwater sound during the construction phase impacting fish and shellfish receptors.	As described in Volume 2, Chapter 3: Fish and shellfish ecology of the Environmental Statement (Document Reference F2.3).
Temporary habitat loss/disturbance and increased SSCs	✓	✓	✓	**Construction phase** • As described in Volume 2, Chapter 3: Fish and shellfish ecology of the Environmental Statement (Document Reference F2.3) for: – Increased SSCs and associated sediment deposition. **Operations and maintenance phase** • As described in Volume 2, Chapter 3: Fish and shellfish ecology of the Environmental Statement (Document Reference F2.3) for: – Increased SSCs and associated sediment deposition. **Decommissioning phase** • As described in Volume 2, Chapter 3: Fish and shellfish ecology of the Environmental Statement (Document Reference F2.3) for: – Increased SSCs and associated sediment deposition.	As described in Volume 2, Chapter 3: Fish and shellfish ecology of the Environmental Statement (Document Reference F2.3).

Potential impact	Phase[a]			Maximum Design Scenario	Justification
	C	O	D		
Collision risk	×	✓	×	**Operations and maintenance phase** • Presence of up to 96 wind turbines within the Mona Array Area • Minimum lower blade tip height of 34 m above Lowest Atronomical Tide (LAT) • Maximum hub height of 168 m above LAT • Maximum blade tip height of 293 m above LAT • Maximum rotor diameter of 250 m • Average blade pitch (in degrees) of 10 • Maximum chord width of 6.8 m • Maximum rotor speed of 8.4 rotations per minute (rpm) (with maximum average speed of 6.2 rpm) • Proportion of time operational of 94% • Operational lifetime of up to 35 years.	The potential for collision risk is derived from wind turbine parameters including rotor diameter, chord width, rotor speed and minimum lower blade tip height. The parameters associated with the most numerous wind turbines (96) represents the MDS because it will result in the greatest potential for collision risk. The parameters associated with the most numerous turbine option have been used, these values are based on the MDS parameter values for the worst-case collision risk.
Barrier to movement	×	✓	×	**Operations and maintenance phase** • Presence of up to up to 96 wind turbines, up to four OSPs within the Mona Array Area of 300 km^2 with a minimum spacing of 1,400 m between rows and within rows.	Maximum density of wind turbines and structures across the Mona Array Area, which maximises the potential barrier to foraging grounds and migration routes for bird species.

5.6 Measures adopted as part of the Mona Offshore Wind Project

5.6.1.1 For the purposes of the EIA process, the term 'measures adopted as part of the project' is used to include the following measures (adapted from The Institute of Environmental Management and Assessment (IEMA), 2016):

- Measures included as part of the project design. These include modifications to the location or design envelope of the Mona Offshore Wind Project which are integrated into the application for consent. These measures are secured through the consent itself through the description of the development and the parameters secured in the DCO and/or marine licences (referred to as primary mitigation in IEMA (2016))
- Measures required to meet legislative requirements, or actions that are standard practice used to manage commonly occurring environmental effects and are secured through the DCO requirements and/or the conditions of the marine licences (referred to as tertiary mitigation in IEMA (2016)).

5.6.1.2 A number of measures (primary and tertiary) have been adopted as part of the Mona Offshore Wind Project to reduce the potential for impacts on offshore ornithology. These are outlined in Table 5-23. As there is a secured commitment to implementing these measures for the Mona Offshore Wind Project, they have been considered in the assessment presented in section 5.7 (i.e. the determination of magnitude and therefore significance assumes implementation of these measures).

5.6.1.3 It should be noted that the Applicant has committed to increase the air draught to 34 m above LAT during the project design phase to reduce the impacts from collision. Air draught is a known factor in calculating collision risk and it is assumed that increasing the air draught will decrease the proportion of birds flying at risk height (Band, 2012), and ultimately reduce the number of predicted collisions.

Table 5-23: Measures adopted as part of the Mona Offshore Wind Project.

Measures adopted as part of the Mona Offshore Wind Project	Justification	How the measure will be secured
Primary measures: Measures included as part of the project design		
The Applicant has committed to a minimum lower blade tip height (air draught) of 34 m above LAT.	Air draught is known to be an important factor for collision risk, with typically fewer collisions predicted with increasing air draught.	To be secured as a requirement of the DCO and within the deemed marine licence in Schedule 14 of the draft DCO.
Tertiary measures: Measures required to meet legislative requirements, or adopted standard industry practice		
Offshore Environmental Management Plan (EMP) that will include measures to minimise disturbance to rafting birds from transiting vessels	The development of and adherence to an Offshore EMP which will include measures to minimise disturbance to rafting birds from transiting vessels.	To be secured within the deemed marine licence in Schedule 14 of the draft DCO and expected to be secured within the standalone NRW marine licence.

Measures adopted as part of the Mona Offshore Wind Project	Justification	How the measure will be secured
The Offshore EMP will include a timing restriction of no offshore export cable installation during the period 1st November to 31st March within the Liverpool Bay SPA.	The timing restriction will ensure no installation of offshore export cables or UXO clearance during the period of 1st November to 31st March within the Mona Offshore Cable Corridor and Access Areas located within the Liverpool Bay SPA in order to minimise disturbance to IEFs within the Mona Offshore Cable Corridor and Access Areas, in particular diver and seaduck species.	To be secured within the deemed marine licence in Schedule 14 of the draft DCO and expected to be secured within the standalone NRW marine licence.
The Offshore EMP will include a MPCP.	Implementation of an EMP including a MPCP which will include planning for accidental spills, address all potential contaminant releases and include key emergency details.	To be secured within the deemed marine licence in Schedule 14 of the draft DCO and expected to be secured within the standalone NRW marine licence.

5.7 Assessment of significant effects

5.7.1 Overview

5.7.1.1 The impacts of the construction, operations and maintenance, and decommissioning phases of the Mona Offshore Wind Project on offshore ornithology have been assessed. These potential impacts are listed in Table 5-22, along with the MDS against which each impact has been assessed.

5.7.1.2 A description of the potential effect on offshore ornithology receptors caused by each identified impact is given below.

5.7.2 Disturbance and displacement from airborne noise, underwater sound, and presence of vessels and infrastructure

5.7.2.1 The construction, operations and maintenance, and decommissioning of the Mona Offshore Wind Project may lead to disturbance and displacement of birds. The MDS is represented by the maximum density of wind turbines and structures across the Mona Array Area and the Mona Offshore Cable Corridor and Access Areas that would cause the greatest extent of disturbance and displacement to birds or the greatest duration of impact. The MDS also represents the maximum underwater sound output from impact piling for each of the relevant infrastructure foundation options and the maximum number of vessel and helicopter movements that would cause greatest visual and sound disturbance and displacement to birds from the Mona Array Area and Mona Offshore Cable Corridor and Access Areas. The MDS is summarised in Table 5-22.

5.7.2.2 Disturbance as the result of activities during the construction, operations and maintenance, 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).

5.7.2.3 As the result of disturbance, displaced 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). Such disturbance and resulting displacement could ultimately 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.

5.7.2.4 Disturbance as a result of activities during the construction of an offshore wind farm (such as installing foundations, wind turbines, inter-array cabling and associated vessel movements) and the offshore export cable has the potential to displace birds. Cable laying vessels will be active for six months within the construction period. Construction activities then result in a point source of disturbance, for example when construction vessels are at a location to undertake piling and install foundations or the wind turbines. The level of disturbance associated with each location would vary depending on the activity undertaken. With regards to vessels in the Mona Array Area, there is no method to quantify the displacement impact of the activities due to their highly local and temporary nature. An EMP that includes measures to minimise disturbance to rafting birds from transiting vessels is anticipated to be secured within the draft DCO and agreed pre-construction. It is expected that impacts of vessels on seabirds are negligible and this has not been taken forward to further assessment.

5.7.2.5 During the operations and maintenance phase, the presence of operational wind turbines has the potential to directly disturb seabirds leading to displacement from the offshore wind farm array area including an area of variable size or buffer around it (Dierschke *et al*., 2016). Therefore, the presence of wind turbines at the Mona Array Area has the potential to directly disturb and displace seabirds that would normally reside within and around the area of sea. Additionally, activities associated with the operations and maintenance of wind turbines (e.g. vessel, helicopter and inspection drone activity) may disturb and displace species within the Mona Array Area and potentially within surrounding buffers to a lower extent.

5.7.2.6 The displacement assessment for the Mona Offshore Wind Project is based on the use of the SNCB Matrix Table approach, which was agreed during consultation with the Offshore Ornithology EWG on 13 July 2022 as part of the Evidence Plan process. As sensitivity to displacement differs considerably between seabird species, species were screened and progressed for the Matrix Table approach using ‘Disturbance Sensitivity’ and ‘Habitat Specialization’ 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 abundance of birds in the Mona Array Area was considered as to whether species were progressed to the matrix stage.

5.7.2.7 For each of the species considered (common guillemot, razorbill, Atlantic puffin, black-legged kittiwake, northern gannet, red-throated diver and Manx shearwater, Table 5-13), displacement impacts were quantified for the population derived within the Mona Array Area plus 2 km buffer (or 4 km buffer if appropriate for the species).

5.7.2.8 SNCBs recommend for most species a standard displacement buffer of 2 km with the exception of the species groups of divers and seaducks as they can be affected at distances over 4 km (JNCC, 2022).

5.7.2.9 Red-throated diver and common scoter were rarely recorded in the Mona Offshore Ornithology Array Area study area during the baseline surveys and have therefore been excluded from the assessment of displacement from the Mona Array Area but included in the Mona Offshore Cable Corridor and Access Areas assessment. There is the potential for disturbance and displacement from airborne noise, underwater sound, and presence of vessels within the Mona Offshore Cable Corridor and Access Areas as the result of site preparation activities in advance of installation activities, cable installation activities, pre-cabling seabed clearance (including Unexploded Ordnance (UXO) detonation), anchor placements and decommissioning activities such as export cable removal.

5.7.2.10 The evidence-based for the displacement rates and associated mortality rates for each species is noted below, and the full approach of the displacement assessment is detailed in Volume 6, Annex 5.2: Offshore ornithology displacement technical report of the Environmental Statement (Document Reference F6.5.2).

Evidence-based displacement and mortality rates

5.7.2.11 Since displacement sensitivity vary between species, the displacement rates and associated mortality rates used to assess the effects of the operations and maintenance phase of the Mona Offshore Wind Project have been derived from previous studies, guidance documents and advice received by SNCBs during the Evidence Plan Process. Given that construction is limited both spatially and temporally and that any potential effects are unlikely to reach the same level as during the operations and maintenance phase, the level to be used for the construction phase of the Mona Offshore Wind Project is a 50% reduction in the displacement rate used for operational phase assessments as recommended by NRW (A) during the second EWG (held on 13 July 2022).

5.7.2.12 There is limited empirical evidence regarding the mortality rate to use when assessing the impacts of displacement of offshore wind farms, however, the current SNCBs guidance, based on expert opinion (Natural England 2014), is to consider a mortality rate of up to 10% (SNCBs, 2017). 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 10% mortality rate. Similarly, Searle *et al.* (2014; 2018) used time and energy budget models to investigate the effects of displacement and barrier effects on breeding populations of seabirds, including auks during the chick rearing period. The study reported changes in time and energy budgets which could impact future survival of auks, however the simulations concluded that the displacement effects were unlikely to result in a mortality rate increase of over 0.5%. Therefore, in line with the advice from the SNCBs (2017), a 1 to 10% mortality of displaced individuals has been used for all species in this assessment, although the Applicant considers that 1% mortality rate to be the more likely impact based on expert judgement. To ensure that the assessments are suitably precautionary for all species, the mortality rates considered for the construction phase remain the same as those used for operational phase impacts.

5.7.2.13 Decommissioning activities within the Mona Array Area are equal to or less than those carried out during the construction phase. Therefore, for the purpose of this assessment it is assumed that the impacts are likely to be similar.

Atlantic puffin, common guillemot, razorbill, Manx shearwater

5.7.2.14 Evidence shows that auk species exhibit a medium level of sensitivity to vessel and helicopter traffic (Garthe and Hüppop, 2004; Furness and Wade, 2012; Langston, 2010; 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 (Orsted, 2021; APEM 2022) 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%.

5.7.2.15 Based on the review of the relevant literature, a displacement rate of 50% during the operations and maintenance phase of the Mona Offshore Wind Project has been deemed appropriate for the auk species (i.e. common guillemot, razorbill and Atlantic 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 Mona Array Area, this ensures a precautionary rate is used for the assessment.

5.7.2.16 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 75% to 85% in the first year of operations fell to 31% to 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 Mona Array Area will reduce over time, and, given that the site is close to other offshore wind farms (such as Burbo Bank and West of Duddon Sands), some habituation may have already occurred within local populations that would result in reduced avoidance of the Mona Array Area compared to a new offshore wind farm in a previously unimpacted region.

5.7.2.17 The conclusion from the literature review suggests that a displacement rate of 50% (range 30% to 70%) during the operations and maintenance phase of the Mona Array Area and 2 km buffer is the most applicable for auk species, whilst still being suitably precautionary for assessment. The EIA has presented predicted impacts the full range of displacement and mortality rates advised by the SNCBs (1 to 100% for both displacement and mortality rates) alongside an assessment of the Applicant's identified scenario of 50% displacement and 1% mortality. It should also be noted that the HRA (see Annex 1.3.1 Offshore ornithology ISAA Supporting Information (Document Reference E1.3.1 F01) also considers an alternative scenario for auk species (specifically common guillemot and razorbill) of 70% displacement and 2% mortality, as these parameters have recently been accepted and used by the Secretary of State within the HRAs for Hornsea Two/Three/Four, East Anglia One North, East Anglia Two, Norfolk Boreas, Norfolk Vanguard, Sheringham Shoal and Dudgeon Extension Projects (SEP and DEP).

5.7.2.18 As there is limited evidence regarding displacement rates in Manx shearwater, it was advised by the SNCBs at the Offshore Ornithology EWG meeting (held 13 July 2023, see S42 Consultation, see Annex 5, Chapter 2: Offshore ornithology displacement technical report (Document Reference F6.5.2)) that these are to be treated similarly to the auk species, using a 50% (range 30% to 70%) displacement rate. The use of a 50% displacement rate in Manx shearwater is also likely to be highly precautionary since this species shows weak avoidance to offshore wind farms and the population vulnerability to displacement is very low (Dierschke *et al.,* 2016; Bradbury *et al.,* 2014).

5.7.2.19 Few studies have provided empirical displacement rates for the construction phase of offshore windfarms. However, studies suggest the displacement rates of auks is either comparable to or significantly lower than that of the operational phase (Royal Haskoning, 2013; Vallejo *et al.,* 2017). Although potential disturbance from construction activities within a development can be high during the construction phase, it is likely to be both temporally and spatially restricted compared to the operations and maintenance phase, and thus the resultant displacement rate of the entire site is lower in comparison.

5.7.2.20 Given that the displacement rate used for the construction phase is a 50% reduction from the operational phase displacement rate, the rate used for auks, kittiwake and Manx shearwater during the construction phase is 25% (range 15% to 35%) as agreed with the SNCBs in the second EWG (held on 13/07/2022).

Northern gannet

5.7.2.21 To assess the effects of the operations and maintenance phase of the Mona Offshore Wind Project on the northern gannet population in the area, a displacement rate of 70% (range 60% to 80%) and a mortality rate of 1% (range 1% to 10%) was used.

5.7.2.22 Evidence suggests that northern 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 (2022) 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 Natural England (pers. comm., 7 July 2022), using a displacement rate of 70% has been deemed appropriate for this assessment.

5.7.2.23 Given that the displacement rate used for the construction phase is a 50% reduction from the operational phase displacement rate, the rate used for northern gannet during the construction phase is 35% (range 30% to 40%) as agreed with the SNCBs.

5.7.2.24 Based on expert judgement a mortality rate of 1% (range 1% to 10%) was selected for this assessment and is considered to be sufficiently precautionary. This decision is supported by additional evidence that suggests that northern gannet have a large mean-maximum (315 km) and maximum (709 km) foraging range (Woodward *et al.*, 2019) and feed on a diverse range of prey items and thus displaced birds will have access to suitable alternative foraging opportunities despite the potential reduced foraging activities within the Mona Array Area.

Black-legged kittiwake

5.7.2.25 Black-legged 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, 2023). However, the population near the Mona Array Area is of high importance and so, following an agreement through the Evidence Plan Process and at the recommendation of JNCC, the species has been considered for the displacement assessment. Displacement impacts on kittiwakes have not been undertaken for any other wind farm outside of Scotland and only the JNCC have requested it.

5.7.2.26 Studies regarding the displacement at Egmond aan Zee OWF (Leopold *et al.,* 2011), Bligh Bank OWF and Thorntonbank OWF (Vanermen, 2013). Horns Rev OWF, Princess Amalia Windpark (Furness, 2013) reported no significant displacement of black-legged kittiwake.

5.7.2.27 A study by Peschko (2020) used a long-term dataset covering 14 years before and 3 years after the construction of OWFs in the southern North Sea to assess the displacement of black-legged kittiwake. They found a 45% decrease in density during the breeding season.

5.7.2.28 As there is no consensus as to the impact, both NRW (A) and Natural England advise against assessing displacement for black-legged kittiwake. As such, to date no consented offshore windfarm located in English or Welsh waters has presented an assessment of displacement for black-legged kittiwake. However, the JNCC recommend that 30-70% displacement and 1-10% mortality is considered.

5.7.2.29 NatureScot advise a 30% displacement rate and 1% to 3% mortality rate for black-legged kittiwake in both the breeding and non-breeding season (NatureScot, 2023).

5.7.2.30 In light of this guidance and additional evidence stated, for the purpose of this assessment, precautionary rates of 50% (range 30% to 70%) for displacement and 1% (range 1% to 10%) for mortality have been used for the operations and maintenance phase of the Mona Offshore Wind Project. Given that the displacement rate used for the construction phase is a 50% reduction from the operational phase displacement rate as agreed with the SNCBs in the second EWG (held on 13/07/2022), the rate used for black-legged kittiwake during the construction phase is 25% (range 15% to 35%).

Construction phase

Magnitude of impact

Mona Offshore Ornithology Offshore Cable Corridor

Red-throated diver

5.7.2.31 Red-throated diver was absent from the Mona Array Area + 4 km buffer and therefore was excluded from assessment of impact within this area. However red-throated diver occur within the nearshore environment where the Mona Offshore Cable Corridor intersects with areas of usage by this species. Therefore, red-throated diver has been included for assessment of impact within Mona Offshore Cable Corridor.

5.7.2.32 NRW requested that a 2 km buffer for this species be applied around the cable laying vessel. Within the MDS up to two cable laying vessels will be present with up to four support vessels at any one time. Any support vessels will be in the immediate vicinity of the cable laying vessels and so any displacement effect from those vessels will be included within the 2 km buffer. Therefore 25.14 km^2 of area would be disturbed around the construction vessels at any given time. However, during construction, vessel activity will be clustered around the area of cable laying and the areas of potential disturbance from each vessel will overlap. Therefore, the overall area of disturbance will likely be smaller than 25.14 km^2.

5.7.2.33 During the winter months (October to March) the densities of birds present within the Mona Offshore Cable Corridor and Access Areas are close to the coast at Colwyn Bay, where up to 1.22 birds per km^2 were present (HiDef, 2023) and therefore up to 30.67 birds could be temporarily displaced.

5.7.2.34 During summer months (April to September) the highest densities of birds present within the Mona Offshore Cable Corridor and Access Areas are close to the coast at Colwyn Bay, where up to 0.099 birds per km^2 were present (Bradbury *et al*., 2014) and therefore up to 2.49 birds could be temporarily displaced.

5.7.2.35 All red-throated diver are assumed to be displaced by vessel activity (displacement rate of 100%). The evidence for the impacts of mortality currently do not support that displacement causes increased mortality among red-throated diver (Dierschke *et al*., 2017; MacArthur Green, 2019). Between 0.5% and 1% mortality was assumed, which was requested by NRW as part of their S42 response. Therefore, in the non-breeding period (December and January) between 0.15 and 0.31 birds may experience mortality, whereas in the migration periods (February to April and September to November) between 0.01 to 0.02 birds may experience mortality.

5.7.2.36 Using an average adult and immature mortality estimate of 0.233, and a non-breeding population of 2,073 this would lead to a baseline mortality rate of 483.01 individuals. The increase in baseline mortality using the estimates presented then equates to an increase mortality rate of between 0.03% to 0.06% for the Mona Offshore Cable Corridor and Access Areas alone in the non-breeding season.

5.7.2.37 During the migration periods, using an average adult and immature mortality estimate of 0.233, and a population of 4,373 this would lead to a baseline mortality rate of 1,019 individuals. The increase in baseline mortality using the estimates presented then equates to an increase mortality rate of <0.01% for the Mona Offshore Cable Corridor and Access Areas alone.

5.7.2.38 As part of the measures adopted for the Mona Offshore Wind Project, no offshore export cable installation activities will occur during the period of 1st November to 31st March within the Liverpool Bay SPA. This therefore means that red-throated diver will not be displaced during the non-breeding period and an increase in baseline mortality of <0.01% is predicted during installation.

5.7.2.39 If the unlikely scenario that all 17 cable laying vessels were to be present at the one time during cable laying activities, this would mean that a total area of 213.69 km^2 would be disturbed, which would equate to an increase in baseline mortality of 0.02% to 0.04% during the summer months for red-throated diver.

5.7.2.40 In either case, all scenarios considered are well below a 1% increase in baseline mortality and the magnitude is therefore, considered to be **negligible**.

Common scoter

5.7.2.41 Common scoter was absent from the Mona Array Area + 4 km buffer and therefore was excluded from assessment of impact within this area. However, common scoter occur within the nearshore environment where the Mona Offshore Cable Corridor and Access Areas intersects.

5.7.2.42 JNCC requested that a 2.5 km buffer for this species, as part of the Section 42 Consultation, be applied around the cable laying vessel (Fliessbach *et al.*, 2019). Within the MDS up to two cable laying vessels will be present with up to four support vessels at any one time. Any support vessels will be in the immediate vicinity of the cable laying vessels and so any displacement effect from those vessels will be included within the 2.5 km buffer. Therefore 39.27 km^2 of area would be disturbed round the vessels at any given time. However, during construction vessel activity will be clustered around the area of cable laying and the areas of potential disturbance from each vessel will overlap. Therefore, the overall area of disturbance will likely be smaller then 39.27 km^2.

5.7.2.43 During the winter months (October to March) The highest densities of birds present within the Mona Offshore Cable Corridor and Access Areas are close to the coast, where up to 56.51 birds per km^2 were present (Bradbury *et al*., 2014) and therefore up to 2,210 birds could be temporary displaced.

5.7.2.44 During summer months (April to September) no birds were present within the Mona Offshore Cable Corridor and Access Areas (Bradbury *et al*., 2014) and therefore no birds would be temporarily displaced and increase in baseline mortality would be 0.00%.

5.7.2.45 All common scoter are assumed to be displaced by vessel activity (displacement rate of 100%). Between 0.5% and 1% mortality was assumed and therefore between 11.05 and 22.10 birds may experience morality.

5.7.2.46 Using an average adult and immature mortality estimate of 0.238, and a non-breeding population of 95,931 (HiDef, 2023) this would lead to a baseline mortality rate of 22,831.58 individuals. The increase in baseline mortality using the estimates presented then equates to an increase between 0.05% to 0.10% for the Mona Offshore Cable Corridor and Access Areas alone.

5.7.2.47 As part of the measures adopted for the Mona Offshore Wind Project, no offshore export cable installation activities will occur during the period of 1st November to 31st March within the Liverpool Bay SPA. This therefore means that common scoter will not be displaced during the non-breeding period and an increase in baseline mortality of 0.00% is predicted during installation.

5.7.2.48 In either case, all scenarios considered are well below a 1% increase in baseline mortality and the magnitude is therefore, considered to be **negligible**.

Other species

5.7.2.49 Within Volume 6, Annex 5.1: Offshore ornithology baseline characterisation technical report (Document Reference F6.5.1), the density of birds for all other seabird and rafting birds was no greater than 1 bird per km^2. As the works being undertaken within the Mona Offshore Cable Corridor and Access Areas are temporary and minor in nature with work likely to be spatially and temporally restricted, no assessment was done for any other species within the Mona Offshore Cable Corridor during construction. The effect has been therefore assessed to be **negligible**.

Mona Offshore Ornithology Array Area

Common guillemot

5.7.2.50 The estimated mortality (when considering a displacement rate of 15% to 35% and a mortality rate of 1% to 10% as requested per guidance of the EWG) resulting from displacement during construction was assessed for each bio-season and for the combined bio-seasons (Table 5-24) as detailed in Volume 6, Annex 5.2: Offshore ornithology displacement technical report of the Environmental Statement (Document Reference F6.5.2).

5.7.2.51 In both bio-seasons and annually, the predicted increase in the baseline mortality rate does not surpass the 1% threshold (Table 5-24).

5.7.2.52 The impact is predicted to be of local spatial extent, short term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **negligible**.

Table 5-24: Common guillemot bio-season and annual displacement estimates for Mona during construction.

Bio-season	Seasonal abundance (Mona Array Area + 2 km buffer)	Regional baseline population		Number of common guillemot subject to mortality (no. of indiv.)	Increase in baseline mortality (%)
		Population	Baseline mortality		
Breeding (March to July)	4,220	136,680	18,178	6 to 148	0.033 to 0.814
Non-breeding (August to February)	3,756	1,139,220	151,516	6 to 131	0.004 to 0.086
Annual	7,976	1,139,220	151,516	12 to 279	0.008 to 0.184

Razorbill

5.7.2.53 The estimated mortality (when considering a displacement rate of 15% to 35% and a mortality rate of 1% to 10%) resulting from displacement during construction was assessed for each bio-season and for the combined bio-seasons (Table 5-25) as detailed in Volume 6, Annex 5.2: Offshore ornithology displacement technical report of the Environmental Statement (Document Reference F6.5.2).

5.7.2.54 In all four bio-seasons (breeding, non-breeding, autumn, and spring migration) and for the combined bio-seasons, the predicted increase in the baseline mortality rate does not surpass the 1% threshold.

5.7.2.55 The impact is predicted to be of local spatial extent, short term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **negligible**.

Table 5-25: Razorbill bio-season and annual displacement estimates for the Mona Array Area plus 2 km buffer during construction.

Bio-season	Seasonal Abundance (Mona Array Area + 2 km buffer)	Regional Baseline Population		Number of razorbill subject to mortality (indiv.)	Increase in baseline mortality (%)
		Population	Baseline mortality		
Spring migration (January to March)	1,924	606,914	104,389	3 to 67	0.003 to 0.064
Breeding (April to July)	83	18,345	3,155	0 to 3	0.000 to 0.095
Autumn migration (August to October)	91	606,914	104,389	0 to 3	0.000 to 0.003

Bio-season	Seasonal Abundance (Mona Array Area + 2 km buffer)	Regional Baseline Population		Number of razorbill subject to mortality (indiv.)	Increase in baseline mortality (%)
		Population	Baseline mortality		
Non-breeding (November to December)	421	341,422	58,725	1 to 15	0.001 to 0.026
Annual	2,519	606,914	104,389	4 to 88	0.004 to 0.084

Atlantic puffin

5.7.2.56 The estimated mortality (when considering a displacement rate of 15% to 35% and a mortality rate of 1% to 10%) resulting from displacement during construction was assessed for each bio-season and for the combined bio-seasons (Table 5-26) as detailed further in Volume 6, Annex 5.2: Offshore ornithology displacement technical report of the Environmental Statement (Document Reference F6.5.2).

5.7.2.57 In both bio-seasons and annually, the predicted increase in the baseline mortality rate does not surpass the 1% threshold.

5.7.2.58 The impact is predicted to be of local spatial extent, short term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **negligible**.

Table 5-26: Atlantic puffin bio-season and annual displacement estimates for the Mona Array Area plus 2 km buffer during construction.

Bio-season	Seasonal Abundance (Mona Array Area + 2 km buffer)	Regional Baseline Population		Number of Atlantic puffin subject to mortality (indiv.)	Increase in baseline mortality (%)
		Population	Baseline Mortality		
Breeding (April to August)	15	203,302	35,781	0 to 1	0.000 to 0.003
Non-breeding (September to March)	22	304,557	53,602	0 to 1	0.000 to 0.002
Annual	37	304,557	53,602	0 to 1	0.000 to 0.002

Northern gannet

5.7.2.59 The estimated mortality (when considering a displacement rate of 30% to 40% and a mortality rate of 1% to 10%) resulting from displacement during construction was assessed for each bio-season and for the combined bio-seasons Table 5-27 as detailed further in Volume 6, Annex 5.2: Offshore ornithology displacement technical report of the Environmental Statement (Document Reference F6.5.2).

5.7.2.60 In all three bio-seasons (spring, breeding and autumn) and annually, the predicted increase in the baseline mortality rate does not surpass the 1% threshold.

5.7.2.61 The impact is predicted to be of local spatial extent, short term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **negligible.**

Table 5-27: Northern gannet bio-season and annual displacement estimates for the Mona Array Area plus 2 km buffer during construction.

Bio-season	Seasonal Abundance (Mona Array Area + 2 km buffer)	Regional Baseline Population		Number of Northern gannet subject to mortality (indiv.)	Increase in baseline mortality (%)
		Population	Baseline Mortality		
Spring migration (December to February)	28	661,888	127,744	0 to 1	0.000 to 0.001
Breeding (March to September)	251	522,888	100,917	1 to 10	0.001 to 0.010
Autumn migration (October to November)	58	545,954	105,369	0 to 2	0.000 to 0.002
Annual	336	661,888	127,744	1 to 13	0.001 to 0.010

Black-legged kittiwake

5.7.2.62 The estimated mortality (when considering a displacement rate of 15% to 35% and a mortality rate of 1% to 10%) resulting from displacement during construction was assessed for each bio-season and for the combined bio-seasons (Table 5-28) as detailed further in Volume 6, Annex 5.2: Offshore ornithology displacement technical report of the Environmental Statement (Document Reference F6.5.2).

5.7.2.63 There is no consensus between the SNCBs regarding the inclusion of a displacement assessment for black-legged kittiwake; however, one is presented here for precaution and for the SNCBs that have requested this information.

5.7.2.64 In all three bio-seasons (spring, breeding and autumn) and annually, the predicted increase in the baseline mortality rate does not surpass the 1% threshold.

5.7.2.65 The impact is predicted to be of local spatial extent, short term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **negligible**.

Table 5-28: Black-legged kittiwake bio-season and annual displacement estimates for the Mona Array Area plus 2 km buffer during construction.

Bio-season	Seasonal Abundance (Mona Array Area + 2 km buffer)	Regional Baseline Population		Number of Black-legged kittiwake subject to mortality (indiv.)	Increase in baseline mortality (%)
		Population	Baseline Mortality		
Spring migration (January to February)	574	691,526	107,878	1 to 20	0.001 to 0.019
Breeding (March to August)	726	156,679	24,442	1 to 25	0.004 to 0.102
Autumn migration (September to December)	560	911,586	142,207	1 to 20	0.001 to 0.014
Annual	1,860	911,586	142,207	5 to 74	0.003 to 0.052

Manx shearwater

5.7.2.66 The estimated mortality (when considering a displacement rate of 15% to 35% and a mortality rate of 1% to 10%) resulting from displacement during construction was assessed for each bio-seasons and for the combined bio-seasons (Table 5-29) as detailed further in Volume 6, Annex 5.2: Offshore ornithology displacement technical report of the Environmental Statement (Document Reference F6.5.2).

5.7.2.67 In all three bio-seasons (spring, breeding and autumn) and annually, the predicted increase in the baseline mortality rate does not surpass the 1% threshold.

5.7.2.68 The impact is predicted to be of local spatial extent, short term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **negligible**.

Table 5-29: Manx shearwater bio-season and annual displacement estimates for the Mona Array Area plus 2 km buffer during construction.

Bio-season	Seasonal Abundance (Mona Array Area + 2 km buffer)	Regional Baseline Population		Number of Manx shearwater subject to mortality (indiv.)	Increase in baseline mortality (%)
		Population	Baseline Mortality		
Spring migration (March)	3	1,580,895	205,516	0 to 0	0.000 to 0.000
Breeding (April to August)	1,249	1,821,544	236,801	2 to 44	0.001 to 0.019

Bio-season	Seasonal Abundance (Mona Array Area + 2 km buffer)	Regional Baseline Population		Number of Manx shearwater subject to mortality (indiv.)	Increase in baseline mortality (%)
		Population	Baseline Mortality		
Autumn migration (September to December)	16	1,580,895	205,516	0 to 1	0.000 to 0.000
Annual	1,268	1,821,544	236,801	2 to 44	0.001 to 0.019

Sensitivity of the receptor

Common Scoter

5.7.2.69 Common scoter are very vulnerable to disturbance and displacement caused by offshore wind farms. The species has a score of five (out of five) for displacement due to vessels (Wade *et al*., 2016).

5.7.2.70 Common scoter present within the Mona Offshore Cable Corridor and Access Areas are likely to be part of the Liverpool Bay SPA and therefore, the species is considered to be of high value.

5.7.2.71 The wintering population within the UK is increasing at the latest SPA review in the short and long-term (Stroud *et al*., 2016) and therefore it's considered wintering common scoter have a medium recoverability.

5.7.2.72 Common scoter is deemed to be of high vulnerability, medium recoverability and high value. The sensitivity of the receptor is therefore, considered to be **high.**

Red-throated diver

5.7.2.73 Red-throated diver are very vulnerable to disturbance and displacement caused by offshore wind farms. The species has a score of five (out of five) for displacement due to vessels (Wade *et al*., 2016).

5.7.2.74 Red-throated diver present within the Mona Offshore Cable Corridor and Access areas are likely to be part of the Liverpool Bay SPA and therefore, the species is considered to be of high value.

5.7.2.75 The wintering population within the UK is increasing at the latest SPA review over the short-term (unknown over the long-term) (Stroud *et al*., 2016) and therefore it's considered wintering common scoter have a medium recoverability. Red-throated diver is deemed to be of high vulnerability, medium recoverability and high value. The sensitivity of the receptor is therefore, considered to be **high.**

Common guillemot

5.7.2.76 According to Wade *et al*. (2016), common guillemot are considered to be sensitive to disturbance from vessels and helicopters at offshore wind farms, with a vulnerability score of three (out of five). Whilst there is evidence from studies that auk species respond negatively to vessel traffic (Ronconi and Clair, 2002), behavioural response to underwater and airborne sounds resulting from construction activities are unknown.

Although common guillemot are likely to respond to visual stimuli during the construction phase, the impacts of disturbance/displacement are short-term and common guillemot have the ability to return to the baseline abundance and distribution after construction.

5.7.2.77 Although the species has a low reproductive success (i.e. laying one egg and not breeding until five years old) (Robinson, 2005), common guillemot have a medium recoverability given their increasing trend in abundance and productivity in the UK (JNCC, 2020).

5.7.2.78 Common guillemot is a qualifying interest for several SPAs likely to be connected to the Mona Array Area (within the mean-max + SD foraging range), however as large colonies from non-SPA sites (i.e. SSSI sites) are also within close proximity (e.g. St Bee's Head) the species is considered to be of medium value.

5.7.2.79 Common guillemot is deemed to be of medium vulnerability, medium recoverability and medium value. The sensitivity of the receptor is therefore, considered to be **medium**.

Razorbill

5.7.2.80 As with common guillemot, razorbill are deemed to be sensitive to disturbance from vessels and helicopters at offshore wind farms, with a vulnerability score of three (out of five). 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.

5.7.2.81 Although the species has a low reproductive success (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).

5.7.2.82 Razorbill is a qualifying interest for several SPAs likely to be connected to the Mona Array Area (within the mean-max + SD foraging range), however as several non-SPA colonies are also within range of the Mona Array Area, the species is considered to be of medium value.

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

Atlantic puffin

5.7.2.84 Together with other auk species, Atlantic puffin are considered to be sensitive to disturbance from vessels and helicopters at offshore wind farms. The species is assigned a vulnerability score of three (out of five) by Wade *et al*. (2016).

5.7.2.85 Although Atlantic puffin are likely to respond to visual stimuli during the construction phase, the impacts of disturbance/displacement are short-term and the population using the Mona Array Area has the ability to return to the baseline conditions after construction.

5.7.2.86 Atlantic puffin have a low reproductive success (i.e. laying one egg and not breeding until five years old) (Robinson, 2005) and are deemed to have a low recoverability given the lack of up-to-date census of the size of the UK breeding population and the overall declining trend in abundance (1986 to 2018) (JNCC, 2020).

5.7.2.87 Atlantic puffin is a qualifying interest for several SPAs likely to be connected to the Mona Array Area (within the mean-max + SD foraging range), with low to no Atlantic puffin likely coming from the few non-SPA sites within foraging range due to those non-

SPA sites consisting of less than 100 birds. The species is therefore considered to be of high value.

5.7.2.88 Atlantic puffin is deemed to be of medium vulnerability, low recoverability and high value. The sensitivity of the receptor is therefore, considered to be **high**.

Northern gannet

5.7.2.89 Northern gannet are considered to have a medium sensitivity to other sources of disturbance such as ship and helicopter traffic (Garthe and Hüppop, 2004; Furness and Wade, 2012), and so northern gannet are considered to be of medium vulnerability.

5.7.2.90 Although northern gannet has a low reproductive success (only laying one egg) and does not breed until five years old (Robinson, 2005), the species is deemed to have a medium recoverability given the consistent increasing trend in abundance since the 1990s (JNCC, 2020). However, the species has suffered significant losses from the outbreak of HPAI during the 2022 breeding season, with it being estimated that around at least 25% of northern gannets within the UK have died due to the disease.

5.7.2.91 Northern gannet is a qualifying interest for several SPAs likely to be connected to the Mona Array Area (within the mean-max + SD foraging range), with a large non-SPA colony within close proximity (Monreith Cliffs and Scar Rocks), the species is therefore considered to be of medium value.

5.7.2.92 Northern gannet is deemed to be of medium vulnerability, medium recoverability and medium value. The sensitivity of the receptor is therefore, considered to be **medium**.

Black-legged kittiwake

5.7.2.93 In terms of behavioural responses to vessels and helicopters at offshore wind farms, black-legged kittiwake are considered to be of low to medium vulnerability to displacement (with a score of two out of five) by Wade *et al*. (2016).

5.7.2.94 Although the reproductive success of black-legged kittiwake is higher (i.e. laying two eggs and breeding until four years old) than auk species and northern gannet (Robinson, 2005), the species is deemed to have a low recoverability given the continuing decline in abundance observed between 1986 and 2018 in the UK (JNCC, 2020). During this period, breeding productivity has declined as the result of food shortage, although it has stabilised in recent years (JNCC, 2020). During the 2022 breeding season HPAI was confirmed in some Kittiwake colonies, but not to the same extent as gannet colonies.

5.7.2.95 Black-legged kittiwake is a qualifying interest for several SPAs likely to be connected to the Mona Array Area (within the mean-max + SD foraging range), with several non-SPA colonies within range and so the species is considered to be of medium value.

5.7.2.96 Black-legged kittiwake is deemed to be of low vulnerability, low recoverability and medium value. The sensitivity of the receptor is therefore, considered to be **medium**.

Manx shearwater

5.7.2.97 In terms of behavioural responses to vessels and helicopters at offshore wind farms, Manx shearwater are considered to be of low vulnerability to displacement (score of one) by Wade *et al*. (2016).

5.7.2.98 Owing to their large foraging range, Manx shearwater is a qualifying interest for several SPAs likely to be connected to the Mona Array Area (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). Therefore, the species is considered to be of high value.

5.7.2.99 Manx shearwater has a low reproductive success (i.e. only laying one egg and not breeding until five years old; Robinson, 2005). There is an incomplete spatial-temporal coverage of breeding abundance at UK colonies and thus a lack of long-term trend (JNCC, 2020). In the light of uncertainly and low reproductive success, Manx shearwater are therefore deemed to have a low recoverability.

5.7.2.100 Manx shearwater is deemed to be of low vulnerability, low recoverability and high value. The sensitivity of the receptor is therefore, considered to be **medium.**

Significance of the effect

5.7.2.101 Given that construction activities will only take place within a small area of the Mona Array Area at any given time, displaced birds will be able to resettle within the Mona Array Area or beyond. As alternative habitats exist, species shown in Table 5-30 are therefore not predicted to suffer a significant decline in bird fitness at a population level. Indeed, the displacement assessment analysis showed the magnitude of the increase in mortality to be negligible and below the 1% threshold increase for the species assessed in Table 5-24 to Table 5-29.

5.7.2.102 For common guillemot, negligible was selected from the negligible to minor range (Table 5-21) due to the impact not exceeding a 0.8% increase in baseline mortality. For razorbill, northern gannet, black-legged kittiwake and Manx shearwater, negligible was selected from the negligible to minor range due to the impact not exceeding a 0.1% increase in baseline mortality and hence, was not regarded as a minor significance of effect.

Table 5-30: Table summarising the significance of effect during construction.

Species	Magnitude of impact	Sensitivity of receptor	Significance of effect
Common guillemot	Negligible	Medium	**Negligible, not significant in EIA terms**
Razorbill	Negligible	Medium	**Negligible, not significant in EIA terms**
Atlantic puffin	Negligible	High	**Minor adverse, not significant in EIA terms**
Northern gannet	Negligible	Medium	**Negligible, not significant in EIA terms**
Black-legged kittiwake	Negligible	Medium	**Negligible, not significant in EIA terms**
Manx shearwater	Negligible	Medium	**Negligible, not significant in EIA terms**
Common scoter	Negligible	High	**Minor adverse, not significant in EIA terms**
Red-throated diver	Negligible	High	**Minor adverse, not significant in EIA terms**

Operations and maintenance phase

Magnitude of impact

Mona Offshore Ornithology Offshore Cable Corridor

5.7.2.103 Routine inspections of the export cable are estimated to occur once per year, with a maximum of two repairs every five years per export cable for the lifetime of the project.

It is estimated that a total of 6.4 km of cable repairs would occur per year, with a maximum of eight vessel trips per year (Table 5-22). One reburial even is estimated to occur every five years, with approximately 15 km per reburial event.

5.7.2.104 The potential for disturbance and displacement from such activities will be very restricted both temporally and spatially. Whilst unscheduled repair events may occur at any time of year, they are expected to be very rare occurrences. Any scheduled repairs would cause minimal disturbance and displacement which would be spatially restricted to the vicinity of the repair site and access routes, and temporally restricted to the time taken to conduct the repairs. Repairs will generally be undertaken in the shortest timespan possible in order to limit disruption.

Mona Offshore Ornithology Array Area

Common scoter

5.7.2.105 There was no common scoter recorded within the Mona Array Area plus 4 km buffer (or during the DAS) and impact therefore magnitude is considered to be **negligible**.

Red-throated diver

5.7.2.106 There was no red-throated diver recorded within the Mona Array Area plus 4 km buffer (or during the DAS) and impact therefore magnitude is considered to be **negligible**.

Common guillemot

5.7.2.107 The estimated mortality (when considering a displacement rate of 30% to 70% and a mortality rate of 1% to 10%) resulting from displacement during the operations and maintenance phase was assessed for each bio-season and for the combined bio-seasons (Table 5-31) as detailed in Volume 6, Annex 5.2: Offshore ornithology displacement technical report of the Environmental Statement (Document Reference F6.5.2).

5.7.2.108 In the non-breeding bio-seasons and annually, the predicted increase in the baseline mortality rate does not surpass the 1% threshold increase.

5.7.2.109 However, during the breeding bio-season using the unlikely scenario of 70% displacement and 10% mortality, an increase in baseline mortality greater than 1% is predicted (Table 5-31). However, recent evidence from the Beatrice Offshore Wind Farm suggests that 70% displacement and 10% mortality rates are overly precautionary and that common guillemot continued to use the area around Beatrice Offshore Wind Farm regardless of turbine operational status (MacArthur Green, 2023). Taking a more realistic 50% displacement and 5% mortality, the increase in baseline mortality would be 0.52% and therefore below the 1% threshold.

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

Table 5-31: Common guillemot bio-seasons and annual displacement estimates for the Mona Array Area plus 2 km buffer during the operations and maintenance phase.

Bio-season	Seasonal Abundance (Mona Array Area + 2 km buffer)	Regional Baseline Population		Number of common guillemot subject to mortality (no. of indiv.)	Increase in baseline mortality (%)
		Population	Baseline Mortality		
Breeding (March to July)	4,220	136,680	18,178	13 to 295	0.072 to 1.623
Non-breeding (August to February)	3,756	1,139,220	151,516	11 to 263	0.007 to 0.174
Annual	7,976	1,139,220	151,516	24 to 558	0.015 to 0.368

5.7.2.111 Following comments received from Natural Resources Wales (Advisory) (NRW (A)) in the Mona Offshore Wind Project examination , a Population Viability Analysis (PVA) was undertaken for common guillemot to investigate the increase in mortality to the SSSI breeding colony of Pen-y-Gogarth/Great Orme SSSI. Full details of the PVA findings are found in Volume 6, Annex 5.7: Offshore Ornithology Assessment of Pen y Gogarth/Great Orme's Head SSSI Technical Report (Document Reference F6.5.7).

Razorbill

5.7.2.112 The estimated mortality (when considering a displacement rate of 30% to 70% and a mortality rate of 1% to 10%) resulting from displacement during the operations and maintenance phase was assessed for each bio-season and for the combined bio-seasons (Table 5-32) as detailed in Volume 6, Annex 5.2: Offshore ornithology displacement technical report of the Environmental Statement (Document Reference F6.5.2).

5.7.2.113 In all bio-seasons and for all bio-seasons combined, the predicted increase in the baseline mortality rate does not surpass the 1% threshold increase.

5.7.2.114 The impact is predicted to be of local spatial extent, medium-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 5-32: Razorbill bio-seasons and annual displacement estimates for the Mona Array Area plus 2 km buffer during the operations and maintenance phase.

Bio-season	Seasonal Abundance (Mona Array Area + 2 km buffer)	Regional Baseline Population		Number of razorbill subject to mortality (indiv.)	Increase in baseline mortality (%)
		Population	Baseline Mortality		
Spring migration (January to March)	1,924	606,914	104,389	6 to 135	0.006 to 0.129
Breeding (April to July)	83	18,345	3,155	0 to 6	0.000 to 0.190

Bio-season	Seasonal Abundance (Mona Array Area + 2 km buffer)	Regional Baseline Population		Number of razorbill subject to mortality (indiv.)	Increase in baseline mortality (%)
		Population	Baseline Mortality		
Autumn migration (August to October)	91	606,914	104,389	0 to 6	0.000 to 0.006
Non-breeding (November to December)	421	341,422	58,725	1 to 29	0.002 to 0.049
Annual	2,519	606,914	104,389	8 to 176	0.007 to 0.169

5.7.2.115 Following comments received from Natural Resources Wales (Advisory) (NRW (A)) in the Mona Offshore Wind Project examination , a PVA was undertaken for razorbill to investigate the increase in mortality to the SSSI breeding colony of Pen-y-Gogarth/Great Orme SSSI. Full details of the PVA findings are found in Volume 6, Annex 5.7: Offshore Ornithology Assessment of Pen y Gogarth/Great Orme's Head SSSI Technical Report (Document Reference F6.5.7).

Atlantic puffin

5.7.2.116 The estimated mortality (when considering a displacement rate of 30% to 70% and a mortality rate of 1% to 10%) resulting from displacement during the operations and maintenance phase was assessed for each bio-season and for the combined bio-seasons (Table 5-33) as detailed in Volume 6, Annex 5.2: Offshore ornithology displacement technical report of the Environmental Statement (Document Reference F6.5.2).

5.7.2.117 In both bio-seasons and for all bio-seasons combined, the predicted increase in baseline mortality does not surpass the 1% increase threshold.

5.7.2.118 The impact is predicted to be of local spatial extent, medium-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 5-33: Atlantic puffin bio-seasons and annual displacement estimates for the Mona Array Area plus 2 km buffer during the operations and maintenance phase.

Bio-season	Seasonal Abundance (Mona Array Area + 2 km buffer)	Regional Baseline Population		Number of Atlantic puffin subject to mortality (indiv.)	Increase in baseline mortality (%)
		Population	Baseline Mortality		
Breeding (April to August)	15	203,302	35,781	0 to 1	0.000 to 0.003
Non-breeding (September to March)	22	304,557	53,602	0 to 2	0.000 to 0.003
Annual	37	304,557	53,602	0 to 3	0.000 to 0.005

Northern gannet

5.7.2.119 The estimated mortality (when considering a displacement rate of 60% to 80% and a mortality rate of 1% to 10%) resulting from displacement during the operations and maintenance phase was assessed for each bio-season and for the combined bio-seasons (Table 5-34) as detailed in Volume 6, Annex 5.2: Offshore ornithology displacement technical report of the Environmental Statement (Document Reference F6.5.2).

5.7.2.120 In all three bio-seasons (spring, breeding and autumn) and for the bio-seasons combined, the predicted increase in baseline mortalities remains well the below the 1% increase threshold.

5.7.2.121 The impact is predicted to be of local spatial extent, medium-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 5-34: Northern gannet bio-seasons and annual displacement estimates for the Mona Array Area plus 2 km buffer during the operations and maintenance phase.

Bio-season	Seasonal Abundance (Mona Array Area + 2 km buffer)	Regional Baseline Population		Number of Northern gannet subject to mortality (indiv.)	Increase in baseline mortality (%)
		Population	Baseline Mortality		
Spring migration (December to February)	28	661,888	127,744	0 to 2	0.000 to 0.002
Breeding (March to September)	251	522,888	100,917	2 to 20	0.002 to 0.020
Autumn migration (October to November)	58	545,954	105,369	0 to 5	0.000 to 0.005
Annual	336	661,888	127,744	2 to 27	0.002 to 0.021

Black-legged kittiwake

5.7.2.122 The estimated mortality (when considering a displacement rate of 30% to 70% and a mortality rate of 1% to 10%) resulting from displacement during the operations and maintenance phase was assessed for each bio-season and for the combined bio-seasons (Table 5-35) as detailed in Volume 6, Annex 5.2: Offshore ornithology displacement technical report of the Environmental Statement (Document Reference F6.5.2).

5.7.2.123 There is no consensus between the SNCBs regarding the inclusion of a displacement assessment for black-legged kittiwake; however, one is presented here for precaution and for the SNCBs that have requested this information.

5.7.2.124 In all three bio-seasons (spring, breeding and autumn) and all bio-seasons combined, the predicted increase in baseline mortalities remains well below the 1% increase threshold.

5.7.2.125 The impact is predicted to be of local spatial extent, medium-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 5-35: Black-legged kittiwake bio-seasons and annual displacement estimates for the Mona Array Area plus 2 km buffer during the operations and maintenance phase.

Bio-season	Seasonal Abundance (Mona Array Area + 2 km buffer)	Regional Baseline Population		Number of Black-legged kittiwake subject to mortality (indiv.)	Increase in baseline mortality (%)
		Population	Baseline Mortality		
Spring migration (January to February)	574	691,526	107,878	3 to 40	0.003 to 0.037
Breeding (March to August)	726	156,679	24,442	2 to 51	0.0094 to 0.208
Autumn migration (September to December)	560	911,586	142,207	2 to 39	0.001 to 0.027
Annual	1,860	911,586	142,207	6 to 130	0.004 to 0.092

5.7.2.126 Following comments received from Natural Resources Wales (Advisory) (NRW (A)) in the Mona Offshore Wind Project examination , a PVA was undertaken for black-legged kittiwake to investigate the increase in mortality to the SSSI breeding colony of Pen-y-Gogarth/Great Orme SSSI. Full details of the PVA findings are found in Volume 6, Annex 5.7: Offshore Ornithology Assessment of Pen y Gogarth/Great Orme's Head SSSI Technical Report (Document Reference F6.5.7).

Manx shearwater

5.7.2.127 The estimated mortality (when considering a displacement rate of 30% to 70% and a mortality rate of 1% to 10%) resulting from displacement during the operations and maintenance phase was assessed for each bio-season and for the combined bio-seasons (Table 5-36) as detailed in Volume 6, Annex 5.2: Offshore ornithology displacement technical report of the Environmental Statement (Document Reference F6.5.2).

5.7.2.128 In all three bio-seasons (spring, breeding season and autumn migration) and for all bio-seasons combined, the predicted increase in baseline mortalities does not surpass the 1% increase threshold.

5.7.2.129 The impact is predicted to be of local spatial extent, medium-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 5-36: Manx shearwater bio-seasons and annual displacement estimates for the Mona Array Area plus 2 km buffer during the operations and maintenance phase.

Bio-season	Seasonal Abundance (Mona Array Area + 2 km buffer)	Regional Baseline Population		Number of Manx shearwater subject to mortality (indiv.)	Increase in baseline mortality (%)
		Population	Baseline Mortality		
Spring migration (March)	3	1,580,895	205,516	0 to 0	0.000 to 0.000
Breeding (April to August)	1,249	1,821,544	236,801	4 to 87	0.002 to 0.037
Autumn migration (September to October)	16	1,580,895	205,516	0 to 1	0.000 to 0.000
Annual	1,268	1,821,544	236,801	4 to 89	0.002 to 0.038

Sensitivity of receptor

Common scoter

5.7.2.130 Common scoter are very vulnerable to disturbance and displacement caused by offshore wind farms. The species has a score of five (out of five) for displacement due to vessels (Wade *et al*., 2016).

5.7.2.131 Common scoter present within the Mona Offshore Cable Corridor are likely to be part of the Liverpool Bay SPA and therefore, the species is considered to be of high value.

5.7.2.132 The wintering population within the UK is increasing at the latest SPA review in the short and long-term (Stroud *et al*., 2016) and therefore it's considered wintering common scoter have a medium recoverability.

5.7.2.133 Common scoter is deemed to be of high vulnerability, medium recoverability and high value. The sensitivity of the receptor is therefore, considered to be **high.**

Red-throated diver

5.7.2.134 Red-throated diver are very vulnerable to disturbance and displacement caused by offshore wind farms. The species has a score of five (out of five) for displacement due to vessels (Wade *et al*., 2016).

5.7.2.135 Red-throated diver present within the Mona Offshore Cable Corridor are likely to be part of the Liverpool Bay SPA and therefore, the species is considered to be of high value.

5.7.2.136 The wintering population within the UK is increasing at the latest SPA review over the short-term (unknown over the long-term) (Stroud *et al*., 2016) and therefore it's considered wintering common scoter have a medium recoverability.

5.7.2.137 Red-throated diver is deemed to be of high vulnerability, medium recoverability and medium value. The sensitivity of the receptor is therefore, considered to be **high.**

Common guillemot

5.7.2.138 Common guillemot is considered to have a high vulnerability to displacement from offshore wind farms, being assigned a score of four (out of five) by Wade *et al.* (2016).

5.7.2.139 Although the species has a low reproductive success (i.e., laying one egg and not breeding until five years old; Robinson, 2005), common guillemot have a medium recoverability given their increasing trend in abundance and productivity in the UK (JNCC, 2020).

5.7.2.140 Common guillemot is a qualifying interest for several SPAs likely to be connected to the Mona Array Area (within the mean-max + SD foraging range), however as large colonies from non-SPA sites are also within close proximity (e.g. St Bee's Head) the species is considered to be of medium value.

5.7.2.141 Common guillemot is deemed to be of high vulnerability, medium recoverability and medium value. The sensitivity of the receptor is, therefore, considered to be **medium**.

Razorbill

5.7.2.142 Razorbill is considered to have a high vulnerability to displacement from offshore wind farms, being assigned a score of four (out of five) by Wade *et al*. (2016).

5.7.2.143 Although the species has a low reproductive success (Robinson, 2005), razorbill are deemed to have a medium recoverability given their increasing trend in abundance in the UK (JNCC, 2020).

5.7.2.144 Razorbill is a qualifying interest for several SPAs likely to be connected to the Mona Array Area (within the mean-max + SD foraging range), however as several non-SPA colonies are also within range of the Mona Array Area, the species is considered to be of medium value.

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

Atlantic puffin

5.7.2.146 Atlantic puffin is considered to have a medium vulnerability to displacement from offshore wind farms, being assigned a score of three (out of five) by Wade *et al*. (2016).

5.7.2.147 Although the species has a low reproductive success (i.e. laying one egg and not breeding until five years old) (Robinson, 2005), Atlantic puffin are deemed to have a low recoverability given the lack of up-to-date census of the size of the UK breeding population and the overall declining trend in abundance (1986 to 2018) (JNCC, 2020).

5.7.2.148 As Atlantic puffin is a qualifying interest for several SPAs likely to be connected to the Mona Array Area (within the mean-max + SD foraging range) the species is considered to be of high value.

5.7.2.149 Atlantic puffin is deemed to be of medium vulnerability, low recoverability and high value. The sensitivity of the receptor is therefore, considered to be **high**.

Northern gannet

5.7.2.150 In terms of behavioural response to offshore wind farm structures, northern 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 showed a strong avoidance of offshore wind farms (Peschko *et al*., 2021).

5.7.2.151 Northern gannet is a qualifying interest for several SPAs likely to be connected to the Mona Array Area (within the mean-max + SD foraging range), with a large non-SPA colony within close proximity (Monreith Cliffs and Scar Rocks), the species is therefore considered to be of medium value.

5.7.2.152 Although northern gannet has a low reproductive success (only laying one egg) and does not breed until five years old (Robinson, 2005), the species is deemed to have a medium recoverability given the consistent increasing trend in abundance since the 1990s (JNCC, 2020). However, the species has suffered from the outbreak of avian flu during the 2022 breeding season.

5.7.2.153 Northern gannet is deemed to be of high vulnerability, medium recoverability and medium value. The sensitivity of the receptor is therefore, considered to be **medium**.

Black-legged kittiwake

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

5.7.2.155 Black-legged kittiwake is a qualifying interest for several SPAs likely to be connected to the Mona Array Area (within the mean-max + SD foraging range), with several non-SPA colonies within range and so the species is considered to be of medium value.

5.7.2.156 Although the reproductive success of black-legged kittiwake is higher (i.e. laying two eggs and breeding until four years old) than auk species and northern gannet (Robinson, 2005), the species is deemed to have a low recoverability given the continuing decline in abundance observed between 1986 and 2018 in the UK (JNCC, 2020). During this period, breeding productivity has declined as the result of food shortage, although it has stabilised in recent years (JNCC, 2020).

5.7.2.157 Black-legged kittiwake is deemed to be of low vulnerability, low recoverability and medium value. The sensitivity of the receptor is therefore, considered to be **medium**.

Manx shearwater

5.7.2.158 In terms of behavioural responses to vessels and helicopters at offshore wind farms, Manx shearwater are considered to be of very low vulnerability to displacement (score of one) by Wade *et al*. (2016).

5.7.2.159 Owing to their large foraging range, Manx shearwater is a qualifying interest for several SPAs likely to be connected to the Mona Array Area (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). Therefore, the species is considered to be of high value.

5.7.2.160 Manx shearwater has a low reproductive success (i.e. only laying one egg and not breeding until five years old) (Robinson, 2005). There is an incomplete spatial-temporal coverage of breeding abundance at UK colonies and thus a lack of long-term trend (JNCC, 2020). In the light of uncertainly and low reproductive success, Manx shearwater are therefore deemed to have a medium recoverability.

5.7.2.161 Manx shearwater is deemed to be of low vulnerability, medium recoverability and high value. The sensitivity of the receptor is therefore, considered to be **medium.**

Significance of effect

5.7.2.162 The displacement assessment analysis showed the magnitude of the increase in mortality to be negligible and below the 1% threshold increase for the species assessed in Table 5-31 to Table 5-36. A summary of the significant of disturbance and displacement during the operations and maintenance phase of the Mona Array Area is provided in Table 5-37. For Atlantic puffin negligible was selected from the negligible to minor range due to the impact not exceeding a 0.5 % increase in baseline mortality. Additionally, the population is vast with a change in baseline mortality greater than 0.1% would be unnoticeable and hence, was not regarded as a minor significance of effect. For northern gannet, black-legged kittiwake, Manx shearwater, common scoter and red-throated diver, negligible was selected from the negligible to minor range due to the impact not exceeding a 0.1% increase in baseline mortality and hence, was not regarded as a minor significance of effect.

Table 5-37: Table summarising the significance of effect during the operations and maintenance phase.

Species	Magnitude of impact	Sensitivity of receptor	Significance of effect
Common guillemot	Low	Medium	**Minor adverse, not significant in EIA terms**
Razorbill	Negligible	Medium	**Negligible, not significant in EIA terms**
Atlantic puffin	Negligible	High	**Negligible, not significant in EIA terms**
Northern gannet	Negligible	Medium	**Negligible, not significant in EIA terms**
Black-legged kittiwake	Negligible	Medium	**Negligible, not significant in EIA terms**
Manx shearwater	Negligible	Medium	**Negligible, not significant in EIA terms**
Common scoter	Negligible	High	**Negligible, not significant in EIA terms**
Red-throated diver	Negligible	High	**Negligible, not significant in EIA terms**

Decommissioning phase

5.7.2.163 Decommissioning activities within the Mona Array Area are equal to or less than those carried out during the construction phase within the Mona Array Area. Therefore, for the purpose of this assessment it is assumed that the level of disturbance is likely to be similar and the potential impact on each species is deemed to be reversible in the short-term as birds are likely to return when activities have been completed.

All receptors

5.7.2.164 Overall, the magnitude of the impact during decommissioning is deemed to be negligible and the sensitivity of the receptor is considered to be medium to high, depending on the species. The effect will, therefore, be of **negligible** or **minor** adverse significance, which is not significant in EIA terms.

5.7.3 Indirect impacts from underwater sound affecting prey species

5.7.3.1 Potential effects on the fish assemblages during the construction and decommissioning phases of the Mona Offshore Wind Project, as identified in Volume 2, Chapter 3: Fish and shellfish ecology of the Environmental Statement (Document Reference F2.3), may have indirect effects on offshore ornithology receptors.

5.7.3.2 Herring and sandeel are sensitive to offshore wind development (including underwater sound). Both species are listed as main prey items for several seabird species (Cramp and Simmons, 1983). Volume 2, Chapter 3: Fish and shellfish ecology of the Environmental Statement (Document Reference F2.3) detailed the findings of the desktop studies in the Mona Fish and Shellfish Ecology study area. High and low intensity sandeel spawning grounds have been identified by Ellis *et al*. (2012) as being present throughout the Mona Fish and Shellfish Ecology study area. Herring spawning grounds have also been identified by Coull *et al*. (1998) as being present within the Mona Fish and Shellfish Ecology study area. The overlap of possible spawning grounds with the Mona Array Area has the potential to indirectly affect the distribution of seabirds, in particular the species showing a high level of specialisation which feed predominantly on young herring and sandeel.

5.7.3.3 Underwater sound produced during piling activities and cable installation during the construction phase may impact upon the availability of prey items. Indeed, underwater sound may cause fish and mobile invertebrates to avoid the construction area. Underwater sound may also affect the physiology and behaviour of fish and mobile invertebrates.

5.7.3.4 Species were screened and progressed for the assessment of significance on the basis of habitat specialisation (using scoring from Wade *et al.*, 2016), knowledge of the prey species targeted by each species (Cramp and Simmons, 1983) and their abundance in the Mona Array Area.

5.7.3.5 Because the auk species (i.e. Atlantic puffin, razorbill and common guillemot) foraging behaviour and prey species are similar, the species are considered together for the purpose of the assessment of significance.

Table 5-38: Species considered for assessment of underwater sound affecting prey species based on habitat specialisation score (Wade *et al.*, 2016).

Ornithological receptor	Habitat specialisation	Abundance recorded in the Mona Array Area	Assessed for significance
Arctic skua	Low	Very Low	No
Arctic tern	Medium	Very Low	No
Atlantic puffin	Medium	Low	Yes
Black-headed gull	Low	Very Low	No
Black-legged kittiwake	Low	High	No
Common guillemot	Medium	Very high	Yes
Common gull	Low	Low	No
Common scoter	High	Absent	No

Ornithological receptor	Habitat specialisation	Abundance recorded in the Mona Array Area	Assessed for significance
Common tern	Medium	Very low	No
European shag	Low	Very low	No
Great black-backed gull	Low	Moderate	No
Great cormorant	Medium	Very low	No
Great skua	Low	Very low	No
Herring gull	Very low	Low	No
Leach's storm-petrel	Very low	Very low	No
Lesser black-backed gull	Very low	Low	No
Little gull	N/A	Low	No
Manx shearwater	Very low	Moderate	No
Northern gannet	Very low	High	No
Northern fulmar	Very low	Moderate	No
Razorbill	Medium	High	Yes
Red-throated diver	High	Very low	No
Sandwich tern	Medium	Very low	No

Construction phase

Magnitude of impact

Auk species (common guillemot, razorbill and Atlantic puffin)

5.7.3.6 Auks directly responding to visual cues are likely to be displaced during construction; the magnitude of the impact on the baseline mortality has been assessed using a displacement assessment matrix in section 5.7.2. However, in addition to direct visual disturbance, birds may be indirectly displaced due to a reduction in prey availability. Because of the short-term duration of the construction work and localised nature, it is however expected that birds will be able to re-settle in the Mona Array Area or beyond.

5.7.3.7 In the absence of quantitative information available, the magnitude is considered qualitatively and taking into consideration the assessment of significance presented in Volume 2, Chapter 3: Fish and shellfish ecology of the Environmental Statement (Document Reference F2.3), which concluded of moderate adverse significance for herring and cod and minor adverse for sprat and sandeel.

5.7.3.8 The impact is predicted to be of local spatial extent, short-duration, intermittent and reversible. It is predicted that the impact will affect the receptor indirectly. The magnitude is therefore, considered to be **low**.

Sensitivity of the receptor

Auk species (common guillemot, razorbill and Atlantic puffin)

5.7.3.9 Although the impact of underwater sound on fish has been well studied, there is no published evidence to our knowledge linking reduction of prey availability to avoidance/displacement of seabirds. In absence of information on vulnerability to underwater sound and reduction of prey availability at offshore wind farms, all species were considered to have a medium vulnerability.

5.7.3.10 Auk species have a low reproductive success (Robinson, 2005), and a low to medium recoverability given their increasing trend in abundance, particularly common guillemot and razorbill (JNCC, 2020).

5.7.3.11 As all three species are qualifying interests for several SPAs likely to be connected to the Mona Array Area (within the mean-max + SD foraging range) the species were considered to be of high value.

5.7.3.12 Auk species are deemed to be of medium vulnerability, low to medium recoverability and high value. The sensitivity of the receptor is therefore, considered to be **medium**.

Significance of the effect

Auk species (common guillemot, razorbill and Atlantic puffin)

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

Decommissioning phase

5.7.3.14 Decommissioning activities within the Mona Array Area are equal to or less than those carried out during the construction phase. Therefore, for the purpose of this assessment it is assumed that the level of disturbance is likely to be similar and the potential impact is deemed to be reversible in the short-term as birds are likely to return when activities have been completed.

Significance of the effect

Auk species (common guillemot, razorbill and Atlantic puffin)

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

5.7.4 Temporary habitat loss/disturbance and increased suspended sediment concentrations (SSCs)

Construction phase

5.7.4.1 Seabirds may be indirectly disturbed and displaced during the construction phase as a result of direct impacts on habitat and increased SSCs, which may result in the loss of a food resource to birds in the Mona Array Area and along the Mona Offshore Cable Corridor and Access Areas.

5.7.4.2 As a result, displaced seabirds may move to areas already occupied by other birds and thus face higher intra/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). Such disturbance and resulting displacement could ultimately 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.

5.7.4.3 The potential construction phase impacts on fish and shellfish receptors are provided in Volume 2, Chapter 3: Fish and shellfish ecology of the Environmental Statement (Document Reference F2.3) and include temporary subtidal habitat loss/disturbance and increased SSCs and associated sediment deposition.

Magnitude of impact

All receptors

5.7.4.4 The increase in SSCs may lead to a short-term avoidance of affected areas that support fish and shellfish species which are susceptible to respond increase SSCs. However, many fish and shellfish species are considered to be tolerant of turbid environments and regularly experience changes in the SSC due to the natural variability in the Irish Sea.

5.7.4.5 In the absence of quantitative information available, the magnitude is considered qualitatively and taking into consideration the assessment of significance on marine fish species presented in Volume 2, Chapter 3: Fish and shellfish ecology of the Environmental Statement (Document Reference F2.3), which concluded of minor adverse significance, which is not significant in EIA terms.

5.7.4.6 Temporary habitat loss could potentially affect spawning, nursery or feeding grounds of fish and shellfish receptors, with demersal fish and shellfish, and demersal spawning species the most vulnerable. The MDS assessed in Volume 2, Chapter 3: Fish and shellfish ecology of the Environmental Statement (Document Reference F2.3) represented a very small proportion of the Mona Offshore Wind Project.

5.7.4.7 The impact is predicted to be of local spatial extent, short-duration, intermittent and reversible. It is predicted that the impact will affect the receptor indirectly. The magnitude is therefore, considered to be **negligible**.

Sensitivity of the receptor

All receptors

5.7.4.8 Seabirds are deemed to be of medium vulnerability, medium recoverability and medium to high value. The sensitivity of the receptor is therefore, considered to be **medium**.

Significance of the effect

All receptors

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

Operations and maintenance phase

Magnitude of impact

All receptors

5.7.4.10 Maintenance activities within the Mona Array Area may lead to increases in SSCs and associated sediment deposition over the operational lifetime of the Mona Offshore Wind Project. The magnitude of the impacts would be a small fraction of those quantified for the construction phase.

5.7.4.11 The impact is predicted to be of local spatial extent, short-duration, intermittent and reversible. It is predicted that the impact will affect the receptor indirectly. The magnitude is therefore, considered to be **negligible**.

Sensitivity of the receptor

All receptors

5.7.4.12 Seabirds are deemed to be of medium vulnerability, medium recoverability and high value. The sensitivity of the receptor is therefore, considered to be **medium**.

Significance of the effect

All receptors

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

Decommissioning phase

5.7.4.14 Decommissioning activities within the Mona Array Area are equal to or less than those carried out during the construction phase within the Mona Array Area. Therefore, for the purpose of this assessment it is assumed that the level of disturbance is likely to be similar and the potential impact is deemed to be reversible in the short-term as seabirds are likely to return when activities have been completed.

Significance of the effect

All receptors

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

5.7.5 Collision risk

5.7.5.1 During the operations and maintenance phase of the Mona Offshore Wind Project, 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.

5.7.5.2 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 collision risk models to predict levels of impact more realistically, based on available literature and expert advice about seabird behaviour and their flight response to wind turbines.

5.7.5.3 Species differ in their susceptibility to collision risk, depending on their flight behaviour and avoidance responses, and the vulnerability of their populations (Garthe and Hüppop, 2004; Furness and Wade, 2012; 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 density of flying birds recorded within the Mona Array Area and consideration of their perceived risk from collision (Garthe and Hüppop, 2004; Furness and Wade, 2012; Wade *et al*., 2016, Table 5-13).

5.7.5.4 Five seabird species were identified as potentially at risk due to their recorded abundance in the Mona Array Area and their likelihood of flying at potential collision height between the lowest and highest sweep of the wind turbine rotor blades above sea level. Additionally, consideration was given to species that may not have been accurately captured during baseline DAS due to the diurnal timing of the surveys, with such species likely to be more active during the nocturnal, dusk and dawn periods (e.g. Manx shearwater and northern fulmar). In total, the significance of the collision effect was assessed for seven seabird species. 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.

5.7.5.5 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 repel birds moving through the Mona Array Area. To our knowledge, there is little published evidence showing the effects of lighting on seabird collision and displacement, although earlier work on seaducks by Desholm and Kahlert (2005) showed that migrating flocks were more prone to enter the offshore wind farm but 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 (Kotzerka *et al*., 2010; Furness *et al*., 2018). Wade *et al*. (2016) ranked vulnerability of seabirds to collision by accounting for the nocturnal activity rate of seabirds.

5.7.5.6 CRM was undertaken using the 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 Mona Array Area. The full methodology is provided in Volume 6, Annex 5.3: Offshore ornithology collision risk technical report of the Environmental Statement (Document Reference F6.5.3).

5.7.5.7 The collision risk models incorporated draft guidance on recommended avoidance rates, bird size, flight speed, flight type and nocturnal activity scores from Natural England (Natural England, pers. Comm., 7 July 2022). Throughout the document, outputs have been presented alongside recently published parameters from JNCC (Ozsanlav-Harris *et al*., 2023). In some instances, values for certain species (e.g. northern fulmar and Manx shearwater) had not been provided within the Natural England guidance document. sCRM parameters for these species therefore followed best available evidence (e.g. Garthe and Hüppop, 2004; Pennycuick, 1997; Gibb *et al*., 2017; Robinson, 2005).

5.7.5.8 It is acknowledged that migratory passage movements may be 'missed' by aerial survey methods. Therefore, a combination of two approaches/tools were followed to quantify the number of birds that may cross the Mona Array Area during migration periods:

- 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 Mona Array Area; instructions are given in Wright et al. (2012)
- An approach used in a strategic assessment of collision risk of Scottish offshore wind (WWT Consulting and MacArthur Green, 2014) to estimate proportions of the seabird population likely to pass the Scottish offshore wind farm sites.

5.7.5.9 The resulting number of seabird and non-seabirds estimated to cross the Mona Array Area was inputted into the Band (2012) single transit CRM.

5.7.5.10 The methodology and detailed results of the CRM for 60 migratory birds are provided in Volume 6, Annex 5.4: Offshore ornithology migratory bird collision risk modelling technical report of the Environmental Statement (Document Reference F6.5.4).

Operations and maintenance phase

Magnitude of impact

Black-legged kittiwake

5.7.5.11 In all three bio-seasons (pre-breeding, breeding and post breeding) and annually the estimated increase in baseline mortalities remains well below the 1% increase threshold for both the species-group (0.993 ± 0.0003) and species-specific (0.9979 ± 0.0013) avoidance rates (Table 5-39). As black-legged kittiwake forage mainly in daytime, aviation and navigation lighting at the Mona Offshore Wind Project is unlikely to result in increasing collision risk.

5.7.5.12 The impact is predicted to be of local spatial extent, medium to 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 5-39: Black-legged kittiwake expected collision mortality across bio-seasons (mean and 95% CIs presented in brackets).

Bio-season	Regional baseline population	Baseline mortality	Collision mortality (indiv.) species-group avoidance rate	Collision mortality (indiv.) species-specific avoidance rate	Increase in baseline mortality (%) (species-group avoidance rate)	Increase in baseline mortality (%) (species-specific avoidance rate)
Pre-breeding (January to February)	691,526	107,878	8.74 (3.09 to 18.15)	3.09 (0.93 to 5.44)	0.008% (0.003% to 0.017%)	0.003% (0.001% to 0.005%
Breeding (March to August)	156,679	24,442	15.52 (5.68 to 31.60)	4.66 (1.70 to 9.48)	0.063% (0.023% to 0.129%)	0.019% (0.007% to 0.039%)

Bio-season	Regional baseline population	Baseline mortality	Collision mortality (indiv.) species-group avoidance rate	Collision mortality (indiv.) species-specific avoidance rate	Increase in baseline mortality (%) (species-group avoidance rate)	Increase in baseline mortality (%) (species-specific avoidance rate)
Post-breeding (September to December)	911,586	142,207	8.41 (2.96 to 17.53)	2.52 (0.89 to 5.26)	0.006% (0.002% to 0.012%)	0.002% (0.001% to 0.004%
Annual	911,586	142,207	32.67 (11.73 to 67.27)	9.80 (3.52 to 20.18)	0.023% (0.008% to 0.047%)	0.007% (0.002% to 0.014%)

Great black-backed gull

5.7.5.13 In both bio-seasons (breeding and non-breeding) and annually the estimated increase in baseline mortalities remains well below the 1% increase threshold for the species-specific avoidance rate (0.9991 ± 0.0002). However, when using species-group avoidance rate (0.994 ± 0.0004) during the breeding season the increase in baseline mortality is marginally greater than 1% (Table 5-40).

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

Table 5-40: Great black-backed gull expected additional mortality due to collisions with turbines across bio-seasons (mean and 95% CIs presented in brackets).

Bio-season	Regional baseline population	Baseline mortality	Collision mortality (indiv.) species-group avoidance rate	Collision mortality (indiv.) species-specific avoidance rate	Increase in baseline mortality (%) (species-group avoidance rate)	Increase in baseline mortality (%) (species-specific avoidance rate)
Breeding (March to August)	1,496	142	1.67 (0.59 to 3.48)	0.25 (0.09 to 0.52)	1.176% (0.415% to 2.451%)	0.176% (0.063% to 0.366%)
Non-breeding (September to February)	17,742	1,685	3.16 (1.07 to 6.66)	0.47 (0.16 to 1.00)	0.188% (0.064% to 0.395%)	0.028% (0.009% to 0.059%)
Annual	17,742	1,685	4.83 (1.66 to 10.13)	0.72 (0.25 to 1.52)	0.287% (0.099% to 0.601%)	0.043% (0.015% to 0.090%)

European herring gull

5.7.5.15 In both bio-seasons (breeding and non-breeding) and for all bio-seasons combined, the estimated increase in baseline mortalities remains well below the 1% increase threshold for both the species-group (0.994 ± 0.0004) and species-specific (0.9952 ± 0.0003) avoidance rates (Table 5-41). As gulls forage mainly in daytime, aviation and navigation lighting at the Mona Offshore Wind Project is unlikely to result in increasing collision risk.

5.7.5.16 The impact is predicted to be of local spatial extent, medium to 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 5-41: European herring gull expected additional mortality due to collisions with turbines across bio-seasons (mean and 95% CIs presented in brackets).

Bio-season	Regional baseline population	Baseline mortality	Collision mortality (indiv.) species-group avoidance rate	Collision mortality (indiv.) species-specific avoidance rate	Increase in baseline mortality (%) (species-group avoidance rate)	Increase in baseline mortality (%) (species-specific avoidance rate)
Breeding (March to August)	31,214	5,338	0.03 (0.01 to 0.06)	0.02 (0.01 to 0.05)	0.001% (<0.001% to 0.001%)	<0.001% (<0.001% to 0.001%)
Non-breeding (September to February)	173,299	29,634	1.48 (0.50 to 3.13)	1.18 (0.40 to 2.51)	0.005% (0.002% to 0.011%)	0.004% (0.001% to 0.008%)
Annual	173,299	29,634	1.51 (0.51 to 3.91)	1.20 (0.41 to 2.55)	0.005% (0.002% to 0.013%)	0.004% (0.001% to 0.009%)

Lesser black-backed gull

5.7.5.17 When using an avoidance rate of 0.994 (±0.0004), the estimated mortalities in all four bio seasons and for all bio-seasons combined were very low and did not surpass the 1% increase threshold for both the species-group (0.994 ± 0.0004) and species-specific (0.9954 ± 0.0003) avoidance rates (Table 5-42). As gulls forage mainly in daytime, aviation and navigation lighting at the Mona Offshore Wind Project is unlikely to result in increasing collision risk.

5.7.5.18 The impact is predicted to be of local spatial extent, medium to 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 5-42: Lesser black-backed gull expected additional mortality due to collisions with turbines across bio-seasons (mean and 95% CIs presented in brackets).

Bio-season	Regional baseline population	Baseline mortality	Collision mortality (indiv.) species-group avoidance rates	Collision mortality (indiv.) species-specific avoidance rates	Increase in baseline mortality (%) (species-group avoidance rates)	Increase in baseline mortality (%) (species-specific avoidance rates)
Pre-breeding (March)	163,304	19,760	0.83 (0.26 to 1.94)	0.64 (0.20 to 1.49)	0.004% (0.001% to 0.010%)	0.003% (0.001% to 0.008%)
Breeding (April to August)	109,785	13,284	0.33 (0.10 to 0.81)	0.25 (0.08 to 0.62)	0.002% (0.001% to 0.006%)	0.002% (0.001% to 0.005%)
Post-breeding (September to October)	163,304	19,760	No predicted collisions		N/A	
Non-breeding (November to February)	41,159	4,980	0.76 (0.23 to 1.69)	0.58 (0.18 to 1.30)	0.015% (0.005% to 0.034%)	0.012% (0.004% to 0.026%)
Annual	163,304	19,760	1.92 (0.59 to 4.43)	1.47 (0.45 to 3.40)	0.010% (0.003% to 0.022%)	0.007% (0.002% to 0.017%)

Northern gannet

5.7.5.19 In all three bio-seasons (pre-breeding, breeding and post-breeding) and for all bio-seasons combined, the estimated increase in baseline mortality remains well below the 1% increase threshold for the species-group (0.993 ± 0.0003) avoidance rate (Table 5-43) and when assuming no or 70% macro-avoidance (Table 5-44). As northern gannet forage mainly in daytime, aviation and navigation lighting at the Mona Offshore Wind Project is unlikely to result in increasing collision risk.

5.7.5.20 The impact is predicted to be of local spatial extent, medium to 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 5-43: Northern gannet expected additional mortality due to collisions with turbines across bio-seasons (mean and 95% CIs presented in brackets), assuming no macro-avoidance.

Bio-season	Regional baseline population	Baseline mortality	Collision mortality (indiv.) species-group avoidance rates	Increase in baseline mortality (%) (species-group avoidance rates)
Pre-breeding (December to February)	661,888	127,744	0.41 (0.09 to 1.12)	0.001 (<0.001% to 0.001%)

Bio-season	Regional baseline population	Baseline mortality	Collision mortality (indiv.) species-group avoidance rates	Increase in baseline mortality (%) (species-group avoidance rates)
Breeding (March to September)	522,888	100,917	4.73 (0.92 to 13.1)	0.005 (0.001% to 0.013%)
Post-breeding (October to November)	545,954	105,369	0.51 (0.11 to 1.3)	<0.001 (<0.001% to 0.001%)
Annual	661,888	127,744	5.65 (1.12 to 15.53)	0.004 (0.001% to 0.012%)

Table 5-44: Northern gannet expected additional mortality due to collisions with turbines across bio-seasons (mean and 95% CIs presented in brackets), assuming 70% macro-avoidance.

Bio-season	Regional baseline population	Baseline mortality	Collision mortality (indiv.) species-group avoidance rates	Increase in baseline mortality (%) (species-group avoidance rates)
Pre-breeding (December to February)	661,888	127,744	0.13 (0.04 to 0.33)	<0.001% (<0.001% to <0.001%)
Breeding (March to September)	522,888	100,917	1.42 (0.28 to 3.94)	0.001% (<0.001% to 0.004%)
Post-breeding (October to November)	545,954	105,369	0.15 (0.03 to 0.39)	<0.001% (<0.001% to <0.001%)
Annual	661,888	127,744	1.70 (0.34 to 4.66)	0.001% (<0.001% to 0.004%)

Northern fulmar

5.7.5.21 When using the species-group avoidance rate of 0.991 (±0.0004), the estimated increase in baseline mortality represents negligible impact in all four bio-seasons and for the combined bio-seasons (Table 5-45). In the absence of quantitative information available on the effect of aviation and navigation lighting on collision risk, the magnitude is considered qualitatively for northern fulmar. Although the species has a higher activity rate than most seabird species, aviation and navigation lighting at the Mona Offshore Wind Project is unlikely to result in increasing collision risk, with very few flights likely to be at collision risk height (Wade *et al*., 2016).

5.7.5.22 The impact is predicted to be of local spatial extent, medium to 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 5-45: Northern fulmar expected additional mortality due to collisions with turbines across bio-seasons (mean and 95% CIs presented in brackets).

Bio-season	Regional baseline population	Baseline mortality	Collision mortality (indiv.) species-group avoidance rates	Increase in baseline mortality (%) (species-group avoidance rates)
Pre-breeding (December)	828,194	183,031	0.03 (0 to 0.17)	<0.001% (<0.001% to 0.001%)
Breeding (January to August)	54,403	12,023	0.32 (0.00 to 1.94)	<0.001% (<0.001% to 0.001%)
Post-breeding (September to October)	828,194	183,031	No predicted collisions	N/A
Non-breeding November	556,367	122,957	0.01 (0.00 to 0.05)	<0.001% (<0.001% to <0.001%)
Annual	828,194	183,031	0.36 (0.00 to 2.16)	<0.001% (<0.001% to 0.001%)

Manx shearwater

5.7.5.23 When using the species-group avoidance rate 0.991 (±0.0004) there are no predicted collisions during the operations phase of the offshore wind farm, and thus no increase in mortality relative to the baseline mortality. In the absence of quantitative information available on the effect of aviation and navigation lighting on collision risk, the magnitude is considered qualitatively for Manx shearwater. Although the species has a high activity rate, aviation and navigation lighting at the Mona Offshore Wind Project is unlikely to result in increasing collision risk, with very few flights likely to be at collision risk height (Wade *et al*., 2016) with Manx shearwater flying close to the sea surface.

5.7.5.24 The impact is predicted to be of local spatial extent, medium to 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 5-46: Manx shearwater expected additional mortality due to collisions with turbines across bio-seasons (mean and 95% CIs presented in brackets).

Bio-season	Regional baseline population	Baseline mortality	Collision mortality (indiv.) species-group avoidance rates	Increase in baseline mortality (%) (species-group avoidance rates)
Pre-breeding (March)	1,580,895	205,516	No predicted collisions	N/A
Breeding (April to August)	1,821,544	236,801	No predicted collisions	N/A
Post-breeding (September to October)	1,580,895	205,516	No predicted collisions	N/A

Bio-season	Regional baseline population	Baseline mortality	Collision mortality (indiv.) species-group avoidance rates	Increase in baseline mortality (%) (species-group avoidance rates)
Annual	1,821,544	236,801	No predicted collisions	N/A

Migratory birds

5.7.5.25 Predictions for collision risk using a range of avoidance rates are provided in Volume 6, Annex 5.4: Offshore ornithology migratory bird collision risk modelling technical report of the Environmental Statement (Document Reference F6.5.4), and the annual collision rate of the assessed species is also presented within Table 5-47.

5.7.5.26 Even assuming a highly precautionary avoidance rate of 98%, the estimated numbers of collisions were low and predicted to be below one bird per annum for all but nine species found to be crossing the Mona Array Area. Details of species assessed and the associated increase in baseline mortality as a percentage are provided in Table 5-47. UK population estimates are taken from Woodward *et al*. (2020) unless otherwise stated within Table 5-47.

5.7.5.27 Due to their very large biogeographic population size and migration routes through the Irish Sea, wader species were at the greatest risk of collision. From the nine species identified as having an estimated number of collisions greater than one bird per annum, six belonged to the wader group. The three remaining species were duck species.

5.7.5.28 Of the wader species/populations considered, oystercatcher (non-breeding), European golden plover (non-breeding), northern lapwing, red knot, dunlin (sub-species *schinzii and arctica*) and common snipe were predicted to be above one collision per year (assuming a 98% avoidance rate).

5.7.5.29 Of the non-wader species/populations considered three duck species were predicted to be above one collision per year (assuming a 98% avoidance rate), these were Eurasian wigeon, mallard and Eurasian teal.

5.7.5.30 In the context of their large populations, the estimated increase in baseline mortalities of both the wader and duck species as the result of collision during migration is expected to be minimal and undetectable given the size of the bio-geographic populations.

5.7.5.31 When looking at the predicted increase in baseline mortality, no species are anticipated to experience an increase in baseline mortality greater than 0.03%.

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

Table 5-47: Summary of collision risk assessment on migratory birds at the Mona Offshore Wind Project.

Note: *denotes species which have had to refer to related species as a proxy for adult baseline mortality rates (goosander used as a proxy for red-breasted merganser, great crested grebe used as a proxy Slavonian grebe, European golden plover used as a proxy for dotterel, common redshank used as a proxy for common greenshank, great skua used as a proxy for pomarine skua and long-tailed skua and long-eared owl used as a proxy for short-eared owl).

Species	UK population	Adult baseline mortality	UK baseline mortality	Avoidance rate (%)	Annual collision rate	Increase in baseline mortality (%)
Tundra swan (Bewick's swan)	4,350	0.178	774	98.0	0.01	0.001
Whooper swan	19,500	0.199	3,881	98.0	0.40	0.010
Greenland white-fronted goose	14,000	0.276	3,864	98.0	0.15	0.004
Light-bellied brent goose (Canadian population)	135,000	0.100	13,500	98.0	0.01	0.0001
Common shelduck	51,000	0.114	5,814	98.0	0.22	0.004
Eurasian wigeon	450,000	0.470	211,500	98.0	1.78	0.001
Gadwall	31,000	0.280	8,680	98.0	0.14	0.002
Eurasian teal	435,000	0.470	204,450	98.0	1.60	0.001
Mallard	675,000	0.373	251,775	98.0	2.89	0.001
Northern pintail	20,000	0.337	6,740	98.0	0.08	0.001
Northern shoveler	19,500	0.420	8,190	98.0	0.08	0.001
Common pochard	29,000	0.350	10,150	98.0	0.12	0.001
Tufted duck	140,000	0.290	40,600	98.0	0.54	0.001
Greater scaup	6,400	0.520	3,328	98.0	0.03	0.001
Long-tailed duck	13,500	0.280	3,780	98.0	0.05	0.001
Common scoter	135,000	0.217	29,295	98.0	0.04	0.0001
Common goldeneye	21,000	0.228	4,788	98.0	0.08	0.002

Species	UK population	Adult baseline mortality	UK baseline mortality	Avoidance rate (%)	Annual collision rate	Increase in baseline mortality (%)
Red-breasted merganser*	11,000	0.180	1,980	98.0	0.04	0.002
Great northern diver*	2,000 (Forrester *et al*. 2007)	0.160	320	98.0	0.02	0.006
European storm petrel	27,214 (Wright *et al*., 2012)	0.130	3,538	98.0	0.30	0.008
Leach's storm petrel	50,658 (Wright *et al*., 2012)	0.120	6,079	98.0	0.75	0.012
Eurasian bittern	795	0.300	239	98.0	0.03	0.013
Great crested grebe*	18,000	0.180	3,240	98.0	0.06	0.002
Horned grebe (Slavonian grebe)*	995	0.180	179	98.0	0.00	0.000
Hen harrier	545	0.190	104	98.0	0.01	0.010
Western osprey	240	0.150	36	98.0	0.01	0.028
Merlin	1,150	0.380	437	98.0	0.01	0.002
Corncrake	1,100	0.714	785	98.0	0.01	0.001
Eurasian oystercatcher (breeding)	95,500	0.120	11,460	98.0	0.57	0.005
Eurasian oystercatcher (non-breeding)	305,000	0.120	36,600	98.0	1.82	0.005
Common ringed plover (breeding)	5,450	0.228	1,243	98.0	0.03	0.002
Common ringed plover (non-breeding)	42,500	0.228	9,690	98.0	0.24	0.002
Eurasian dotterel*	425	0.270	115	98.0	0.00	0.000
European golden plover (breeding)	50,500	0.270	13,635	98.0	0.27	0.002

Species	UK population	Adult baseline mortality	UK baseline mortality	Avoidance rate (%)	Annual collision rate	Increase in baseline mortality (%)
European golden plover (non-breeding)	410,000	0.270	110,700	98.0	2.22	0.002
Grey plover	33,500	0.140	4,690	98.0	0.20	0.004
Northern lapwing	635,000	0.295	187,325	98.0	3.40	0.002
Red knot	265,000	0.159	42,135	98.0	1.55	0.004
Sanderling	20,500	0.170	3,485	98.0	0.11	0.003
Purple sandpiper	9,900	0.205	2,030	98.0	0.05	0.002
Dunlin (sub-species *schinzii* and *arctica*)	350,000	0.260	91,000	98.0	1.77	0.002
Dunlin (sub-species *alpina*)	35,000	0.260	9,100	98.0	0.24	0.003
Ruff	820	0.476	390	98.0	0.01	0.003
Common snipe	1,100,000	0.519	570,900	98.0	6.16	0.001
Black-tailed godwit (Icelandic race)	41,000	0.060	2,460	98.0	0.26	0.011
Bar-tailed godwit	53,500	0.285	15,248	98.0	0.40	0.003
Whimbrel	310	0.110	34	98.0	0.00	0.000
Eurasian curlew (breeding)	58,500	0.101	5,909	98.0	0.39	0.007
Eurasian curlew (non-breeding)	125,000	0.101	12,625	98.0	0.84	0.007
Common greenshank*	290	0.260	75	98.0	0.00	0.000
Wood sandpiper	68	0.464	32	98.0	0.00	0.000
Common redshank (breeding)	22,000	0.260	5,720	98.0	0.11	0.002

Species	UK population	Adult baseline mortality	UK baseline mortality	Avoidance rate (%)	Annual collision rate	Increase in baseline mortality (%)
Common redshank (Icelandic race - non-breeding)	100,000	0.260	26,000	98.0	0.52	0.002
Ruddy turnstone	43,000	0.140	6,020	98.0	0.23	0.004
Great skua	9,634 (Wright *et al*., 2012)	0.112	1,079	98.0	0.22	0.020
Pomarine skua*	2,000 (Forrester *et al*., 2007)	0.112	224	98.0	0.03	0.013
Long-tailed skua*	1,000 (Forrester *et al*., 2007)	0.112	112	98.0	0.01	0.009
Black-headed gull	276,028 (Wright *et al*., 2012)	0.100	27,603	98.0	0.83	0.003
Short-eared owl*	2,200	0.310	682	98.0	0.03	0.004

Sensitivity of the receptor

Black-legged kittiwake

5.7.5.33 Black-legged kittiwake was rated as relatively 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.

5.7.5.34 Despite a higher reproductive success (i.e. laying two eggs and breeding until four years old) than most seabird species (Robinson, 2005), the species is deemed to have a low recoverability given the continuing decline in abundance observed between 1986 and 2018 in the UK (JNCC, 2020). During this period, breeding productivity has declined as the result of food shortage, although it has stabilised in recent years (JNCC, 2020).

5.7.5.35 Black-legged kittiwake is a qualifying interest for several SPAs likely to be connected to the Mona Array Area (within the mean-max + SD foraging range), with several non-SPA colonies within range and so the species is considered to be of medium value.

5.7.5.36 Black-legged kittiwake is deemed to be of high vulnerability, low recoverability and medium value. The sensitivity of the receptor is therefore, considered to be **high**.

Great black-backed gull

5.7.5.37 Great 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.

5.7.5.38 The abundance of breeding great black-backed gull in the UK has changed relatively little between census (JNCC, 2020). The species is deemed to have a medium recoverability due to a low reproductive success and the stable trend in breeding abundance.

5.7.5.39 As great black-backed gull is a qualifying interest for several SPAs likely to be connected to the Mona Array Area (within the mean-max + SD foraging range), with a non-SPA colony within range and so the species is considered to be of medium value.

5.7.5.40 Great black-backed gull is deemed to be of high vulnerability, medium recoverability and medium value. The sensitivity of the receptor is therefore, considered to be **medium.**

European herring gull

5.7.5.41 European 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.

5.7.5.42 As European herring gull is a qualifying interest for several SPAs likely to be connected to the Mona Array Area (within the mean-max + SD foraging range) with multiple non-SPA colonies within range, the species is considered to be of medium value.

5.7.5.43 Although European herring gull have a relatively high reproductive success, breeding abundance is declining in the coastal natural nesting population, and this may be indicative of decline in the entire UK breeding population (JNCC, 2020). There is evidence that the urban nesting gull population has increased in recent years, but census of these sites is lacking to derive a UK wide trend that includes both the urban and natural populations. The species is therefore deemed to be of medium recoverability.

5.7.5.44 European herring gull is deemed to be of high vulnerability, medium recoverability and medium value. The sensitivity of the receptor is therefore, considered to be **medium.**

Lesser black-backed gull

5.7.5.45 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.

5.7.5.46 As lesser black-backed gull is a qualifying interest for several SPAs likely to be connected to the Mona Array Area (within the mean-max + SD foraging range), with multiple non-SPA colonies within range, the species is considered to be of medium value.

5.7.5.47 Although lesser black-backed gull has a relatively high reproductive success, the species breeding abundance has exhibited a downward trend over the last 15 to 20 years in the UK (JNCC, 2020). It must be noted that this trend excludes urban nesting gulls from the sample and, therefore, may not be representative of trends in the entire UK population. The species is deemed to be of medium recoverability.

5.7.5.48 Lesser black-backed gull is deemed to be of high vulnerability, medium recoverability and medium value. The sensitivity of the receptor is therefore, considered to be **medium**.

Northern gannet

5.7.5.49 Although the latest scientific guidance showed the species to display a high level of macro-avoidance (Peschko *et al*., 2021), the species is rated as relatively vulnerable to collision impacts by Wade *et al*. (2016).

5.7.5.50 Northern gannet is a qualifying interest for several SPAs likely to be connected to the Mona Array Area (within the mean-max + SD foraging range), with a large non-SPA colony within close proximity (Monreith Cliffs and Scar Rocks), the species is therefore considered to be of medium value.

5.7.5.51 Although northern gannet has a low reproductive success, the species is deemed to have a medium recoverability given the 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. The species is deemed to be of medium recoverability.

5.7.5.52 Northern gannet is deemed to be of medium vulnerability, medium recoverability and medium value. The sensitivity of the receptor is therefore, considered to be **medium**.

Northern fulmar

5.7.5.53 Northern fulmar was rated as the least vulnerable seabird to collision impacts by Wade *et al.* (2016).

5.7.5.54 As northern fulmar is a qualifying interest for several SPAs likely to be connected to the Mona Array Area (within the mean-max + SD foraging range) with multiple non-SPAs within range, the species is considered to be of medium value. Furthermore, the northern fulmar population is endemic to the North Atlantic and most breed in Britain and Ireland (Mitchell *et al*., 2004).

5.7.5.55 The species has a very low reproductive success (Robinson, 2005). Long term trend data suggests that breeding abundance peaked in 1996 (JNCC, 2020) and recent declines represent a period of ‘re-adjustment’ following a period of artificially inflated population size. The species is deemed to be of medium recoverability.

5.7.5.56 Northern fulmar is deemed to be of low vulnerability, medium recoverability and medium value. The sensitivity of the receptor is therefore, considered to be **low**.

Manx shearwater

5.7.5.57 Manx shearwater was rated as the least vulnerable seabirds to collision impacts by Wade *et al*. (2016).

5.7.5.58 As Manx shearwater is a qualifying interest for several SPAs likely to be connected to the Mona Array Area (within the mean-max + SD foraging range) the species is considered to be of high value. Furthermore, the Manx shearwater population is endemic to the North Atlantic and most breed in Britain and Ireland (Mitchell *et al*., 2004).

5.7.5.59 The species has a very low reproductive success (Robinson, 2005). 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). Therefore, the species is considered to be of high value.

5.7.5.60 Manx shearwater has a low reproductive success (i.e. only laying one egg and not breeding until five years old; Robinson, 2005). There is an incomplete spatial-temporal coverage of breeding abundance at UK colonies and thus a lack of long-term trend (JNCC, 2020). In the light of uncertainly and low reproductive success, Manx shearwater are therefore deemed to have a medium recoverability.

5.7.5.61 Manx shearwater is deemed to be of low vulnerability, medium recoverability and high value. The sensitivity of the receptor is therefore, considered to be **medium**.

Migratory bird species

5.7.5.62 Although migratory bird species 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.

5.7.5.63 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). This assessment of migratory birds included the following migratory seabirds: European storm petrel, Leach’s storm petrel, great skua, pomarine skua, long-tailed skua and black-headed gull. On a precautionary basis and for the purposes of this assessment migratory bird species (including seabirds) are assumed to have **medium** sensitivity to collision.

Significance of the effect

5.7.5.64 Overall, the magnitude of the collision risk impact at the Mona offshore wind farm is expected to be negligible to low depending on the species (Table 5-48). Although sensitivity of the receptor varies from low to high, the effect is expected to be of **negligible to minor adverse** significance depending on species, which is not significant in EIA terms.

5.7.5.65 For great black-backed gull, a minor adverse effect was concluded when using the species-group avoidance rate as the increase in baseline mortality was estimated to be 1.176%. However, the species-specific avoidance rate estimated an increase in baseline mortality of 0.176%, therefore for precaution the higher estimate of impact was taken forward to this conclusion of a negligible to minor adverse effect. However, as there are two potential avoidance rates which provided varying outputs and the species-group avoidance rate was only marginally above the 1% threshold (1.176% increase in baseline mortality), no PVA was undertaken for the project alone. A PVA for cumulative collision impact on great black-backed gull was undertaken (see section 5.9.3), which concluded low magnitude of impact, therefore if a project alone PVA was undertaken the same conclusions would be made.

5.7.5.66 For black-legged kittiwake, European herring gull, lesser black-backed gull, northern gannet, norther fulmar and migratory birds, negligible was selected from the negligible to minor range due to the impact not exceeding a 1% increase in baseline mortality and hence, was not regarded as a minor significance of effect.

Table 5-48: Table summarising the significance of effect of collision from the Mona Offshore Wind Project impacts during the operations and maintenance phase.

Species	Magnitude of impact	Sensitivity of receptor	Significance of effect
Black-legged kittiwake	Negligible	High	**Negligible, not significant in EIA terms**
Great black-backed gull	Low	Medium	**Minor adverse, not significant in EIA terms**
European herring gull	Negligible	Medium	**Negligible, not significant in EIA terms**
Lesser black-backed gull	Negligible	Medium	**Negligible, not significant in EIA terms**
Northern gannet	Negligible	Medium	**Negligible, not significant in EIA terms**
Northern fulmar	Negligible	Low	**Negligible, not significant in EIA terms**
Manx shearwater	Negligible	Medium	**Negligible, not significant in EIA terms**
Migratory birds	Negligible	Medium	**Negligible, not significant in EIA terms**

5.7.6 Combined displacement and collision risk

Operations and maintenance phase

Magnitude of impact

5.7.6.1 Two species are known to be adversely affected by both displacement and collision during the operations and maintenance phase, these are black-legged kittiwake and northern gannet. Impacts must be combined in order for the true magnitude of impact to be understood. There is no consensus between the SNCBs regarding the inclusion of a displacement assessment for black-legged kittiwake; however, one is presented here for precaution and for the SNCBs that have requested this information.

5.7.6.2 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 area. Equally, birds estimated to be subject to collision risk mortality would not be able to be subjected to displacement consequent mortality as well. As a more refined method to consider displacement and collision together whilst reducing any double counting of impacts is not agreed with SNCBs and therefore the precautionary and highly unlikely approach is presented in this assessment.

5.7.6.3 Outputs from the impact assessments from disturbance and displacement (section 5.7.2) and collision risk (section 5.7.5) combined are tabulated and presented in Table 5-49.

Table 5-49: Combined displacement and collision cumulative impacts.

Species	Impact	Pre-breeding/Spring Migration	Breeding	Post-breeding/Autumn Migration	Annual
Black-legged kittiwake	Displacement (30 to 70% displacement and 1 to 10% mortality)	3 to 40	2 to 51	2 to 39	6 to 126
	Collisions (species-group avoidance rate)	8.74	15.52	8.41	32.67
	Collisions (species-specific avoidance rate)	2.55	4.53	2.52	9.80
	Combined (minimum estimate)	5.55	6.53	4.52	15.80
	Combined (maximum estimate)	48.74	66.52	47.41	158.67
	Regional population baseline mortality	107,878	24,442	142,207	142,207
	Increase in baseline mortality (%)	**0.005 to 0.045**	**0.026 to 0.272**	**0.003 to 0.033**	**0.011 to 0.112**
Northern gannet	Displacement (60 to 80% displacement and 1 to 10% mortality)	0 to 2	2 to 20	0 to 5	2 to 27
	Collisions (species-group avoidance rates) (no macro-avoidance)	0.41	4.73	0.51	5.65
	Combined (minimum estimate)	0.41	6.73	0.51	7.22
	Combined (maximum estimate)	2.41	26.73	5.51	34.22
	Regional population baseline mortality	127,744	100,917	105,369	127,744
	Increase in baseline mortality (%)	**<0.001 to 0.002**	**0.007 to 0.026**	**<0.001 to 0.005**	**0.006 to 0.027**

Black-legged kittiwake

5.7.6.4 The combined estimated mortality (when considering a displacement rate of 30% to 70% and a mortality rate of 1% to 10%) and collisions using both species-group and species-specific avoidance rates was assessed for each bio-season and annually (Table 5-49).

5.7.6.5 In all three bio-seasons (spring, breeding and autumn) and annually, the predicted increase in baseline mortalities remains well below the 1% increase threshold.

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

Northern gannet

5.7.6.7 The combined estimated mortality (when considering a displacement rate of 60% to 80% and a mortality rate of 1% to 10%) and collisions using the species-group avoidance rate was assessed for each bio-season and annually (Table 5-49).

5.7.6.8 In all three bio-seasons (spring, breeding and autumn) and annually, the predicted increase in baseline mortalities remains well the below the 1% increase threshold.

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

Sensitivity of the receptor

Black-legged kittiwake

5.7.6.10 As previously described in displacement (paragraph 5.7.2.96) and collision (paragraph 5.7.5.36), black-legged kittiwake is deemed to be of overall medium vulnerability, low recoverability and medium value. The sensitivity of the receptor is therefore, considered to be **medium**.

Northern gannet

5.7.6.11 As previously described in displacement (paragraph 5.7.2.92) and collision (paragraph 5.7.5.52), northern gannet is deemed to be overall of medium vulnerability, medium recoverability and medium value. The sensitivity of the receptor is therefore, considered to be **medium**.

Significance of the effect

Black-legged kittiwake

5.7.6.12 Overall, the magnitude of the combined displacement and collision cumulative impact is low, and the sensitivity of the receptor is medium. The effect will, therefore, be of **minor** adverse significance, which is not significant in EIA terms.

Northern gannet

5.7.6.13 Overall, the magnitude of the combined displacement and collision cumulative impact is low 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.

5.7.7 Barrier to movement

5.7.7.1 Barrier effects may arise in addition to displacement. Whilst displacement is a reduction in the number of seabirds occurring within or immediately adjacent to an offshore wind farm (Furness *et al*., 2013), the barrier effect refers to the disruption of preferred flight lines. This might impose an additional energetic cost to movements, particularly during the breeding season when seabirds make daily commutes between foraging grounds at sea and nesting sites. Additional energetic costs could have long-term implications for individuals and impact bird fitness (breeding productivity and survival). Birds may also have to navigate around the offshore wind farms during migratory movements. In the case of migrating birds, avoidance of a single offshore wind farm may be trivial relative to the total length and cost of the journey. There is a general lack of empirical data on the barrier effects for migratory birds.

5.7.7.2 For breeding seabirds, in a study of the effects of offshore wind farms as barriers to movement on seabirds of differing morphology, 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 cormorants. Most importantly the authors found costs of extra flight to avoid an offshore 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.

5.7.7.3 Although the Mona Array Area lies within the mean-maximum foraging ranges of several breeding colonies, connectivity has to be established to the Mona Array Area and it is unlikely that the site will provide a barrier to foraging movements given that birds generally forage widely within their mean-maximum foraging ranges. The risk of collision (as detailed in paragraph 5.7.5) is deemed to be greater than the risk of barrier effect.

5.7.7.4 Because the magnitude of the effect is likely to be similar amongst bird species moving through the area, receptors are grouped in the assessment of the barrier effect.

Operations and maintenance phase

Magnitude of impact

All receptors

5.7.7.5 In the absence of quantitative information available, the magnitude is considered qualitatively for breeding seabird and migratory non-seabirds.

5.7.7.6 As breeding seabirds generally forage widely within their foraging range of breeding colonies, the Mona Offshore Wind Project is unlikely to form a significant barrier to the movement from any breeding colonies. Furthermore, the Mona Offshore Wind Project is unlikely to form a barrier to the movement of migratory birds given that migratory movements at sea occur over a broad front.

5.7.7.7 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 receptor

All receptors

5.7.7.8 Seabird species vary in their vulnerability to barrier effects. Some species such as gulls, fulmars, gannets and terns are considered to have a low sensitivity (Maclean *et al*., 2009). Other species such as divers and auks are considered to have higher sensitivity to barrier effects due to a higher wing-loading (i.e. they have a higher ratio of body weight to wing area and therefore energy expenditure during flight is likely to be higher. These species are notable by their characteristically direct flight paths) compared with other species (Maclean *et al*., 2009). Evidence from studies at operational offshore wind farms (Everaert and Kuijken, 2007; Krijgsveld *et al.,* 2011; Everaert, 2014) has shown that gulls are unlikely to see wind turbines as a barrier to movement.

5.7.7.9 Overall breeding seabirds and migratory non-seabirds are deemed to be of medium vulnerability, medium recoverability and medium value. The sensitivity of the receptor is therefore, considered to be **medium.**

Significance of effect

5.7.7.10 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 **negligible** adverse significance, which is not significant in EIA terms.

5.7.8 Future monitoring

5.7.8.1 No future monitoring is considered given the level of certainty around the potential effects.

5.8 Cumulative effects assessment methodology

5.8.1 Methodology

5.8.1.1 For offshore ornithology, a ZOI has been applied for the CEA to ensure direct and indirect cumulative effects can be appropriately identified and assessed. The ZOI has been defined as the area within the BDMPS region as defined by Furness (2015) following advice from the EWG (Meeting 6 held 19 October 2023).

5.8.1.2 The CEA takes into account the impact associated with the Mona Offshore Wind Project together with all other projects and plans within the ZOI. 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 5, Annex 5.1: Cumulative effects screening matrix of the Environmental Statement (Document Reference F5.5.1)). Each project has been considered on a case-by-case basis for screening in or out of this chapter's assessment based upon data confidence, effect-receptor pathways and the spatial/temporal scales involved.

5.8.1.3 The offshore ornithology CEA methodology has followed the methodology set out in Volume 1, Chapter 5: EIA methodology of the Environmental Statement (Document Reference F1.5). As part of the assessment, all projects and plans considered alongside the Mona Offshore Wind Project have been allocated into 'tiers' reflecting their current stage within the planning and development process, these are listed below.

5.8.1.4 The tiered approach uses the following categorisations:

- Tier 1
  - Those currently operational that were not operational when baseline data was collected, and/or those that are operational but have an on-going impact
  - Under construction
  - Permitted application
  - Submitted application
- Tier 2
  - Scoping report has been submitted and is in the public domain
- Tier 3
  - Scoping report has not been submitted and is not in the public domain
  - Identified in a relevant development plan
  - Identified in other plans and programmes.

5.8.1.5 This tiered approach is adopted to provide a clear assessment of the Mona Offshore Wind Project alongside other projects, plans and activities.

5.8.1.6 The specific projects, plans and activities screened into the CEA are outlined in Table 5-50. The location of screened in projects and their proximity to the Mona Offshore Wind Project are further shown in Figure 5.2. All projects screened out are detailed within Volume 5, Annex 5.1 Cumulative effects screening annex of the Environmental Statement (Document Reference F5.5.1). Table 5-50 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 5, Annex 5.1 Cumulative effects screening annex of the Environmental Statement (Document Reference F5.5.1). Table 5-50 has been updated since application following a request from JNCC and NRW (A) to update the CEA to consider selected projects which have moved between tiers (e.g. the Morgan Generation Assets project has moved from tier 2 to tier 1).

5.8.1.7 Some of the potential impacts considered within the Mona Offshore Wind Project 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 Mona Offshore Wind Project 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.

5.8.1.8 Other aspects, namely indirect impacts associated with prey distribution and availability are very difficult to quantify, and although it is acknowledged that cumulative effects are possible, the magnitude of these impacts is not considered to be significant at a population level for any offshore ornithology receptor and is therefore not considered further within the CEA. The impacts excluded from the cumulative assessment are:

- Indirect impacts (affecting prey species) from airborne noise, underwater sound and the presence of vessels at any phase of the Mona Offshore Wind Project as they will be spatially limited and all were predicted as low
- Temporary habitat loss/disturbance and increased SSCs at any phase of the Mona Offshore Wind Project as there is low potential for cumulative effect because the contribution from the Mona Offshore Wind Project and surrounding offshore wind farms is small (and even if these occurred at the same time this would not constitute a significant effect)
- Impacts associated with the construction phase including construction activities at the landfall and laying of the export cable. Adjudged to cause changes of such small magnitude that these will not contribute in any meaningful way at a population level to a potential cumulative impact (based on determination for the Mona Offshore Wind Project effects alone).

5.8.1.9 Impacts considered in the cumulative assessment are as follows:

- Disturbance and displacement from infrastructure (and barrier effects)
- Collision risk
- Combined displacement and collision risk.

Table 5-50: List of other projects, plans and activities considered within the offshore ornithology CEA.

Project/Plan	Status	Distance from Mona Array Area (km)	Distance from Mona offshore cable corridor (km)	Description of project/plan	Dates of construction (if applicable)	Dates of operation (if applicable)	Overlap with the Mona Offshore Wind Project
Tier 1							
Morgan Offshore Wind Project Generation Assets (hereafter referred to as the Morgan Generation Assets)	Submitted application	5.52 km	32.93 km	1,500 MW capacity.	2026 to 2029	2030 to 2065	Potential construction phase overlap with Mona Offshore Wind Project construction phase. Project operations and maintenance phase overlap
Morecambe Offshore Windfarm Generation Assets (hereafter referred to as the Morecambe Generation Assets)	Submitted application	8.9 km	21.5 km	480 MW capacity, Area: 497 km^2	2026 to 2028	2029 to 2064	Potential construction phase overlap with Mona Offshore Wind Project construction phase. Project operations and maintenance phase overlap
Morgan and Morecambe Offshore Wind Farms Transmission Assets	Submitted application	8.92 km	21.53 km	Cable corridor	2026 to 2029	2029 to 2065	Potential construction phase overlap

Project/Plan	Status	Distance from Mona Array Area (km)	Distance from Mona offshore cable corridor (km)	Description of project/plan	Dates of construction (if applicable)	Dates of operation (if applicable)	Overlap with the Mona Offshore Wind Project
Gwynt y Môr Offshore Wind Farm	Operational	17.8 km	9.9 km	Capacity of 576 MW, 90 km^2 area.	2012	2015 to 2033	Project operations and maintenance phase overlap
Rhyl Flats Offshore Wind Farm	Operational	25.6 km	3.8 km	25 wind turbines, 90 MW capacity.	2007	2009 to 2027	Project operations and maintenance phase overlap
Walney Extension 3 Offshore Wind Farm	Operational	27.3 km	53.6 km	330 MW capacity..	2017	2018 to 2039	Project operations and maintenance phase overlap
Walney Extension 4 Offshore Wind Farm	Operational	27.2 km	47.8 km	329 MW capacity.	2017	2018 to 2039	Project operations and maintenance phase overlap
North Hoyle Offshore Wind Farm	Operational	29.6	13.6	30 turbines 60 MW covering an area of approximately 10 km^2 and is located 4 miles off the North Wales coast.	2003	Marine License lapses in 2025; CML1465	Project operations and maintenance phase overlap if licence is extended.
West of Duddon Sands Offshore Wind Farm	Operational	30.4 km	43.9 km	389 MW capacity	2013	2014 to 2033	Project operations and maintenance phase overlap

Project/Plan	Status	Distance from Mona Array Area (km)	Distance from Mona offshore cable corridor (km)	Description of project/plan	Dates of construction (if applicable)	Dates of operation (if applicable)	Overlap with the Mona Offshore Wind Project
Burbo Bank Extension Offshore Wind Farm	Operational	30.6 km	26.1 km	Capacity - 258 MW - 32 wind turbines.	2016	2017 to 2045	Project operations and maintenance phase overlap
Walney Extension blade tip boosters	Operational	30.7 km	47.8 km	This licence allows for adding aerodynamic tip boosters to each blade (87 wind turbines so 261 total blades), which will increase the rotor diameters for Walney 3 from 164 m to 165 m, and from 154 m to 155.3 m for Walney 4.	unknown	unknown	Project operations and maintenance phase overlap
Walney 1 Offshore Wind Farm	Operational	35.4 km	49.6 km	183.6 MW capacity. Area - 36.5 km^2.	2010	2011 to 2032	Project operations and maintenance phase overlap
Walney 2 Offshore Wind Farm	Operational	34.0 km	51.5 km	183.6 MW capacity. Area - 36.5 km^2.	2011	2012 to 2032	Project operations and maintenance phase overlap

Project/Plan	Status	Distance from Mona Array Area (km)	Distance from Mona offshore cable corridor (km)	Description of project/plan	Dates of construction (if applicable)	Dates of operation (if applicable)	Overlap with the Mona Offshore Wind Project
Burbo Bank Offshore Wind Farm	Operational	40.3 km	32.8 km	Capacity of 90 MW. Area - 10 km^2.	2006	2007 to 2039	Project operations and maintenance phase overlap
Barrow Offshore Wind Farm	Operational	43.3	53.9	30 turbine 90MW capacity offshore wind farm in the East Irish Sea approximately seven kilometres southwest of Walney Island, near Barrow-in-Furness, Cumbria, England.	2005	Marine License lapses in 2026; L/2016/00297/4	Project operations and maintenance phase overlap if licence is extended.
Ormonde Wind Farm	Operational	44.0 km	58.0 km	150 MW capacity. Area - 8.7 km^2.	2010	2012 to 2036	Project operations and maintenance phase overlap
Robin Rigg Offshore Wind Farm	Operational	98.6 km	126.0 km	174 MW capacity	2009	2010 to 2023	Project operations and maintenance phase overlap
Llŷr 1 Floating Wind Farm	Submitted application	267.0 km	245.9 km	100 MW capacity.	2026 to 2027	Unknown	Project operations and maintenance phase overlap
Rampion Offshore Wind Farm	Operational	401.2 km	365.1 km	400 MW capacity. Area - 72 km^2.	2015	2017 to 2042	Project operations and maintenance phase overlap

Project/Plan	Status	Distance from Mona Array Area (km)	Distance from Mona offshore cable corridor (km)	Description of project/plan	Dates of construction (if applicable)	Dates of operation (if applicable)	Overlap with the Mona Offshore Wind Project
Awel y Môr Offshore Wind Farm	Consent granted	13.5 km	3.6 km	500 MW capacity.	2026 to 2029	2030 to 2055	Potential construction phase overlap with the Mona Offshore Wind Project construction phase. Project operations and maintenance phase overlap
West Anglesey Demonstration Zone tidal site (Morlais)	Consent granted	53.8. km	50.6 km	240 MW	unknown	unknown	Project operations and maintenance phase overlap
Holyhead Deep – Tidal energy (Minesto)	Operational	57.9 km	55.6 km	0.5 MW	2018	2018 to unknown	Project operations and maintenance phase overlap
Erebus Floating Wind Demo	Submitted application	259.9 km	240.2 km	100 MW capacity.	2025	2026 to 2051	Potential construction phase overlap with Mona Offshore Wind Project construction phase. Project operations and maintenance phase overlap
White Cross Offshore Windfarm	Submitted application	287.7 km	211.2 km	100 MW site. Planned floating offshore wind farm off the coast of	2026	unknown	Potential construction phase overlap with Mona Offshore Wind Project construction phase. Project operations and

Project/Plan	Status	Distance from Mona Array Area (km)	Distance from Mona offshore cable corridor (km)	Description of project/plan	Dates of construction (if applicable)	Dates of operation (if applicable)	Overlap with the Mona Offshore Wind Project
				Pembrokeshire. Comprises up to 18 wind turbines.			maintenance phase overlap
TwinHub (Wave Hub Floating Wind Farm)	Consent granted	377.1 km	350.9 km	Two floating offshore wind platforms, each with two wind turbines. Installed capacity of 32 MW.	unknown	unknown	Project operations and maintenance phase overlap
Rampion 2 Offshore Wind Farm	Submitted application	394.8 km	358.1 km	Up to 1,200 MW capacity. Area - 270 km^2.	2025	2029 to unknown	Potential construction phase overlap with Mona Offshore Wind Project construction phase. Project operations and maintenance phase overlap
West of Orkney Windfarm	Submitted application	553.9 km	573.9 km	Offshore wind project comprising up to 125 wind turbines, 30 km from the coast of Orkney.	2027	unknown	Project operations and maintenance phase overlap
Tier 2							

Project/Plan	Status	Distance from Mona Array Area (km)	Distance from Mona offshore cable corridor (km)	Description of project/plan	Dates of construction (if applicable)	Dates of operation (if applicable)	Overlap with the Mona Offshore Wind Project
ENI Hynet – carbon capture storage (CCS)	Pre-application	12.1 km	9.5 km	project in the east Irish Sea. Works will include installation of a new cable, a new Douglas CCS platform and work on the existing Hamilton, Hamilton North and Lennox wellhead platforms.	Unknown	Unknown	Project operations and maintenance phase overlap
Mooir Vannin Offshore Wind Farm	Scoping report submitted	34.53 km	54.45 km	Up to 700 MW capacity	Unknown	Unknown	Project operations and maintenance phase overlap
North Irish Sea Array offshore Wind Farm	Scoping report submitted	112.7 km	118.6 km	500 MW capacity.	unknown	unknown	Project operations and maintenance phase overlap
Codling Wind Park	Scoping report submitted	125.1 km	123.6 km	900 MW planned capacity, off of the coast Wicklow. Spread over an area of 125 km^2	unknown	unknown	Project operations and maintenance phase overlap

Project/Plan	Status	Distance from Mona Array Area (km)	Distance from Mona offshore cable corridor (km)	Description of project/plan	Dates of construction (if applicable)	Dates of operation (if applicable)	Overlap with the Mona Offshore Wind Project
Dublin Array Offshore Wind Farm	Scoping report submitted	126.1 km	129.0 km	600 MW offshore wind power project. Area of 54 km^2.	unknown	unknown	Project operations and maintenance phase overlap
North Channel Wind 2	Scoping report submitted	128.5 km	151.5 km	Site area of approx. 38 km2. Using Tension Leg platform. 5-7 wind turbines	unknown	unknown	Project operations and maintenance phase overlap
Oriel Wind Farm	Scoping report submitted	130.4 km	138.1 km	375 MW capacity, spread over 28 km^2.	unknown	unknown	Project operations and maintenance phase overlap
Arklow Bank Wind Park Phase 2	Scoping report submitted	146.7 km	142.8 km	800 MW capacity.	unknown	unknown	Project operations and maintenance phase overlap
North Channel Wind 1	Scoping report submitted	157.3 km	180.9 km	Site area of approx. 38 km2. Using Tension Leg platform. 5-7 wind turbines	unknown	unknown	Project operations and maintenance phase overlap
Shelmalere Offshore Wind Farm	Scoping report submitted	177.1 km	168.9 km	1,000 MW capacity.	unknown	unknown	Project operations and maintenance phase overlap

Project/Plan	Status	Distance from Mona Array Area (km)	Distance from Mona offshore cable corridor (km)	Description of project/plan	Dates of construction (if applicable)	Dates of operation (if applicable)	Overlap with the Mona Offshore Wind Project
North Celtic Sea Ofshore Wind Farm	Scoping report submitted	256.4 km	248.8 km	Up to 800 MW Planned capacity.	unknown	unknown	Project operations and maintenance phase overlap
Llŷr 2 Floating Wind Farm	Scoping report submitted	263.17 km	240.12 km	1,000 MW capacity.	Unknown	Unknown	Project operations and maintenance phase overlap
Valorous Floating Offshore Wind Project	Scoping report submitted	271.7 km	252.4 km	300 MW floating offshore wind project in the Celtic Sea region.	Unknown	Unknown	Project operations and maintenance phase overlap
Inis Ealga Marine Energy Park offshore wind farm	Scoping report submitted	302.1 km	292.0 km	1,000 MW capacity.	Unknown	Unknown	Project operations and maintenance phase overlap
Emerald Floating Wind Project	Scoping report submitted	338.8 km	331.3 km	1,000 MW capacity.	Unknown	Unknown	Project operations and maintenance phase overlap
Project Saoirse Wave energy	Scoping report submitted	392.5 km	395.4 km	Pre-commercial demonstration wave energy conversion project located 4-6 km offshore Co. Clare, starting with 5 MW of capacity	Unknown	Unknown	Project operations and maintenance phase overlap

Project/Plan	Status	Distance from Mona Array Area (km)	Distance from Mona offshore cable corridor (km)	Description of project/plan	Dates of construction (if applicable)	Dates of operation (if applicable)	Overlap with the Mona Offshore Wind Project
Project Ilen Floating Offshore Wind Project	Scoping report submitted	433.9 km	436.8 km	1.35 GW floating offshore wind project located at least 35 km offshore Co. Clare. One of the Western Star projects.	Unknown	Unknown	Project operations and maintenance phase overlap

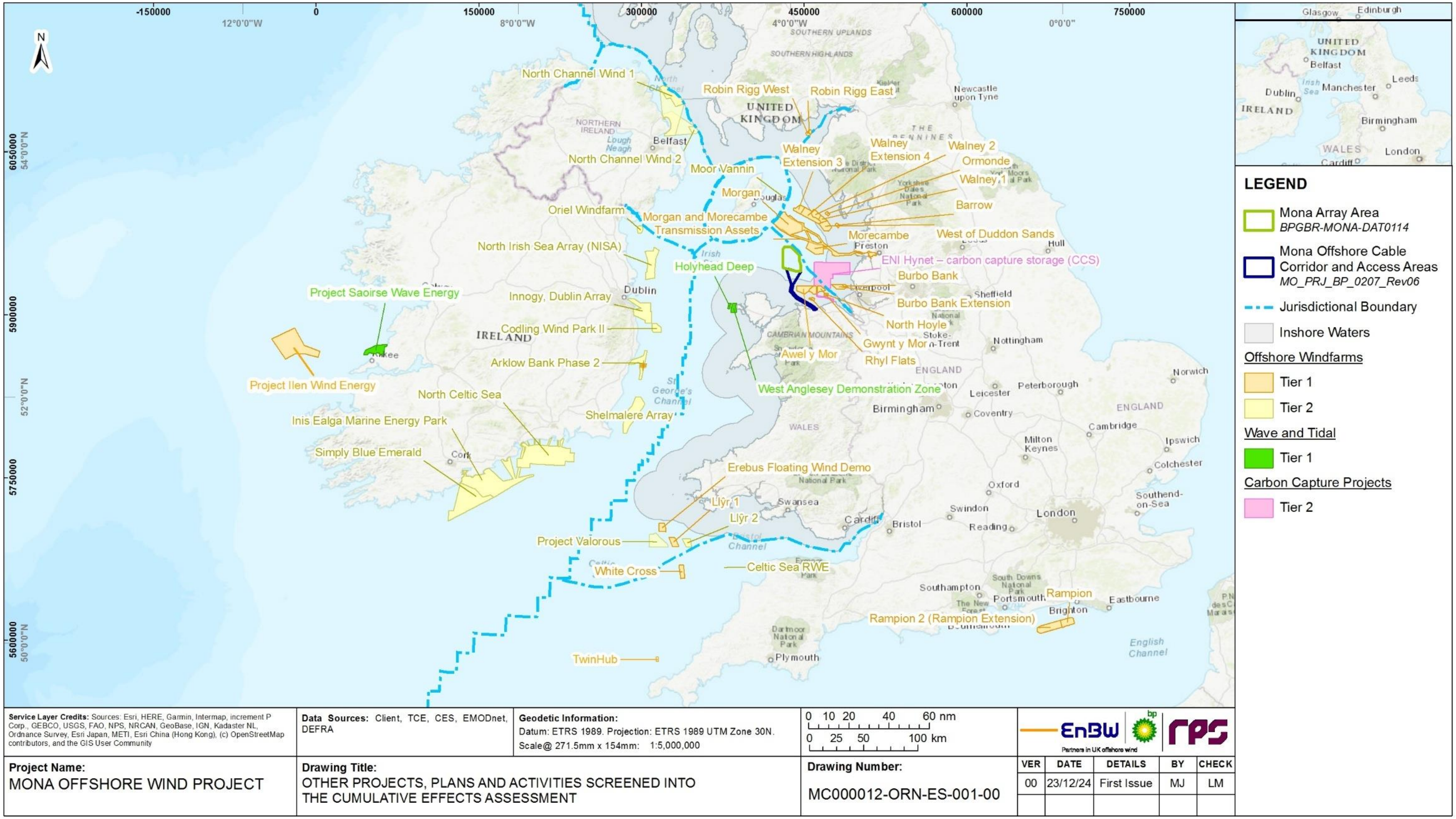


Figure 5.2: Other projects, plans and activities screened into the cumulative effects assessment.

5.8.1.10 The MDSs identified in Table 5-51 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 MDS above (Table 5-22) due to there being a potential for cumulative effects. Effects of greater adverse significance are not predicted to arise should any other development scenario (e.g. different wind turbine layout), to that assessed here, be taken forward in the final design scheme.

Table 5-51: Maximum design scenario considered for the assessment of potential cumulative effects on offshore ornithology.

a C=construction, O=operations and maintenance, D=decommissioning
b Barrier effect is included as CEA is based on SNCB Matrix approach (JNCC, 2017)

Potential cumulative effect	Phase[a]			Maximum Design Scenario	Justification
	C	O	D		
Disturbance and displacement from infrastructure	✓	✓	✓	MDS as described for the Mona Offshore Wind Project (Table 5-22) assessed cumulatively with the following offshore wind farms: **Construction phase** **Tier 1** • Awel y Môr Offshore Wind Farm • Erebus Floating Wind Demo • White Cross Offshore Windfarm • Rampion 2 Wind Farm • West of Orkney Windfarm • Morgan Generation Assets • Morecambe Offshore Windfarm Generation Assets. • Morgan and Morecambe Offshore Wind Farms Transmission Assets • Llŷr 1 Floating Wind Farm • Morgan Generation Assets • Morecambe Offshore Windfarm Generation Assets • Morgan and Morecambe Offshore Wind Farms Transmission Assets **Operations and maintenance Phase** **Tier 1** • Barrow Offshore Wind Farm • North Hoyle Offshore Wind Farm • Gwynt y Môr Offshore Wind Farm	There is a possibility that construction could overlap temporally with Awel y Môr, the Morgan Generation Assets, Morecambe Offshore Windfarm Generation Assets, Morgan and Morecambe Offshore Wind Farms Transmission Assets, Erebus and Llŷr 1 Floating Wind Farm. There is a possibility that decommissioning could overlap temporally with Awel y Môr and Erebus. However, the impact from construction and decommissioning are of small, temporary magnitude. There is potential for a cumulative effect from operations and maintenance activities and so a quantitative cumulative effect assessment is required.

Potential cumulative effect	Phase[a]			Maximum Design Scenario	Justification
	C	O	D		
				• Rhyl Flats Offshore Wind Farm • Walney (3 & 4) Extension Offshore Wind Farm • West of Duddon Sands Offshore Wind Farm • Burbo Bank Extension Offshore Wind Farm • Walney 1 & 2 Offshore Wind Farms • Burbo Bank Offshore Wind Farm • Ormonde Wind Farm • Robin Rigg Offshore Wind Farm • Rampion Offshore Wind Farm • Awel y Môr Offshore Wind Farm • Erebus Floating Wind Demo • White Cross Offshore Windfarm • TwinHub (Wave Hub Floating Wind Farm) • Rampion 2 Wind Farm • West of Orkney Windfarm • Llŷr 1 Floating Wind Farm **Tier 2**	

Potential cumulative effect	Phase[a]			Maximum Design Scenario	Justification
	C	O	D		
				• ENI Hynet –CCS • Mooir Vannin Offshore Wind Farm • North Irish Sea Array Offshore Wind Farm • Codling Wind Park • Dublin Array Offshore Wind Farm • North Channel Wind 2 • Oriel Wind Farm • Arklow Bank Wind Park Phase 2 • North Channel Wind 1 • Shelmalere Offshore Wind Farm • North Celtic Sea • Llŷr 2 Floating Wind Farm • Valorous Floating Offshore Wind Project • Inis Ealga Marine Energy Park • Emerald Floating Wind Project **Decommissioning Phase** **Tier 1** • Awel y Môr Offshore Wind Farm • Erebus Floating Wind Demo • White Cross Offshore Windfarm • Rampion 2 Wind Farm • West of Orkney Windfarm	
Collision risk	×	✓	×	MDS as described for the Mona Offshore Wind Project (Table 5-22) assessed cumulatively with the following offshore wind farms: **Operations and maintenance Phase**	There is potential for a cumulative effect from operations and maintenance

Potential cumulative effect	Phase[a]			Maximum Design Scenario	Justification
	C	O	D		
				Tier 1 • Barrow Offshore Wind Farm • North Hoyle Offshore Wind Farm • Gwynt y Môr Offshore Wind Farm • Rhyl Flats Offshore Wind Farm • Walney (3 & 4) Extension Offshore Wind Farm • West of Duddon Sands Offshore Wind Farm • Burbo Bank Extension Offshore Wind Farm • Walney 1 & 2 Offshore Wind Farms • Burbo Bank Offshore Wind Farm • Ormonde Wind Farm • Robin Rigg Offshore Wind Farm • Rampion Offshore Wind Farm • Awel y Môr Offshore Wind Farm • West Anglesey Demonstration Zone Tidal Site (Morlais) • Holyhead Deep – tidal energy (Minesto) • Erebus Floating Wind Demo • White Cross Offshore Windfarm • TwinHub (Wave Hub Floating Wind Farm) • Rampion 2 Wind Farm • West of Orkney Windfarm • Morgan Generation Assets • Morecambe Offshore Windfarm Generation Assets • Llŷr 1 Floating Wind Farm **Tier 2** • Mooir Vannin Offshore Wind Farm	activities, so a detailed, quantitative cumulative effect assessment is required.

Potential cumulative effect	Phase[a]			Maximum Design Scenario	Justification
	C	O	D		
				• North Irish Sea Array Offshore Wind Farm • Codling Wind Park • Dublin Array Offshore Wind Farm • North Channel Wind 2 • Oriel Wind Farm • Arklow Bank Wind Park Phase 2 • North Channel Wind 1 • Shelmalere Offshore Wind Farm • North Celtic Sea Wind Farm • Llŷr 2 Floating Wind Farm • Valorous Floating Offshore Wind Project • Inis Ealga Marine Energy Park • Emerald Floating Wind Project • Project Iien wave energy	

5.9 Cumulative effects assessment

5.9.1 Overview

5.9.1.1 A description of the significance of cumulative effects upon offshore ornithology receptors arising from each identified impact is given below.

5.9.1.2 The CEA is limited by the data available upon which to base the assessment. Due to the age of developments in the Irish 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 assessments. Historical offshore wind projects did not undertake certain assessments as part of their applications and therefore these predicted impacts have been gap-filled (i.e. the Applicant has used the best-available data to estimate such impacts). Additionally, historical offshore wind projects which did not carry out certain impact assessments as part of the Environmental Statements of each project (e.g. displacement and/or collision risk due to limited data at the time of assessment) for species such as black-legged kittiwake, northern gannet, northern fulmar, Manx shearwater and gull species (European herring gull, great black-backed gull and lesser black-backed gull) were also gap-filled by the Applicant.

5.9.1.3 The Applicant was provided with advice from Natural England and endorsed by NRW and the JNCC (hereafter referred to as the ‘SNCB Advice Note’) regarding suggested methodologies for ‘gap filling’ historical offshore wind projects in October 2023. It was requested that indicative estimates for currently ‘unknown’ displacement and collision impacts be generated for inclusion in the CEAs to further facilitate the SNCB’s understanding of the total quantitative cumulative impact for offshore ornithology.

5.9.1.4 Information on the gap-filling methodology used and the species and historical projects that this has been applied to is provided in Appendix A.

5.9.1.5 The following historical projects were gap-filled within the CEA for displacement:

- Barrow Offshore Wind Farm
- Burbo Bank Offshore Wind Farm
- Gwynt y Môr Offshore Wind Farm
- North Hoyle Offshore Wind Farm
- Ormonde Wind Farm (Manx shearwater only)
- Rhyl Flats Offshore Wind Farm
- Robin Rigg Offshore Wind Farm (black-legged kittiwake, Manx shearwater and northern gannet only)
- Walney 1 & 2 Offshore Wind Farms

5.9.1.6 The following historical projects were gap-filled within the CEA for collision:

- Barrow Offshore Wind Farm
- Burbo Bank Extension Offshore Wind Farm (great black-backed gull only)
- Burbo Bank Offshore Wind Farm

- Gwynt y Môr Offshore Wind Farm (black-legged kittiwake, great-black-backed gull, herring gull and northern gannet)
- North Hoyle Offshore Wind Farm
- Rhyl Flats Offshore Wind Farm (black-legged kittiwake, great-black-backed gull, herring gull and northern gannet only)
- Robin Rigg Offshore Wind Farm
- Walney Extension Offshore Wind Farm (northern gannet only)
- Walney 1 & 2 Offshore Wind Farms (black-legged kittiwake, great-black-backed gull, herring gull and northern gannet)
- West of Duddon Sands Offshore Wind Farm (black-legged kittiwake, great-black-backed gull, herring gull and northern gannet)

5.9.1.7 The method followed to gap-filled projects is the most robust and repeatable for the purposes of producing indicative estimates for currently unquantified impacts from historical projects, as requested by SNCBs. The results of the gap-filling of historical project are intended to facilitate the SNCB's understanding of the total quantitative cumulative. Although the gap-filled methodology used follows the approach proposed by the SNCBs and provides indicative estimates for currently unquantified impacts from historical projects, there are a number of caveats associated with the estimates of gap-filled projects (Appendix A).

5.9.1.8 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.

5.9.1.9 For the cumulative assessment, impacts from Tier 1 and Tier 2 projects have been assessed together to provide 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.

5.9.1.10 There is a possibility that construction and decommissioning could overlap temporally with Morgan and Morecambe Offshore Wind Farms Transmission Assets, with the potential to impact red-throated diver. However, the impact from construction and decommissioning are of small, temporary magnitude. Additionally, there is no spatial overlap between Mona Offshore Wind Project and Morgan and Morecambe Offshore Wind Farms Transmission Assets during construction and decommissioning. As such, the cumulative impact on red-throated divers is not considered further.

5.9.2 Disturbance and displacement from airborne noise, underwater sound, and presence of vessels and infrastructure

5.9.2.1 There is potential for cumulative displacement as a result of construction and operations and maintenance activities associated with the Mona Offshore Wind Project along with other developments.

5.9.2.2 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 Mona Offshore Wind Project 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.

5.9.2.3 The level of data available and the ease with which disturbance and displacement impacts can be combined across the offshore 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 CEA projects and other activities.

5.9.2.4 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.

5.9.2.5 The species assessed for cumulative displacement impacts were common guillemot, razorbill, Atlantic puffin, northern gannet, black-legged kittiwake and Manx shearwater.

5.9.2.6 The cumulative results are presented as displacement matrices ranging from 1% to 100% mortality and 5% to 100% displacement. Each cell presents potential cumulative bird mortality following displacement from the Mona Offshore Wind Project and the other offshore wind farm projects during each bio-season. Light blue highlighted cells are based on the displacement and mortality rates used in the alone assessment. Additionally, orange highlighted cells represent a displacement rate within the middle of the range presented.

5.9.2.7 With regards to vessels in the Mona Offshore Wind Project, there is no method to quantify the displacement impact of the activities due to their local and temporary nature. An offshore EMP that will include measures to minimise disturbance to rafting birds from transiting vessels is secured as a requirement of the draft DCO (Document Reference C1). It is therefore expected that impacts of vessels on seabirds are negligible due to the management of vessel traffic.

Tier 1 and Tier 2

Construction phase

Magnitude of impact

Common guillemot

5.9.2.8 The estimated number of birds present within the array area of each of the other relevant projects (projects that potentially overlap in their construction activities with Mona Offshore Wind Project) during each bio-season are presented in Table 5-52.

Table 5-52: Common guillemot cumulative abundances for potential overlapping construction phase offshore wind projects for disturbance and displacement assessment.

Project	Annual Abundance	Breeding Season Abundance	Non-breeding Season Abundance
Tier 1			
Awel y Môr Offshore Wind Farm	4,488	1,569	2,919
Erebus Floating Wind Demo	35,339	7,001	28,338
Llŷr 1 Floating Wind Farm	15,035	2,026	13,009
Morecambe Offshore Windfarm Generation Assets	14,689	6,374	8,315
Morgan Offshore Wind Project Generation Assets	7,834	4,010	3,824
White Cross Offshore Windfarm	4,363	3,304	1,059
West of Orkney Windfarm	9,136	4,861	4,275
TOTAL (minus the Mona Offshore Wind Project)	**90,884**	**29,145**	**61,739**
Mona Offshore Wind Project	7,976	4,220	3,756
TOTAL (all projects)	**98,860**	**33,365**	**65,495**

5.9.2.9 The following displacement matrices provide the estimated cumulative mortality of common guillemot predicted to occur due to displacement during construction, as determined by the relevant specified rates of displacement and mortality Table 5-53 to Table 5-55). The approach used for the cumulative displacement assessment follows that presented in Volume 6, Annex 5.2: Offshore ornithology displacement technical report of the Environmental Statement (Document Reference F6.5.2). Numbers to the right of the thick red line represent an increase in baseline mortality of >1%.

Table 5-53: Construction phase cumulative common guillemot mortality following displacement from offshore wind farms in the breeding season.

Displacement level (% at risk of displacement)52145	Mortality level (% of displaced birds at risk of mortality)						
	1%	2%	5%	10%	25%	50%	100%
5%	17	33	83	167	417	834	1,668
10%	33	67	167	334	834	1,668	3,337
15%	50	100	250	500	1,251	2,502	5,005
20%	67	133	334	667	1,668	3,337	6,673
25%	83	167	417	834	2,085	4,171	8,341
30%	100	200	500	1,001	2,502	5,005	10,010
35%	117	234	584	1,168	2,919	5,839	11,678
60%	200	400	1,001	2,002	5,005	10,010	20,019
80%	267	534	1,335	2,669	6,673	13,346	26,692
100%	334	667	1,668	3,337	8,341	16,683	33,365

Table 5-54: Construction phase cumulative common guillemot mortality following displacement from offshore wind farms in the non-breeding season.

Displacement level (% at risk of displacement)	Mortality level (% of displaced birds at risk of mortality)						
	1%	2%	5%	10%	25%	50%	100%
5%	33	65	164	327	819	1,637	3,275
10%	65	131	327	655	1,637	3,275	6,550
15%	98	196	491	982	2,456	4,912	9,824
20%	131	262	655	1,310	3,275	6,550	13,099
25%	164	327	819	1,637	4,093	8,187	16,374
30%	196	393	982	1,965	4,912	9,824	19,649
35%	229	458	1,146	2,292	5,731	11,462	22,923
60%	393	786	1,965	3,930	9,824	19,649	39,297
80%	524	1,048	2,620	5,240	13,099	26,198	52,396
100%	655	1,310	3,275	6,550	16,374	32,748	65,495

Table 5-55: Construction phase cumulative common guillemot mortality following displacement from offshore wind farms annually.

Displacement level (% at risk of displacement)	Mortality level (% of displaced birds at risk of mortality)						
	1%	2%	5%	10%	25%	50%	100%
5%	49	99	247	494	1,236	2,472	4,943
10%	99	198	494	989	2,472	4,943	9,886
15%	148	297	741	1,483	3,707	7,415	14,829
20%	198	395	989	1,977	4,943	9,886	19,772
25%	247	494	1,236	2,472	6,179	12,358	24,715
30%	297	593	1,483	2,966	7,415	14,829	29,658
35%	346	692	1,730	3,460	8,650	17,301	34,601
60%	593	1,186	2,966	5,932	14,829	29,658	59,316
80%	791	1,582	3,954	7,909	19,772	39,544	79,088
100%	989	1,977	4,943	9,886	24,715	49,430	98,860

5.9.2.10 During the breeding season, the potential displacement from construction when using a displacement rate of 25% (range: 15 to 35%) and a mortality of 1% (range: 1% to 10%), results in an additional loss of 83 (50 to 1,168) individuals from the breeding population (Table 5-53). The justification for the displacement and mortality rates are given in section 5.7.2. The regional seas UK Western Waters BDMPS population of common guillemots within the breeding season is estimated to be 1,145,528 individuals (Table 5-15). Assuming an average baseline mortality rate of 0.133 (Table 5-16), background mortality in the breeding season is 152,355 individuals. The addition of 83 (50 to 1,168) individual mortalities due to cumulative displacement from construction activities would increase the mortality relative to the baseline mortality by 0.05 % (0.03 to 0.77%).

5.9.2.11 During the non-breeding season, the displacement from construction results in an additional loss of 164 (98 to 2,292) individuals from the non-breeding population (Table 5-54). The regional seas UK Western Waters BDMPS population of common guillemots within the non-breeding season is estimated to be 1,139,220 individuals (Table 5-15). Assuming an average baseline mortality rate of 0.133, background mortality in the non-breeding season is 151,516 individuals. The addition of 164 (98 to 2,292) individual mortalities due to cumulative displacement from construction activities would increase the mortality relative to the baseline mortality by 0.11 % (0.06 to 1.51%).

5.9.2.12 The annual estimated mortality resulting from displacement during construction is 247 (148 to 3,460) individuals (Table 5-55). Using the largest BDMPS UK Western Waters population of 1,145,528 individuals and the average baseline mortality rate of 0.133 (Table 5-16), the annual background predicted mortality would be 152,355. The addition of 247 (148 to 3,460) mortalities would increase the baseline mortality rate by 0.16% (0.10% to 2.27%). The annual predicted mortality from the cumulative assessment during construction is above the 1% threshold increase when using 35% displacement and 10% mortality, which is highly precautionary. The construction period is short term, with the extent of construction overlap varying between each offshore wind farm (Table 5-51) and so it is likely that the impact estimated even at the 25% displacement and 1% mortality range is an overestimate. Expected mortality arising from construction activities is likely to be on the lower end of the range considered.

5.9.2.13 The cumulative impact is therefore predicted to be of national spatial extent, short term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore considered to be **low**.

Razorbill

5.9.2.14 The estimated cumulative abundance of razorbill from the relevant projects (projects that overlap in their construction activities with the Mona Offshore Wind Project) are presented in Table 5-56.

Table 5-56: Razorbill cumulative abundances for overlapping construction phase offshore wind projects for disturbance and displacement assessment.

Project	Annual Cumulative Abundance	Pre-breeding Cumulative Abundance	Breeding Season Cumulative Abundance	Post-breeding Cumulative Abundance	Non-breeding Cumulative Abundance
Tier 1					
Awel y Môr Offshore Wind Farm	692	336	140	66	150
Erebus Floating Wind Demo	3,867	896	194	1,708	1,069
Llŷr 1 Floating Wind Farm	2,659	257	21	1888	493
Morecambe Offshore Windfarm Generation Assets	1,979	382	252	694	651
Morgan Offshore Wind Project Generation Assets	1,787	328	35	254	1,170
West of Orkney Windfarm	326	97	70	144	15
White Cross Offshore Windfarm	786	345	40	40	361
TOTAL (minus the Mona Offshore Wind Project)	**12,096**	**2,641**	**752**	**4,794**	**3,909**
Mona Offshore Wind Project	2,519	1,924	83	91	421
TOTAL (all projects)	**14,615**	**4,565**	**835**	**4,885**	**4,330**

5.9.2.15 The following displacement matrices provide the estimated cumulative mortality of guillemot predicted to occur due to displacement during construction, as determined by the relevant specified rates of displacement and mortality (Table 5-57 to Table 5-61). The approach used for the cumulative displacement assessment follows that presented in Volume 6, Annex 5.2: Offshore ornithology displacement technical report of the Environmental Statement (Document Reference F6.5.2). Numbers to the right of the thick red line represent an increase in baseline mortality of >1%.

Table 5-57: Construction phase cumulative razorbill mortality following displacement from offshore wind farms in the pre-breeding season.

Displacement level (% at risk of displacement)	Mortality level (% of displaced birds at risk of mortality)						
	1%	2%	5%	10%	25%	50%	100%
5%	2	5	11	23	57	114	228
10%	5	9	23	46	114	228	457
15%	7	14	34	68	171	342	685
20%	9	18	46	91	228	457	913
25%	11	23	57	114	285	571	1,141
30%	14	27	68	137	342	685	1,370
35%	16	32	80	160	399	799	1,598
60%	27	55	137	274	685	1,370	2,739
80%	37	73	183	365	913	1,826	3,652
100%	46	91	228	457	1,141	2,283	4,565

Table 5-58: Construction phase cumulative razorbill mortality following displacement from offshore wind farms in the breeding season.

Displacement level (% at risk of displacement)	Mortality level (% of displaced birds at risk of mortality)						
	1%	2%	5%	10%	25%	50%	100%
5%	0	1	2	4	10	21	42
10%	1	2	4	8	21	42	84
15%	1	3	6	13	31	63	125
20%	2	3	8	17	42	84	167
25%	2	4	10	21	52	104	209
30%	3	5	13	25	63	125	251
35%	3	6	15	29	73	146	292
60%	5	10	25	50	125	251	501
80%	7	13	33	67	167	334	668
100%	8	17	42	84	209	418	835

Table 5-59: Construction phase cumulative razorbill mortality following displacement from offshore wind farms in the post-breeding season.

Displacement level (% at risk of displacement)	Mortality level (% of displaced birds at risk of mortality)						
	1%	2%	5%	10%	25%	50%	100%
5%	2	5	12	24	61	122	244
10%	5	10	24	49	122	244	489
15%	7	15	37	73	183	366	733
20%	10	20	49	98	244	489	977
25%	12	24	61	122	305	611	1,221
30%	15	29	73	147	366	733	1,466
35%	17	34	85	171	427	855	1,710
60%	29	59	147	293	733	1,466	2,931
80%	39	78	195	391	977	1,954	3,908
100%	49	98	244	489	1,221	2,443	4,885

Table 5-60: Construction phase cumulative razorbill mortality following displacement from offshore wind farms in the non-breeding season.

Displacement level (% at risk of displacement)	Mortality level (% of displaced birds at risk of mortality)						
	1%	2%	5%	10%	25%	50%	100%
5%	2	4	11	22	54	108	217
10%	4	9	22	43	108	217	433
15%	6	13	32	65	162	325	650
20%	9	17	43	87	217	433	866
25%	11	22	54	108	271	541	1,083
30%	13	26	65	130	325	650	1,299
35%	15	30	76	152	379	758	1,516
60%	26	52	130	260	650	1,299	2,598
80%	35	69	173	346	866	1,732	3,464
100%	43	87	217	433	1,083	2,165	4,330

Table 5-61: Construction phase cumulative razorbill mortality following displacement from offshore wind farms annually.

Displacement level (% at risk of displacement)	Mortality level (% of displaced birds at risk of mortality) 1%	2%	5%	10%	25%	50%	100%
5%	7	15	37	73	183	365	731
10%	15	29	73	146	365	731	1,462
15%	22	44	110	219	548	1,096	2,192
20%	29	58	146	292	731	1,462	2,923
25%	37	73	183	365	913	1,827	3,654
30%	44	88	219	438	1,096	2,192	4,385
35%	51	102	256	512	1,279	2,558	5,115
60%	88	175	438	877	2,192	4,385	8,769
80%	117	234	585	1,169	2,923	5,846	11,692
100%	146	292	731	1,462	3,654	7,308	14,615

5.9.2.16 During the spring migration (pre-breeding) season the displacement from construction when using a displacement rate of 25% (range: 15% to 35%) and a mortality of 1% (range: 1 to 10%), results in an additional loss of 11 (seven to 160) individuals (Table 5-57). The regional seas UK Western Waters BDMPS population of razorbill in the spring migration period is estimated to be 606,914 individuals (Table 5-15). Assuming an average baseline mortality rate of 0.172 (Table 5-16), background mortality during spring migration is 104,389 individuals. The addition of 11 (seven to 160) individual mortalities due to cumulative displacement from construction activities would increase the mortality relative to the baseline mortality by 0.01 % (0.01 to 0.15%).

5.9.2.17 During the breeding season, displacement from construction results in the loss of two (one to 29) individuals from the breeding population (Table 5-58). The regional seas UK Western Waters BDMPS population of razorbill within the breeding season is estimated to be 198,969 individuals (Table 5-15). Assuming an average baseline mortality rate of 0.172, background mortality in the breeding season is 34,223 individuals. The addition of two (one to 29) individual mortalities due to cumulative displacement from construction activities would increase the mortality relative to the baseline mortality by 0.01 % (<0.01 to 0.09%).

5.9.2.18 During the autumn migration season (post-breeding), displacement from construction results in a loss of 12 (seven to 171) individuals from the migratory population (Table 5-59). The regional seas UK Western Waters BDMPS population of razorbill during the autumn migration period is estimated to be 606,914 individuals (Table 5-15). Assuming an average baseline mortality rate of 0.172, background mortality during autumn migration is 104,389 individuals. The addition of 12 (seven to 171) individual mortalities due to cumulative displacement from construction activities would increase the mortality relative to the baseline mortality by 0.01 % (0.01 to 0.16%).

5.9.2.19 During the non-breeding season (winter season), displacement from construction results a in a loss of 11 (six to 152) individuals from the non-breeding population (Table 5-60). The regional seas UK Western Waters BDMPSS population of razorbill within the non-breeding season is estimated to be 341,422 individuals (Table 5-15). Assuming an average baseline mortality rate of 0.172, background mortality in the non-breeding season is 58,724 individuals. The addition of 11 (six to 152) individual mortalities due to cumulative displacement from construction activities would increase the mortality relative to the baseline mortality by 0.02 % (0.01 to 0.26%).

5.9.2.20 The annual estimated mortality resulting from displacement during construction is 37 (22 to 512) individuals (Table 5-61). Using the largest UK Western Waters BDMPS population of 606,914 razorbill and, using the average baseline mortality rate of 0.172, the background predicted mortality would be 104,389 individuals. The addition of 37 (22 to 512) mortalities would increase the baseline mortality rate by 0.04% (0.02% to 0.49%). The annual predicted mortality from the cumulative assessment is below the 1% threshold increase in baseline mortality.

5.9.2.21 The cumulative effect is predicted to be of national spatial extent, medium term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore considered to be **negligible**.

Atlantic puffin

5.9.2.22 The estimated cumulative abundance of Atlantic puffin from the relevant projects is presented in Table 5-62.

Table 5-62: Atlantic puffin cumulative abundances for overlapping construction phase offshore wind projects for disturbance and displacement assessment.

Project	Annual Abundance	Breeding Season Abundance	Non-breeding Season Abundance
Tier 1			
Awel y Môr Offshore Wind Farm	8	8	0
Erebus Floating Wind Demo	1,576	1,416	160
Llŷr 1 Floating Wind Farm	744	152	592
Morecambe generation	59	39	20
Morgan Offshore Wind Project Generation Assets	14	9	5
West of Orkney Windfarm	6,449	5,272	1,177
White Cross Offshore Wind Farm	80	49	31
TOTAL (minus Mona)	8,930	6,945	1,985
Mona	37	15	22
TOTAL (all projects)	8,967	6,960	2,007

5.9.2.23 The following displacement matrices provide the estimated cumulative mortality of Atlantic puffin predicted to occur due to displacement, as determined by the relevant specified rates of displacement and mortality (Table 5-63 to Table 5-65). The approach used for the cumulative displacement assessment follows that presented in Volume 6, Annex 5.2: Offshore ornithology displacement technical report of the Environmental Statement (Document Reference F6.5.2). Numbers to the right of the thick red line represent an increase in baseline mortality of >1%.

Table 5-63: Construction phase cumulative Atlantic puffin mortality following displacement from offshore wind farms in the breeding season.

Displacement level (% at risk of displacement)	Mortality level (% of displaced birds at risk of mortality)						
	1%	2%	5%	10%	25%	50%	100%
5%	3	7	17	35	87	174	348
10%	7	14	35	70	174	348	696
15%	10	21	52	104	261	522	1,044
20%	14	28	70	139	348	696	1,392
25%	17	35	87	174	435	870	1,740
30%	21	42	104	209	522	1,044	2,088
35%	24	49	122	244	609	1,218	2,436
60%	42	84	209	418	1,044	2,088	4,176
80%	56	111	278	557	1,392	2,784	5,568
100%	70	139	348	696	1,740	3,480	6,960

Table 5-64: Construction phase cumulative Atlantic puffin mortality following displacement from offshore wind farms in the non-breeding season.

Displacement level (% at risk of displacement)	Mortality level (% of displaced birds at risk of mortality)						
	1%	2%	5%	10%	25%	50%	100%
5%	1	2	5	10	25	50	100
10%	2	4	10	20	50	100	201
15%	3	6	15	30	75	151	301
20%	4	8	20	40	100	201	401
25%	5	10	25	50	125	251	502
30%	6	12	30	60	151	301	602
35%	7	14	35	70	176	351	702
60%	12	24	60	120	301	602	1,204
80%	16	32	80	161	401	803	1,606
100%	20	40	100	201	502	1,004	2,007

Table 5-65: Construction phase cumulative Atlantic puffin mortality following displacement from offshore wind farms annually.

Displacement level (% at risk of displacement)/	Mortality level (% of displaced birds at risk of mortality)						
	1%	2%	5%	10%	25%	50%	100%
5%	4	9	22	45	112	224	448
10%	9	18	45	90	224	448	897
15%	13	27	67	135	336	673	1,345
20%	18	36	90	179	448	897	1,793
25%	22	45	112	224	560	1,121	2,242
30%	27	54	135	269	673	1,345	2,690
35%	31	63	157	314	785	1,569	3,138
60%	54	108	269	538	1,345	2,690	5,380
80%	72	143	359	717	1,793	3,587	7,174
100%	90	179	448	897	2,242	4,484	8,967

5.9.2.24 During the breeding season, the displacement from construction when using a displacement rate of 25% (range: 15% to 35%) and a mortality of 1% (range: 1 to 10%), results in an additional loss of 17 (10 to 244) individuals from the breeding population (Table 5-63). The regional seas UK Western Waters BDMPSS population of Atlantic puffin within the breeding season is estimated to be 1,482,791 individuals (Table 5-15). Assuming an average baseline mortality rate of 0.176 (Table 5-16), background mortality in the breeding season is 260,971 individuals. The addition of 17 (10 to 244) individual mortalities due to cumulative displacement from construction activities would increase the mortality relative to the baseline mortality by 0.01% (<0.01 to 0.09%)

5.9.2.25 During the non-breeding season, the displacement from construction results in an additional loss of five (three to 70) individual from the non-breeding population (Table 5-64). The regional seas UK Western Waters BDMPSS population of common guillemots within the non-breeding season is estimated to be 304,557 individuals (Table 5-15). Assuming an average baseline mortality rate of 0.176, background mortality in the non-breeding season is 53,602 individuals. The addition of five (three to 70) individual mortalities due to cumulative displacement from construction activities would increase the mortality relative to the baseline mortality by 0.01% (0.01% to 0.13%)

5.9.2.26 The annual estimated mortality resulting from displacement during construction is 22 (13 to 314) individuals (Table 5-65). Using the largest UK Western Waters BDMPS population of 1,482,791 Atlantic puffin and, using the average baseline mortality rate of 0.176, the background predicted mortality would be 260,971 individuals. The addition of 22 (13 to 314) mortalities would increase the baseline mortality rate by 0.01% (0.01 to 0.12%) The annual predicted mortality from the cumulative assessment is below the 1% threshold increase in baseline mortality.

5.9.2.27 The cumulative effect is predicted to be of national spatial extent, medium term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **negligible**.

Northern gannet

5.9.2.28 The estimated cumulative abundance of northern gannet from the relevant projects is presented in Table 5-66.

Table 5-66: Northern gannet cumulative abundances for overlapping construction phase offshore wind projects for disturbance and displacement assessment.

Project	Annual Abundance	Pre-breeding Abundance	Breeding Season Abundance	Post-breeding Abundance
Tier 1				
Awel y Môr Offshore Wind Farm	529	0	328	201
Erebus Floating Wind Demo	658	100	224	334
Llŷr 1 Floating Wind Farm	1,026	65	246	715
Morecambe Offshore Windfarm Generation Assets	673	8	541	124
Morgan Offshore Wind Project Generation Assets	254	35	154	65
West of Orkney Windfarm	2,188	59	958	1,171
White Cross Offshore Wind Farm	456	141	239	76
TOTAL (minus the Mona Offshore Wind Project)	**5,784**	**408**	**2,690**	**2,686**
Mona Offshore Wind Project	337	28	251	58
TOTAL (all projects)	**6,121**	**436**	**2,941**	**2,744**

5.9.2.29 The following displacement matrices provide the estimated cumulative mortality of northern gannet predicted to occur due to displacement, as determined by the relevant specified rates of displacement and mortality (Table 5-67 to Table 5-70). The approach used for the cumulative displacement assessment follows that presented in Volume 6, Annex 5.2: Offshore ornithology displacement technical report of the Environmental Statement (Document Reference F6.5.2). Numbers to the right of the thick red line represent an increase in baseline mortality of >1%.

Table 5-67: Construction phase cumulative northern gannet mortality following displacement from offshore wind farms in the pre-breeding season.

281	Mortality level (% of displaced birds at risk of mortality)						
Displacement level (% at risk of displacement)	**1%**	**2%**	**5%**	**10%**	**25%**	**50%**	**100%**
10%	0	1	2	4	11	22	44
20%	1	2	4	9	22	44	87
30%	1	3	7	13	33	65	131
35%	2	3	8	15	38	76	153
40%	2	3	9	17	44	87	174
50%	2	4	11	22	55	109	218
60%	3	5	13	26	65	131	262
70%	3	6	15	31	76	153	305
80%	3	7	17	35	87	174	349
90%	4	8	20	39	98	196	392
100%	4	9	22	44	109	218	436

Table 5-68: Construction phase cumulative northern gannet mortality following displacement from offshore wind farms in the breeding season.

	Mortality level (% of displaced birds at risk of mortality)						
Displacement level (% at risk of displacement)	**1%**	**2%**	**5%**	**10%**	**25%**	**50%**	**100%**
10%	3	6	15	29	74	147	294
20%	6	12	29	59	147	294	588
30%	9	18	44	88	221	441	882
35%	10	21	51	103	257	515	1,029
40%	12	24	59	118	294	588	1,176
50%	15	29	74	147	368	735	1,471
60%	18	35	88	176	441	882	1,765
70%	21	41	103	206	515	1,029	2,059
80%	24	47	118	235	588	1,176	2,353
90%	26	53	132	265	662	1,323	2,647
100%	29	59	147	294	735	1,471	2,941

Table 5-69: Construction phase cumulative northern gannet mortality following displacement from offshore wind farms in the post-breeding season.

Displacement level (% at risk of displacement)	Mortality level (% of displaced birds at risk of mortality)						
	1%	2%	5%	10%	25%	50%	100%
10%	3	5	14	27	69	137	274
20%	5	11	27	55	137	274	549
30%	8	16	41	82	206	412	823
35%	10	19	48	96	240	480	960
40%	11	22	55	110	274	549	1,098
50%	14	27	69	137	343	686	1,372
60%	16	33	82	165	412	823	1,646
70%	19	38	96	192	480	960	1,921
80%	22	44	110	220	549	1,098	2,195
90%	25	49	123	247	617	1,235	2,470
100%	27	55	137	274	686	1,372	2,744

Table 5-70: Construction phase cumulative northern gannet mortality following displacement from offshore wind farms annually.

Displacement level (% at risk of displacement)	Mortality level (% of displaced birds at risk of mortality)						
	1%	2%	5%	10%	25%	50%	100%
10%	6	12	31	61	153	306	612
20%	12	24	61	122	306	612	1,224
30%	18	37	92	184	459	918	1,836
35%	21	43	107	214	536	1,071	2,142
40%	24	49	122	245	612	1,224	2,448
50%	31	61	153	306	765	1,530	3,061
60%	37	73	184	367	918	1,836	3,673
70%	43	86	214	428	1,071	2,142	4,285
80%	49	98	245	490	1,224	2,448	4,897
90%	55	110	275	551	1,377	2,754	5,509
100%	61	122	306	612	1,530	3,061	6,121

5.9.2.30 During the spring migration (pre-breeding) season the displacement from construction when using a displacement rate of 35% (range: 30% to 40%) and a mortality of 1% (range: 1 to 10%), results in an additional loss of two (one to 17) individual

(Table 5-67). The regional seas UK Western Waters BDMPS population of northern gannet in the spring migration period is estimated to be 661,888 individuals (Table 5-15). Assuming an average baseline mortality rate of 0.193 (Table 5-16), background mortality during spring migration is 127,744 individuals. The addition of two (one to 17) individual mortalities due to cumulative displacement from construction activities would increase the mortality relative to the baseline mortality by <0.01% (<0.01% to 0.01%).

5.9.2.31 During the breeding season, displacement from construction results in the loss of 10 (nine to 118) individuals from the breeding population (Table 5-68). The regional seas UK Western Waters BDMPS population of northern gannet within the breeding season is estimated to be 522,888 individuals (Table 5-15). Assuming an average baseline mortality rate of 0.193, background mortality in the breeding season is 100,917 individuals. The addition of 10 (nine to 118) individual mortalities due to cumulative displacement from construction activities would increase the mortality relative to the baseline mortality by 0.01% (0.01 to 0.12%).

5.9.2.32 During the post breeding season, displacement from construction results in the loss of 10 (eight to 110) individuals (Table 5-69). The regional seas UK Western Waters BDMPS population of northern gannet during the autumn migration period is estimated to be 545,954 individuals (Table 5-15). Assuming an average baseline mortality rate of 0.193, background mortality during autumn migration is 105,369 individuals. The addition of 10 (eight to 110) individual mortalities due to cumulative displacement from construction activities would increase the mortality relative to the baseline mortality by 0.01% (0.01 to 0.10%)

5.9.2.33 The annual estimated mortality resulting from displacement during construction is 21 (18 to 245) individuals (Table 5-70). Using the largest UK Western Waters BDMPS population of 661,888 individuals, with an average baseline mortality rate of 0.193, the background predicted mortality would be 127,744. The addition of 21 (18 to 245) mortalities would increase the baseline mortality rate by 0.02% (0.01 to 0.19%) The annual predicted mortality from the cumulative assessment is below the 1% threshold increase in baseline mortality.

5.9.2.34 The cumulative effect is predicted to be of national spatial extent, medium term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **negligible**.

Black-legged kittiwake

5.9.2.35 The estimated cumulative abundance of black-legged kittiwake from the relevant projects is presented in Table 5-71.

Table 5-71: Black-legged kittiwake cumulative abundances for overlapping construction phase offshore wind projects for disturbance and displacement assessment.

Project	Annual Abundance	Pre-breeding Abundance	Breeding Season Abundance	Post-breeding Abundance
Tier 1				
Awel y Môr Offshore Wind Farm	467	298	87	82
Erebus Floating Wind Demo	2,532	2,022	2	508
Llŷr 1 Floating Wind Farm	2,238	206	88	1,944

Project	Annual Abundance	Pre-breeding Abundance	Breeding Season Abundance	Post-breeding Abundance
Morecambe Offshore Windfarm Generation Assets	3,522	76	1,729	1,717
Morgan Offshore Wind Project Generation Assets	2,447	791	505	1151
Rampion 2 (Rampion Extension)	388	286	5	97
West of Orkney Windfarm	2,706	1,217	690	799
White Cross Offshore Windfarm	914	698	44	172
TOTAL (minus the Mona Offshore Wind Project)	**15,214**	**5,594**	**3,150**	**6,470**
Mona Offshore Wind Project	1,860	574	726	560
TOTAL (all projects)	**17,074**	**6,168**	**3,876**	**7,030**

5.9.2.36 The following displacement matrices provide the estimated cumulative mortality of black-legged kittiwake predicted to occur due to displacement, as determined by the relevant specified rates of displacement and mortality (Table 5-72 to Table 5-75). The approach used for the cumulative displacement assessment follows that presented in Volume 6, Annex 5.2: Offshore ornithology displacement technical report of the Environmental Statement (Document Reference F6.5.2). Numbers to the right of the thick red line represent an increase in baseline mortality of >1%.

Table 5-72: Construction phase cumulative black-legged kittiwake mortality following displacement from offshore wind farms in the pre-breeding season.

Displacement level (% at risk of displacement)	Mortality level (% of displaced birds at risk of mortality)							
		1%	**2%**	**5%**	**10%**	**25%**	**50%**	**100%**
	5%	3	6	15	31	77	154	308
	10%	6	12	31	62	154	308	617
	15%	9	19	46	93	231	463	925
	20%	12	25	62	123	308	617	1,234
	25%	15	31	77	154	386	771	1,542
	30%	19	37	93	185	463	925	1,850
	35%	22	43	108	216	540	1,079	2,159
	60%	37	74	185	370	925	1,850	3,701
	80%	49	99	247	493	1,234	2,467	4,934
	100%	62	123	308	617	1,542	3,084	6,168

Table 5-73: Construction phase cumulative black-legged kittiwake mortality following displacement from offshore wind farms in the breeding season.

Displacement level (% at risk of displacement)	Mortality level (% of displaced birds at risk of mortality)						
	1%	2%	5%	10%	25%	50%	100%
5%	2	4	10	19	48	97	194
10%	4	8	19	39	97	194	388
15%	6	12	29	58	145	291	581
20%	8	16	39	78	194	388	775
25%	10	19	48	97	242	485	969
30%	12	23	58	116	291	581	1,163
35%	14	27	68	136	339	678	1,357
60%	23	47	116	233	581	1,163	2,326
80%	31	62	155	310	775	1,550	3,101
100%	39	78	194	388	969	1,938	3,876

Table 5-74: Construction phase cumulative black-legged kittiwake mortality following displacement from offshore wind farms in the post-breeding season.

Displacement level (% at risk of displacement)	Mortality level (% of displaced birds at risk of mortality)						
	1%	2%	5%	10%	25%	50%	100%
5%	4	7	18	35	88	176	352
10%	7	14	35	70	176	352	703
15%	11	21	53	105	264	527	1,055
20%	14	28	70	141	352	703	1,406
25%	18	35	88	176	439	879	1,758
30%	21	42	105	211	527	1,055	2,109
35%	25	49	123	246	615	1,230	2,461
60%	42	84	211	422	1,055	2,109	4,218
80%	56	112	281	562	1,406	2,812	5,624
100%	70	141	352	703	1,758	3,515	7,030

Table 5-75: Construction phase cumulative black-legged kittiwake mortality following displacement from offshore wind farms annually.

Displacement level (% at risk of displacement)	Mortality level (% of displaced birds at risk of mortality)						
	1%	**2%**	**5%**	**10%**	**25%**	**50%**	**100%**
5%	9	17	43	85	213	427	854
10%	17	34	85	171	427	854	1,707
15%	26	51	128	256	640	1,281	2,561
20%	34	68	171	341	854	1,707	3,415
25%	43	85	213	427	1,067	2,134	4,269
30%	51	102	256	512	1,281	2,561	5,122
35%	60	120	299	598	1,494	2,988	5,976
60%	102	205	512	1,024	2,561	5,122	10,244
80%	137	273	683	1,366	3,415	6,830	13,659
100%	171	341	854	1,707	4,269	8,537	17,074

5.9.2.37 During the spring migration (pre-breeding) season the displacement from construction when using a displacement rate of 25% (range: 15% to 35%) and a mortality of 1% (range: 1 to 10%), results in an additional loss of 15 (nine to 216) individuals (Table 5-72). The regional seas UK Western Waters & Channel BDMPS population of black-legged kittiwake in the spring migration period is estimated to be 691,526 individuals (Table 5-15). Assuming an average baseline mortality rate of 0.156 (Table 5-16), background mortality during spring migration is 107,878 individuals. The addition of 15 (nine to 216) individual mortalities due to cumulative displacement from construction activities would increase the mortality relative to the baseline mortality by 0.01% (0.01 to 0.20%)

5.9.2.38 During the breeding season, displacement from construction results in the loss of 10 (six to 136) individuals from the breeding population (Table 5-73) The regional seas UK Western Waters & Channel BDMPS population of black-legged kittiwake within the breeding season is estimated to be 245,234 individuals (Table 5-15). Assuming an average baseline mortality rate of 0.156, background mortality in the breeding season is 38,256 individuals. The addition of 10 (six to 136) individual mortalities due to cumulative displacement from construction activities would increase the mortality relative to the baseline mortality by 0.03% (0.02 to 0.35%)

5.9.2.39 During the autumn migration season (post-breeding), displacement from construction results in a loss of 18 (11 to 246) individuals from the migratory population (Table 5-74). The regional seas UK Western Waters & Channel BDMPS population of black-legged kittiwake during the autumn migration period is estimated to be 911,586 individuals (Table 5-15). Assuming an average baseline mortality rate of 0.156, background mortality during autumn migration is 142,207 individuals. The addition of 18 (11 to 246) individual mortalities due to cumulative displacement from construction activities would increase the mortality relative to the baseline mortality by 0.01% (0.01 to 0.17%) .

5.9.2.40 The annual estimated mortality resulting from displacement during construction is 43 (26 to 598) individuals (Table 5-75). Using the largest UK Western Waters & Channel BDMPS population of 911,586 individuals, with an average baseline mortality rate of 0.156, the background predicted mortality would be 142,207. The addition of 43 (26 to 598) mortalities would increase the baseline mortality rate by 0.03% (0.02 to 0.342%)The annual predicted mortality from the cumulative assessment is below the 1% threshold increase in baseline mortality.

5.9.2.41 The cumulative effect is predicted to be of national spatial extent, medium term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **negligible**.

Manx shearwater

5.9.2.42 The estimated cumulative abundances of Manx shearwater are presented in Table 5-76 for the relevant projects.

Table 5-76: Manx shearwater cumulative abundances for overlapping construction phase offshore wind projects for disturbance and displacement assessment.

Project	Annual Cumulative Abundance	Pre-breeding Cumulative Abundance	Breeding Season Cumulative Abundance	Post-breeding Cumulative Abundance
Tier 1				
Awel y Môr Offshore Wind Farm	417	177	26	214
Erebus Floating Wind Demo	2,115	18	1,540	557
Llŷr 1 Floating Wind Farm	4,728	1,267	3434	27
Morecambe Offshore Windfarm Generation Assets	8,972	1,617	4,705	2,650
Morgan Offshore Wind Project Generation Assets	1,638	0	1,254	384
Rampion 2 (Rampion Extension) Offshore Wind Farm	0	0	0	0
West of Orkney Windfarm	11	0	8	3
White Cross Offshore Windfarm	12,181	12,126	33	22
TOTAL (minus the Mona Offshore Wind Project)	**30,062**	**15,205**	**11,000**	**3,857**
Mona Offshore Wind Project	1,268	3	1,249	16
TOTAL (all projects)	**31,330**	**15,208**	**12,249**	**3,873**

5.9.2.43 The following displacement matrices provide the estimated cumulative mortality of Manx shearwater predicted to occur due to displacement, as determined by the relevant specified rates of displacement and mortality (Table 5-77 to Table 5-80). The approach used for the cumulative displacement assessment follows that presented in Volume 6, Annex 5.2: Offshore ornithology displacement assessment technical report of the Environmental Statement (Document Reference F6.5.2). Numbers to the right of the thick red line represent an increase in baseline mortality of >1%.

Table 5-77: Construction phase cumulative Manx shearwater mortality following displacement from offshore wind farms in the pre-breeding season.

Displacement level (% at risk of displacement)	Mortality level (% of displaced birds at risk of mortality)						
	1%	2%	5%	10%	25%	50%	100%
5%	8	15	38	76	190	380	760
10%	15	30	76	152	380	760	1,521
15%	23	46	114	228	570	1,141	2,281
20%	30	61	152	304	760	1,521	3,042
25%	38	76	190	380	951	1,901	3,802
30%	46	91	228	456	1,141	2,281	4,562
35%	53	106	266	532	1,331	2,661	5,323
60%	91	182	456	912	2,281	4,562	9,125
80%	122	243	608	1,217	3,042	6,083	12,166
100%	152	304	760	1,521	3,802	7,604	15,208

Table 5-78: Construction phase cumulative Manx shearwater mortality following displacement from offshore wind farms in the breeding season.

Displacement level (% at risk of displacement)	Mortality level (% of displaced birds at risk of mortality)						
	1%	2%	5%	10%	25%	50%	100%
5%	6	12	31	61	153	306	612
10%	12	24	61	122	306	612	1,225
15%	18	37	92	184	459	919	1,837
20%	24	49	122	245	612	1,225	2,450
25%	31	61	153	306	766	1,531	3,062
30%	37	73	184	367	919	1,837	3,675
35%	43	86	214	429	1,072	2,144	4,287
60%	73	147	367	735	1,837	3,675	7,349
80%	98	196	490	980	2,450	4,900	9,799
100%	122	245	612	1,225	3,062	6,125	12,249

Table 5-79: Construction phase cumulative Manx shearwater mortality following displacement from offshore wind farms in the post-breeding season.

Displacement level (% at risk of displacement)	Mortality level (% of displaced birds at risk of mortality)						
	1%	2%	5%	10%	25%	50%	100%
5%	2	4	10	19	48	97	194
10%	4	8	19	39	97	194	387
15%	6	12	29	58	145	290	581
20%	8	15	39	77	194	387	775
25%	10	19	48	97	242	484	968
30%	12	23	58	116	290	581	1,162
35%	14	27	68	136	339	678	1,356
60%	23	46	116	232	581	1,162	2,324
80%	31	62	155	310	775	1,549	3,098
100%	39	77	194	387	968	1,937	3,873

Table 5-80: Construction phase cumulative Manx shearwater mortality following displacement from offshore wind farms annually.

Displacement level (% at risk of displacement)	Mortality level (% of displaced birds at risk of mortality)						
	1%	2%	5%	10%	25%	50%	100%
5%	16	31	78	157	392	783	1,567
10%	31	63	157	313	783	1,567	3,133
15%	47	94	235	470	1,175	2,350	4,700
20%	63	125	313	627	1,567	3,133	6,266
25%	78	157	392	783	1,958	3,916	7,833
30%	94	188	470	940	2,350	4,700	9,399
35%	110	219	548	1,097	2,741	5,483	10,966
60%	188	376	940	1,880	4,700	9,399	18,798
80%	251	501	1,253	2,506	6,266	12,532	25,064
100%	313	627	1,567	3,133	7,833	15,665	31,330

5.9.2.44 During the spring migration (pre-breeding) season the displacement from construction when using a displacement rate of 25% (range: 15% to 35%) and a mortality of 1% (range: 1 to 10%), results in an additional loss of 38 (23 to 532) individuals (Table 5-77). The regional seas UK Western Waters & Channel BDMPS population of Manx shearwater in the spring migration period is estimated to be 1,580,895 individuals (Table 5-15). Assuming an average baseline mortality rate of 0.130

(Table 5-16), background mortality during spring migration is 205,516 individuals. The addition of 38 (23 to 532) individual mortalities due to cumulative displacement from construction activities would increase the mortality relative to the baseline mortality by 0.02% (0.01 to 0.26%)

5.9.2.45 During the breeding season the displacement from construction when using a displacement rate of 25% (range: 15% to 35%) and a mortality of 1% (range: 1 to 10%), results in an additional loss of 31 (18 to 429) individuals (Table 5-78). The regional seas UK Western Waters & Channel BDMPS population of Manx shearwater within the breeding season is estimated to be 1,821,544 individuals (Table 5-15). Assuming an average baseline mortality rate of 0.130, background mortality in the breeding season is 236,801 individuals. The addition of 31 (18 to 429) individual mortalities due to cumulative displacement from construction activities would increase the mortality relative to the baseline mortality by 0.01% (0.01 to 0.18%)

5.9.2.46 During the autumn migration season (post-breeding), displacement from construction results in a loss of 10 (six to 136) individuals from the migratory population (Table 5-79). The regional seas UK Western Waters & Channel BDMPS population of Manx shearwater during the autumn migration period is estimated to be 1,580,895 individuals (Table 5-15). Assuming an average baseline mortality rate of 0.130, background mortality during autumn migration is 205,516 individuals. The addition of 10 (six to 136) individual mortalities due to cumulative displacement from construction activities would increase the mortality relative to the baseline mortality by <0.01% (<0.01 to 0.07%)

5.9.2.47 The annual estimated mortality resulting from displacement during construction 78 (47 to 1,097) individuals (Table 5-80). Using the largest population of 1,821,544 individuals, with an average baseline mortality rate of 0.130), the background predicted mortality would be 236,801. The addition of 78 (47 to 1,097) mortalities would increase the baseline mortality rate by 0.03% (0.02 to 0.46%)The annual predicted mortality from the cumulative assessment is below the 1% threshold increase in baseline mortality.

5.9.2.48 The cumulative effect is predicted to be of national spatial extent, medium term duration, intermittent 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

Common guillemot

5.9.2.49 Evidence of common guillemot sensitivity to displacement from the construction phase of offshore wind farms is summarised from paragraph 5.9.2.8 onwards. Overall, based on evidence from studies and reviews, common guillemot is deemed to be of medium vulnerability, medium recoverability and medium value. The sensitivity of the receptor is therefore, considered to be **medium**.

Razorbill

5.9.2.50 Evidence of razorbill sensitivity to displacement from the construction phase of offshore wind farms is summarised in paragraph 5.9.2.14 onwards. Overall, based on evidence from studies and reviews, razorbill is deemed to be of medium vulnerability, medium recoverability and medium value. The sensitivity of the receptor is therefore, considered to be **medium.**

Atlantic puffin

5.9.2.51 Evidence of Atlantic puffin sensitivity to displacement from the construction phase of offshore wind farms is summarised in paragraph 5.9.2.22 onwards. Overall, based on evidence from studies and reviews, Atlantic puffin is deemed to be of medium vulnerability, low recoverability and high value. The sensitivity of the receptor is therefore, considered to be **high**.

Northern gannet

5.9.2.52 Evidence of northern gannet sensitivity to displacement from the construction phase of offshore wind farms is summarised in paragraph 5.9.2.28 onwards. Based on evidence from operational wind farms demonstrating that northern gannet show a high avoidance of offshore wind farms, this species is deemed to be of medium vulnerability, medium recoverability and medium value. The sensitivity of the receptor is therefore, considered to be **medium.**

Black-legged kittiwake

5.9.2.53 Evidence of black-legged kittiwake sensitivity to displacement from the construction phase of offshore wind farms is summarised in paragraph 5.9.2.35 onwards. For kittiwake, there is evidence from other operating offshore wind farm projects that displacement is not likely to occur to any significant level. However, due to low reproductive rates, black-legged kittiwake is deemed to be of low vulnerability, low recoverability and medium value. The sensitivity of the receptor is therefore, considered to be **medium.**

Manx shearwater

5.9.2.54 For Manx shearwater, there is evidence from other operating offshore wind farm projects that displacement is not likely to occur to any significant level (JNCC, 2022). However, due to low reproductive rates, Manx shearwater is deemed to be of low vulnerability, low recoverability and high value. The sensitivity of the receptor is therefore, considered to be **medium**.

Significance of effect

5.9.2.55 Table 5-81 summarises the significance of effect cumulative on the species susceptible to disturbance and displacement impacts. Common guillemot was the only species with a magnitude assessed to be greater than negligible. All impacts are considered non-significant in EIA terms.

Table 5-81: Table summarising the cumulative significance of effect during construction.

Species	Magnitude of impact	Sensitivity of receptor	Significance of effect
Common guillemot	Low	Medium	**Minor adverse, not significant in EIA terms**
Razorbill	Negligible	Medium	**Negligible, not significant in EIA terms**
Atlantic puffin	Negligible	High	**Negligible, not significant in EIA terms**
Northern gannet	Negligible	Medium	**Negligible, not significant in EIA terms**
Black-legged kittiwake	Negligible	Medium	**Negligible, not significant in EIA terms**
Manx shearwater	Negligible	Medium	**Negligible, not significant in EIA terms**

Tier 1 and Tier 2

Operations and maintenance phase

Magnitude of impact

Common guillemot

5.9.2.56 The estimated cumulative abundance of guillemots from the projects considered within the CEA is presented in Table 5-82

Table 5-82: Common guillemot cumulative abundances for offshore wind projects for disturbance and displacement assessment during the operations and maintenance phase.

Project	Annual Abundance	Breeding Season Abundance	Non-breeding Season Abundance
Tier 1			
Awel y Môr Offshore Wind Farm	4,488	1,569	2,919
Barrow Offshore Wind Farm	105	43	62
Burbo Bank Offshore Wind Farm	99	41	58
Burbo Bank Extension Offshore Wind Farm	2,562	1,000	1,561
Erebus Floating Wind Demo	35,339	7,001	28,338
Gwynt y Môr Offshore Wind Farm	354	149	205
Twinhub (Wave Hub Floating Wind Farm)	256	39	217
Llŷr 1 Floating Wind Farm	15,035	2,026	13,009
Morecambe Offshore Windfarm Generation Assets	14,689	6,374	8,315
Morgan Offshore Wind Project Generation Assets	7,834	4,010	3,824
North Hoyle Offshore Wind Farm	108	45	63
Ormonde Wind Farm	968	912	56
Robin Rigg Offshore Wind Farm	226	138	88
Rhyl Flats Offshore Wind Farm	117	49	68
Walney 1 & 2 Offshore Wind Farms	388	161	227
Walney (3 & 4) Extension Offshore Wind Farm	6,096	4,169	1,927
West of Duddon Sands Offshore Windfarm	1,487	1,321	166

Project	Annual Abundance	Breeding Season Abundance	Non-breeding Season Abundance
West of Orkney Windfarm	9,136	4,861	4,275
White Cross Offshore Windfarm	4,363	3,304	1,059
Total abundance (minus the Mona Offshore Wind Project)	103,649	37,212	66,437
Mona Offshore Wind Project	7,976	4,220	3,756
Cumulative total abundance (all projects)	111,625	41,432	70,193
Collision impacts			
Tier 1			
Holyhead Deep – Tidal Energy	8	Unavailable	Unavailable
West Anglesey Demonstration Zone tidal site	46	38	8

5.9.2.57 The following displacement matrices provide the estimated cumulative mortality of common guillemot predicted to occur due to displacement, as determined by the relevant specified rates of displacement and mortality (Table 5-83 to Table 5-85). The approach used for the cumulative displacement assessment follows that presented in Volume 6, Annex 5.2: Offshore ornithology displacement technical report of the Environmental Statement (Document Reference F6.5.2). Numbers to the right of the thick red line represent an increase in baseline mortality of >1%.

Table 5-83: Operations and maintenance phase cumulative common guillemot mortality following displacement from offshore wind farms in the breeding season.

Displacement level (% at risk of displacement)	Mortality level (% of displaced birds at risk of mortality)						
	1%	2%	5%	10%	25%	50%	100%
10%	41	83	207	414	1,036	2,072	4,143
20%	83	166	414	829	2,072	4,143	8,286
30%	124	249	621	1,243	3,107	6,215	12,430
40%	166	331	829	1,657	4,143	8,286	16,573
50%	207	414	1,036	2,072	5,179	10,358	20,716
60%	249	497	1,243	2,486	6,215	12,430	24,859
70%	290	580	1,450	2,900	7,251	14,501	29,002
80%	331	663	1,657	3,315	8,286	16,573	33,146
90%	373	746	1,864	3,729	9,322	18,644	37,289
100%	414	829	2,072	4,143	10,358	20,716	41,432

Table 5-84: Operations and maintenance phase cumulative common guillemot mortality following displacement from offshore wind farms in the non-breeding season.

Displacement level (% at risk of displacement)	Mortality level (% of displaced birds at risk of mortality)						
	1%	2%	5%	10%	25%	50%	100%
10%	70	140	351	702	1,755	3,510	7,019
20%	140	281	702	1,404	3,510	7,019	14,039
30%	211	421	1,053	2,106	5,264	10,529	21,058
40%	281	562	1,404	2,808	7,019	14,039	28,077
50%	351	702	1,755	3,510	8,774	17,548	35,097
60%	421	842	2,106	4,212	10,529	21,058	42,116
70%	491	983	2,457	4,914	12,284	24,568	49,135
80%	562	1,123	2,808	5,615	14,039	28,077	56,154
90%	632	1,263	3,159	6,317	15,793	31,587	63,174
100%	702	1,404	3,510	7,019	17,548	35,097	70,193

Table 5-85: Operations and maintenance phase cumulative common guillemot mortality following displacement from offshore wind farms annually.

Displacement level (% at risk of displacement)	Mortality level (% of displaced birds at risk of mortality)						
	1%	2%	5%	10%	25%	50%	100%
10%	112	223	558	1,116	2,791	5,581	11,163
20%	223	447	1,116	2,233	5,581	11,163	22,325
30%	335	670	1,674	3,349	8,372	16,744	33,488
40%	447	893	2,233	4,465	11,163	22,325	44,650
50%	558	1,116	2,791	5,581	13,953	27,906	55,813
60%	670	1,340	3,349	6,698	16,744	33,488	66,975
70%	781	1,563	3,907	7,814	19,534	39,069	78,138
80%	893	1,786	4,465	8,930	22,325	44,650	89,300
90%	1,005	2,009	5,023	10,046	25,116	50,231	100,463
100%	1,116	2,233	5,581	11,163	27,906	55,813	111,625

5.9.2.58 During the breeding season, the displacement from operation when using a displacement of 50% (range of 30 to 70%) and a mortality of 1% (range of 1 to 10%), results in an additional loss of 207 (124 to 2,900) individuals from the breeding population. The regional seas UK Western Waters BDMPS population of common guillemot within the breeding season is estimated to be 1,145,528 individuals (Table 5-15). Assuming an average baseline mortality rate of 0.133 (Table 5-16), background mortality in the breeding season is 152,355 individuals. The addition of 207 (124 to 2,900) individual mortalities due to cumulative displacement from the presence of infrastructure, plus the additional 38 mortalities from collision with underwater turbines, would increase the mortality relative to the baseline mortality by 0.16% (0.11 to 1.93%).

5.9.2.59 During the non-breeding season, the displacement from operation results in an additional loss of 351 (211 to 4,914) individuals from the non-breeding population (Table 5-84). The regional seas UK Western Waters BDMPS population of common guillemot within the non-breeding season is estimated to be 1,139,220 individuals (Table 5-15). Assuming an average baseline mortality rate of 0.133, background mortality in the non-breeding season is 151,516 individuals. The addition of 351 (211 to 4,914) individual mortalities due to cumulative displacement from the presence of infrastructure, plus the additional 8 mortalities from collision with underwater turbines, would increase the mortality relative to the baseline mortality by 0.24% (0.14 to 3.25%).

5.9.2.60 The annual estimated mortality resulting from displacement during operation is 558 (335 to 7,814) individuals (Table 5-85). Using the largest BDMPS UK Western Waters population of 1,145,528 individuals and, using the average baseline mortality rate of 0.133 (Table 5-16), the annual background predicted mortality would be 152,355. The additional of 558 (335 to 7,814) mortalities, plus the additional 54 mortalities from collision with underwater turbines would increase the baseline mortality rate by 0.40% (0.26% to 5.16%).

5.9.2.61 These numbers demonstrate that the operations and maintenance phase of the Mona Offshore Wind Project combined with the operations phase of the surrounding offshore wind farms in the Irish Sea could cumulatively cause an increase greater than a 1% increase in baseline mortality and further assessment (using PVA) was required.

5.9.2.62 As the predicted increase in baseline mortality of common guillemot exceeds an increase of 1% when considering the highest rate of displacement (70%) and mortality rates (10%) annually, a PVA was undertaken to investigate the population effects of these predicted cumulative impacts. The input parameters are summaries in Table 5-86 and provided in full in Appendix B.

5.9.2.63 The PVA revealed that the predicted impact on common guillemot from cumulative offshore wind farms would result in the population being between 2.4% to 23.4% smaller under the three impact scenarios after 35 years (in 2065), when compared to the non-impacted population (

5.9.2.64 Table 5-87). However, the CPS is not an appropriate metric due to the PVAs being run density independently. Therefore the CGR is a more appropriate metric. The CGR is 0.992 (i.e. a 0.8% reduction) when considering the worst case scenario.

5.9.2.65 Overall the predicted median growth rate under the three impact scenarios and the unimpacted baseline scenario would continue to be positive (>1), including when considering the lower and upper 95% confidence intervals and therefore the population is predicted to increase in size under the modelled scenarios.

Table 5-86: Summary of the annual CEA PVA inputs for common guillemot.

Scenario	Predicted adult mortalities	Increase in baseline mortality (%)	Decrease in survival rate
A: 30% displacement and 1% mortality (plus predicted collisions from tidal projects)	389	0.26%	0.00033947

Scenario	Predicted adult mortalities	Increase in baseline mortality (%)	Decrease in survival rate
B 50% displacement and 1% mortality (plus predicted collisions from tidal projects)	612	0.40%	0.00053436
C: 70% displacement and 10% mortality (plus predicted collisions from tidal projects)	7,868	5.16%	0.00686823

Table 5-87: PVA outputs for common guillemot CEA.

Year	Impact scenario	Median adult population size	Population change (%) since 2017	Median growth rate	2.5 percentile of growth rate	97.5 percentile of growth rate	Median CPS	Median CGR
2030	Baseline	1,685,359	2.72	1.027	0.955	1.092	-	-
	Impact (Scenario A)	1,685,270	2.68	1.027	0.955	1.091	1.000	1.000
	Impact (Scenario B)	1,685,202	2.65	1.027	0.955	1.091	0.999	0.999
	Impact (Scenario C)	1,672,311	1.92	1.019	0.947	1.084	0.992	0.992
2065	Baseline	4,138,135	151.65	1.026	1.017	1.034	-	-
	Impact (Scenario A)	4,083,497	148.17	1.026	1.017	1.034	0.986	1.000
	Impact (Scenario B)	4,048,656	146.28	1.025	1.017	1.033	0.979	0.999
	Impact (Scenario C)	3,134,554	90.50	1.018	1.009	1.026	0.757	0.992

5.9.2.66 Regardless of which of the modelled scenarios (up to 70% displacement and 10% mortality) is considered, the common guillemot population in the UK Western waters table BDMPS is predicted to grow. 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, which is not significant in EIA terms.

5.9.2.67 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**.

Razorbill

5.9.2.68 The estimated cumulative abundance of razorbill from the projects considered within the CEA is presented in Table 5-88.

Table 5-88: Razorbill cumulative abundances for offshore wind projects for disturbance and displacement assessment during the operations and maintenance phase.

Project	Annual Abundance	Pre-breeding Abundance	Breeding Season Abundance	Post-breeding Abundance	Non-breeding Abundance
Tier 1					
Awel y Môr Offshore Wind Farm	692	336	140	66	150
Barrow Offshore Wind Farm	8	3	1	2	2
Burbo Bank Offshore Wind Farm	28	10	3	6	9
Burbo Bank Extension Offshore Wind Farm	93	Bioseason not presented in original application	64	Bioseason not presented in original application	29
Erebus Floating Wind Demo	3,867	896	194	1,708	1,069
Gwynt y Môr Offshore Wind Farm	105	39	12	22	32
TwinHub (Wave Hub Floating Wind Farm)	65	Unavailable	12	Unavailable	53
Llŷr 1 Floating Wind Farm	2,659	257	21	1,888	493
Morecambe Offshore Windfarm Generation Assets	1,979	382	252	694	651
Morgan Offshore Wind Project Generation Assets	1,787	328	35	254	1,170
North Hoyle Offshore Wind Farm	29	11	3	6	9
Ormonde Wind Farm	198	10	174	6	8
Robin Rigg Offshore Wind Farm	103	15	63	11	14
Rhyl Flats Offshore Wind Farm	33	12	4	7	10
Walney 1 & 2 Offshore Wind Farms	111	40	12	25	34
Walney (3 & 4) Extension Offshore Wind Farm	4,016	0	76	874	3,066
West of Duddon Sands Offshore Windfarm	202	Unavailable	Unavailable	Unavailable	202
West of Orkney Windfarm	326	97	70	144	15
White Cross Offshore Windfarm	786	345	40	40	361
Total (minus the Mona Offshore Wind Project)	**17,087**	**2,781**	**1,176**	**5,753**	**7,377**

Project	Annual Abundance	Pre-breeding Abundance	Breeding Season Abundance	Post-breeding Abundance	Non-breeding Abundance
Mona Offshore Wind Project	2,519	1,924	83	91	421
Cumulative total (all projects)	**19,606**	**4,705**	**1,259**	**5,844**	**7,798**
Collision impacts					
Tier 1					
Holyhead Deep – Tidal Energy	1	Unavailable	Unavailable	Unavailable	Unavailable
West Anglesey Demonstration Zone tidal site	23.4	0	11.7	0	11.7

5.9.2.69 The following displacement matrices provide the estimated cumulative mortality of razorbill predicted to occur due to displacement, as determined by the relevant specified rates of displacement and mortality (Table 5-89 to Table 5-93). The approach used for the cumulative displacement assessment follows that presented in Volume 6, Annex 5.2: Offshore ornithology displacement technical report of the Environmental Statement (Document Reference F6.5.2). Numbers to the right of the thick red line represent an increase in baseline mortality of >1%.

Table 5-89: Operations and maintenance phase cumulative razorbill mortality following displacement from offshore wind farms in the pre-breeding season.

Displacement level (% at risk of displacement)	Mortality level (% of displaced birds at risk of mortality)						
	1%	**2%**	**5%**	**10%**	**25%**	**50%**	**100%**
10%	5	9	24	47	118	235	471
20%	9	19	47	94	235	471	941
30%	14	28	71	141	353	706	1,412
40%	19	38	94	188	471	941	1,882
50%	24	47	118	235	588	1,176	2,353
60%	28	56	141	282	706	1,412	2,823
70%	33	66	165	329	823	1,647	3,294
80%	38	75	188	376	941	1,882	3,764
90%	42	85	212	423	1,059	2,117	4,235
100%	47	94	235	471	1,176	2,353	4,705

Table 5-90: Operations and maintenance phase cumulative razorbill mortality following displacement from offshore wind farms in the breeding season.

Displacement level (% at risk of displacement)	Mortality level (% of displaced birds at risk of mortality)						
	1%	2%	5%	10%	25%	50%	100%
10%	1	3	6	13	31	63	126
20%	3	5	13	25	63	126	252
30%	4	8	19	38	94	189	378
40%	5	10	25	50	126	252	504
50%	6	13	31	63	157	315	630
60%	8	15	38	75	189	378	755
70%	9	18	44	88	220	441	881
80%	10	20	50	101	252	504	1,007
90%	11	23	57	113	283	567	1,133
100%	13	25	63	126	315	630	1,259

Table 5-91: Operations and maintenance phase cumulative razorbill mortality following displacement from offshore wind farms in the post-breeding season.

Displacement level (% at risk of displacement)	Mortality level (% of displaced birds at risk of mortality)						
	1%	2%	5%	10%	25%	50%	100%
10%	6	12	29	58	146	292	584
20%	12	23	58	117	292	584	1,169
30%	18	35	88	175	438	877	1,753
40%	23	47	117	234	584	1,169	2,338
50%	29	58	146	292	731	1,461	2,922
60%	35	70	175	351	877	1,753	3,506
70%	41	82	205	409	1,023	2,045	4,091
80%	47	94	234	468	1,169	2,338	4,675
90%	53	105	263	526	1,315	2,630	5,260
100%	58	117	292	584	1,461	2,922	5,844

Table 5-92: Operations and maintenance phase cumulative razorbill mortality following displacement from offshore wind farms in the non-breeding season.

Displacement level (% at risk of displacement)	Mortality level (% of displaced birds at risk of mortality)						
	1%	2%	5%	10%	25%	50%	100%
10%	8	16	39	78	195	390	780
20%	16	31	78	156	390	780	1,560
30%	23	47	117	234	585	1,170	2,339
40%	31	62	156	312	780	1,560	3,119
50%	39	78	195	390	975	1,950	3,899
60%	47	94	234	468	1,170	2,339	4,679
70%	55	109	273	546	1,365	2,729	5,459
80%	62	125	312	624	1,560	3,119	6,238
90%	70	140	351	702	1,755	3,509	7,018
100%	78	156	390	780	1,950	3,899	7,798

Table 5-93: Operations and maintenance phase cumulative razorbill mortality following displacement from offshore wind farms annually.

Displacement level (% at risk of displacement)	Mortality level (% of displaced birds at risk of mortality)						
	1%	2%	5%	10%	25%	50%	100%
10%	20	39	98	196	490	980	1,961
20%	39	78	196	392	980	1,961	3,921
30%	59	118	294	588	1,470	2,941	5,882
40%	78	157	392	784	1,961	3,921	7,842
50%	98	196	490	980	2,451	4,902	9,803
60%	118	235	588	1,176	2,941	5,882	11,764
70%	137	274	686	1,372	3,431	6,862	13,724
80%	157	314	784	1,568	3,921	7,842	15,685
90%	176	353	882	1,765	4,411	8,823	17,645
100%	196	392	980	1,961	4,902	9,803	19,606

5.9.2.70 During the spring migration (pre-breeding) season the displacement from operation when using the displacement of 50% (range of 30 to 70%) and a mortality rate of 1% (range of 1 to 10%), results in an additional loss of 24 (14 to 329) individuals (Table 5-89). The regional seas UK Western Waters BDMPS population of razorbill in the spring migration period is estimated to be 606,914 individuals (Table 5-15). Assuming an average baseline mortality rate of 0.172 (Table 5-16), background mortality during spring migration is 104,389 individuals. The addition of 24 (14 to 329) individual mortalities, due to cumulative displacement from the presence of infrastructure would increase the mortality relative to the baseline mortality by 0.02% (0.01 to 0.32%). Zero mortalities were estimated for underwater collision.

5.9.2.71 During the breeding season, displacement from operation results in the loss of six (four to 88) individuals from the breeding population (Table 5-89). The regional seas UK Western Waters BDMPS population of razorbill within the breeding season is estimated to be 198,969 individuals (Table 5-15). Assuming an average baseline mortality rate of 0.172, background mortality in the breeding season is 34,223 individuals. The addition of six (four to 88) individual mortalities due to cumulative displacement from the presence of infrastructure, plus the additional 11.7 mortalities from collision with underwater turbines would increase the mortality relative to the baseline mortality by 0.05% (0.05 to 0.29%).

5.9.2.72 During the autumn migration season (post-breeding), displacement from operation results in a loss of 29 (18 to 409) individuals from the migratory population (Table 5-91). The regional seas UK Western Waters BDMPS population of razorbill during the autumn migration period is estimated to be 606,914 individuals (Table 5-15). Assuming an average baseline mortality rate of 0.172, background mortality during autumn migration is 104,389 individuals. The addition of 29 (18 to 409) individual mortalities due to cumulative displacement from the presence of infrastructure would increase the mortality relative to the baseline mortality by 0.03% (0.02 to 0.39%). Zero mortalities were estimated for underwater collision.

5.9.2.73 During the non-breeding season (winter season), displacement from operation results in a loss of 39 (23 to 546) individuals from the non-breeding population (Table 5-92). The regional seas UK Western Waters BDMPS population of razorbill within the non-breeding season is estimated to be 341,422 individuals (Table 5-15). Assuming an average baseline mortality rate of 0.172, background mortality in the breeding season is 58,724 individuals. The addition of 39 (23 to 546) individual mortalities due to cumulative displacement from the presence of infrastructure, plus the additional 11.7 mortalities from collision with underwater turbines would increase the mortality relative to the baseline mortality by 0.09% (0.06 to 0.95%).

5.9.2.74 The annual estimated mortality resulting from displacement during construction is 98 (59 to 1,372 individuals) (Table 5-93). Using the largest BDMPS population of 606,914 individuals and, using the average baseline mortality rate of 0.172, the background predicted mortality would be 104,389. The addition of 98 (59 to 1,372 individuals) mortalities, plus the additional 23.4 mortalities from collision with underwater turbines would increase the baseline mortality rate by 0.12% (0.08 to 1.34%). The annual predicted mortality from the most extreme scenario cumulative assessment (70% displacement, 10% mortality) is marginally above the 1% threshold increase in baseline mortality.

5.9.2.75 These numbers demonstrate that the operations and maintenance phase of the Mona Offshore Wind Project combined with the operations phase of the surrounding offshore wind farms in the Irish Sea could cumulatively cause an increase greater than a 1% increase in baseline mortality and further assessment (using PVA) was required.

5.9.2.76 As the predicted increase in baseline mortality of razorbill exceeds an increase of 1% when considering the highest rate of displacement (70%) and mortality rates (10%) annually, a PVA was undertaken to investigate the population effects of these predicted cumulative impacts. The input parameters are summaries in Table 5-94 and provided in full in Appendix B.2.

5.9.2.77 The PVA revealed that the predicted impact on razorbill from cumulative offshore wind farms would result in the population being between 0.6% to 9.0% smaller under the three impact scenarios after 35 years (in 2065), when compared to the non-impacted population (

5.9.2.78 Table 5-95). However, the CPS is not an appropriate metric due to the PVAs being run density independently. Therefore the CGR is a more appropriate metric. The CGR is 0.997 (i.e. a 0.3% reduction) when considering the worst case scenario.

5.9.2.79 Overall the predicted median growth rate under the three impact scenarios and the unimpacted baseline scenario would continue to be positive (>1) and therefore the population is predicted to increase in size under the modelled scenarios.

Table 5-94: Summary of the annual CEA PVA inputs for razorbill.

Scenario	Predicted adult mortalities	Increase in baseline mortality (%)	Decrease in survival rate
A: 30% displacement and 1% mortality (plus predicted collisions from tidal projects)	83	0.08%	0.00013679
B 50% displacement and 1% mortality (plus predicted collisions from tidal projects)	122	0.12%	0.00020140
C: 70% displacement and 10% mortality (plus predicted collisions from tidal projects)	1,397	1.34%	0.00230118

Table 5-95: PVA outputs for razorbill CEA.

Year	Impact scenario	Median adult population size	Population change (%) since 2017	Median growth rate	2.5 percentile of growth rate	97.5 percentile of growth rate	Median CPS	Median CGR
2030	Baseline	701,018	1.63	1.016	0.896	1.096	-	-
	Impact (Scenario A)	701,050	1.61	1.016	0.896	1.095	1.000	1.000
	Impact (Scenario B)	700,652	1.59	1.016	0.895	1.095	1.000	1.000
	Impact (Scenario C)	699,439	1.35	1.014	0.894	1.093	0.997	0.997
2065	Baseline	957,341	38.64	1.009	0.992	1.025	-	-
	Impact (Scenario A)	953,183	37.90	1.009	0.992	1.025	0.994	1.000

Year	Impact scenario	Median adult population size	Population change (%) since 2017	Median growth rate	2.5 percentile of growth rate	97.5 percentile of growth rate	Median CPS	Median CGR
	Impact (Scenario B)	950,308	37.47	1.009	0.992	1.025	0.992	1.000
	Impact (Scenario C)	871,000	26.19	1.006	0.989	1.022	0.910	0.997

5.9.2.80 Regardless of which of the modelled scenarios (up to 70% displacement and 10% mortality) is considered, the common guillemot population in the UK Western waters BDMPS is predicted to grow. 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, which is not significant in EIA terms. 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**.

Atlantic puffin

5.9.2.81 The estimated cumulative abundance of Atlantic puffin from the relevant projects is presented in Table 5-96.

Table 5-96: Atlantic puffin cumulative abundance for overlapping construction phase onshore wind projects for disturbance and displacement assessment

Project	Annual Abundance	Breeding Season Abundance	Non-breeding Season Abundance
Tier 1			
Awel y Môr Offshore Wind Farm	8	8	0
Barrow Offshore Wind Farm	1	1	0
Burbo Bank Offshore Wind Farm	<1	<1	<1
Burbo Bank Extension Offshore Wind Farm	10	10	0
Erebus Floating Wind Demo	1,576	1,416	160
Gwynt y Môr Offshore Wind Farm	3	2	<1
TwinHub (Wave Hub Floating Wind Farm)	0	0	0
Llŷr 1 Floating Wind Farm	744	152	592
Morecambe Offshore Windfarm Generation Assets	59	39	20

Project	Annual Abundance	Breeding Season Abundance	Non-breeding Season Abundance
Morgan Offshore Wind Project Generation Assets	14	9	5
North Hoyle Offshore Wind Farm	0	0	0
Ormonde Wind Farm	1	1	0
Robin Rigg Offshore Wind Farm	0	0	0
Rhyl Flats Offshore Wind Farm	1	<1	<1
Walney 1 & 2 Offshore Wind Farms	5	3	2
Walney (3 & 4) Extension Offshore Wind Farm	172	53	119
West of Duddon Sands Offshore Windfarm	96	61	35
West of Orkney Windfarm	6,449	5,272	1,177
White Cross Offshore Wind Farm	80	49	31
Total (minus the Mona Offshore Wind Project)	**9,219**	**7,076**	**2,142**
Mona Offshore Wind Project	37	15	22
Cumulative total (all projects)	**9,256**	**7,091**	**2,164**
Collision impacts			
Tier 1			
Holyhead Deep – Tidal Energy	0	Unavailable	Unavailable
West Anglesey Demonstration Zone tidal site	1	1	0

5.9.2.82 The following displacement matrices provide the estimated cumulative mortality of Atlantic puffin predicted to occur due to displacement, as determined by the relevant specified rates of displacement and mortality (Table 5-97 to Table 5-99). The approach used for the cumulative displacement assessment follows that of the project alone displacement assessment Volume 6, Annex 5.2: Offshore ornithology displacement technical report of the Environmental Statement (Document Reference F6.5.2). Numbers to the right of the thick red line represent an increase in baseline mortality of >1%.

Table 5-97: Operations and maintenance phase cumulative Atlantic puffin mortality following displacement from offshore wind farms in the breeding season.

Displacement level (% at risk of displacement)	Mortality level (% of displaced birds at risk of mortality)						
	1%	2%	5%	10%	25%	50%	100%
10%	7	14	35	71	177	355	709
20%	14	28	71	142	355	709	1,418
30%	21	43	106	213	532	1,064	2,127
40%	28	57	142	284	709	1,418	2,837
50%	35	71	177	355	886	1,773	3,546
60%	43	85	213	425	1,064	2,127	4,255
70%	50	99	248	496	1,241	2,482	4,964
80%	57	113	284	567	1,418	2,837	5,673
90%	64	128	319	638	1,596	3,191	6,382
100%	71	142	355	709	1,773	3,546	7,091

Table 5-98: Operations and maintenance phase cumulative Atlantic puffin mortality following displacement from offshore wind farms in the non-breeding season.

Displacement level (% at risk of displacement)	Mortality level (% of displaced birds at risk of mortality)						
	1%	2%	5%	10%	25%	50%	100%
10%	2	4	11	22	54	108	216
20%	4	9	22	43	108	216	433
30%	6	13	32	65	162	325	649
40%	9	17	43	87	216	433	866
50%	11	22	54	108	271	541	1,082
60%	13	26	65	130	325	649	1,299
70%	15	30	76	152	379	758	1,515
80%	17	35	87	173	433	866	1,732
90%	19	39	97	195	487	974	1,948
100%	22	43	108	216	541	1,082	2,164

Table 5-99: Operations and maintenance phase cumulative Atlantic puffin mortality following displacement from offshore wind farms annually.

Displacement level (% at risk of displacement)	Mortality level (% of displaced birds at risk of mortality)						
	1%	2%	5%	10%	25%	50%	100%
10%	9	19	46	93	231	463	926
20%	19	37	93	185	463	926	1,851
30%	28	56	139	278	694	1,388	2,777
40%	37	74	185	370	926	1,851	3,702
50%	46	93	231	463	1,157	2,314	4,628
60%	56	111	278	555	1,388	2,777	5,554
70%	65	130	324	648	1,620	3,240	6,479
80%	74	148	370	740	1,851	3,702	7,405
90%	83	167	417	833	2,083	4,165	8,330
100%	93	185	463	926	2,314	4,628	9,256

5.9.2.83 During the breeding season, the displacement from operation when using the displacement rate of 50% (range of 30 to 70%) and a mortality rate of 1% (range of 1 to 10%), results in an additional loss of 35 (21 to 496) individuals from the breeding population (Table 5-69). The regional seas UK Western Waters BDMPS population of Atlantic puffin within the breeding season is estimated to be 1,482,791 individuals (Table 5-15). Assuming an average baseline mortality rate of 0.176 (Table 5-16), background mortality in the breeding season is 260,971 individuals. The addition of 35 (21 to 496) individual mortalities due to cumulative displacement from the presence of infrastructure, plus the additional one mortality from underwater collision would increase the mortality relative to the baseline mortality by 0.01% (0.01 to 0.19%).

5.9.2.84 During the non-breeding season, the displacement from operation results in an additional loss of 11 (six to 152) individuals from the non-breeding population (Table 5-98). The regional seas UK Western Waters BDMPS population of Atlantic puffin within the non-breeding season is estimated to be 304,557 individuals (Table 5-15). Assuming an average baseline mortality rate of 0.176, background mortality in the non-breeding season is 53,602 individuals. The addition of 11 (six to 152) individual mortalities due to cumulative displacement from the presence of infrastructure would increase the mortality relative to the baseline mortality by 0.02% (0.01 to 0.28%). Zero mortalities were estimated for underwater collision.

5.9.2.85 The annual estimated mortality resulting from displacement during operation is 46 (28 to 648) individuals (Table 5-99). Using the largest UK Western Waters BDMPS population of 1,482,791 Atlantic puffin and, using the average baseline mortality rate of 0.176, the background predicted mortality would be 260,971 individuals. The addition of 46 (28 to 648) mortalities, plus the additional one mortality from underwater collision would increase the baseline mortality rate by 0.02% (0.01% to 0.25%). The annual predicted mortality from the cumulative assessment is below the 1% threshold increase in baseline mortality.

5.9.2.86 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 **negligible**.

Northern gannet

5.9.2.87 The estimated cumulative abundance of northern gannet from the relevant projects is presented in Table 5-100.

Table 5-100: Northern gannet cumulative abundances for offshore wind projects for disturbance and displacement assessment during the operations and maintenance phase.

Project	Annual Abundance	Pre-breeding Season	Breeding Season Abundance	Post-breeding Season Abundance
Tier 1				
Awel y Môr Offshore Wind Farm	529	0	328	201
Barrow Offshore Wind Farm	17	3	8	6
Burbo Bank Offshore Wind Farm	14	3	6	5
Burbo Bank Extension Offshore Wind Farm	695	25	648	22
Erebus Floating Wind Demo	658	100	224	334
Gwynt y Môr Offshore Wind Farm	60	13	27	20
Llŷr 1 Floating Wind Farm	1,026	65	246	715
Morecambe Offshore Windfarm Generation Assets	673	8	541	124
Morgan Offshore Wind Project Generation Assets	254	35	154	65
North Hoyle Offshore Wind Farm	15	3	7	5
Ormonde Wind Farm	208	3	199	6
Robin Rigg Offshore Wind Farm	22	4	11	7
Rhyl Flats Offshore Wind Farm	18	4	8	6
TwinHub (Wave Hub Floating Wind Farm)	397	Unavailable	244	153
Walney 1 & 2 Offshore Wind Farms	77	15	36	26

Project	Annual Abundance	Pre-breeding Season	Breeding Season Abundance	Post-breeding Season Abundance
Walney (3 & 4) Extension Offshore Wind Farm	433	24	150	259
West of Duddon Sands Offshore Wind Farm	460	11	431	18
West of Orkney Windfarm	2,188	59	958	1,171
White Cross Offshore Windfarm	456	141	239	76
Total (minus the Mona Offshore Wind Project)	**8,200**	**516**	**4,465**	**3,219**
Mona Offshore Wind Project	337	28	251	58
Cumulative total (all projects)	**8,537**	**544**	**4,716**	**3,277**
Collision impacts				
Tier 1				
Holyhead Deep – Tidal Energy	0	Unavailable	Unavailable	Unavailable
West Anglesey Demonstration Zone tidal site	1	Unavailable	1	Unavailable

5.9.2.88 The following displacement matrices provide the estimated cumulative mortality of northern gannet predicted to occur due to displacement, as determined by the relevant specified rates of displacement and mortality (Table 5-101 to Table 5-104). The approach used for the cumulative displacement assessment follows that of the project alone displacement assessment Volume 6, Annex 5.2: Offshore ornithology displacement technical report of the Environmental Statement (Document Reference F6.5.2). Numbers to the right of the thick red line represent an increase in baseline mortality of >1%.

Table 5-101: Operations and maintenance phase cumulative northern gannet mortality following displacement from offshore wind farms in the pre-breeding season.

Displacement level (% at risk of displacement)	Mortality level (% of displaced birds at risk of mortality)						
	1%	2%	5%	10%	25%	50%	100%
10%	1	1	3	5	14	27	54
20%	1	2	5	11	27	54	109
30%	2	3	8	16	41	82	163
40%	2	4	11	22	54	109	218
50%	3	5	14	27	68	136	272
60%	3	7	16	33	82	163	326
70%	4	8	19	38	95	190	381
80%	4	9	22	44	109	218	435
90%	5	10	24	49	122	245	490
100%	5	11	27	54	136	272	544

Table 5-102: Operations and maintenance phase cumulative northern gannet mortality following displacement from offshore wind farms in the breeding season.

Displacement level (% at risk of displacement)	Mortality level (% of displaced birds at risk of mortality)						
	1%	2%	5%	10%	25%	50%	100%
10%	5	9	24	47	118	236	472
20%	9	19	47	94	236	472	943
30%	14	28	71	141	354	707	1,415
40%	19	38	94	189	472	943	1,886
50%	24	47	118	236	590	1,179	2,358
60%	28	57	141	283	707	1,415	2,830
70%	33	66	165	330	825	1,651	3,301
80%	38	75	189	377	943	1,886	3,773
90%	42	85	212	424	1,061	2,122	4,244
100%	47	94	236	472	1,179	2,358	4,716

Table 5-103: Operations and maintenance phase cumulative norther gannet mortality following displacement from offshore wind farms in the post- breeding season.

Displacement level (% at risk of displacement)	Mortality level (% of displaced birds at risk of mortality)						
	1%	2%	5%	10%	25%	50%	100%
10%	3	7	16	33	82	164	328
20%	7	13	33	66	164	328	655
30%	10	20	49	98	246	492	983
40%	13	26	66	131	328	655	1,311
50%	16	33	82	164	410	819	1,639
60%	20	39	98	197	492	983	1,966
70%	23	46	115	229	573	1,147	2,294
80%	26	52	131	262	655	1,311	2,622
90%	29	59	147	295	737	1,475	2,949
100%	33	66	164	328	819	1,639	3,277

Table 5-104: Operations and maintenance phase cumulative northern gannet mortality following displacement from offshore wind farms annually.

Displacement level (% at risk of displacement)	Mortality level (% of displaced birds at risk of mortality)						
	1%	2%	5%	10%	25%	50%	100%
10%	9	17	43	85	213	427	854
20%	17	34	85	171	427	854	1,707
30%	26	51	128	256	640	1,281	2,561
40%	34	68	171	341	854	1,707	3,415
50%	43	85	213	427	1,067	2,134	4,269
60%	51	102	256	512	1,281	2,561	5,122
70%	60	120	299	598	1,494	2,988	5,976
80%	68	137	341	683	1,707	3,415	6,830
90%	77	154	384	768	1,921	3,842	7,683
100%	85	171	427	854	2,134	4,269	8,537

5.9.2.89 During the spring migration (pre-breeding) season the displacement from operation when using the displacement rate of 70% (range of 60 to 80%) and a mortality rate of 1% (range of 1 to 10%), results in an additional loss of four (three to 44) individuals (Table 5-101). The regional seas UK Western Waters BDMPS population of northern gannet in the spring migration period is estimated to be 661,888 individuals (Table 5-15). Assuming an average baseline mortality rate of 0.193 (Table 5-16), background mortality during spring migration is 127,744 individuals. The addition of four (three to 44) individual mortalities due to cumulative displacement from the presence of infrastructure would increase the mortality relative to the baseline mortality by <0.01% (<0.01 to 0.03%). Zero mortalities were estimated from underwater collision.

5.9.2.90 During the breeding season, displacement from operation results in the loss of 33 (28to 377) individuals from the breeding population (Table 5-101). The regional seas UK Western Waters BDMPS population of northern gannet within the breeding season is estimated to be 522,888 individuals (Table 5-15). Assuming an average baseline mortality rate of 0.193, background mortality in the breeding season is 100,917 individuals. The addition of 33 (28 to 377) individual mortalities due to cumulative displacement from the presence of infrastructure, plus the additional one mortality from underwater collision would increase the mortality relative to the baseline mortality by 0.03% (0.03 to 0.37%).

5.9.2.91 During the autumn migration season (post-breeding), displacement from operation results in a loss of 23 (20 to 262) individuals from the migratory population (Table 5-103). The regional seas UK Western Waters BDMPS population of northern gannet during the autumn migration period is estimated to be 545,954 individuals (Table 5-15). Assuming an average baseline mortality rate of 0.193, background mortality during autumn migration is 105,369 individuals. The addition of 23 (20 to 262) individual mortalities due to cumulative displacement from the presence of infrastructure would increase the mortality relative to the baseline mortality by 0.02% (0.02 to 0.25%).

5.9.2.92 The annual estimated mortality resulting from displacement during construction is 60 (51 to 683) individuals (Table 5-104). Using the largest UK Western Waters BDMPS population of 661,888 individuals, with an average baseline mortality rate of 0.193, the background predicted mortality would be 127,744. The addition of 60 (51 to 683) mortalities, plus the additional one mortality from underwater collision would increase the baseline mortality rate by 0.05% (0.04 to 0.54%). The annual predicted mortality from the cumulative assessment is below the 1% threshold increase in baseline mortality.

5.9.2.93 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 **negligible**.

Black-legged kittiwake

5.9.2.94 The estimated cumulative abundance of black-legged kittiwake from the relevant projects is presented in Table 5-105.

Table 5-105: Black-legged kittiwake cumulative abundances for offshore wind projects for disturbance and displacement assessment during the operations and maintenance phase.

Project	Annual Abundance	Pre-breeding Abundance	Breeding Season Abundance	Post-breeding Abundance
Tier 1				
Awel y Môr Offshore Wind Farm	467	298	87	82
Barrow Offshore Wind Farm	64	23	20	21
Burbo Bank Offshore Wind Farm	56	22	14	20
Burbo Bank Extension Offshore Wind Farm	802	50	707	45
Erebus Floating Wind Demo	2,532	2,022	2	508
Gwynt y Môr Offshore Wind Farm	188	72	51	65
TwinHub (Wave Hub Floating Wind Farm)	249	56	4	189
Llŷr 1 Floating Wind Farm	2,238	206	88	1,944
Morecambe Offshore Windfarm Generation Assets	3,522	76	1,729	1,717
Morgan Offshore Wind Project Generation Assets	2,447	791	505	1151
North Hoyle Offshore Wind Farm	57	21	17	19
Ormonde Wind Farm	102	22	60	20
Rampion Offshore Wind Farm	2,112	831	1,059	222
Robin Rigg Offshore Wind Farm	79	30	21	28
Rhyl Flats Offshore Wind Farm	58	22	16	20
Walney 1 & 2 Offshore Wind Farms	243	94	63	86
Walney (3 & 4) Extension Offshore Wind Farm	2,900	1,467	319	1,114
West of Duddon Sands Offshore Wind Farm	584	68	454	62

Project	Annual Abundance	Pre-breeding Abundance	Breeding Season Abundance	Post-breeding Abundance
West of Orkney Windfarm	2,706	1,217	690	799
White Cross Offshore Windfarm	914	698	44	172
Tier 2				
Rampion 2 (Rampion Extension) Offshore Wind Farm	388	286	5	97
Total (minus the **Mona** Offshore Wind Project**)**	**22,708**	**8,372**	**5,955**	**8,381**
Mona Offshore Wind Project	1,860	574	726	560
Cumulative total (all projects)	**24,568**	**8,946**	**6,681**	**8,941**

5.9.2.95 The following displacement matrices provide the estimated cumulative mortality of black-legged kittiwake predicted to occur due to displacement, as determined by the relevant specified rates of displacement and mortality (Table 5-106 to Table 5-109). The approach used for the cumulative displacement assessment follows that presented in Volume 6, Annex 5.2: Offshore ornithology displacement technical report of the Environmental Statement (Document Reference F6.5.2). Numbers to the right of the thick red line represent an increase in baseline mortality of >1%.

Table 5-106: Operations and maintenance phase cumulative black-legged kittiwake mortality following displacement from offshore wind farms in the pre-breeding season.

Displacement level (% at risk of displacement)	Mortality level (% of displaced birds at risk of mortality)						
	1%	2%	5%	10%	25%	50%	100%
10%	9	18	45	89	224	447	895
20%	18	36	89	179	447	895	1,789
30%	27	54	134	268	671	1,342	2,684
40%	36	72	179	358	895	1,789	3,578
50%	45	89	224	447	1,118	2,237	4,473
60%	54	107	268	537	1,342	2,684	5,368
70%	63	125	313	626	1,566	3,131	6,262
80%	72	143	358	716	1,789	3,578	7,157
90%	81	161	403	805	2,013	4,026	8,051
100%	89	179	447	895	2,237	4,473	8,946

Table 5-107: Operations and maintenance phase cumulative black-legged kittiwake mortality following displacement from offshore wind farms in the breeding season.

Displacement level (% at risk of displacement)	Mortality level (% of displaced birds at risk of mortality)						
	1%	2%	5%	10%	25%	50%	100%
10%	7	13	33	67	167	334	668
20%	13	27	67	134	334	668	1,336
30%	20	40	100	200	501	1,002	2,004
40%	27	53	134	267	668	1,336	2,672
50%	33	67	167	334	835	1,670	3,341
60%	40	80	200	401	1,002	2,004	4,009
70%	47	94	234	468	1,169	2,338	4,677
80%	53	107	267	534	1,336	2,672	5,345
90%	60	120	301	601	1,503	3,006	6,013
100%	67	134	334	668	1,670	3,341	6,681

Table 5-108: Operations and maintenance phase cumulative black-legged kittiwake mortality following displacement from offshore wind farms in the post-breeding season.

Displacement level (% at risk of displacement)	Mortality level (% of displaced birds at risk of mortality)						
	1%	2%	5%	10%	25%	50%	100%
10%	9	18	45	89	224	447	894
20%	18	36	89	179	447	894	1,788
30%	27	54	134	268	671	1,341	2,682
40%	36	72	179	358	894	1,788	3,576
50%	45	89	224	447	1,118	2,235	4,471
60%	54	107	268	536	1,341	2,682	5,365
70%	63	125	313	626	1,565	3,129	6,259
80%	72	143	358	715	1,788	3,576	7,153
90%	80	161	402	805	2,012	4,023	8,047
100%	89	179	447	894	2,235	4,471	8,941

Table 5-109: Operations and maintenance phase cumulative black-legged kittiwake mortality following displacement from offshore wind farms annually.

Displacement level (% at risk of displacement)	Mortality level (% of displaced birds at risk of mortality)						
	1%	**2%**	**5%**	**10%**	**25%**	**50%**	**100%**
10%	25	49	123	246	614	1,228	2,457
20%	49	98	246	491	1,228	2,457	4,914
30%	74	147	369	737	1,843	3,685	7,370
40%	98	197	491	983	2,457	4,914	9,827
50%	123	246	614	1,228	3,071	6,142	12,284
60%	147	295	737	1,474	3,685	7,370	14,741
70%	172	344	860	1,720	4,299	8,599	17,198
80%	197	393	983	1,965	4,914	9,827	19,654
90%	221	442	1,106	2,211	5,528	11,056	22,111
100%	246	491	1,228	2,457	6,142	12,284	24,568

5.9.2.96 During the spring migration (pre-breeding) season, the displacement from operation when using the displacement rate of 50% (range of 30 to 70%) and a mortality rate of 1% (range of 1 to 10%) results in an additional loss of 45 (27 to 626) individuals (Table 5-106). The regional seas UK Western Waters & Channel BDMPS population of black-legged kittiwake in the spring migration period is estimated to be 691,526 individuals (Table 5-15). Assuming an average baseline mortality rate of 0.156 (Table 5-16), background mortality during spring migration is 107,878 individuals. The addition of 45 (27 to 626) individual mortalities due to cumulative displacement from the presence of infrastructure would increase the mortality relative to the baseline mortality by 0.04 % (0.02 to 0.58%).

5.9.2.97 During the breeding season, the displacement from operation results in a loss of 33 (20 to 468) individuals from the migratory population (Table 5-107). The regional seas UK Western Waters & Channel BDMPS population of black-legged kittiwake within the breeding season is estimated to be 245,234 individuals (Table 5-15). Assuming an average baseline mortality rate of 0.156, background mortality in the breeding season is 38,256 individuals. The addition of 33 (20 to 468) individual mortalities due to cumulative displacement from the presence of infrastructure would increase the mortality relative to the baseline mortality by 0.09% (0.05 to 1.22%). The breeding season predicted mortality from the most extreme scenario cumulative assessment (70% displacement, 10% mortality) is above the 1% threshold increase in baseline mortality.

5.9.2.98 However, recent evidence suggests that 70% displacement and 10% mortality is overly cautious and that kittiwake continued to use the area around a windfarm (Leopold *et al.* 2011; Vanermen, 2013; Furness, 2013; Peschko, 2020; NatureScot, 2023). Taking a more realistic 50% displacement and considering a precautionary mortality rate of 5%, the increase in baseline mortality would be 0.44%, which is below the 1% threshold for further investigation.

5.9.2.99 During the autumn migration season (post-breeding) displacement from operation results in a loss of 45 (27 to 626) individuals from the migratory population (Table 5-108). The regional seas UK Western Waters & Channel BDMPS population of black-legged kittiwake during the autumn migration period is estimated to be 911,586 individuals (Table 5-15). Assuming an average baseline mortality rate of 0.156, background mortality during autumn migration is 142,207 individuals. The addition of 45 (27 to 626) individual mortalities due to cumulative displacement from construction activities would increase the mortality relative to the baseline mortality by 0.03% (0.02 to 0.44%).

5.9.2.100 The annual estimated mortality resulting from displacement during construction is 123 (74 to 1,720) individuals (Table 5-109). Using the largest UK Western Waters & Channel BDMPS population of 911,586 individuals, with an average baseline mortality rate of 0.156, the background predicted mortality would be 142,207. The addition of 123 (74 to 1,720) mortalities would increase the baseline mortality rate by 0.09% (0.05% to 1.21%). The annual predicted mortality from the cumulative assessment is above the 1% threshold increase in baseline mortality.

5.9.2.101 However, recent evidence suggests that 70% displacement and 10% mortality is overly cautious and that kittiwake continued to use the area around a windfarm (MacArthur Green, 2023;.Leopold *et al.* 2011; Vanermen, 2013; Furness, 2013; Peschko, 2020; NatureScot, 2023;). Taking a more realistic 50% displacement and even considering a precautionary mortality rate of 5%, the increase in baseline mortality would be 0.43%, which is below the 1% threshold for further investigation.

5.9.2.102 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**.

Manx shearwater

5.9.2.103 The estimated cumulative abundance of Manx shearwater from the relevant projects is presented in Table 5-110.

Table 5-110: Manx shearwater cumulative abundances for offshore wind projects for disturbance and displacement assessment during the operations and maintenance phase.

Project	Annual Abundance	Pre-breeding Abundance	Breeding Season Abundance	Post-breeding Abundance
Tier 1				
Awel y Môr Offshore Wind Farm	417	177	26	214
Barrow Offshore Wind Farm	2	0	2	0
Burbo Bank Offshore Wind Farm	3	0	2	1
Burbo Bank Extension Offshore Wind Farm	444	0	443	1
Erebus Floating Wind Demo	2,115	18	1,540	557
Gwynt y Môr Offshore Wind Farm	17	1	13	3

Project	Annual Abundance	Pre-breeding Abundance	Breeding Season Abundance	Post-breeding Abundance
Llŷr 1 Floating Wind Farm	4,728	1,267	3434	27
Morecambe Offshore Windfarm Generation Assets	8,972	1,617	4,705	2,650
Morgan Offshore Wind Project Generation Assets	1,638	0	1,254	384
North Hoyle offshore wind farm	2	0	2	0
Ormonde Wind Farm	1,001	Unavailable	1,001	Unavailable
Rampion Offshore Wind Farm	33	0	33	0
Robin Rigg Offshore Wind Farm	4	0	3	1
Rhyl Flats Offshore Wind Farm	5	0	4	1
TwinHub (Wave Hub Floating Wind Farm)	1,274	Unavailable	1,270	3
Walney 1 & 2 Offshore Wind Farms	19	1	14	4
Walney (3 & 4) Extension Offshore Wind Farm	912	Unavailable	588	324
West of Duddon Sands Offshore Wind Farm	548	1	544	3
West of Orkney Windfarm	10	0	8	3
White Cross Offshore Windfarm	12,181	12,126	33	22
Tier 2				
Rampion 2 (Rampion Extension) Offshore Wind Farm	0	0	0	0
TOTAL (minus the Mona Offshore Wind Project)	**34,325**	**15,208**	**14,919**	**4,199**
Mona Offshore Wind Project	1,268	3	1249	16
TOTAL (all projects)	**35,593**	**15,211**	**16,168**	**4,215**

5.9.2.104 The following displacement matrices provide the estimated cumulative mortality of Manx shearwater predicted to occur due to displacement, as determined by the relevant specified rates of displacement and mortality (Table 5-111 to Table 5-114). The approach used for the cumulative displacement assessment follows that presented in Volume 6, Annex 5.2: Offshore ornithology displacement assessment of the Environmental Statement (Document Reference F6.5.2). Numbers to the right of the thick red line represent an increase in baseline mortality of >1%.

Table 5-111: Operations and maintenance phase cumulative Manx shearwater mortality following displacement from offshore wind farms in the pre-breeding season.

Displacement level (% at risk of displacement)	Mortality level (% of displaced birds at risk of mortality) 1%	2%	5%	10%	25%	50%	100%
10%	15	30	76	152	380	761	1,521
20%	30	61	152	304	761	1,521	3,042
30%	46	91	228	456	1,141	2,282	4,563
40%	61	122	304	608	1,521	3,042	6,084
50%	76	152	380	761	1,901	3,803	7,606
60%	91	183	456	913	2,282	4,563	9,127
70%	106	213	532	1,065	2,662	5,324	10,648
80%	122	243	608	1,217	3,042	6,084	12,169
90%	137	274	684	1,369	3,422	6,845	13,690
100%	152	304	761	1,521	3,803	7,606	15,211

Table 5-112: Operations and maintenance phase cumulative Manx shearwater mortality following displacement from offshore wind farms in the breeding season.

Displacement level (% at risk of displacement)	Mortality level (% of displaced birds at risk of mortality) 1%	2%	5%	10%	25%	50%	100%
10%	16	32	81	162	404	808	1,617
20%	32	65	162	323	808	1,617	3,234
30%	49	97	243	485	1,213	2,425	4,850
40%	65	129	323	647	1,617	3,234	6,467
50%	81	162	404	808	2,021	4,042	8,084
60%	97	194	485	970	2,425	4,850	9,701
70%	113	226	566	1,132	2,829	5,659	11,317
80%	129	259	647	1,293	3,234	6,467	12,934
90%	146	291	728	1,455	3,638	7,275	14,551
100%	162	323	808	1,617	4,042	8,084	16,168

Table 5-113: Operations and maintenance phase cumulative Manx shearwater mortality following displacement from offshore wind farms in the post-breeding season.

Displacement level (% at risk of displacement)	Mortality level (% of displaced birds at risk of mortality)						
	1%	2%	5%	10%	25%	50%	100%
10%	4	8	21	42	105	211	421
20%	8	17	42	84	211	421	843
30%	13	25	63	126	316	632	1,264
40%	17	34	84	169	421	843	1,686
50%	21	42	105	211	527	1,054	2,107
60%	25	51	126	253	632	1,264	2,529
70%	30	59	148	295	738	1,475	2,950
80%	34	67	169	337	843	1,686	3,372
90%	38	76	190	379	948	1,897	3,793
100%	42	84	211	421	1,054	2,107	4,215

Table 5-114: Operations and maintenance phase cumulative Manx shearwater mortality following displacement from offshore wind farms annually.

Displacement level (% at risk of displacement)	Mortality level (% of displaced birds at risk of mortality)						
	1%	2%	5%	10%	25%	50%	100%
10%	36	71	178	356	890	1,780	3,559
20%	71	142	356	712	1,780	3,559	7,119
30%	107	214	534	1,068	2,670	5,339	10,678
40%	142	285	712	1,424	3,559	7,119	14,237
50%	178	356	890	1,780	4,449	8,898	17,797
60%	214	427	1,068	2,136	5,339	10,678	21,356
70%	249	498	1,246	2,492	6,229	12,458	24,915
80%	285	569	1,424	2,847	7,119	14,237	28,475
90%	320	641	1,602	3,203	8,009	16,017	32,034
100%	356	712	1,780	3,559	8,898	17,797	35,593

5.9.2.105 During the spring migration (pre-breeding) season the displacement from operation when using the displacement rate of 50% (range of 30 to 70%) and a mortality rate of 1% (range of 1 to 10%), results in an additional loss of 76 (46 to 1,065) individuals (Table 5-111). The regional seas UK Western Waters & Channel BDMPS population of Manx shearwater in the spring migration period is estimated to be 1,580,895 individuals (Table 5-15). Assuming an average baseline mortality rate of 0.130 (Table 5-16), background mortality during spring migration is 205,516 individuals. The addition of 76 (46 to 1,065) individual mortalities due to cumulative displacement from the presence of infrastructure would increase the mortality relative to the baseline mortality by 0.04 % (0.02 to 0.52%).

5.9.2.106 During the breeding season the displacement from operation results in a loss of 81 (49 to 1,132) individuals from the migratory population (Table 5-112). The regional seas UK Western Waters & Channel BDMPS population of Manx shearwater within the breeding season is estimated to be 1,821,544 individuals (Table 5-15). Assuming an average baseline mortality rate of 0.130, background mortality in the breeding season is 236,801 individuals. The addition of 81 (49 to 1,132) individual mortalities due to cumulative displacement from construction activities would increase the mortality relative to the baseline mortality by 0.03% (0.02 to 0.48%).

5.9.2.107 During the autumn migration season (post-breeding), displacement from operation results in a loss of 21 (13 to 295) individuals from the migratory population (Table 5-113). The regional seas UK Western Waters & Channel BDMPS population of Manx shearwater during the autumn migration period is estimated to be 1,580,895 individuals (Table 5-15). Assuming an average baseline mortality rate of 0.130, background mortality during autumn migration is 205,516 individuals. The addition of 21 (13 to 295) individual mortalities due to cumulative displacement from the presence of infrastructure would increase the mortality relative to the baseline mortality by 0.01% (0.01 to 0.14%).

5.9.2.108 The annual estimated mortality resulting from displacement during construction is 178 (107 to 2,492) individuals (Table 5-114). Using the largest population of 1,821,544 individuals, with an average baseline mortality rate of 0.130, the background predicted mortality would be 236,801. The addition of 178 (107 to 2,492) mortalities would increase the baseline mortality rate by 0.08% (0.05 to 1.05%). The annual predicted mortality from the cumulative assessment is above the 1% threshold increase in baseline mortality when considering 70% displacement and 10% mortality.

5.9.2.109 Manx shearwater have a very large foraging range (~2000km), and therefore, the potential for being displaced by an offshore wind farm leading to 10% mortality is not considered to be realistic. Initially, as part of the EWG, a 1-10% displacement was requested by the JNCC (D.3.14 of Technical Engagement Plan Appendices - Part 1 (A to E) (Document Reference E4.1)), which was then changed to 30-70% (in line with auk). In addition, Manx shearwater have a very large population (over one million birds) and therefore, the potential for population impacts when the 1% threshold is only just surpassed (1.05% increase in baseline mortality) will not have a significant impact on the population size or growth rate. Therefore, the Applicant can conclude on the magnitude without the need to run a PVA.

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

Sensitivity of the receptor

Common guillemot

5.9.2.111 Evidence of guillemot sensitivity to displacement from offshore wind farms is summarised from paragraph 5.9.2.56 onwards. Common guillemot is deemed to be of medium vulnerability, medium recoverability and medium value. Overall, based on evidence from post-construction studies and reviews, guillemot is deemed to be of medium vulnerability, medium recoverability and high value. The sensitivity of the receptor is therefore, considered to be **medium**.

Razorbill

5.9.2.112 Evidence of razorbill sensitivity to displacement from offshore wind farms is summarised from paragraph 5.9.2.68 onwards. Overall, based on evidence from post-construction studies and reviews, razorbill is deemed to be of medium vulnerability, medium recoverability and medium value. The sensitivity of the receptor is therefore, considered to be **medium.**

Atlantic puffin

5.9.2.113 Evidence of Atlantic puffin sensitivity to displacement from offshore wind farms is summarised from paragraph 5.9.2.81 onwards. Overall, based on evidence from post-construction studies and reviews, Atlantic puffin is deemed to be of medium vulnerability, low recoverability and high value. The sensitivity of the receptor is therefore, considered to be **high**.

Northern gannet

5.9.2.114 Evidence of northern gannet sensitivity to displacement from offshore wind farms is summarised from paragraph 5.9.2.87 onwards. Based on evidence from operational wind farms demonstrating that northern gannet show a high avoidance of offshore wind farms, northern gannet is deemed to be of high vulnerability, medium recoverability and medium value. The sensitivity of the receptor is therefore, considered to be **medium.**

Black-legged kittiwake

5.9.2.115 Evidence of black-legged kittiwake sensitivity to displacement from offshore wind farms is summarised from paragraph 5.9.2.94 onwards. For kittiwake, there is evidence from other operating offshore wind farm projects that displacement is not likely to occur to any significant level. However, due to low reproductive rates, black-legged kittiwake is deemed to be of low vulnerability, low recoverability and medium value. The sensitivity of the receptor is therefore, considered to be **medium.**

Manx shearwater

5.9.2.116 For Manx shearwater, there is evidence from other operating offshore wind farm projects that displacement is not likely to occur to any significant level. However, due to low reproductive rates, Manx shearwater is deemed to be of low vulnerability, low recoverability and medium value. The sensitivity of the receptor is therefore, considered to be **medium**.

Significance of effect

5.9.2.117 Table 5-115 summarises the significance of effect cumulative on the species susceptible to disturbance and displacement impacts. All impacts are considered non-significant in EIA terms.

Table 5-115: Table summarising the cumulative significance of effect during operation.

Species	Magnitude of impact	Sensitivity of receptor	Significance of effect
Common guillemot	Low	Medium	**Minor adverse, not significant in EIA terms**
Razorbill	Low	Medium	**Minor adverse, not significant in EIA terms**
Atlantic puffin	Negligible	High	**Negligible, not significant in EIA terms**
Northern gannet	Low	Medium	**Minor adverse, not significant in EIA terms**
Black-legged kittiwake	Low	Medium	**Minor adverse, not significant in EIA terms**
Manx shearwater	Low	Medium	**Minor adverse, not significant in EIA terms**

Decommissioning phase

5.9.2.118 During the decommissioning phase, cumulative disturbance and displacement of red-throated divers, guillemots and razorbills would only occur if these activities occurred at the same time across offshore wind farms. Disturbance effects during the decommissioning phase are anticipated to be like construction if the decommissioning schedule of the Mona Offshore Wind Project will overlap with that for the other offshore wind farms within the CEA study area. The magnitude of impact would be negligible, with significance ranging from **negligible** to **minor** depending on the species, which is not significant in EIA terms.

5.9.3 Collision risk

Tier 1 and Tier 2

Operations and maintenance phase

5.9.3.1 The Mona Offshore Wind Project, together with other offshore wind farms in the Irish Sea, may contribute to cumulative collision risk, in the event the operations and maintenance phases of different projects overlap. Seabirds and migratory birds are highly mobile; therefore they can encounter different offshore wind farms, and be at risk of collisions, across large areas.

5.9.3.2 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. species biometrics) and the collision risk model used (e.g. deterministic) may vary from those put forward in this chapter. All of the impacts from other projects have been corrected to the latest avoidance rates (Ozsanlav-Harris *et al*., 2023) therefore Band Option 2 outputs have taken from other projects to allow this correction to occur.

5.9.3.3 The expected annual collision mortality for seabirds has been compiled from relevant offshore wind farms and is shown in Table 5-116.

5.9.3.4 The expected annual collision mortality for migratory birds has been compiled from relevant offshore wind farms and is shown in Table 5-128 to Table 5-133. Due to the number of species considered within the migratory bird section the tables are broken down as follows:

- Table 5-128 contains Bewick's swan, whooper swan, Greenland white-fronted goose, light-bellied brent goose (Canadian population), shelduck, wigeon, gadwall, teal, mallard and pintail
- Table 5-129 contains pochard, tufted duck, scaup, long-tailed duck, common scoter, goldeneye, red-breasted merganser, great northern diver and European storm petrel
- Table 5-130 contains Leach's storm petrel, bittern, great crested grebe, Slavonian grebe, hen harrier, osprey, merlin, corncrake and oystercatcher (breeding and non-breeding)

Table 5-131 contains ringed plover (breeding and non-breeding), dotterel, golden plover (breeding and non-breeding), grey plover, lapwing, knot, sanderling and purple sandpiper

- Table 5-132 contains dunlin, ruff, snipe, black-tailed godwit, bar-tailed godwit, whimbrel, curlew (breeding and non-breeding) and greenshank
- Table 5-133 contains wood sandpiper, redshank (breeding and non-breeding), turnstone, great skua, pomarine skua, long-tailed skua, black-headed gull and short-eared owl.

5.9.3.5 Any sections marked "Unavailable" in the tables from Table 5-116 to Table 5-133 are due to a lack of assessment or no available published data for the relevant species. Where this occurs, these offshore wind farms have been assessed qualitatively. Where a range of collision risks was provided, the worst-case scenario figure was used in this cumulative assessment.

Magnitude of impact

Black-legged kittiwake

5.9.3.6 The expected mean seasonal and annual collision mortality for kittiwake has been compiled for relevant offshore wind farms and is shown in Table 5-116, with estimates based on the species-group advocated avoidance rate of 99.28.

Table 5-116: Expected annual collision mortality across relevant offshore wind farms for black-legged kittiwake (avoidance rate 99.28)

Project	Annual	Pre-breeding Season	Breeding Season	Post-breeding Season
Tier 1				
Awel y Môr Offshore Wind Farm	35.25	15.30	11.66	8.29
Barrow Offshore Wind Farm	2.63	0.63	1.19	0.81
Burbo Bank Offshore Wind Farm	1.81	0.44	0.68	0.69
Burbo Bank Extension Offshore Wind Farm	23.04	unavailable	unavailable	unavailable

Project	Annual	Pre-breeding Season	Breeding Season	Post-breeding Season
Erebus Floating Wind Demo	37.65	12.51	0.50	24.64
Gwynt y Môr Offshore Wind Farm	29.40	6.79	11.82	10.79
TwinHub (Wave Hub Floating Wind Farm)	9.72	unavailable	unavailable	unavailable
Llŷr 1 Floating Wind Farm	24.48	2.16	1.13	21.19
Morecambe Generation Assets	25.44	0.62	16.32	8.50
Morgan Generation Assets	40.00	5.30	16.40	18.30
North Hoyle Offshore Wind Farm	3.22	0.77	1.47	0.98
Ormonde Wind Farm	3.27	unavailable	unavailable	unavailable
Rampion Offshore Wind Farm	128.16	41.76	70.56	15.84
Robin Rigg Offshore Wind Farm	3.34	0.74	1.33	1.27
Rhyl Flats Offshore Wind Farm	3.27	0.75	1.34	1.18
Walney 1 Offshore Wind Farm	4.84	1.16	1.81	1.87
Walney 2 Offshore Wind Farm	4.53	0.56	3.26	0.71
Walney (3 & 4) Extension Offshore Wind Farm	120.37	15.19	18.79	86.40
West of Duddon Sands Offshore Wind Farm	10.74	2.59	3.99	4.16
West of Orkney Windfarm	54.49	20.99	17.06	16.44
White Cross Offshore Windfarm	14.81	9.26	3.70	1.85
Tier 2				
Rampion 2 (Rampion Extension) Offshore Wind Farm	28.00	17.00	1.00	10.00
Total (minus the **Mona Offshore Wind Project)**	**608.46**	**154.51**	**184.01**	**233.91**
Mona Offshore Wind Project	32.67	8.74	15.52	8.41

Project	Annual	Pre-breeding Season	Breeding Season	Post-breeding Season
Cumulative total (all projects)	**641.13**	**163.25**	**199.53**	**242.32**

5.9.3.7 The estimated cumulative collision mortality of black-legged kittiwake from the projects considered within the CEA is 641.13 per year (Table 5-116). Using the largest population of 911,586 individuals (during the post-breeding/autumn migration), with an average baseline mortality rate of 0.156 (Table 5-16), the background predicted mortality would be 142,207. The addition of 641.13 mortalities would increase the baseline mortality rate by 0.45%. The annual predicted mortality from the cumulative collision risk assessment is below the 1% threshold increase in baseline mortality.

5.9.3.8 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**.

Great black-backed gull

5.9.3.9 The expected mean seasonal and annual collision mortality for great black-backed gull has been compiled for relevant offshore wind farms and is shown in Table 5-117 using the species-group avoidance rate of 99.39. Additionally, within Table 5-118 avoidance rates have been corrected to account for the species-specific avoidance rate of 99.91 calculated by Ozsanlav-Harris *et al.* (2023) which is considered more appropriate for this species, with species-specific estimates based on sufficient sample size.

Table 5-117: Expected annual collision mortality across relevant offshore wind farms for great black-backed gull (avoidance rate 99.39)

Project	Annual	Breeding Season	Non-breeding Season
Tier 1			
Awel y Môr Offshore Wind Farm	5.94	5.32	0.62
Barrow Offshore Wind Farm	2.21	0.78	1.42
Burbo Bank Offshore Wind Farm	2.31	1.31	1.00
Burbo Bank Extension Offshore Wind Farm	6.69	3.94	2.75
Erebus Floating Wind Demo	0.82	0.00	0.82
Gwynt y Môr Offshore Wind Farm	10.27	5.74	4.53
TwinHub (Wave Hub Floating Wind Farm)	15.74	unavailable	unavailable
Llŷr 1 Floating Wind Farm	1.61	0.65	0.96
Morecambe Generation Assets	1.75	0.66	1.09
Morgan Generation Assets	5.70	1.10	4.60

Project	Annual	Breeding Season	Non-breeding Season
North Hoyle offshore wind farm	1.69	0.96	0.73
Ormonde Wind Farm	0.29	unavailable	unavailable
Rampion Offshore Wind Farm	38.06	4.76	33.31
Robin Rigg Offshore Wind Farm	4.16	1.97	2.18
Rhyl Flats Offshore Wind Farm	1.91	0.89	1.01
Walney 1 Offshore Wind Farm	4.24	2.52	1.72
Walney 2 Offshore Wind Farm	4.15	2.10	2.06
Walney (3 & 4) Extension Offshore Wind Farm	25.96	5.89	20.07
West of Duddon Sands Offshore Wind Farm	8.32	5.67	2.68
West of Orkney Windfarm	No connectivity	No connectivity	No connectivity
White Cross Offshore Windfarm	0.93	0.93	0
Tier 2			
Rampion 2 (Rampion Extension) Offshore Wind Farm	19.84	6.25	13.59
Total (minus the **Mona** Offshore Wind Project**)**	**162.58**	**51.44**	**95.14**
Mona Offshore Wind Project	4.83	1.67	3.16
Cumulative total (all projects)	**167.41**	**53.11**	**98.30**

Table 5-118: Expected annual collision mortality across relevant offshore wind farms for great black-backed gull (avoidance rate 99.91)

Project	Annual	Breeding Season	Non-breeding Season
Tier 1			
Awel y Môr Offshore Wind Farm	0.87	0.78	0.09
Barrow Offshore Wind Farm	0.33	0.12	0.21
Burbo Bank Offshore Wind Farm	0.34	0.19	0.15
Burbo Bank Extension Offshore Wind Farm	0.99	0.58	0.41
Erebus Floating Wind Demo	0.12	0.00	0.12

Project	Annual	Breeding Season	Non-breeding Season
Gwynt y Môr Offshore Wind Farm	1.52	0.85	0.67
TwinHub (Wave Hub Floating Wind Farm)	2.32	unavailable	unavailable
Llŷr 1 Floating Wind Farm	0.24	0.10	0.14
Morecambe Offshore Windfarm Generation Assets	0.26	0.10	0.16
Morgan Offshore Wind Project Generation Assets	0.84	0.16	0.68
North Hoyle offshore wind farm	0.25	0.14	0.11
Ormonde Wind Farm	0.04	unavailable	unavailable
Rampion Offshore Wind Farm	5.62	0.70	4.91
Robin Rigg Offshore Wind Farm	0.61	0.29	0.32
Rhyl Flats Offshore Wind Farm	0.28	0.13	0.15
Walney 1 Offshore Wind Farm	0.63	0.37	0.25
Walney 2 Offshore Wind Farm	0.61	0.31	0.30
Walney (3 & 4) Extension Offshore Wind Farm	3.83	0.87	2.96
West of Duddon Sands Offshore Wind Farm	1.23	0.84	0.40
West of Orkney Windfarm	No connectivity	No connectivity	No connectivity
White Cross Offshore Windfarm	0.14	0.14	0.00
Tier 2			
Rampion 2 (Rampion Extension) Offshore Wind Farm	2.93	0.92	2.01
Total (minus the Mona Offshore Wind Project)	**23.99**	**7.59**	**14.04**
Mona Offshore Wind Project	0.71	0.25	0.47
Cumulative total (all projects)	**24.70**	**7.84**	**14.50**

5.9.3.10 The estimated annual cumulative collision mortality of great black-backed gull from the projects considered within the CEA, using species-specific (0.9991) and species-group (0.9939) avoidance rates used in the CRM for cumulative projects is 24.70 per year and 167.41 per year, respectively (Table 5-117 and Table 5-118).

5.9.3.11 Using the largest population (during the non-breeding season) of 17,742 individuals, with an average baseline mortality rate of 0.095 (Table 5-16), the background predicted baseline mortality would be 1,685. The addition of these mortalities to the baseline mortality rate results in an increase of 1.47% and 9.93% for avoidance rates of 0.9991 and 0.9939, respectively.

5.9.3.12 As the predicted increase in baseline mortality of the population for great black-backed gull exceeds an increase of 1% when considering an avoidance rate of 0.9939 and 0.9991 annually, a PVA was undertaken to investigate the population effects of these predicted cumulative impacts. The input parameters are summarised in Table 5-119 and provided in full in Appendix B.3B.2.

5.9.3.13 The PVA revealed that the addition of great black-backed gull collision impacts from cumulative offshore wind farms would result in the population being 5.3% to 31.2% smaller under the two impact scenarios (species-specific avoidance rate (0.9991) or species-group avoidance rate (0.9939)) after 35 years (in 2065), when compred to the non-impacted population (Table 5-120). However, the counterfactual of population size (CPS) is not an appropriate metric due to the PVAs being run density independently. Therefore the counterfactual of growth rate (CGR) is a more appropriate metric. The CGR is 0.998 (i.e. a 0.2% reduction) when considering the species-specific avoidance rate (0.9991) or 0.990 (i.e. a 1% reduction) when considering the species-group avoidance rate (0.9939).

5.9.3.14 Overall the predicted median growth rate under the two impact scenarios and the unimpacted baseline scenario would continue to be positive (>1), including when considering the lower and upper 95% confidence intervals and therefore the population is predicted to increase in size under the modelled scenarios.

Table 5-119: Summary of the annual CEA PVA inputs for great black-backed gull.

Scenario	Predicted adult mortalities	Increase in baseline mortality (%)	Decrease in survival rate
A: 99.91% Avoidance rate	24.70	1.47%	0.0013922
B: 99.39% Avoidance rate	167.41	9.93%	0.0094357

Table 5-120: PVA outputs for great black-backed gull CEA.

Year	Impact scenario	Median adult population size	Population change (%) since 2017	Median growth rate	2.5 percentile of growth rate	97.5 percentile of growth rate	Median CPS	Median CGR
2030	Baseline	106,348	12.72%	1.127	1.058	1.195	-	-
2030	Impact (Scenario A)	106,167	12.55%	1.125	1.057	1.193	0.999	0.998
2030	Impact (Scenario B)	105,180	11.54%	1.115	1.046	1.183	0.990	0.990
2065	Baseline	6,830,545	7151.07%	1.126	1.120	1.133	-	-
2065	Impact (Scenario A)	6,466,720	6765.40%	1.125	1.118	1.131	0.947	0.998
2065	Impact (Scenario B)	4,702,469	4891.86%	1.115	1.108	1.121	0.688	0.990

5.9.3.15 Due to the minimal level of change to baseline conditions (within the CGR), 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**.

Herring gull

5.9.3.16 The expected mean seasonal and annual collision mortality for herring gull has been compiled for relevant offshore wind farms and is shown in Table 5-121 using the species-group avoidance rate of 99.39. Additionally, within Table 5-122 avoidance rates have been corrected to account for the species-specific avoidance rate of 99.52

calculated by Ozsanlav-Harris *et al.* (2023) which are considered more appropriate for this species, with species-specific estimates based on sufficient sample size.

Table 5-121: Expected annual collision mortality across relevant offshore wind farms for herring gull (avoidance rate 99.39)

Project	Annual	Breeding Season	Non-breeding Season
Tier 1			
Awel y Môr Offshore Wind Farm	3.61	2.03	1.59
Barrow Offshore Wind Farm	16.15	14.34	1.81
Burbo Bank Offshore Wind Farm	3.38	1.85	1.53
Burbo Bank Extension Offshore Wind Farm	28.97	unavailable	unavailable
Erebus Floating Wind Demo	4.60	2.83	1.77
Gwynt y Môr Offshore Wind Farm	unavailable	unavailable	unavailable
TwinHub (Wave Hub Floating Wind Farm)	33.55	unavailable	unavailable
Llŷr 1 Floating Wind Farm	0.00	0.00	0.00
Morecambe Offshore Windfarm Generation Assets	4.16	1.78	2.38
Morgan Offshore Wind Project Generation Assets	9.90	2.00	7.90
North Hoyle offshore wind farm	4.36	2.39	1.97
Ormonde Wind Farm	0.44	unavailable	unavailable
Robin Rigg Offshore Wind Farm	10.15	6.92	3.23
Rhyl Flats Offshore Wind Farm	7.62	5.18	2.44
Walney 1 Offshore Wind Farm	17.97	14.75	3.22
Walney 2 Offshore Wind Farm	12.72	4.81	7.91
Walney (3 & 4) Extension Offshore Wind Farm	75.64	46.36	29.28
West of Duddon Sands Offshore Wind Farm	39.63	32.37	7.26
West of Orkney Windfarm	0	0	0
White Cross Offshore Windfarm	0.30	0.30	0

Project	Annual	Breeding Season	Non-breeding Season
Total (minus the Mona Offshore Wind Project)	**312.05**	**159.23**	**89.85**
Mona Offshore Wind Project	1.51	0.03	1.48
Cumulative total (all projects)	**313.56**	**159.26**	**91.33**

Table 5-122: Expected annual collision mortality across relevant offshore wind farms for herring gull (avoidance rate 99.52)

Project	Annual	Breeding Season	Non-breeding Season
Tier 1			
Awel y Môr Offshore Wind Farm	2.84	1.59	1.25
Barrow Offshore Wind Farm	12.71	11.28	1.42
Burbo Bank Offshore Wind Farm	2.66	1.46	1.20
Burbo Bank Extension Offshore Wind Farm	22.80	0.00	0.00
Erebus Floating Wind Demo	3.62	2.23	1.39
Gwynt y Môr Offshore Wind Farm	30.60	16.78	13.83
TwinHub (Wave Hub Floating Wind Farm)	26.40	unavailable	unavailable
Llŷr 1 Floating Wind Farm	0.00	0.00	0.00
Morecambe Generation Assets	3.27	1.40	1.87
Morgan Generation Assets	7.79	1.57	6.22
North Hoyle offshore wind farm	3.43	1.88	1.55
Ormonde Wind Farm	0.35	unavailable	unavailable
Robin Rigg Offshore Wind Farm	7.99	5.45	2.54
Rhyl Flats Offshore Wind Farm	6.00	4.08	1.92
Walney 1 Offshore Wind Farm	14.14	11.61	2.53
Walney 2 Offshore Wind Farm	10.01	3.78	6.22

Project	Annual	Breeding Season	Non-breeding Season
Walney (3 & 4) Extension Offshore Wind Farm	59.52	36.48	23.04
West of Duddon Sands Offshore Wind Farm	31.18	25.47	5.71
West of Orkney Windfarm	0	0	0
White Cross Offshore Windfarm	0.24	0.24	0.00
Total (minus the **Mona Offshore Wind Project)**	**245.55**	**125.30**	**70.71**
Mona Offshore Wind Project	1.19	0.02	1.16
Cumulative total (all projects)	**246.74**	**125.32**	**71.87**

5.9.3.17 The estimated annual cumulative collision mortality of herring gull from the projects considered within the CEA, using species-specific (0.9952) and species-group (0.9939) avoidance rates used in the CRM for cumulative projects is 246.74 per year and 313.56 per year, respectively.

5.9.3.18 Using the largest population (during the breeding season) of 217,167 individuals, with an average baseline mortality rate of 0.171 (Table 5-16), the background predicted mortality would be 37,136. The addition of 246.74 mortalities per year when considering the species-specific avoidance rate (0.9952) or 313.56 mortalities per year when considering the species-group avoidance rate (0.9939) would increase the baseline mortality rate by 0.66% or 0.84%, respectively. The annual predicted mortality from the cumulative collision risk assessment is below the 1% threshold increase in baseline mortality.

5.9.3.19 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.**

Lesser black-backed gull

5.9.3.20 The expected mean seasonal and annual collision mortality for lesser black-backed gull has been compiled for relevant offshore wind farms and is shown in Table 5-123, using the species-group avoidance rate of 99.39. Additionally, within Table 5-124 avoidance rates have been corrected to account for the species-specific avoidance rate of 99.54 calculated by Ozsanlav-Harris *et al.* (2023) which are considered more appropriate for this species, with species-specific estimates based on sufficient sample size.

Table 5-123: Expected annual collision mortality across relevant offshore wind farms for lesser black-backed gull (avoidance rate 99.39)

Project	Annual	Pre-breeding season	Breeding season	Post-breeding season	Non-breeding Season
Tier 1					
Awel y Môr Offshore Wind Farm	Species not assessed due to low numbers recorded	Species not assessed due to low numbers recorded	Species not assessed due to low numbers recorded	Species not assessed due to low numbers recorded	Species not assessed due to low numbers recorded
Barrow Offshore Wind Farm	7.32	unavailable	unavailable	unavailable	unavailable
Burbo Bank Offshore Wind Farm	2.10	unavailable	unavailable	unavailable	unavailable
Burbo Bank Extension Offshore Wind Farm	53.68	unavailable	unavailable	unavailable	unavailable
Erebus Floating Wind Demo	8.21	0.00	7.61	0.60	Grouped as post-breeding
Gwynt y Môr Offshore Wind Farm	7.32	unavailable	unavailable	unavailable	unavailable
Llŷr 1 Floating Wind Farm	1.93	0.41	1.12	0.20	0.20
Morecambe Generation Assets	3.55	0.15	2.02	1.23	0.15
Morgan Generation Assets	1.30	0.30	0.30	0.40	0.30
North Hoyle offshore wind farm	0.71	unavailable	unavailable	unavailable	unavailable
Ormonde Wind Farm	26.96	unavailable	unavailable	unavailable	unavailable
Robin Rigg Offshore Wind Farm	5.42	0.22	4.41	0.41	0.38
Rhyl Flats Offshore Wind Farm	0.70	unavailable	unavailable	unavailable	unavailable
TwinHub (Wave Hub Floating Wind Farm)	8.30	unavailable	unavailable	unavailable	unavailable
Walney 1 & 2 Offshore Wind Farms	69.78	unavailable	unavailable	unavailable	unavailable

Project	Annual	Pre-breeding season	Breeding season	Post-breeding season	Non-breeding Season
Walney (3 & 4) Extension Offshore Wind Farm	35.75	3.17	8.91	7.56	16.10
West of Duddon Sands Offshore Wind Farm	63.93	unavailable	unavailable	unavailable	unavailable
West of Orkney Windfarm	Species not assessed due to low numbers recorded	Species not assessed due to low numbers recorded	Species not assessed due to low numbers recorded	Species not assessed due to low numbers recorded	Species not assessed due to low numbers recorded
White Cross Offshore Windfarm	0.41	0.00	0.41	0.00	0.00
Total (minus the **Mona** Offshore Wind Project**)**	**297.36**	**4.25**	**24.77**	**10.41**	**17.14**
Mona Offshore Wind Project	1.92	0.83	0.33	0.00	0.76
Cumulative total (all projects)	**299.28**	**5.08**	**25.10**	**10.41**	**17.90**

Table 5-124: Expected annual collision mortality across relevant offshore wind farms for lesser black-backed gull (avoidance rate 99.54)

Project	Annual	Pre-breeding season	Breeding Season	Post-breeding season	Non-breeding Season
Tier 1					
Awel y Môr Offshore Wind Farm	Species not assessed due to low numbers recorded	Species not assessed due to low numbers recorded	Species not assessed due to low numbers recorded	Species not assessed due to low numbers recorded	Species not assessed due to low numbers recorded
Barrow Offshore Wind Farm	5.52	unavailable	unavailable	unavailable	unavailable
Burbo Bank Offshore Wind Farm	1.58	unavailable	unavailable	unavailable	unavailable
Burbo Bank Extension Offshore Wind Farm	40.48	unavailable	unavailable	unavailable	unavailable
Erebus Floating Wind Demo	6.19	0.00	5.74	0.45	0.00
Gwynt y Môr Offshore Wind Farm	5.52	unavailable	unavailable	unavailable	unavailable

Project	Annual	Pre-breeding season	Breeding Season	Post-breeding season	Non-breeding Season
Llŷr 1 Floating Wind Farm	1.46	0.31	0.84	0.15	0.15
Morecambe Generation Assets	2.68	0.11	1.52	0.93	0.11
Morgan Generation Assets	0.98	0.23	0.23	0.30	0.23
North Hoyle offshore wind farm	0.53	unavailable	unavailable	unavailable	unavailable
Ormonde Wind Farm	20.33	unavailable	unavailable	unavailable	unavailable
Robin Rigg Offshore Wind Farm	4.09	4.41	0.41	0.38	0.01
Rhyl Flats Offshore Wind Farm	0.52	unavailable	unavailable	unavailable	unavailable
TwinHub (Wave Hub Floating Wind Farm)	6.26	unavailable	unavailable	unavailable	unavailable
Walney 1 & 2 Offshore Wind Farms	52.62	unavailable	unavailable	unavailable	unavailable
Walney (3 & 4) Extension Offshore Wind Farm	26.96	2.39	6.72	5.70	12.14
West of Duddon Sands Offshore Wind Farm	48.21	unavailable	unavailable	unavailable	unavailable
West of Orkney Windfarm	Species not assessed due to low numbers recorded	Species not assessed due to low numbers recorded	Species not assessed due to low numbers recorded	Species not assessed due to low numbers recorded	Species not assessed due to low numbers recorded
White Cross Offshore Windfarm	0.31	0.00	0.31	0.00	0.00
Total (minus the Mona Offshore Wind Project)	**224.24**	**7.45**	**15.77**	**7.92**	**12.64**
Mona Offshore Wind Project	1.47	0.64	0.26	0.00	0.58
Cumulative total (all projects)	**225.68**	**8.07**	**16.02**	**7.92**	**13.22**

5.9.3.21 The estimated cumulative collision mortality of lesser black-backed gull from the projects considered within the CEA is 299.28 per year using species-group avoidance rate of 99.39% and 225.68 per year using species-specific rates of 99.54%.

5.9.3.22 Using the largest population of 240,750 individuals, with an average baseline mortality rate of 0.121 (Table 5-16), the background predicted mortality would be 29,131. The addition of between 225.65 and 299.28 mortalities would increase the baseline mortality rate by between 0.77% and 1.03% depending on the avoidance rate used.

5.9.3.23 As the predicted increase in baseline mortality of the population for lesser black-backed gull exceeds an increase of 1% when considering an avoidance rate of 0.9939 annually, a PVA was undertaken to investigate the population effects of these predicted cumulative impacts. The input parameters are summarised in Table 5-125 and provided in full in Appendix B.4.

5.9.3.24 The PVA revealed that the addition of lesser black-backed gull collision impacts from cumulative offshore wind farms would result in the population being 4.8% to 5.0% smaller under the two impact scenarios (species-specific avoidance rate (0.9954) or species-group avoidance rate (0.9939) after 35 years (in 2065), than a non-impacted population (Table 5-126). However, the CPS is not an appropriate metric due to the PVAs being run density independently. Therefore the CGR is a more appropriate metric. The CGR is 0.999 (i.e. a 0.1% reduction) when considering the species-specific avoidance rate (0.9954) and species-group avoidance rate (0.9939).

5.9.3.25 Overall the predicted median growth rate under the two impact scenarios and the unimpacted baseline scenario is predicted to decline, however the variation around the median indicates both increasing and decreasing populations and therefore the population is predicted to increase in size under the modelled scenarios. The predicted CEA impact is having a marginally small change (0.1% change) to this growth rate.

Table 5-125: Summary of the annual CEA PVA inputs for lesser black-backed gull.

Scenario	Predicted adult mortalities	Increase in baseline mortality (%)	Decrease in survival rate
A: 99.54% Avoidance rate	225.68	0.77%	0.0009374
B: 99.39% Avoidance rate	299.28	1.03%	0.0012431

Table 5-126: PVA outputs for lesser black-backed gull CEA.

Year	Impact scenario	Median adult population size	Population change (%) since 2015	Median growth rate	2.5 percentile of growth rate	97.5 percentile of growth rate	Median CPS	Median CGR
2030	Baseline	223,566	-1.54%	0.985	0.859	1.206	-	-
2030	Impact (Scenario A)	223,271	-1.63%	0.984	0.858	1.204	0.999	0.999
2030	Impact (Scenario B)	223,177	-1.70%	0.983	0.858	1.205	0.999	0.999
2065	Baseline	183,729	-17.88%	0.995	0.972	1.017	-	-
2065	Impact (Scenario A)	176,802	-20.88%	0.994	0.971	1.016	0.962	0.999
2065	Impact (Scenario B)	174,610	-21.87%	0.993	0.971	1.015	0.950	0.999

5.9.3.26 Due to the minimal level of change to baseline conditions (within the CGR of 0.1%), 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**.

Northern gannet

5.9.3.27 The expected mean seasonal and annual collision mortality for northern gannet has been compiled for relevant offshore wind farms and is shown in Table 5-127, using the species-group avoidance rate of 99.28.

Table 5-127: Expected annual collision mortality across relevant offshore wind farms for northern gannet (avoidance rate 99.28)

Project	Annual	Pre-breeding season	Breeding season	Post-breeding season
Tier 1				
Awel y Môr Offshore Wind Farm	13.41	0.00	10.88	2.53
Barrow Offshore Wind Farm	0.74	0.07	0.57	0.10
Burbo Bank Offshore Wind Farm	0.48	0.06	0.36	0.06
Burbo Bank Extension Offshore Wind Farm	12.44	unavailable	unavailable	unavailable
Erebus Floating Wind Demo	4.59	0.61	3.37	0.61
Gwynt y Môr Offshore Wind Farm	9.56	1.02	7.30	1.24
TwinHub (Wave Hub Floating Wind Farm)	26.12	unavailable	unavailable	unavailable
Llŷr 1 Floating Wind Farm	3.91	0.31	3.09	0.51
Morecambe Offshore Windfarm Generation Assets	1.26	0.02	1.24	0.00
Morgan Offshore Wind Project Generation Assets	0.45	0.00	0.39	0.06
North Hoyle offshore wind farm	0.97	0.10	0.74	0.13
Ormonde Wind Farm	6.72	unavailable	unavailable	unavailable
Robin Rigg Offshore Wind Farm	0.91	0.09	0.70	0.12
Rhyl Flats Offshore Wind Farm	1.62	0.40	1.04	0.18
Walney 1 Offshore Wind Farm	1.16	0.12	0.89	0.15
Walney 2 Offshore Wind Farm	1.33	0.14	1.02	0.17

Project	Annual	Pre-breeding season	Breeding season	Post-breeding season
Walney (3 & 4) Extension Offshore Wind Farm	33.77	0.92	16.30	16.56
West of Duddon Sands Offshore Wind Farm	2.55	0.26	1.96	0.33
West of Orkney Windfarm	48.83	2.10	33.80	12.92
White Cross Offshore Windfarm	6.11	0	4.42	1.69
Total (minus the Mona Offshore Wind Project)	**176.93**	**6.22**	**88.06**	**37.37**
Mona Offshore Wind Project	5.65	0.41	4.73	0.51
Cumulative total (all projects)	**182.58**	**6.63**	**92.79**	**37.88**

5.9.3.28 The estimated cumulative collision mortality of northern gannet from the projects considered within the CEA is 182.58 per year when assuming a 99.28% avoidance rate and no macro-avoidance.

5.9.3.29 Using the largest population of 661,888 individuals, with an average baseline mortality rate of 0.193 (Table 5-16), the background predicted mortality would be 127,744. The addition of 182.58 mortalities would increase the baseline mortality rate by 0.14%. The annual predicted mortality from the cumulative collision risk assessment is well below the 1% threshold increase in baseline mortality.

5.9.3.30 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.**

Migratory birds

5.9.3.31 A total of 16 migratory species are estimated to experience a cumulative collision mortality greater than one per year. This includes nine wader species, five duck species and one gull.

5.9.3.32 Due to their very large biogeographic population size and migration routes through the Irish sea, wader species were at the greatest risk of collision. Despite this, no increase in annual mortality due to a combined collision risk is anticipated to be greater than 0.09% (dunlin, sub-species *alpina*) for any wader species.

5.9.3.33 The annual predicted mortality from the cumulative collision risk assessment is below the 1% threshold increase in baseline mortality for all assessed migratory bird species.

5.9.3.34 Due to the minimal level of change to baseline mortality across the migratory bird species, the cumulative effect is predicted to be of national spatial extent, medium to long term duration, continuous and high reversibility. It is predicted that the impact will affect the receptor group directly. The magnitude is therefore, considered to be **low.**

Table 5-128: Expected annual collision mortality across relevant offshore wind farms for all migratory bird species assessed for collision risk.

Project	Species									
	Bewick swan	Whooper swan	White-fronted goose	Light-bellied brent goose	Shelduck	Wigeon	Gadwall	Teal	Mallard	Pintail
Tier 1										
Barrow Offshore Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Burbo Bank Offshore Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Burbo Bank Extension Offshore Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	0.00	Unavailable	Unavailable	0.00	Unavailable	0.00
Llŷr 1 Floating Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Morgan Generation Assets	0.02	0.13	0.06	0.21	0.04	0.18	0.00	0.09	0.09	0.00
Morecambe Offshore Windfarm Generation Assets	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
North Hoyle Offshore Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Ormonde Wind Farm	Unavailable	0.12	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Walney 1 & 2 Offshore Wind Farms	Unavailable	N/A	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Walney (3 & 4) Extension Offshore Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	1.00	2.00	Unavailable	1.00	Unavailable	0.00
West of Duddon Sands Offshore Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Gwynt y Môr Offshore Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Rhyl Flats Offshore Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Robin Rigg Offshore Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable

Project	Species									
	Bewick swan	Whooper swan	White-fronted goose	Light-bellied brent goose	Shelduck	Wigeon	Gadwall	Teal	Mallard	Pintail
Arklow Bank Wind Park Phase 1	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Awel y Môr Offshore Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Erebus Floating Wind Demo	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
White Cross Offshore Windfarm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Tier 2										
North Irish Sea Array	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Codling Wind Park	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Dublin Array Offshore Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Oriel Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Arklow Bank Wind Park Phase 2	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Shelmalere Offshore Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Llŷr 2 Floating Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Inis Eagla Marine Energy Park	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Total (minus Mona Offshore Wind Project)	**0.00**	**0.12**	**0.00**	**0.00**	**1.00**	**2.00**	**0.00**	**1.00**	**0.00**	**0.00**
Mona Offshore Wind Project	0.01	0.40	0.15	0.01	0.22	1.78	0.14	1.60	2.89	0.08
Cumulative total	**0.01**	**0.52**	**0.15**	**0.01**	**1.22**	**3.78**	**0.14**	**2.6**	**2.89**	**0.08**
Increase in baseline mortality (%)	**0.02**	**0.13**	**0.06**	**0.21**	**0.04**	**0.18**	**0.00**	**0.09**	**0.09**	**0.00**

Table 5-129: Expected annual collision mortality across relevant offshore wind farms for all migratory bird species assessed for collision risk.

Project	Species: Shoveler	Pochard	Tufted duck	Scaup	Long-tailed duck	Common scoter	Goldeneye	Red-breasted merganser	Great northern diver	European storm petrel
Tier 1										
Barrow Offshore Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Burbo Bank Offshore Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Burbo Bank Extension Offshore Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	2.00	Unavailable	Unavailable	Unavailable	Unavailable
Llŷr 1 Floating Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Morgan Generation Assets	0.01	0.09	0.08	0.01	0.01	0.00	0.02	0.01	Unavailable	Unavailable
Morecambe Offshore Windfarm Generation Assets	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
North Hoyle Offshore Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Ormonde Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	0.85	Unavailable	Unavailable	Unavailable	Unavailable
Walney 1 & 2 Offshore Wind Farms	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Walney (3 & 4) Extension Offshore Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
West of Duddon Sands Offshore Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Gwynt y Môr Offshore Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Rhyl Flats Offshore Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Robin Rigg Offshore Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable

Project	Species									
	Shoveler	Pochard	Tufted duck	Scaup	Long-tailed duck	Common scoter	Goldeneye	Red-breasted merganser	Great northern diver	European storm petrel
Arklow Bank Wind Park Phase 1	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Awel y Môr Offshore Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	0.04	Unavailable	Unavailable
White Cross Offshore Windfarm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Erebus Floating Wind Demo	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	0.00
Tier 2										
North Irish Sea Array	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Codling Wind Park	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Dublin Array Offshore Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Oriel Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Arklow Bank Wind Park Phase 2	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Shelmalere Offshore Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Llŷr 2 Floating Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Inis Eagla Marine Energy Park	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Total (minus Mona Offshore Wind Project)	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**2.85**	**0.00**	**0.04**	**0.00**	**0.00**
Mona Offshore Wind Project	0.08	0.12	0.54	0.03	0.05	0.04	0.08	0.04	0.02	0.30
Cumulative total	**0.08**	**0.12**	**0.54**	**0.03**	**0.05**	**2.89**	**0.08**	**0.08**	**0.02**	**0.30**
Increase in baseline mortality (%)	**0.001**	**0.001**	**0.001**	**0.001**	**0.001**	**0.010**	**0.002**	**0.004**	**0.006**	**0.008**

Table 5-130: Expected annual collision mortality across relevant offshore wind farms for all migratory bird species assessed for collision risk.

Project	Species									
	Leach's storm petrel	Bittern	Great crested grebe	Slavonian grebe	Hen harrier	Osprey	Merlin	Corncrake	Oystercatcher (breeding)	Oystercatcher (non-breeding)
Tier 1										
Barrow Offshore Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Burbo Bank Offshore Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Burbo Bank Extension Offshore Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	0.00	0.00
Llŷr 1 Floating Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Morgan Generation Assets	Unavailable	0.01	0.01	0.00	0.00	0.00	0.14	0.01	0.19	0.23
Morecambe Offshore Windfarm Generation Assets	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
North Hoyle Offshore Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Ormonde Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Walney 1 & 2 Offshore Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Walney (3 & 4) Extension Offshore Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	4.00	4.00
West of Duddon Sands Offshore Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Gwynt y Môr Offshore Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Rhyl Flats Offshore Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Robin Rigg Offshore Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable

Project	Species									
	Leach's storm petrel	Bittern	Great crested grebe	Slavonian grebe	Hen harrier	Osprey	Merlin	Corncrake	Oystercatcher (breeding)	Oystercatcher (non-breeding)
Arklow Bank Wind Park Phase 1	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Awel y Môr Offshore Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	1.11	1.11
Erebus Floating Wind Demo	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
White Cross Offshore Windfarm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Tier 2										
North Irish Sea Array	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Codling Wind Park	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Dublin Array Offshore Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Oriel Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Arklow Bank Wind Park Phase 2	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Shelmalere Offshore Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Llŷr 2 Floating Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Inis Eagla Marine Energy Park	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Total (minus Mona Offshore Wind Project)	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**5.11**	**5.11**
Mona Offshore Wind Project	0.75	0.03	0.06	0.00	0.01	0.01	0.01	0.01	0.57	1.82
Cumulative total	**0.75**	**0.03**	**0.06**	**0.00**	**0.01**	**0.01**	**0.01**	**0.01**	**5.68**	**6.93**
Increase in baseline mortality (%)	**0.012**	**0.013**	**0.002**	**0.000**	**0.010**	**0.028**	**0.002**	**0.001**	**0.050**	**0.019**

Table 5-131: Expected annual collision mortality across relevant offshore wind farms for all migratory bird species assessed for collision risk.

Project	Species									
	Ringed plover (breeding)	Ringed plover (non-breeding)	Dotterel	Golden plover (breeding)	Golden plover (non-breeding)	Grey plover	Lapwing	Knot	Sanderling	Purple sandpiper
Tier 1										
Barrow Offshore Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Burbo Bank Offshore Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Burbo Bank Extension	0.00	0.00	Unavailable	0.00	0.00	0.00	Unavailable	0.00	Unavailable	Unavailable
Llŷr 1 Floating Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Morgan Generation Assets	0.02	0.23	0.00	1.20	0.50	0.02	0.62	0.06	0.02	0.01
Morecambe Offshore Windfarm Generation Assets	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
North Hoyle Offshore Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Ormonde Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Walney 1 & 2 Offshore Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Walney (3 & 4) Extension Offshore Wind Farm	0.00	0.00	Unavailable	0.00	0.00	0.00	Unavailable	4.00	Unavailable	Unavailable
West of Duddon Sands Offshore Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Gwynt y Môr Offshore Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable

Project	Species									
	Ringed plover (breeding)	Ringed plover (non-breeding)	Dotterel	Golden plover (breeding)	Golden plover (non-breeding)	Grey plover	Lapwing	Knot	Sanderling	Purple sandpiper
Rhyl Flats Offshore Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Robin Rigg Offshore Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Arklow Bank Wind Park Phase 1	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Awel y Môr Offshore Wind Farm	0.04	0.14	Unavailable	0.87	0.87	Unavailable	Unavailable	0.57	0.09	Unavailable
Erebus Floating Wind Demo	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
White Cross Offshore Windfarm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Tier 2										
North Irish Sea Array	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Codling Wind Park	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Dublin Array Offshore Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Oriel Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Arklow Bank Wind Park Phase 2	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Shelmalere Offshore Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Llŷr 2 Floating Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Inis Eagla Marine Energy Park	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Total (minus Mona Offshore Wind Project)	**0.04**	**0.14**	**0.00**	**0.87**	**0.87**	**0.00**	**0.00**	**4.57**	**0.09**	**0.00**

Project	Species									
	Ringed plover (breeding)	Ringed plover (non-breeding)	Dotterel	Golden plover (breeding)	Golden plover (non-breeding)	Grey plover	Lapwing	Knot	Sanderling	Purple sandpiper
Mona Offshore Wind Project	0.03	0.24	0.00	0.27	2.22	0.20	3.40	1.55	0.11	0.05
Cumulative total	**0.07**	**0.38**	**0.00**	**1.14**	**3.09**	**0.20**	**3.40**	**6.12**	**0.20**	**0.05**
Increase in baseline mortality (%)	0.006	0.004	0.000	0.008	0.003	0.004	0.002	0.015	0.006	0.002

Table 5-132: Expected annual collision mortality across relevant offshore wind farms for all migratory bird species assessed for collision risk.

Project	Species									
	Dunlin (sub-species schinzii and arctica)	Dunlin (sub-species alpina)	Ruff	Snipe	Black-tailed godwit (Icelandic race)	Bar-tailed godwit	Whimbrel	Curlew (breeding)	Curlew (non-breeding)	Greenshank
Tier 1										
Barrow Offshore Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Burbo Bank Offshore Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Burbo Bank Extension	0.00	0.00	Unavailable	Unavailable	0.00	0.00	Unavailable	0.00	0.00	Unavailable

Project	Species									
	Dunlin (sub-species schinzii and arctica)	Dunlin (sub-species alpina)	Ruff	Snipe	Black-tailed godwit (Icelandic race)	Bar-tailed godwit	Whimbrel	Curlew (breeding)	Curlew (non-breeding)	Greenshank
Llŷr 1 Floating Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Morgan Generation Assets	2.79	0.32	0.01	3.11	0.05	0.07	0.01	0.40	0.20	0.00
Morecambe Offshore Windfarm Generation Assets	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
North Hoyle Offshore Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Ormonde Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Walney 1 & 2 Offshore Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Walney (3 & 4) Extension Offshore Wind Farm	8.00	8.00	Unavailable	Unavailable	0.00	1.00	Unavailable	1.00	1.00	Unavailable
West of Duddon Sands Offshore Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Gwynt y Môr Offshore Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Rhyl Flats Offshore Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Robin Rigg Offshore Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Arklow Bank Wind Park Phase 1	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Awel y Môr Offshore Wind Farm	0.05	0.05	Unavailable	Unavailable	0.28	Unavailable	Unavailable	0.47	0.47	0.01
Erebus Floating Wind Demo	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
White Cross Offshore Windfarm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Tier 2										

Project	Species									
	Dunlin (sub-species schinzii and arctica)	Dunlin (sub-species alpina)	Ruff	Snipe	Black-tailed godwit (Icelandic race)	Bar-tailed godwit	Whimbrel	Curlew (breeding)	Curlew (non-breeding)	Greenshank
North Irish Sea Array	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Codling Wind Park	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Dublin Array Offshore Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Oriel Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Arklow Bank Wind Park Phase 2	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Shelmalere Offshore Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Llŷr 2 Floating Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Inis Eagla Marine Energy Park	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Total (minus Mona Offshore Wind Project)	**8.05**	**8.05**	**0.00**	**0.00**	**0.28**	**1.00**	**0.00**	**1.47**	**1.47**	**0.01**
Mona Offshore Wind Project	1.77	0.24	0.01	6.16	0.26	0.40	0.00	1.13	0.58	0.01
Cumulative total	**9.82**	**8.29**	**0.01**	**6.16**	**0.54**	**1.40**	**0.00**	**2.60**	**2.05**	**0.02**
Increase in baseline mortality (%)	**0.011**	**0.091**	**0.003**	**0.001**	**0.022**	**0.009**	**0.000**	**0.044**	**0.016**	**0.027**

Table 5-133: Expected annual collision mortality across relevant offshore wind farms for all migratory bird species assessed for collision risk.

Project	Species								
	Wood sandpiper	Redshank (breeding)	Redshank (non-breeding)	Turnstone	Great skua	Pomarine skua	Long-tailed skua	Black-headed gull	Short-eared owl
Tier 1									
Barrow Offshore Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Burbo Bank Offshore Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Burbo Bank Extension Offshore Wind Farm	Unavailable	0.00	0.00	Unavailable	0.00	Unavailable	Unavailable	1.00	Unavailable
Llŷr 1 Floating Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Morgan Generation Assets	0.00	0.11	1.15	0.03	Unavailable	Unavailable	Unavailable	Unavailable	0.05
Morecambe Offshore Windfarm Generation Assets	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
North Hoyle Offshore Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Ormonde Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Walney 1 & 2 Offshore Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Walney (3 & 4) Extension Offshore Wind Farm	Unavailable	1.00	1.00	0.00	0.00	Unavailable	Unavailable	1.00	Unavailable
West of Duddon Sands Offshore Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Gwynt y Môr Offshore Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Rhyl Flats Offshore Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Robin Rigg Offshore Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Arklow Bank Wind Park Phase 1	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Awel y Môr Offshore Wind Farm	Unavailable	0.16	1.53	0.11	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable

Project	Species								
	Wood sandpiper	Redshank (breeding)	Redshank (non-breeding)	Turnstone	Great skua	Pomarine skua	Long-tailed skua	Black-headed gull	Short-eared owl
Erebus Floating Wind Demo	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
White Cross Offshore Windfarm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Tier 2									
North Irish Sea Array	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Codling Wind Park	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Dublin Array Offshore Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Oriel Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Arklow Bank Wind Park Phase 2	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Shelmalere Offshore Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Llŷr 2 Floating Wind Farm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
White Cross Offshore Windfarm	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Inis Eagla Marine Energy Park	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable
Total (minus Mona Offshore Wind Project)	**0.00**	**1.16**	**2.53**	**0.11**	**0.00**	**0.00**	**0.00**	**2**	**0.00**
Mona Offshore Wind Project	0.00	0.32	3.26	0.10	0.22	0.03	0.01	0.83	0.03
Cumulative total	**0.00**	**1.48**	**5.79**	**0.21**	**0.22**	**0.03**	**0.01**	**2.83**	**0.03**
Increase in baseline mortality (%)	**0.000**	**0.026**	**0.022**	**0.003**	**0.020**	**0.013**	**0.009**	**0.008**	**0.004**

Sensitivity of the receptor

Black-legged kittiwake

5.9.3.35 Black-legged kittiwake was rated as relatively 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.

5.9.3.36 Despite a higher reproductive success (i.e. laying two eggs and breeding until four years old) than most seabird species (Robinson, 2005), the species is deemed to have a low recoverability given the continuing decline in abundance observed between 1986 and 2018 in the UK (JNCC, 2020). During this period, breeding productivity has declined as the result of food shortage, although it has stabilised in recent years (JNCC, 2020).

5.9.3.37 Black-legged kittiwake is a qualifying interest for several SPAs likely to be connected to the Mona Array Area (within the mean-max + SD foraging range), with several non-SPA colonies within range and so the species is considered to be of medium value.

5.9.3.38 Black-legged kittiwake is deemed to be of high vulnerability, low recoverability and medium value. The sensitivity of the receptor is therefore, considered to be **high**.

Great black-backed gull

5.9.3.39 Great 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.

5.9.3.40 The abundance of breeding great black-backed gull in the UK has changed relatively little between census (JNCC, 2020). The species is deemed to have a medium recoverability due to a low reproductive success and the stable trend in breeding abundance.

5.9.3.41 As great black-backed gull is a qualifying feature of interest for several SPAs likely to be connected to the Mona Array Area (within the mean-max + SD foraging range), with a non-SPA colony within range, the species is considered to be of medium value.

5.9.3.42 Great black-backed gull is deemed to be of high vulnerability, medium recoverability and medium value. The sensitivity of the receptor is therefore, considered to be **medium.**

European herring gull

5.9.3.43 European 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.

5.9.3.44 As European herring gull is a qualifying interest for several SPAs likely to be connected to the Mona Array Area (within the mean-max + SD foraging range) with multiple non-SPA colonies within range, the species is considered to be of medium value.

5.9.3.45 Although European herring gull have a relatively high reproductive success, breeding abundance is declining in the coastal natural nesting population, and this may be indicative of decline in the entire UK breeding population (JNCC, 2020). There is evidence that the urban nesting gull population has increased in recent years, but census of these sites is lacking to derive a UK wide trend that includes both the urban and natural populations. The species is therefore deemed to be of medium recoverability.

5.9.3.46 European herring gull is deemed to be of high vulnerability, medium recoverability and medium value. The sensitivity of the receptor is therefore, considered to be **medium.**

Lesser black-backed gull

5.9.3.47 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.

5.9.3.48 As lesser black-backed gull is a qualifying interest for several SPAs likely to be connected to the Mona Array Area (within the mean-max + SD foraging range), with multiple non-SPA colonies within range, the species is considered to be of medium value.

5.9.3.49 Although lesser black-backed gull has a relatively high reproductive success, the species breeding abundance has exhibited a downward trend over the last 15-20 years in the UK (JNCC, 2020). It must be noted that this trend excludes urban nesting gulls from the sample and, therefore, may not be representative of trends in the entire UK population. The species is deemed to be of medium recoverability.

5.9.3.50 Lesser black-backed gull is deemed to be of high vulnerability, medium recoverability and medium value. The sensitivity of the receptor is therefore, considered to be **medium**.

Northern gannet

5.9.3.51 Although the latest scientific guidance showed the species to display a high level of macro-avoidance (Peschko *et al*., 2021), the species is rated as relatively vulnerable to collision impacts by Wade *et al*. (2016).

5.9.3.52 Northern gannet is a qualifying interest for several SPAs likely to be connected to the Mona Array Area (within the mean-max + SD foraging range), with a large non-SPA colony within close proximity (Monreith Cliffs and Scar Rocks), the species is therefore considered to be of medium value.

5.9.3.53 Although northern gannet has a low reproductive success, the species is deemed to have a medium recoverability given the 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. The species is deemed to be of medium recoverability.

5.9.3.54 Northern gannet is deemed to be of high vulnerability, medium recoverability and medium value. The sensitivity of the receptor is therefore, considered to be **medium**.

Migratory birds

5.9.3.55 Although migratory bird species 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 likely above rotor height, although during periods of poor weather this risk may increase.

5.9.3.56 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).

5.9.3.57 Of the assessed migratory species, nine are qualifying features of SPAs, as noted in Table 5-11. These species are Bewick's swan, shelduck, wigeon, grey plover, lapwing, ruff, bar-tailed godwit, whimbrel and turnstone. Therefore, on a precautionary basis and for the purposes of this assessment, migratory birds as a collective group have been assumed to have **medium** sensitivity to a cumulative collision risk.

Significance of the effect

5.9.3.58 Overall, the magnitude of the cumulative impact is low for all seabird and migratory species (Table 5-134). Although sensitivity of the receptor varies from medium to high, the effect is expected to be of **minor** adverse significance for all species, which is not significant in EIA terms. For black-legged kittiwake, minor was selected from the minor to moderate range due to the impact not exceeding a 1% increase in baseline mortality and hence, was not regarded as a moderate significance of effect.

Table 5-134: Table summarising the significance of effect of collision from cumulative impacts during the operations and maintenance phase.

Species	Magnitude of impact	Sensitivity of receptor	Significance of effect
Black-legged kittiwake	Low	High	**Minor, not significant in EIA terms**
Great black-backed gull	Low	Medium	**Minor, not significant in EIA terms**
European herring gull	Low	Medium	**Minor, not significant in EIA terms**
Lesser black-backed gull	Low	Medium	**Minor, not significant in EIA terms**
Northern gannet	Low	Medium	**Minor, not significant in EIA terms**
Migratory birds	Low	Medium	**Minor, not significant in EIA terms**

5.9.4 Combined displacement and collision risk

Tier 1 and Tier 2

Operations and maintenance phase

Magnitude of impact

5.9.4.1 For species such as black-legged kittiwake and northern gannet that are both adversely affected by displacement and collision during the operations and maintenance phase, impacts must be combined in order for the true magnitude of impact to be understood.

5.9.4.2 It is recognised that assessing these two potential impacts together could amount to double counting, as birds that are subject to displacement would not be subject to potential collision risk as they are already assumed to have not entered the array area. Equally, birds estimated to be subject to collision risk mortality would not be able to be subjected to displacement consequent mortality as well. As a more refined method to consider displacement and collision together whilst reducing any double counting of impacts is not agreed with SNCBs the precautionary and highly unlikely approach is presented in this assessment.

Black-legged kittiwake

5.9.4.3 Outputs from the combined impact from displacement and collision from the Mona Offshore Wind Project, together with other offshore wind farms in the Irish Sea are tabulated and presented in Table 5-135.

Table 5-135: Black-legged kittiwake combined displacement and collision cumulative impacts.

Impact	Pre-breeding/Spring Migration	Breeding	Post-breeding/Autumn Migration	Annual
Predicted displacement impact when considering 50% displacement and 1% mortality	45	33	45	123
Range of predicted displacement impact when considering between 30% displacement and 1% mortality and 70% displacement and 10% mortality	27 to 626	20 to 468	27 to 626	74 to 1,720
Collisions (avoidance rate 99.28)	163	200	242	641
Predicted combined impact (considering 50% displacement and 1% mortality)	208	233	287	764
Range of combined impacts (considering between 30% displacement and 1% mortality and 70% displacement and 10% mortality)	190 to 789	220 to 668	269 to 868	715 to 2,361
Predicted increase in baseline mortality (%) (considering 50% displacement and 1% mortality)	**0.19%**	**0.61%**	**0.20%**	**0.54%**

5.9.4.4 The combined mortality for black-legged kittiwake from displacement and collision for the projects considered within the CEA is 764 (715 to 2,361) individuals per annum when considering a displacement scenario of 50% displacement and 1% mortality (range 30-70% displacement and 1-10% mortality).

5.9.4.5 Using the largest UK Western Waters BDMPS population of 911,586 individuals, with an average baseline mortality rate of 0.156, the background predicted mortality would be 142,207. The addition of 774 (721 to 2,508) mortalities would increase the baseline mortality rate by 0.54% (0.50% to 1.66%) The annual predicted mortality from the combined cumulative displacement and collision risk assessment is below the 1% threshold increase in baseline mortality. However, recent evidence suggests that 70% displacement and 10% mortality is overly cautious and that kittiwake continued to use the area within and around a windfarm (Leopold *et al.* 2011; Vanermen, 2013; Furness, 2013; Peschko, 2020; NatureScot, 2023). Taking a more realistic 30% displacement and considering a precautionary mortality rate of 3%, the increase in baseline mortality would be 0.61%, which is below the 1% threshold for further investigation.

5.9.4.6 The combined 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.**

Northern gannet

5.9.4.7 Outputs from the combined impact from displacement and collision from the Mona Offshore Wind Project, together with other offshore wind farms in the Irish Sea are tabulated and presented in Table 5-136.

Table 5-136: Northern gannet combined displacement and collision cumulative impacts.

Impact	Pre-breeding/Spring Migration	Breeding	Post-breeding/Autumn Migration	Annual
Predicted displacement impact when considering 70% displacement and 1% mortality (plus tidal collisions)	4	33	23	60
Range of predicted displacement impact when considering between 60% displacement and 1% mortality and 80% displacement and 10% mortality.	3 to 44	28 to 377	20 to 262	51 to 683
Collisions (avoidance rate 99.28) (no macro-avoidance)	7	93	38	183
Predicted combined impact (considering 70% displacement and 1% mortality)	11	126	61	243
Range of combined impacts (considering between 60% displacement and 1% mortality and 80% displacement and 10% mortality)	10 to 51	121 to 470	58 to 300	234 to 866
Predicted increase in baseline mortality (%) (considering 70% displacement and 1% mortality)	**0.01%**	**0.10%**	**0.06%**	**0.19%**

5.9.4.8 The combined mortality for northern gannet from displacement and collision for the projects considered within the CEA is 243 (234 to 866) individuals per annum (when assuming 99,28% avoidance rate and no macro-avoidance).

5.9.4.9 Using the largest UK Western Waters BDMPS population of 661,888 individuals, with an average baseline mortality rate of 0.193 the background predicted mortality would be 127,774. The addition of 243 (234 to 866) mortalities would increase the baseline mortality rate by 0.19% (0.18% to 0.68%). The annual predicted mortality from the cumulative collision risk assessment is below the 1% threshold increase in baseline mortality.

5.9.4.10 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

Black-legged kittiwake

5.9.4.11 As seen in displacement and collision, black-legged kittiwake is deemed to be of overall medium vulnerability, low recoverability and medium value. The sensitivity of the receptor is therefore, considered to be **medium**.

Northern gannet

5.9.4.12 As seen in displacement and collision, northern gannet is deemed to be overall of medium vulnerability, medium recoverability and medium value. The sensitivity of the receptor is therefore, considered to be **medium**.

Significance of the effect

Black-legged kittiwake

5.9.4.13 Overall, the magnitude of the combined displacement and collision cumulative impact is low, and the sensitivity of the receptor is medium. The effect will, therefore, be of **minor** adverse significance, which is not significant in EIA terms.

Northern gannet

5.9.4.14 Overall, the magnitude of the combined displacement and collision cumulative impact is low, 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.

5.10 Transboundary effects

5.10.1.1 A screening of transboundary impacts has been carried out and any potential for significant transboundary effects with regard to offshore ornithology from the Mona Offshore Wind Project upon the interests of other states has been assessed as part of the EIA. The potential transboundary impacts assessed within sections 5.8 and 5.9 of this technical report are summarised below:

- Disturbance and displacement (including impacts on species which may have connectivity to UK SPAs) during the construction, operations and maintenance, and decommissioning phases. Overall, the effect will be of negligible adverse to minor adverse significance, which is not significant in EIA terms
- Indirect disturbance and displacement resulting from changes to prey and habitats (including impacts on species which may have connectivity to UK SPAs) during the construction, operations and maintenance, and decommissioning phases. Overall, the effect will be of minor adverse significance, which is not significant in EIA terms
- Collision risk (including impacts on species which may have connectivity to UK SPAs) during the construction, operations and maintenance, and decommissioning phases. Overall, the effect will be of negligible to minor adverse significance, which is not significant in EIA terms
- Barrier effect (including impacts on species which may have connectivity to UK SPAs) during the construction, operations and maintenance, and decommissioning phases. Overall, the effect will be of negligible adverse significance, which is not significant in EIA terms

- No significant transboundary effects have been identified during the screening process.

5.11 Inter-related effects

5.11.1.1 Inter-relationships are considered to be the impacts and associated effects of different aspects of the proposal on the same receptor. These are considered to be:

- Project lifetime effects: Assessment of the scope for effects that occur throughout more than one phase of the Mona Offshore Wind Project (construction, operations and maintenance, and decommissioning), to interact to potentially create a more significant effect on a receptor than if just assessed in isolation in these three phases (e.g. subsea noise effects from piling, operational turbines, vessels and decommissioning)
- Receptor-led effects: Assessment of the scope for all effects to interact, spatially and temporally, to create inter-related effects on a receptor. As an example, all effects on offshore ornithology, such as displacement/disturbance, collision and increased SSCs, may interact to produce a different, or greater effect on this receptor than when the effects are considered in isolation. Receptor-led effects may be short term, temporary or transient effects, or incorporate longer term effects.

5.11.1.2 A description of the likely interactive effects arising from the Mona Offshore Wind Project on offshore ornithology is provided in Volume 2, Chapter 11: Inter-related effects - offshore of the Environmental Statement (Document Reference F2.11).

5.12 Summary of impacts, mitigation measures and monitoring

5.12.1.1 Information on offshore ornithology within the Offshore Ornithology study areas, as defined in section 5.3.4.1, was collected through review of available literature, other offshore wind farm assessments, UK statutory guidance, detailed analysis of the data collected during the site-specific aerial surveys and intertidal surveys, and consultation with relevant stakeholders.

- Table 5-137 presents a summary of the potential impacts, measures adopted as part of the project and residual effects in respect to offshore ornithology. The impacts assessed include disturbance and displacement from airborne noise, underwater sound, and presence of vessels and infrastructure, indirect impacts from underwater sound affecting prey species, temporary habitat loss/disturbance and increased SSCs, collision risk and barrier to movement. Overall, it is concluded that there will be **no significant effects** arising from the Mona Offshore Wind Project during the construction, operations and maintenance, or decommissioning phases
- Table 5-138 presents a summary of the potential cumulative impacts, mitigation measures and residual effects. The cumulative impacts assessed include disturbance and displacement from airborne noise, underwater sound and presence of vessels and infrastructure and collision risk. Overall, it is concluded that there are **no significant cumulative effects** to any species from the Mona Offshore Wind Project alongside other projects/plans.

5.12.1.2 Potential transboundary impacts have been identified in relation to offshore ornithology. Overall, it is concluded that there will be **no significant transboundary effects** arising from the Mona Offshore Wind Project.

Table 5-137: Summary of potential environmental effects, mitigation and monitoring.

[a] C=construction, O=operations and maintenance, D=decommissioning

Description of impact	Phase[a] C	O	D	Measures adopted as part of the project	Magnitude of impact	Sensitivity of the receptor	Significance of effect	Further mitigation	Residual effect	Proposed monitoring
Disturbance and displacement from airborne noise, underwater sound, and presence of vessels and infrastructure	✓	✓	✓	Offshore EMP that will include measures to minimise disturbance to rafting birds from transiting vessels.	<u>Common guillemot</u> C: Negligible O: low D: Negligible <u>Razorbill</u> C: Negligible O: Negligible D: Negligible <u>Atlantic puffin</u> C: Negligible O: Negligible D: Negligible <u>Northern gannet</u> C: Negligible O: Negligible D: Negligible <u>Black-legged kittiwake</u> C: Negligible O: Negligible D: Negligible <u>Manx shearwater</u> C: Negligible O: Negligible D: Negligible	<u>Common guillemot</u> C: Medium O: Medium D: Medium <u>Razorbill</u> C: Medium O: Medium D: Medium <u>Atlantic puffin</u> C: High O: High D: High <u>Northern gannet</u> C: Medium O: Medium D: Medium <u>Black-legged kittiwake</u> C: Medium O: Medium D: Medium <u>Manx shearwater</u> C: Medium	<u>Common guillemot</u> C: Negligible adverse O: Minor adverse D: Negligible adverse <u>Razorbill</u> C: Negligible adverse O: Negligible adverse D: Negligible adverse <u>Atlantic puffin</u> C: Minor adverse O: Negligible adverse D: Minor adverse <u>Northern gannet</u> C: Negligible adverse O: Negligible adverse	None	<u>Common guillemot</u> C: Negligible adverse O: Minor adverse D: Negligible adverse <u>Razorbill</u> C: Negligible adverse O: Negligible adverse D: Negligible adverse <u>Atlantic puffin</u> C: Minor adverse O: Negligible adverse D: Minor adverse <u>Northern gannet</u> C: Negligible adverse O: Negligible adverse D: Negligible adverse	None

Description of impact	Phase[a] C	O	D	Measures adopted as part of the project	Magnitude of impact	Sensitivity of the receptor	Significance of effect	Further mitigation	Residual effect	Proposed monitoring
					Common scoter C: Negligible O: Negligible D: Negligible Red-throated diver C: Negligible O: Negligible D: Negligible	O: Medium D: Medium Common scoter C: High O: High D: High Red-throated diver C: High O: High D: High	D: Negligible adverse Black-legged kittiwake C: Negligible adverse O: Negligible adverse D: Negligible adverse Manx shearwater C: Negligible adverse O: Negligible adverse D: Negligible adverse Common scoter C: Minor adverse O: Negligible adverse D: Minor adverse Red-throated diver C: Minor adverse O: Negligible adverse		Black-legged kittiwake C: Negligible adverse O: Negligible adverse D: Negligible adverse Manx shearwater C: Negligible adverse O: Negligible adverse D: Negligible adverse Common scoter C: Minor adverse O: Negligible adverse D: Minor adverse Red-throated diver C: Minor adverse O: Negligible adverse D: Minor adverse	

Description of impact	Phase[a] C	O	D	Measures adopted as part of the project	Magnitude of impact	Sensitivity of the receptor	Significance of effect	Further mitigation	Residual effect	Proposed monitoring
							D: Minor adverse			
Indirect impacts from underwater sound affecting prey species	✓	×	✓	None	Auk species C: Low D: Low	Auk species C: Medium D: Medium	Auk species C: Minor adverse D: Minor adverse	None	Auk species C: Minor adverse D: Minor adverse	None
Temporary habitat loss/disturbance and increased SSCs	✓	✓	✓	None	All receptors C: Negligible O: Negligible D: Negligible	All receptors C: Medium O: Medium D: Medium	All receptors C: Minor adverse O: Minor adverse D: Minor adverse	None	All receptors C: Minor adverse O: Minor adverse D: Minor adverse	None
Collision risk	×	✓	×	Increasing 'minimum air draught to 34 over LAT to reduce bird collision	Black-legged kittiwake O: Negligible Great black-backed gull O: Low European herring gull O: Negligible Lesser black-backed gull O: Negligible	Black-legged kittiwake O: High Great black-backed gull O: Medium European herring gull O: Medium Lesser black-backed gull	Black-legged kittiwake O: Negligible adverse Great black-backed gull O: Minor adverse European herring gull O: Negligible adverse	None	Black-legged kittiwake O: Negligible adverse Great black-backed gull O: Minor adverse European herring gull O: Negligible adverse	None

Description of impact	Phase[a] C	O	D	Measures adopted as part of the project	Magnitude of impact	Sensitivity of the receptor	Significance of effect	Further mitigation	Residual effect	Proposed monitoring
					Northern gannet O: Negligible Northern fulmar O: Negligible Manx shearwater O: No change Migratory birds (non-seabirds) O: Negligible	O: Medium Northern gannet O: Medium Northern fulmar O: Low Manx shearwater O: Medium Migratory birds (non-seabirds) O: Medium	Lesser black-backed gull O: Negligible adverse Northern gannet O: Negligible adverse Northern fulmar O: Negligible adverse Manx shearwater O: No change Migratory birds (non-seabirds) O: Negligible adverse		Lesser black-backed gull O: Negligible adverse Northern gannet O: Negligible adverse Northern fulmar O: Negligible adverse Manx shearwater O: No change Migratory birds (non-seabirds) O: Negligible adverse	
Barrier to movement	×	✓	×	Offshore EMP that will include measures to minimise disturbance to rafting birds from transiting vessels	All receptors O: Negligible	All receptors O: Medium	All receptors O: Negligible adverse	None	All receptors O: Negligible adverse	None

Table 5-138: Summary of potential cumulative environmental effects, mitigation and monitoring.

[a] C=construction, O=operations and maintenance, D=decommissioning

Description of effect	Phase[a] C	Phase[a] O	Phase[a] D	Measures adopted as part of the project	Magnitude of impact	Sensitivity of the receptor	Significance of effect	Further mitigation	Significant residual effect	Proposed monitoring
Disturbance and displacement from airborne noise, underwater sound, and presence of vessels and infrastructure	✓	✓	✓	Offshore EMP that will include measures to minimise disturbance to rafting birds from transiting vessels	Common guillemot C: Negligible O: Low D: Negligible Razorbill C: Negligible O: Negligible D: Negligible Atlantic puffin C: Negligible O: Low D: Negligible Northern gannet C: Negligible O: Low D: Negligible Black-legged kittiwake C: Negligible O: Low	Common guillemot C: Medium O: Medium D: Medium Razorbill C: Medium O: Medium D: Medium Atlantic puffin C: High O: High D: High Northern gannet C: Medium O: Medium D: Medium Black-legged kittiwake C: Medium O: Medium	Common guillemot C: Negligible adverse O: Minor adverse D: Negligible adverse Razorbill C: Negligible adverse O: Negligible adverse D: Negligible adverse Atlantic puffin C: Minor adverse O: Minor adverse D: Minor adverse Northern gannet C: Negligible adverse O: Minor adverse D: Negligible adverse Black-legged kittiwake C: Negligible adverse	None	Common guillemot C: Negligible adverse O: Minor adverse D: Negligible adverse Razorbill C: Negligible adverse O: Negligible adverse D: Negligible adverse Atlantic puffin C: Minor adverse O: Minor adverse D: Minor adverse Northern gannet C: Negligible adverse O: Minor adverse D: Negligible adverse Black-legged kittiwake C: Negligible adverse	None

Description of effect	Phase[a] C	O	D	Measures adopted as part of the project	Magnitude of impact	Sensitivity of the receptor	Significance of effect	Further mitigation	Significant residual effect	Proposed monitoring
					D: Negligible Manx shearwater C: Negligible O: Low D: Negligible	D: Medium Manx shearwater C: Medium O: Medium D: Medium	O: Minor adverse D: Negligible adverse Manx shearwater C: Negligible adverse O: Minor adverse D: Negligible adverse		O: Minor adverse D: Negligible adverse Manx shearwater C: Negligible adverse O: Minor adverse D: Negligible adverse	
Collision Risk	×	✓	×	Increasing minimum air draught to 34 over LAT to reduce bird collision	Black-legged kittiwake O: Low Great black-backed gull O: Medium European herring gull O: Low Lesser black-backed gull O: Low Northern gannet O: Low	Black-legged kittiwake O: High Great black-backed gull O: Medium European herring gull O: Medium Lesser black-backed gull O: Medium Northern gannet O: Medium	Black-legged kittiwake O: Minor adverse Great black-backed gull O: Minor adverse European herring gull O: Minor adverse Lesser black-backed gull O: Minor adverse Northern gannet O: Minor adverse	None	Black-legged kittiwake O: Minor adverse Great black-backed gull O: Minor adverse European herring gull O: Minor adverse Lesser black-backed gull O: Minor adverse Northern gannet O: Minor adverse	None
Combined collision risk and disturbance and displacement from airborne noise, underwater sound, and presence of vessels and infrastructure	×	✓	×	Increasing minimum air draught to 34 over LAT air draught to reduce bird collision	Black-legged kittiwake O: Low Northern gannet O: Low	Black-legged kittiwake O: Medium Northern gannet O: Medium	Black-legged kittiwake O: Minor adverse Northern gannet O: Minor adverse	None	Black-legged kittiwake O: Minor adverse Northern gannet O: Minor adverse	None

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– Mona Offshore Wind Project Offshore Ornithology Cumulative Effects

Appendix A: Cumulative Effects Assessment and In-combination Gap-filling Historical Projects - Methodology

A.1 Introduction

5.13.1.1 This Appendix presents the methodology used to generate indicative numbers for previously unquantified impacts from historical projects and accords with that recommended in the SNCB Advice Note (provided to the Applicant in October 2023) which is presented in Section D.6.13 of Appendix D of Technical Engagement Plan (Document Reference E4.1)). The historical projects and species considered are presented within A.2 for both displacement and collisions assessments.

5.13.1.2 The details of the post-application engagement with SNCBs are provided in Table 5-139.

Table 5-139: Post-application consultation regarding the quantification of historical projects within the cumulative effects assessment and in-combination assessment and the Applicant's response.

<table>
<tr><th>Consultee and form of consultation</th><th>Comment summary</th><th>Response to issue raised and/or were considered in this chapter</th></tr>
<tr><td>NRW (A)'s Relevant Representations</td><td rowspan="5">Request for the Applicant to undertake gap-filling for historical offshore wind projects in the eastern Irish Sea, in line with the SNCB advice note.</td><td rowspan="5">The Applicant's response to NRW (A)'s and the JNCC's written representations confirmed that a 'gap-filling' exercise was being undertaken in line with the SNCB advice (which is presented in Section D.6.13 of Appendix D of Technical Engagement Plan (Document Reference E4.1)) to generate indicative estimates for impacts from historical projects that were unquantified at application. The indicative estimates for impacts from historical projects (using a gap-fill approach) are presented in section 5.9 and in volume 6, Annex 5.7: Offshore Ornithology Assessment of Pen y Gogarth/Great Orme's Head Site of Special Scientific Interest Technical Report of the Environmental Statement (Document Reference F6.5.7).</td></tr>
<tr><td>The JNCC's Relevant Representations</td></tr>
<tr><td>RSPB's Relevant Representation</td></tr>
<tr><td>NRW (A)'s Written Representation at Deadline 1</td></tr>
<tr><td>The JNCC's Written representation at Deadline 1</td></tr>
</table>

Consultee and form of consultation	Comment summary	Response to issue raised and/or were considered in this chapter
Meeting with NRW, the JNCC and Natural England on 29 August 2024	Natural England feedback: Agree that broadly the approach provides the information requested by SNCBs, but clarification is required on a few points. The results suggest that some of the historic projects do contribute to the cumulative effect so SNCBs maintain their position that this quantification was necessary. We are happy with the general approach and the use of MERP makes sense.	The Applicant welcomes this feedback and, on this basis, has made no changes to the methodology outside of addressing the SNCBs comments made during the meeting (see below in this table). The Applicant welcomes agreement that the MERP data is the best evidence available to characterise baseline abundance for historical projects given its spatial coverage and more recent temporal coverage.
	The JNCC feedback: Agree with Natural England. Clarification is needed to rule out adverse effects, but agree risk is low.	
	Request for the project to consider further justification for the use of percentage of birds in flight from Mona, Morgan Generation Assets and Morecambe Generation Assets surveys for projects that are closer to the coast and may have different percentages of birds in flight.	The Awel y Môr, Burbo Bank Extension and Walney Extension offshore wind projects are closer to the coast than the Mona Offshore Wind Project, Morgan Generation Assets and Morecambe Generation Assets and, therefore, provide a good comparison to determine whether there is any difference in the proportions of birds in flight at inshore projects versus those further offshore. Section A.2.4 discusses the available data from Awel y Môr, Walney Extension and Burbo Bank Extension and Table 5-144 presents the percentage of birds flying at the Awel y Môr offshore wind project in addition to the percentage of birds in flight from Mona Offshore Wind Project, Morgan Generation Assets and Morecambe Generation Assets. As shown in Section A.2.3, the proportions of birds in flight for the Awel y Môr offshore wind project are similar to those in Mona Offshore Wind Project, Morgan Generation Assets and Morecambe Generation Assets; therefore, the use of those percentages of birds in flight for the gap-filled projects is robust and justified.
	Request from the JNCC to consider if Atlantic puffin should be included in the gap-filling exercise following updates to Volume 2, Chapter 5: Offshore Ornithology at Deadline 2.	Gap-filled historical projects have been included for Atlantic puffin in the CEA presented in section 5.9

Consultee and form of consultation	Comment summary	Response to issue raised and/or were considered in this chapter
JNCC, Natural England and NRW joint written feedback received via email (dated 6 September 2024) Summary of Natural England's comments made in the meeting on 29 August 2024, received 18 September 2024.	Request for justification for the use of deterministic CRM as opposed to stochastic CRM	An explanation is provided in paragraph 5.13.1.21. The CRMs for the projects that required gap-filling were run deterministically as the data sources used to quantify density did not provide any parameter variation around the mean value. Similarly, the wind turbine parameters (e.g. rotor speed, wind availability etc.) are not presented with variation and therefore a stochastic model cannot be run.
	Request for all wind farm parameters to be presented for added clarity and reproducibility of the CRM	Table 5-144 presents all information necessary to run the CRMs, including the wind farm width (km) and latitude.
	Request for clarification on Burbo Bank OWF predicted collision impacts being higher when using as-built parameters compared to consented	As shown in Table 5-144, the air gap for Burbo Bank reduced from 29 m to 26 m between consented and as-built, respectively. CRM outputs are highly sensitive to the air gap variable and therefore, a reduction of air gap would increase the predicted impact to offshore ornithological receptors.

A.2 Methodology

A.2.1 Approach to updating CEA / In-combination assessment

5.13.1.3 Written advice was provided by the SNCBs around 'gap-filling' for historical offshore wind projects. The SNCB Advice Note recommended three approaches to quantifying impacts for historical projects:

- Review the submitted environmental statement. It is accepted that displacement mortality / collision risk estimates may not be presented. However, if there is abundance data, utilise this to populate project-specific displacement matrices / run project-specific collision risk models (CRMs) for relevant species.
- If no abundance data is available, use a nearby wind farm as a proxy. Scale the impact to the size of the historical project when compared to the proxy.
- If no abundance data is available and to provide a more rigorous assessment, use the best available bird density estimates and known array footprint plus buffers to generate refined project-specific assessments of displacement and collision.

5.13.1.4 The first approach was considered in the application offshore ornithology documents whereby site-specific abundance data for historical projects from submitted Environmental Statements were used to generate a quantified impact. The impacts from historical offshore wind projects for which quantitative analyses were not possible due to data availability were considered qualitatively. It should be noted that post application, the Applicant undertook a further review of all available documentation for historical wind projects considered within this technical note.

5.13.1.5 The Applicant has not progressed with the second approach (i.e. use of proxy data) due to very high levels of variation presented within nearby wind farms. After considering this approach in consultation with the Morgan Generation Assets and Morecambe Generation Assets ornithology consultants, it was concluded that there is no pragmatic or consistent way to use proxy wind farms due to differences in site-specific conditions between projects; therefore, that approach has not been pursued further. The Applicant received agreement on the broad methodology and justification for not progressing the use of proxy data in a meeting with the SNCBs on 29 August 2024.

5.13.1.6 The Applicant has therefore undertaken what the SNCB Advice Note describes as a "more rigorous assessment" to gap-fill these historical projects in line with the third approach outlined in paragraph 5.13.1.3 above. As stated within the SNCB Advice Note "If baseline characterisation data are not available for a given "gap-filling" project, MERP, strategic VAS of OWF areas, or the recent Welsh Atlas data could be considered'. The Applicant considered it more appropriate to use the data outputs of the Marine Ecosystems Research Programme (MERP) (Waggitt et al., 2020) (hereafter referred to as MERP data), as recommended by the SNCBs. The MERP data produces average density estimates at a 10x10 km grid square resolution of the entire north east Atlantic using data from aerial and boat-based surveys from 1980 to 2018. This large temporal and spatial coverage represents the best available data within this area. Using a published data source also removes potential differences in reproduction and analysis of the data.

A.2.2 Data sources used for abundance estimates (displacement effect)

5.13.1.7 If baseline characterisation data from project-specific documentation were not available for a given historical project or were not presented in a usable format (e.g. raw counts for all surveys combined) to allow for the calculation of displacement impacts, the Applicant obtained data on seabird distribution from the Marine Ecosystems Research Programme (MERP) (Waggitt *et al*., 2020) as specified by the SNCB's Advice Note from October 2023.

5.13.1.8 The Applicant considers the MERP data the best evidence available to characterise baseline abundance given its spatial coverage (the northeast Atlantic) and more recent temporal coverage (1980 and 2018). However, MERP data represents relative and not absolute density estimates; therefore, any predicted impacts presented should be taken as potential and not absolute impacts.

5.13.1.9 A full breakdown of what data has been used to gap-fill each historical project and each species is provided in Table 5-140.

Table 5-140: Data source used to gap-fill historical projects for displacement.

Project	Species requiring gap-filling	Season requiring gap-filling	Data used to gap-fill historical project
Barrow Offshore Wind Farm	All	All	MERP data are used for Barrow for all species and all seasons.
Burbo Bank	All	All	MERP data are used for Burbo Bank for all species and all seasons.
Burbo Bank Extension	Black-legged kittiwake, Manx shearwater and northern gannet	Non-breeding	MERP data are used for Burbo Bank Extension for black-legged kittiwake, Manx shearwater and northern gannet for the non-breeding season.

Project	Species requiring gap-filling	Season requiring gap-filling	Data used to gap-fill historical project
Gwynt y Môr	All	All	MERP data are used for Gwynt y Môr for all species and all seasons.
Ormonde	All	Non-breeding	Site-specific data from the project's reports has been used for all species for the breeding season (Percival, 2005) and MERP data are used in the non-breeding season.
North Hoyle	All	All	MERP data are used for North Hoyle for all species and all seasons.
Robin Rigg	Black-legged kittiwake, Manx shearwater and northern gannet	All	MERP data are used for Robin Rigg for black-legged kittiwake, Manx shearwater and northern gannet for all seasons and for common guillemot and razorbill during the non-breeding season.
	Common guillemot and razorbill	Non-breeding	
Rhyl Flats Offshore Wind Farm	All	All	MERP data are used for Rhyl Flats for all species and all seasons.
Walney 1 & 2 Offshore Wind Farms	All	All	MERP data are used for Walney 1 & 2 for all species and all seasons.
West of Duddon Sands	Black-legged kittiwake, Manx shearwater and northern gannet	Non-breeding	MERP data are used in the non-breeding season.

5.13.1.10 Data were extracted from the publicly available MERP data which included monthly density estimates at a 10 x 10 km resolution (Waggitt *et al.*, 2020). Each gap-filled project was loaded into QGIS (version 3.34) and overlaid with the MERP data. The MERP data was then clipped to each of the projects (plus a 2 km buffer) for which gap-filling was undertaken. The spatial overlap (km^2) was then calculated for each of the 10 x 10 km grid squares, which allowed the abundance to be estimated.

5.13.1.11 A worked example is presented below for northern gannet at the Gwynt y Môr Project (Table 5-141). The Gwynt y Môr Array Area plus 2 km buffer overlaps with five 10 x 10 km squares. Each of the five squares has a different density estimate for northern gannet (Table 5-141). The area of the grid square that overlaps with the Gwynt y Môr Array Area plus 2 km buffer is then multiplied by the density of birds to provide an abundance estimate. The summed total of all abundances within each 10 x 10 km grid square provides a relative abundance estimate of birds present within Gwynt y Môr Array Area plus 2 km buffer.

Table 5-141: Worked example of the MERP data for northern gannet within the Gwynt y Môr Array Area plus 2 km buffer.

Grid square	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Area (km^2)
Density (birds per km^2)													
1	0.079	0.074	0.088	0.111	0.125	0.147	0.172	0.190	0.187	0.141	0.101	0.088	55.13
2	0.065	0.061	0.072	0.091	0.103	0.122	0.143	0.159	0.156	0.117	0.083	0.072	81.89
3	0.060	0.056	0.067	0.085	0.096	0.114	0.134	0.149	0.147	0.110	0.078	0.067	5.42
4	0.067	0.063	0.075	0.094	0.106	0.126	0.149	0.165	0.162	0.122	0.086	0.075	11.86
5	0.062	0.058	0.068	0.087	0.098	0.116	0.137	0.153	0.150	0.112	0.080	0.069	8.13
Abundance													
1	4.372	4.099	4.869	6.133	6.874	8.114	9.476	10.453	10.311	7.789	5.581	4.849	N/A
2	5.312	4.973	5.911	7.473	8.401	9.972	11.724	12.986	12.801	9.600	6.826	5.905	N/A
3	0.327	0.306	0.364	0.460	0.518	0.616	0.726	0.806	0.794	0.594	0.422	0.364	N/A
4	0.796	0.744	0.885	1.121	1.261	1.499	1.764	1.955	1.927	1.444	1.025	0.885	N/A
5	0.50	0.47	0.56	0.70	0.79	0.95	1.12	1.24	1.22	0.91	0.65	0.56	N/A
Total	**11.31**	**10.59**	**12.58**	**15.89**	**17.85**	**21.15**	**24.81**	**27.44**	**27.06**	**20.34**	**14.50**	**12.56**	**N/A**

A.2.3 Data sources used for density estimates (collision effect)

5.13.1.12 If collision risk data from project-specific documentation were not available for a given historical project, the Applicant obtained data on seabird densities from MERP (Waggitt *et al*., 2020) as specified by the SNCB's advice note from October 2023.

5.13.1.13 The calculation of densities used for input into collision risk modelling for northern gannet, black-legged kittiwake, lesser black-backed gull and herring gull followed the same method as for displacement and aligns with the recommended method from the SNCBs whereby the density of the birds within each of the 10 x 10 km grid squares presented within the MERP data was extracted (Waggitt *et al*., 2020). An average density was used per month, with the average taken from the different squares overlapping each historical project. The average density was used within the stochastic collision risk model (MacGregor et al. 2018), which was run deterministically as no variation is provided by the MERP data. This was run in the sCRM Shiny app (Caneco 2022) using the parameters presented below.

5.13.1.14 There is no predicted density estimate for great black-backed gull within the MERP data. Therefore, a different data source has been used to quantify the density of this species within the Irish Sea. The Seabird Mapping and Sensitivity Tool (SeaMaST) was identified as the most appropriate due to spatial and temporal coverage (Bradbury *et al*., 2014).

5.13.1.15 The SeaMaST data is presented at 3 x 3 km resolution for both flying and sitting birds and with a breakdown for boat-based and aerial surveys data. As the great black-backed gull densities presented from the aerial surveys were negligible, the boat-based survey data was used for collision risk modelling to be precautionary. It should be acknowledged that boat-based surveys consistently record larger densities of gull species compared to the aerial data outputs of Bradbury *et al*. (2014). The Applicant considers that using the boat-based data may overestimate the risk, but using this data is deemed more precautionary than aerial survey data.

5.13.1.16 Unlike MERP, SeaMaST presents the data in the breeding and non-breeding season and not monthly. Therefore, the seasonal definition from Furness (2015) was used with April to August as breeding and September to March as non-breeding. The density was considered consistent for each of these months.

5.13.1.17 Similarly to the MERP data, the SeaMaST data has multiple grid squares covering the historical projects, and therefore, the average density across the squares was used in the CRM.

5.13.1.18 A full breakdown of the data that has been used to gap-fill each historical project is provided in Table 5-142.

Table 5-142: Data sources used to gap-fill historical projects to assess collision effect

Project	Species requiring gap-filling	Season requiring gap-filling	Data used to gap-fill historical project
Barrow	Northern gannet, black-legged kittiwake and herring gull	All	MERP data are used for Barrow for northern gannet, black-legged kittiwake and herring gull.
	Great black-backed gull	All	SeaMaST data are used for Barrow for great black-backed gull.
Burbo Bank	Northern gannet, black-legged kittiwake and herring gull	All	MERP data are used for Burbo Bank for northern gannet, black-legged kittiwake and herring gull.
	Great black-backed gull		SeaMaST data are used for Burbo Bank for great black-backed gull.
Burbo Bank Extension	Great black-backed gull	All	SeaMaST data are used for Burbo Bank Extension for great black-backed gull.
Gwynt y Môr	Northern gannet, black-legged kittiwake and herring gull.	All	MERP data are used for Gwynt y Môr for northern gannet, black-legged kittiwake and herring gull.
	Great black-backed gull		SeaMaST data are used for Gwynt y Môr for great black-backed gull.
North Hoyle	Northern gannet, black-legged kittiwake and herring gull	All	MERP data are used for North Hoyle for northern gannet, black-legged kittiwake and herring gull.
	Great black-backed gull	All	SeaMaST data are used for North Hoyle for great black-backed gull.
Robin Rigg	Northern gannet, black-legged kittiwake, lesser black-backed gull and herring gull.	All	MERP data are used for Robin Rigg for northern gannet, black-legged kittiwake, lesser black-backed gull and herring gull.
	Great black-backed gull		SeaMaST data are used for Robin Rigg for great black-backed gull.
Rhyl Flats Offshore Wind Farm	Northern gannet, black-legged kittiwake and herring gull	All	MERP data are used for Rhyl Flats for northern gannet, black-legged kittiwake and herring gull.

Project	Species requiring gap-filling	Season requiring gap-filling	Data used to gap-fill historical project
	Great black-backed gull		SeaMaST data are used for Rhyl Flats for great black-backed gull.
Walney 1 & 2 Offshore Wind Farms	Northern gannet, black-legged kittiwake and herring gull.	All	MERP data are used for Walney 1 and 2 for northern gannet, black-legged kittiwake and herring gull.
	Great black-backed gull		SeaMaST data are used for Walney 1 and 2 for great black-backed gull.
Walney Extension	Northern gannet	All	Project specific data was used for northern gannet (Ørsted, 2023)
West of Duddon Sands	Northern gannet, black-legged kittiwake and herring gull.	All	MERP data are used for West of Duddon Sands for northern gannet, black-legged kittiwake and herring gull.
	Great black-backed gull		SeaMaST data are used for West of Duddon Sands for great black-backed gull.

A.2.4 Correction factors for flying birds (MERP)

4.1.1.1. The MERP dataset incorporates all bird behaviours (i.e. sitting and flying birds). Only birds in flight are at risk of collision and therefore correction of the densities obtained from the MERP dataset is required.

4.1.1.2. The MERP data was corrected by using the average number of birds flying as recorded within the Mona Offshore Wind Project, Morgan Offshore Wind Project: Generation Assets and Morecambe Offshore Wind Farm: Generation Assets Digital Aerial Surveys (DAS) (Table 5-143), with data provided by each project. These three projects were considered to provide the best estimate as these recent surveys collectively cover a large proportion of the Irish Sea close to the historical projects to be gap-filled. The Applicant also considers these surveys to be the most valid, as each DAS programme was undertaken over a period of two years. Baseline characterisation surveys for older projects often lack appropriate sampling design and monthly coverage and, therefore, not considered as robust.

4.1.1.3. As advised during the meeting with NRW, the JNCC and Natural England on 29 August 2024, the Applicant has considered nearshore projects, specifically Awel y Môr, Burbo Bank Extension and Walney Extension. These projects being located in the eastern Irish Sea having used survey methods comparable to those undertaken for the Mona Offshore Wind Project, Morgan Generation Assets and Morecambe Generation Assets.

4.1.1.4. Whist the application documentation for Burbo Bank Extension (Dong Energy, 2013a) and Walney Extension (Dong Energy, 2013b) presents information on the behaviour of birds during site-specific surveys, these data are not in a format to allow for direct comparison with the data available for the Mona Offshore Wind Project, Morgan Generation Assets and Morecambe Generation Assets.

4.1.1.5. Given that birds in flight data was not available for the Walney extension or Burbo Bank Extension, the annual averages were calculated using monthly data from Awel y Môr, compared to Mona Offshore Wind Project, Morgan Generation Assets and Morecambe

Generation Assets (see Table 5-143). As the differences between the Awel y Môr and the Mona Offshore Wind Project, Morgan Generation Assets and Morecambe Generation Assets average would not make a material change to the conclusion of the assessment (see Table 5-143), the correction factors used within this technical note are based on the Mona Offshore Wind Project, Morgan Generation Assets and Morecambe Generation Assets average and were applied to the MERP data to derive densities of birds in flight.

4.1.1.6. All densities used in the collision risk modelling are presented in section A.2.5. For clarity, the CRMs were run using the non-corrected densities and the average percentage of flying birds per species was applied to the CRM outputs. The collisions are presented to two decimal places, therefore when annual impacts should be used which take account of rounding.

Table 5-143: Percentage of birds recorded flying during Awel y Môr, Mona, Morgan and Morecambe DAS.

Species		Mona[1]	Morgan[2]	Morecambe[3]	Mona, Morgan and Morecambe Average	Awel y Môr[4]
Northern gannet	Percentage flying	45.35%	48.81%	26.88%	40.35%	27.76%
	Number of birds flying	434	307	268	N/A	98
	Total number of birds recorded	957	629	997	N/A	353
Black-legged kittiwake	Percentage flying	65.26%	59.21%	36.44%	53.64%	67.68%
	Number of birds flying	2,262	1,832	1,750	N/A	377
	Total number of birds recorded	3,466	3,094	4,803	N/A	557
Lesser black-backed gull	Percentage flying	61.82%	57.43%	61.22%	60.16%	N/A5
	Number of birds flying	34	58	90	N/A	N/A
	Total number of birds recorded	55	101	147	N/A	N/A
Herring gull	Percentage flying	50.00%	47.88%	29.59%	42.49%	33.91%
	Number of birds flying	36	158	87	N/A	39
	Total number of birds recorded	72	330	294	N/A	115

Footnotes

[1] Percentage of flying birds within Mona DAS taken from Volume 6, Annex 5.1: Offshore Ornithology Baseline Characterisation Technical Report (Document Reference F6.5.1)

[2] Percentage of flying birds within Morgan DAS taken from Volume 5 - Appendix 12.1 - Offshore Ornithology Technical Report (Morgan Offshore Wind Project, 2024)

[3] Percentage of flying birds within Morecambe DAS taken from Volume 4, Annex 5.1: Offshore ornithology baseline characterisation (Morecambe Offshore Windfarm, 2024). Total number of birds presented is from modelled estimates.

[4] Percentage of flying birds within Awel y Môr DAS taken from Volume 4, Annex 4.1: Offshore Ornithology Baseline Characterisation Report (Awel Y Môr Offshore Wind Farm, 2022). Total number of birds presented is from modelled estimates.

[5] Awel y Môr DAS reported a very low number of lesser black-backed gull (nine individuals throughout all surveys) and therefore has not been included.

A.2.5 Wind farm parameters

5.13.1.19 Wind farm parameters for additional projects (both as-built and consented parameters) were sourced from the MacArthur Green database (Crown Estate, 2019). This database summarises offshore ornithological collision risk modelling data for all UK offshore wind farms. The database presents the consented and as-built scenarios if there is a difference. For some projects (e.g. Robin Rigg and Rhyl Flats), there is no consented parameter information available either within the MacArthur Green database or within the original submissions to deviate from the as-built scenario and therefore when undertaking CRM for these historical projects, only the as-built impact is presented.

5.13.1.20 The Crown Estate (2019) database does not include some of the parameters required for modelling the consented turbine scenarios for the Walney 1, Walney 2 and West of Duddon Sands offshore wind farms (namely hub height, which is required to calculate air gap). As-built parameters for these projects were used and accepted by the regulators for the gap-filled assessment of lesser black-backed gull by Walney Extension Offshore Wind Farms (Dong Energy, 2014). The Applicant has only presented as-built impacts for these two wind farms as this approach was accepted in the consenting of the Walney Extension Offshore Wind Farm.

A.2.6 Collision risk model used

5.13.1.21 Collision risk modelling was undertaken using the stochastic CRM (sCRM) developed by Marine Scotland (McGregor *et al*., 2018). The sCRM provides a user-friendly ‘Shiny App’ online interface, allowing input parameter variability to be incorporated into the model, producing predicted collision estimates with associated uncertainty. Additionally, the sCRM provides a useful audit trail of input parameters and outputs, enabling reviewers to easily assess and reproduce the results of any modelling scenario. The User Guide for the sCRM Shiny App provided by Marine Scotland (Donovan, 2017) has been followed for modelling collision impacts predicted for the Mona Array Area.

5.13.1.22 Collision risk models were run deterministically as there was no variation metric available for the density estimates or wind farm and wind turbine parameters, and therefore, a stochastic CRM could not be run, using Band Option 2 of the sCRM. The proportion of birds flying at collision risk height was determined using generic flight height data rather than site-based data. These generic data were taken from Johnston et al. (2014a; 2014b), who analysed flight height measurements from surveys conducted at 32 sites around the UK.

Table 5-144: Wind farm parameters used within the CRMs for the historical projects gap-filling.

Project	Consented or as-built	Number of turbines	Turbine capacity (mw)	Hub height (m from HAT)	Rotor radius (m)	Average RPM	Maximum blade width (m)	Blade pitch (°)	Latitude (decimal degrees)	Width (km)
Barrow Offshore Wind Farm	Consent	There is precedent that the as-built parameters have been used when undertaking gap-filled analysis for collision impacts. See Dong Energy (2014).								
	As-built	30	3	71	45	16.1	3.5	6	53.99	4.7
Burbo Bank	Consent	30	3	74	45	16.1	3.5	6	53.48	5.3
	As-built	25	3.6	79.5	53.5	13	4.2	15	53.48	5.3
Burbo Bank Extension	Consent	69	3.6	81	60	13	4.2	6	53.48	13.4
	As-built	32	8	103	82	10.5	5.4	15	53.48	13.4
Gwynt y Môr	Consent	250	3	67.5	45	16.1	3.6	15	53.45	15.2
	As-built	160	3.6	94	53.5	13	4.2	15	53.45	15.2
North Hoyle Offshore Wind Farm	Consent	There is precedent that the as-built parameters have been used when undertaking gap-filled analysis for collision impacts. See Dong Energy (2014).								
	As-built	30	2	63	40	16.7	3.5	15	53.42	4.7
Robin Rigg	Consented	Parameters not presented in The Crown Estate (2019).								
	As-built	60	3	76	45	16.1	3.5	15	54.75	6.01
Rhyl Flats Offshore Wind Farm	Consented	Parameters not presented in The Crown Estate (2019).								
	As-built	25	3.6	76	53.5	13.5	4.2	15	53.38	5.6
Walney 1 & 2 Offshore Wind Farms	Consented	There is precedent that the as-built parameters have been used when undertaking gap-filled analysis for collision impacts. See Dong Energy (2014).								
	As-built	102	3.6	78.5 to 86	53.5 to 60	13	4.2	15	54.03 and 54.08	7.8 to 8.9
	Consented	There is precedent that the as-built parameters have been used when undertaking gap-filled analysis for collision impacts. See Dong Energy (2014).								

Project	Consented or as-built	Number of turbines	Turbine capacity (mw)	Hub height (m from HAT)	Rotor radius (m)	Average RPM	Maximum blade width (m)	Blade pitch (°)	Latitude (decimal degrees)	Width (km)
West of Duddon Sands	As-built	108	3.6	86	60	13	4.2	15	53.98	11.9

A.2.7 Collision risk

A.2.7.1 Black-legged kittiwake

Table 5-145: Monthly densities (birds per km²) of black-legged kittiwake within selected historical offshore wind farm projects (all behaviours).

Project	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Barrow Offshore Wind Farm	0.46	0.47	0.31	0.19	0.18	0.16	0.14	0.40	0.13	0.22	0.37	0.43
Burbo Bank Offshore Wind Farm	0.43	0.45	0.30	0.18	0.17	0.15	0.13	0.12	0.20	0.33	0.37	0.40
Gwynt y Môr Offshore Wind Farm	0.42	0.44	0.31	0.21	0.19	0.17	0.15	0.13	0.20	0.33	0.36	0.40
North Hoyle Offshore Wind Farm	0.43	0.44	0.30	0.19	0.18	0.16	0.14	0.36	0.13	0.20	0.33	0.40
Robin Rigg East Offshore Wind Farm	0.45	0.46	0.32	0.21	0.19	0.18	0.16	0.16	0.24	0.38	0.41	0.43
Robin Rigg West Offshore Wind Farm	0.45	0.46	0.32	0.21	0.20	0.18	0.17	0.16	0.24	0.38	0.40	0.43
Rhyl Flats Offshore Wind Farm	0.42	0.44	0.32	0.22	0.20	0.17	0.15	0.14	0.21	0.32	0.36	0.39
Walney 1 Offshore Wind Farm	0.46	0.47	0.31	0.19	0.18	0.16	0.14	0.13	0.22	0.37	0.40	0.43
Walney 2 Offshore Wind Farm	0.47	0.49	0.33	0.20	0.19	0.17	0.15	0.14	0.23	0.38	0.41	0.45
West of Duddon Sands Offshore Wind Farm	0.46	0.47	0.31	0.19	0.18	0.16	0.14	0.13	0.22	0.36	0.40	0.43

Table 5-146: Monthly predicted collision impacts of flying black-legged kittiwake within selected historical offshore wind farm projects, based on consented wind farm parameters using the species-group avoidance rate (99.28).

Project	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual Total
Burbo Bank Offshore Wind Farm	0.22	0.22	0.18	0.11	0.12	0.10	0.09	0.08	0.12	0.18	0.19	0.20	1.78
Gwynt y Môr Offshore Wind Farm	3.37	3.42	2.89	2.05	2.04	1.84	1.65	1.35	1.87	2.93	2.86	3.13	29.38

Table 5-147: Monthly predicted collision impacts of flying black-legged kittiwake within selected historical offshore wind farm projects, based on as-built wind farm parameters using the species-group avoidance rate (99.28).

Project	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual Total
Barrow Offshore Wind Farm	0.32	0.31	0.25	0.15	0.15	0.14	0.14	0.36	0.10	0.17	0.25	0.29	2.63
Burbo Bank Offshore Wind Farm	0.27	0.27	0.22	0.14	0.14	0.13	0.11	0.10	0.14	0.23	0.23	0.24	2.22

Project	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual Total
Gwynt y Môr Offshore Wind Farm	0.42	0.42	0.36	0.25	0.25	0.22	0.20	0.17	0.23	0.36	0.35	0.39	3.62
North Hoyle Offshore Wind Farm	0.38	0.39	0.31	0.20	0.22	0.18	0.16	0.41	0.13	0.20	0.30	0.34	3.22
Robin Rigg Offshore Wind Farm	0.37	0.37	0.31	0.22	0.22	0.21	0.20	0.17	0.23	0.35	0.34	0.35	3.34
Rhyl Flats Offshore Wind Farm	0.37	0.38	0.33	0.23	0.23	0.21	0.18	0.16	0.22	0.31	0.31	0.34	3.28
Walney 1 Offshore Wind Farm	0.58	0.58	0.46	0.30	0.31	0.28	0.24	0.22	0.32	0.52	0.50	0.53	4.85
Walney 2 Offshore Wind Farm	0.27	0.29	0.53	0.75	0.72	0.56	0.46	0.24	0.14	0.16	0.19	0.22	4.51
West of Duddon Sands Offshore Wind Farm	1.30	1.29	1.02	0.66	0.68	0.61	0.54	0.48	0.73	1.13	1.12	1.18	10.72

A.2.8 Great black-backed gull

Table 5-148: Densities (birds per km^2) of flying great black-backed gull within selected historical offshore wind farm projects.

Project	BDMPS – Non-breeding (September to March)		BDMPS – Breeding (April to August)	
	Boat	Aerial	Boat	Aerial
Barrow Offshore Wind Farm	0.0550	0.0001	0.0233	0.0001
Burbo Bank Offshore Wind Farm	0.0426	0.0003	0.0453	0.0001
Burbo Bank Extension Offshore Wind Farm	0.0291	0.0003	0.0341	<0.0001
Gwynt y Môr Offshore Wind Farm	0.0160	<0.0001	0.0163	<0.0001
North Hoyle Offshore Wind Farm	0.0243	0.0001	0.0248	<0.0001
Robin Rigg Offshore Wind Farm	0.0528	<0.0001	0.0350	0.0001
Rhyl Flats Offshore Wind Farm	0.0329	<0.0001	0.0216	0.0001
Walney 1 Offshore Wind Farm	0.0339	0.0001	0.0408	<0.0001
Walney 2 Offshore Wind Farm	0.0382	0.0001	0.0303	<0.0001
West of Duddon Sands Offshore Wind Farm	0.0235	0.0001	0.0428	<0.0001

Table 5-149: Monthly predicted collision impacts of flying great black-backed gull within selected historical offshore wind farm projects, based on consented wind farm parameters, from boat-based bird densities using the species-group avoidance rate of 99.39.

Project	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual Total
Burbo Bank Offshore Wind Farm	0.16	0.15	0.19	0.21	0.23	0.23	0.23	0.22	0.19	0.18	0.16	0.16	2.29
Burbo Bank Extension Offshore Wind Farm	0.44	0.43	0.52	0.63	0.70	0.70	0.71	0.68	0.52	0.49	0.44	0.43	6.70
Gwynt y Môr Offshore Wind Farm	0.73	0.71	0.85	0.91	1.00	1.00	1.02	0.96	0.85	0.81	0.72	0.71	10.26

Table 5-150: Monthly predicted collision impacts of flying great black-backed gull within selected historical offshore wind farm projects, based on as-built wind farm parameters, from boat-based bird densities using the species-group avoidance rate of 99.39.

Project	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual Total
Barrow Offshore Wind Farm	0.23	0.22	0.12	0.12	0.14	0.14	0.14	0.13	0.27	0.26	0.22	0.22	2.21
Burbo Bank Offshore Wind Farm	0.17	0.17	0.20	0.22	0.24	0.25	0.25	0.24	0.20	0.19	0.17	0.17	2.46
Burbo Bank Extension Offshore Wind Farm	0.25	0.25	0.30	0.36	0.40	0.40	0.41	0.39	0.30	0.28	0.25	0.25	3.82
Gwynt y Môr Offshore Wind Farm	0.18	0.18	0.21	0.23	0.25	0.25	0.26	0.24	0.21	0.20	0.18	0.18	2.57
North Hoyle Offshore Wind Farm	0.11	0.11	0.14	0.15	0.16	0.17	0.17	0.16	0.14	0.13	0.11	0.11	1.66
Robin Rigg Offshore Wind Farm	0.35	0.34	0.41	0.29	0.32	0.32	0.32	0.31	0.41	0.39	0.35	0.34	4.16
Rhyl Flats Offshore Wind Farm	0.16	0.16	0.19	0.13	0.14	0.14	0.15	0.14	0.19	0.18	0.16	0.16	1.91
Walney 1 Offshore Wind Farm	0.28	0.27	0.32	0.41	0.45	0.45	0.46	0.43	0.32	0.31	0.27	0.27	4.24
Walney 2 Offshore Wind Farm	0.33	0.32	0.38	0.32	0.35	0.35	0.36	0.34	0.39	0.37	0.33	0.32	4.15
West of Duddon Sands Offshore Wind Farm	0.43	0.42	0.50	0.96	1.05	1.06	1.08	1.02	0.50	0.48	0.43	0.42	8.32

A.2.9 Herring gull

Table 5-151: Monthly densities (birds per km²) of Herring gull within selected historical offshore wind farm projects (all behaviours).

Project	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Barrow Offshore Wind Farm	0.25	0.28	1.01	1.44	1.38	1.30	1.21	0.66	0.11	0.13	0.17	0.21
Burbo Bank Offshore Wind Farm	0.24	0.26	0.26	0.24	0.20	0.15	0.12	0.10	0.11	0.13	0.16	0.20
Gwynt y Môr Offshore Wind Farm	0.22	0.24	0.24	0.22	0.18	0.14	0.11	0.10	0.10	0.12	0.15	0.19
North Hoyle Offshore Wind Farm	0.23	0.26	0.25	0.23	0.19	0.15	0.12	0.10	0.11	0.13	0.16	0.20
Robin Rigg Offshore Wind Farm	0.29	0.32	0.44	0.53	0.45	0.35	0.27	0.16	0.12	0.15	0.19	0.24
Rhyl Flats Offshore Wind Farm	0.24	0.26	0.26	0.23	0.19	0.15	0.12	0.10	0.11	0.13	0.16	0.20
Walney 1 Offshore Wind Farm	0.23	0.25	0.55	0.87	0.80	0.70	0.60	0.25	0.10	0.12	0.16	0.19
Walney 2 Offshore Wind Farm	0.20	0.22	0.34	0.46	0.40	0.31	0.25	0.14	0.09	0.11	0.14	0.17
West of Duddon Sands Offshore Wind Farm	0.23	0.25	0.54	0.86	0.79	0.68	0.58	0.25	0.10	0.12	0.16	0.20

Table 5-152: Monthly predicted collision impacts of flying herring gull within selected historical offshore wind farm projects, based on consented wind farm parameters using the species-group avoidance rate of 99.39.

Project	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual Total
Burbo Bank Offshore Wind Farm	0.33	0.34	0.41	0.39	0.36	0.28	0.23	0.18	0.18	0.20	0.22	0.27	3.37
Gwynt y Môr Offshore Wind Farm	3.73	3.94	4.73	4.54	4.10	3.19	2.55	2.20	1.98	2.26	2.52	3.14	38.90

Table 5-153: Monthly predicted collision impacts of flying herring gull within selected historical offshore wind farm projects, based on as-built wind farm parameters using the species-group avoidance rate of 99.39.

Project	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual Total
Barrow Offshore Wind Farm	0.39	0.42	1.83	2.76	2.98	2.80	2.63	1.35	0.21	0.24	0.25	0.31	16.15
Burbo Bank Offshore Wind Farm	0.35	0.37	0.45	0.43	0.39	0.30	0.25	0.20	0.19	0.22	0.24	0.29	3.68

Project	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual Total
Gwynt y Môr Offshore Wind Farm	0.91	0.97	1.14	1.08	1.01	0.78	0.61	0.51	0.49	0.55	0.63	0.76	9.43
North Hoyle Offshore Wind Farm	0.41	0.44	0.54	0.52	0.46	0.35	0.30	0.22	0.25	0.23	0.29	0.36	4.37
Robin Rigg Offshore Wind Farm	0.70	0.76	1.25	1.59	1.49	1.16	0.92	0.51	0.34	0.40	0.45	0.57	10.14
Rhyl Flats Offshore Wind Farm	0.53	0.57	0.95	1.19	1.11	0.87	0.68	0.38	0.26	0.31	0.34	0.43	7.64
Walney 1 Offshore Wind Farm	0.69	0.73	1.94	3.21	3.26	2.86	2.49	0.99	0.35	0.40	0.48	0.56	17.97
Walney 2 Offshore Wind Farm	1.50	1.52	1.23	0.78	0.82	0.74	0.66	0.58	0.86	1.35	1.29	1.40	12.70
West of Duddon Sands Offshore Wind Farm	1.55	1.64	4.25	7.10	7.20	6.22	5.40	2.20	0.79	0.90	1.07	1.32	39.62

A.2.10 Lesser black-backed gull

Table 5-154: Monthly densities (birds per km^2) of lesser black-backed gull within selected historical offshore wind farm projects (all behaviours).

Project	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Robin Rigg Offshore Wind Farm	0.03	0.03	0.07	0.18	0.22	0.28	0.35	0.17	0.07	0.06	0.04	0.04

Table 5-155: Monthly predicted collision impacts of flying lesser black-backed gull, based on as-built parameters using the species-group avoidance rate of 99.39.

Project	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual total
Robin Rigg Offshore Wind Farm	0.08	0.08	0.22	0.61	0.82	1.05	1.33	0.61	0.23	0.18	0.11	0.11	5.42

A.2.11 Northern gannet

Table 5-156: Monthly densities (birds per km²) of northern gannet within selected historical offshore wind farm projects (all behaviours).

Project	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Barrow Offshore Wind Farm	0.06	0.06	0.07	0.09	0.10	0.12	0.14	0.16	0.16	0.12	0.08	0.07
Burbo Bank Offshore Wind Farm	0.05	0.05	0.06	0.07	0.08	0.10	0.12	0.13	0.13	0.10	0.07	0.06
Gwynt y Môr Offshore Wind Farm	0.07	0.06	0.07	0.09	0.11	0.13	0.15	0.16	0.16	0.12	0.09	0.07
North Hoyle Offshore Wind Farm	0.06	0.06	0.07	0.09	0.10	0.12	0.14	0.15	0.15	0.11	0.08	0.07
Robin Rigg Wind Farm	0.05	0.05	0.06	0.08	0.10	0.12	0.15	0.17	0.17	0.12	0.07	0.06
Rhyl Flats Offshore Wind Farm	0.06	0.06	0.07	0.09	0.10	0.12	0.14	0.16	0.16	0.12	0.08	0.07
Walney 1 Offshore Wind Farm	0.07	0.06	0.07	0.09	0.11	0.13	0.16	0.18	0.18	0.13	0.09	0.07
Walney 2 Offshore Wind Farm	0.07	0.07	0.08	0.10	0.12	0.14	0.17	0.19	0.19	0.14	0.10	0.08
West of Duddon Sands Offshore Wind Farm	0.07	0.06	0.07	0.09	0.11	0.13	0.16	0.17	0.17	0.13	0.09	0.07

Table 5-157: Monthly predicted collision impacts of flying northern gannet within selected historical offshore wind farm projects, based on consented parameters

Project	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual Total
Burbo Bank Offshore Wind Farm	0.02	0.02	0.03	0.03	0.04	0.06	0.07	0.07	0.06	0.04	0.02	0.02	0.46
Gwynt y Môr Offshore Wind Farm	0.36	0.32	0.49	0.70	0.99	1.20	1.40	1.36	1.16	0.77	0.47	0.34	9.57

Table 5-158: Monthly predicted collision impacts of flying northern gannet within selected historical offshore wind farm projects, based on as-built parameters.

Project	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual Total
Barrow Offshore Wind Farm	0.02	0.02	0.04	0.05	0.07	0.09	0.11	0.12	0.09	0.07	0.03	0.03	0.74
Burbo Bank Offshore Wind Farm	0.02	0.02	0.03	0.04	0.05	0.07	0.08	0.08	0.07	0.05	0.03	0.02	0.57
Gwynt y Môr Offshore Wind Farm	0.03	0.03	0.05	0.07	0.10	0.12	0.14	0.14	0.12	0.08	0.05	0.04	0.97
North Hoyle Offshore Wind Farm	0.03	0.03	0.06	0.08	0.09	0.12	0.14	0.13	0.11	0.09	0.04	0.04	0.97
Robin Rigg Offshore Wind Farm	0.03	0.03	0.04	0.06	0.09	0.11	0.14	0.14	0.12	0.08	0.04	0.03	0.90

Project	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual Total
Rhyl Flats Offshore Wind Farm	0.14	0.15	0.20	0.20	0.19	0.15	0.12	0.09	0.09	0.09	0.09	0.11	1.62
Walney 1 Offshore Wind Farm	0.04	0.04	0.06	0.08	0.11	0.14	0.17	0.18	0.15	0.10	0.05	0.04	1.15
Walney 2 Offshore Wind Farm	0.04	0.05	0.07	0.10	0.13	0.16	0.19	0.20	0.17	0.11	0.06	0.05	1.32
West of Duddon Sands Offshore Wind Farm	0.09	0.08	0.13	0.18	0.26	0.31	0.39	0.37	0.32	0.21	0.12	0.09	2.55

Appendix B: PVA Input Parameters

B.1 PVA input parameters CEA of common guillemot

B.1.1 Set up

The log file was created on: 2024-12-13 14:54:25 using Tool version 2, with R version 3.5.1, PVA package version: 4.18 (with UI version 1.7)

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

B.1.2 Basic information

This run had reference name “CEA_GU_Mona”.

PVA model run type: simplescenarios.

Model to use for environmental stochasticity: betagamma.

Model for density dependence: nodd.

Include demographic stochasticity in model?: Yes.

Number of simulations: 5000.

Random seed: 15.

Years for burn-in: 5.

Case study selected: None.

B.1.3 Baseline demographic rates

Species chosen to set initial values: Common guillemot.

Region type to use for breeding success data: Global.

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

Age at first breeding: 4.

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

Number of subpopulations: 1.

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

Units for initial population size: whole.population

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

B.1.4 Population 1

Initial population values: Initial population 1,145,528 in 2015

Productivity rate per pair: mean: 0.583 , sd: 0.075

Adult survival rate: mean: 0.94 , sd: 0.025

Immatures survival rates:

Age class 0 to 1 - mean: 0.56 , sd: 0.058 , DD: NA

Age class 1 to 2 - mean: 0.792 , sd: 0.152 , DD: NA

Age class 2 to 3 - mean: 0.917 , sd: 0.098 , DD: NA

Age class 3 to 4 - mean: 0.938 , sd: 0.107 , DD: NA

Age class 4 to 5 - mean: 0.94 , sd: 0.025 , DD: NA

Age class 5 to 6 - mean: 0.94 , sd: 0.025 , DD: NA

B.1.5 Impacts

Number of impact scenarios: 3.

Are impacts applied separately to each subpopulation?: No

Are impacts of scenarios specified separately for immatures?: No

Are standard errors of impacts available?: No

Should random seeds be matched for impact scenarios?: No

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

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

B.1.6 Impact on Demographic Rates

Scenario A - Name: 30% displacement and 1% mortality

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.00033947, se: NA

Scenario B - Name: 50% displacement and 1% mortality

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.00053436, se: NA

Scenario C - Name: 70% displacement and 10% mortality

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.00686823, se: NA

B.1.7 Output:

First year to include in outputs: 2030

Final year to include in outputs: 2065

How should outputs be produced, in terms of ages?: whole.population

Target population size to use in calculating impact metrics: NA

Quasi-extinction threshold to use in calculating impact metrics: NA

B.2 PVA input parameters for CEA of razorbill

B.2.1 Set up

The log file was created on: 2024-12-13 14:54:25 using Tool version 2, with R version 3.5.1, PVA package version: 4.18 (with UI version 1.7)

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

B.2.2 Basic information

This run had reference name “CEA_RZ_Mona”.

PVA model run type: simplescenarios.

Model to use for environmental stochasticity: betagamma.

Model for density dependence: nodd.

Include demographic stochasticity in model?: Yes.

Number of simulations: 5000.

Random seed: 15.

Years for burn-in: 5.

Case study selected: None.

B.2.3 Baseline demographic rates

Species chosen to set initial values: Razorbill.

Region type to use for breeding success data: Global.

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

Age at first breeding: 5.

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

Number of subpopulations: 1.

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

Units for initial population size: whole.population

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

B.2.4 Population 1

Initial population values: Initial population 606,914 in 2015

Productivity rate per pair: mean: 0.532, sd: 0.084

Adult survival rate: mean: 0.895 , sd: 0.067

Immatures survival rates:

Age class 0 to 1 - mean: 0.794 , sd: 0.001 , DD: NA

Age class 1 to 2 - mean: 0.794 , sd: 0.001, DD: NA

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

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

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

B.2.5 Impacts

Number of impact scenarios: 3.

Are impacts applied separately to each subpopulation?: No

Are impacts of scenarios specified separately for immatures?: No

Are standard errors of impacts available?: No

Should random seeds be matched for impact scenarios?: No

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

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

B.2.6 Impact on Demographic Rates

Scenario A - Name: 30% displacement and 1% mortality

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.00013679, se: NA

Scenario B - Name: 50% displacement and 1% mortality

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.00020140, se: NA

Scenario C - Name: 70% displacement and 10% mortality

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.00230118, se: NA

B.2.7 Output:

First year to include in outputs: 2030

Final year to include in outputs: 2065

How should outputs be produced, in terms of ages?: whole.population

Target population size to use in calculating impact metrics: NA

Quasi-extinction threshold to use in calculating impact metrics: NA

B.3 PVA input parameters for CEA of great black-backed gull

B.3.1 Set up

The log file was created on: 2024-12-13 14:54:25 using Tool version 2, with R version 3.5.1, PVA package version: 4.18 (with UI version 1.7)

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

B.3.2 Basic information

This run had reference name “CEA_GB_Mona”.

PVA model run type: simplescenarios.

Model to use for environmental stochasticity: betagamma.

Model for density dependence: nodd.

Include demographic stochasticity in model?: Yes.

Number of simulations: 5000.

Random seed: 15.

Years for burn-in: 5.

Case study selected: None.

B.3.3 Baseline demographic rates

Species chosen to set initial values: Great black-bakced gull.

Region type to use for breeding success data: Global.

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

Age at first breeding: 5.

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

Number of subpopulations: 1.

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

Units for initial population size: whole.population

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

B.3.4 Population 1

Initial population values: Initial population 17,742 in 2015

Productivity rate per pair: mean: 1.061 , sd: 0.132

Adult survival rate: mean: 0.93 , sd: 0.001

Immatures survival rates:

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

Age class 1 to 2 - mean: 0.93 , sd: 0.001, DD: NA

Age class 2 to 3 - mean: 0.93 , sd: 0.001, DD: NA

Age class 3 to 4 - mean: 0.93 , sd: 0.001, DD: NA

Age class 4 to 5 - mean: 0.93 , sd: 0.001, DD: NA

B.3.5 Impacts

Number of impact scenarios: 2.

Are impacts applied separately to each subpopulation?: No

Are impacts of scenarios specified separately for immatures?: No

Are standard errors of impacts available?: No

Should random seeds be matched for impact scenarios?: No

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

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

B.3.6 Impact on Demographic Rates

Scenario A - Name: 99.91% Avoidance rate

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.0013922, se: NA

Scenario B - Name: 99.39% Avoidance rate

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.0094357, se: NA

B.3.7 Output:

First year to include in outputs: 2030

Final year to include in outputs: 2065

How should outputs be produced, in terms of ages?: whole.population

Target population size to use in calculating impact metrics: NA

Quasi-extinction threshold to use in calculating impact metrics: NA

B.4 PVA input parameters for CEA of lesser black-backed gull

B.4.1 Set up

The log file was created on: 2024-12-13 14:54:25 using Tool version 2, with R version 3.5.1, PVA package version: 4.18 (with UI version 1.7)

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

B.4.2 Basic information

This run had reference name “CEA_LB_Mona”.

PVA model run type: simplescenarios.

Model to use for environmental stochasticity: betagamma.

Model for density dependence: nodd.

Include demographic stochasticity in model?: Yes.

Number of simulations: 5000.

Random seed: 15.

Years for burn-in: 5.

Case study selected: None.

B.4.3 Baseline demographic rates

Species chosen to set initial values: Lesser black-bakced gull.

Region type to use for breeding success data: Global.

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

Age at first breeding: 5.

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

Number of subpopulations: 1.

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

Units for initial population size: whole.population

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

B.4.4 Population 1

Initial population values: Initial population 240,750 in 2015

Productivity rate per pair: mean: 0.438, sd: 0.282

Adult survival rate: mean: 0.885 , sd: 0.056

Immatures survival rates:

Age class 0 to 1 - mean: 0.82, sd: 0.001 , DD: NA

Age class 1 to 2 - mean: 0.885 , sd: 0.056, DD: NA

Age class 2 to 3 - mean: 0.885 , sd: 0.056, DD: NA

Age class 3 to 4 - mean: 0.885 , sd: 0.056, DD: NA

Age class 4 to 5 - mean: 0.885 , sd: 0.056, DD: NA

B.4.5 Impacts

Number of impact scenarios: 2.

Are impacts applied separately to each subpopulation?: No

Are impacts of scenarios specified separately for immatures?: No

Are standard errors of impacts available?: No

Should random seeds be matched for impact scenarios?: No

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

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

B.4.6 Impact on Demographic Rates

Scenario A - Name: 99.54% Avoidance rate

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.0009374, se: NA

Scenario B - Name: 99.39% Avoidance rate

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.0012431, se: NA

B.4.7 Output:

First year to include in outputs: 2030

Final year to include in outputs: 2065

How should outputs be produced, in terms of ages?: whole.population

Target population size to use in calculating impact metrics: NA

Quasi-extinction threshold to use in calculating impact metrics: