Arklow Bank Wind Park 2

Environmental Impact Assessment Report

Volume II, Chapter 12: Offshore Ornithology

SSE Renewables

Version	Date	Status	Author	Reviewed by	Approved by
1.0	24/04/2024	Final (External)	Mac Arthur Green	GoBe Consultants	Sure Partners Limited

Statement of Authority

Experts	Qualifications	Relevant Experience
Dr Mark Trinder	BSc. (Hons), MSc., PhD	Mark has over 15 years of undertaking offshore wind farm ornithological impact assessments in the UK, including all aspects of data analysis, reporting, and representation at public examinations. He has also contributed to a range of statutory guidance.
Dr Shirley Raveh	BSc. (Hons), MSc., PhD	Shirley has a track record in academic research of animal responses to changes in their environments which has given her an ideal background for conducting offshore wind farm impact assessment.
Ruth Peters-Grundy	M.Sc. Wildlife Biology and Conservation, Edinburgh Napier University (2019) B.Sc. (Hons) Biology with Applied Environmental Science, Keele University (2014).	Ruth Peters-Grundy is Senior Ecological Consultant at HiDef Aerial Surveying Ltd. Ruth has 5 years of experience in Offshore Environmental Consultancy, focused on marine mammals and marine ornithology. She has worked on multiple large offshore wind projects, including undertaking Environmental Impact Assessment and Habitats Regulation Assessment/Appraisal, as well as conducting a variety of external and internal research and development projects.
Carl Dixon	B.Sc. (Hons.) in Biology (Ecology) and M.Sc in Ecological Monitoring from University College Cork	Carl is a senior ecologist who has over 25 years' experience in ecological assessment. Prior to setting up DixonBrosnan Environmental Consultants in 2000, Carl set up and ran Core Environmental Services which included REPS planning for landowners and ecological assessments. Carl has particular experience in freshwater ecology, including electrofishing fish stock assessments and water quality assessments. He also has considerable experience in habitat mapping and mammal ecology including survey work and reporting in relation to Badgers and bats. Other competencies include surveys for invasive species and bird surveys. Carl has extensive experience with regards to EIAR and NIS mitigation and impact assessment. He has experience in large-scale industrial developments with extensive experience in complex assessments as part

	of multi-disciplinary teams. Such projects include gas pipelines, incinerators, electrical cable routes, oil refineries and quarries.

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Glossary

Term	Meaning
Arklow Bank Wind Park 1 (ABWP1)	Arklow Bank Wind Park 1 consists of seven wind turbines, offshore export cable and inter-array cables. Arklow Bank Wind Park 1 has a capacity of 25.2 MW. Arklow Bank Wind Park 1 was constructed in 2003/04 and is owned and operated by Arklow Energy Limited. It remains the first and only operational offshore wind farm in Ireland.
Arklow Bank Wind Park 2 – Offshore Infrastructure	"The Proposed Development", Arklow Bank Wind Park 2 Offshore Infrastructure: This includes all elements under the existing Maritime Area Consent.
Arklow Bank Wind Park 2 (ABWP2) (the Project)	Arklow Bank Wind Park 2 (ABWP2) (The Project) is the onshore and offshore infrastructure. This EIAR is being prepared for the Offshore Infrastructure. Consents for the Onshore Grid Infrastructure (Planning Reference 310090) and Operations Maintenance Facility (Planning Reference 211316) has been granted on 26th May 2022 and 20th July 2022, respectively. • Arklow Bank Wind Park 2 Offshore Infrastructure: This includes all elements to be consented in accordance with the Maritime Area Consent. This is the subject of this EIAR and will be referred to as 'the Proposed Development' in the EIAR. • Arklow Bank Wind Park 2 Onshore Grid Infrastructure: This relates to the onshore grid infrastructure for which planning permission has been granted. • Arklow Bank Wind Park 2 Operations and Maintenance Facility (OMF): This includes the onshore and nearshore infrastructure at the OMF, for which planning permission has been granted. • Arklow Bank Wind Park 2 EirGrid Upgrade Works: any non-contestable grid upgrade works, consent to be sought and works to be completed by EirGrid.
Array Area	The Array Area is the area within which the Wind Turbine Generators (WTGs), the Offshore Substation Platforms (OSPs), and associated cables (export, inter- array and interconnector cabling) and foundations will be installed.
Cable Corridor and Working Area	The Cable Corridor and Working Area is the area within which export, inter-array and interconnector cabling will be installed. This area will also facilitate vessel jacking operations associated with installation of WTG structures and associated foundations within the Array Area.
Competent Authority (CA)	The authority designated as responsible for performing the duties arising from the EIA Directive as amended. For this application, the Competent Authority is An Bord Pleanála (ABP).
Environmental Impact Assessment (EIA)	An Environmental Impact Assessment (EIA) is a statutory process by which certain planned Projects must be assessed before a formal decision to proceed can be made. It involves the collection and consideration of environmental information, which fulfils the assessment requirements of the Directive

Term	Meaning
	2011/92/EU on the assessment of the effects of certain public and private projects on the environment as amended by Directive 2014/52/EU of the European Parliament and of the Council (EIA Directive) and the regulations transposing the EIA Directive (EIA Regulations)
EirGrid	State-owned electric power transmission system operator (TSO) in Ireland and Transmission Asset Owner (TAO) for the Project's transmission assets.
Intertidal area	The area between the high water mark (HWM) and the low water mark (LWM).
Landfall	The area in which the offshore export cables make landfall and is the transitional area between the offshore cabling and the onshore cabling.
Maritime Area Consent (MAC)	A consent to occupy a specific part of the maritime area on a non-exclusive basis for the purpose of carrying out a Permitted Maritime Usage strictly in accordance with the conditions attached to the MAC granted on 22nd December 2022 with reference number 2022-MAC-002.
Mitigation Measure	Measure which would avoid, reduce, or offset an impact.
Permitted Maritime Usage	The construction and operation of an offshore wind farm and associated infrastructure (including decommissioning and other works required on foot of any permission for such offshore wind farm).
The Application	The full set of documents that will be submitted to An Bord Pleanála in support of the consent.
The Developer	Sure Partners Ltd.

Acronyms

Term	Meaning
AA	Appropriate Assessment
ABP	An Bord Pleanála
ABWP1	Arklow Bank Wind Park 1
ABWP2	Arklow Bank Wind Park 2
BDMPS	Biologically Defined Minimum Population Scale
BoCCI	Birds of Conservation Concern in Ireland
BTO	British Trust for Ornithology
CFP	Common Fisheries Policy
CIA	Cumulative Impact Assessment
CIEEM	Chartered Institute of Ecology and Environmental Management
CRM	Collision Risk Modelling
DAERA	Department of Agriculture, Environment and Rural Affairs
DECC	Department for Energy and Climate Change
DHLGH	Department of Housing, Local Government and Heritage
ECMG	East Coast Monitoring Group
EEZ	European Economic Zone
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
EMF	Electromagnetic Field
EMP	Environmental Management Plan
EPA	Environmental Protection Agency
ESAS	European Seabirds At Sea

Term	Meaning
EU	European Union
EVMP	Environmental Vessel Management Plan
HPAIV	highly pathogenic avian influenza virus
HRA	Habitats Regulations Assessment
HWM	High Water Mark
IBMs	Individual Based Models
IMO	International Maritime Organisation
JNCC	Joint Nature Conservation Committee
LAT	Lowest Astronomical Tide
MAP Act	Maritime Area Planning Act 2021
MDSS	Material Data Safety Sheet
MPCP	Marine Pollution Contingency Plan
MPDM	Marine Planning and Development Management
NAF	nocturnal activity factor
NIEA	Northern Ireland Environmental Agency
NMPF	National Marine Planning Framework
NPWS	National Parks and Wildlife Service
NRW	Natural Resources Wales
OGI	Onshore Grid Infrastructure
OMF	Operations and Maintenance Facility
OREDP	Offshore Renewable Energy Development Plan
OSP	Offshore Substation Platform
OWEZ	Egmond aan Zee Offshore Windfarm

Term	Meaning
PAWP	Princess Amalia Windpark
PCH	Potential Collision Height
PVA	Population viability analysis
RPM	Revolutions Per Minute
RSPB	Royal Society for the Protection of Birds
SEAI	Sustainable Energy Authority of Ireland
SNCB	Statutory Nature Conservation Bodies
SNH	Scottish Natural Heritage
SOSS	Strategic Ornithological Support Services
SPA	Special Protection Area
UK	United Kingdom
VP	Vantage Points
WTG	Wind Turbine Generator
WWT	Wildfowl and Wetlands Trust
ZoI	Zone of Influence

Units

Unit	Description
Km^2	Square kilometre (area)
Km	Kilometre
MW	Megawatt
m	metre

12 Offshore Ornithology

12.1 Introduction

12.1.1.1 This Chapter of the Environmental Impact Assessment Report (EIAR) presents the assessment of the potential impacts of the Arklow Bank Wind Park 2 (ABWP2) Offshore Infrastructure (hereafter referred to as 'the Proposed Development') on Offshore Ornithology. Specifically, this Chapter considers the potential impact of the Proposed Development below the High Water Mark (HWM) during the construction, operational and maintenance, and decommissioning phases.

12.1.1.2 The assessment presented is informed by the following technical Chapters:

- Chapter 9: Benthic Subtidal and Intertidal Ecology; and
- Chapter 10: Fish, Shellfish and Sea Turtle Ecology.

12.1.1.3 This Chapter has been prepared by MacArthur Green using digital aerial survey data collected by HiDef Aerial Surveying Limited ('HiDef').

12.1.1.4 The HiDef team that undertook the surveys comprised:

- Richard Schofield: European Seabirds at Sea (ESAS) certified, over 40 years ornithological technical expertise;
- Pete Ullrich: over 10 years ornithology surveying of UK offshore windfarm sites and 40 years ornithological technical expertise;
- Micky Maher: over 15 years undertaking work for the Royal Society for the Protection of Birds (RSPB), JNCC, NatureScot, National Trust and Scottish Wildlife Trusts, authored several bird identification scientific papers;

12.1.1.5 The MacArthur Green team that undertook the assessment comprised:

- Dr Mark Trinder: Principal Ornithologist with over 15 years of wildlife impact assessment experience, working for the Institute of Zoology, Wildfowl and Wetlands Trust, RPS and MacArthur Green. Biology BSc. (Hons), Wildlife Management and Control (MSc.) and PhD in population modelling;
- Dr Shirley Raveh: Senior Consultant. 18 months consultancy experience, preceded by over 10 years of research experience studying wildlife responses to environmental change.

12.1.1.6 This Chapter draws upon information contained within the following technical appendices:

- Volume III, Appendix 12.1: Offshore Ornithology Technical Report;
- Volume III, Appendix 12.2: Offshore Ornithology: Monthly Seabird Densities;
- Volume III, Appendix 12.3: Offshore Ornithology: Monthly Seabird Abundance;
- Volume III, Appendix 12.4: Offshore Ornithology: Collision Risk Input Parameters;
- Volume III, Appendix 12.5: Offshore Ornithology: Seabird Collision Modelling Tabulated Results;
- Volume III, Appendix 12.6: Offshore Ornithology: Seabird Species Abundance Plots;
- Volume III, Appendix 12.7: Offshore Ornithology: Migrant Non-Seabird Collision Risk Modelling;
- Volume III, Appendix 12.8: Offshore Ornithology: Seabird Spatial Distribution Maps;
- Volume III, Appendix 12.9: Offshore Ornithology: Review of Seabird Monitoring Data: 2000 to 2010;
- Volume III, Appendix 12.10: Offshore Ornithology: Kittiwake population viability analysis (PVA); and

- Volume III, Appendix 12.11: Arklow Bank Wind Park 2 Onshore Cable Corridor and Landfall – Baseline Bird Survey.

12.2 Regulatory background

12.2.1.1 Planning policy on renewable energy infrastructure is presented in Chapter 2: Policy Context. Planning policy, specifically in relation to offshore ornithology, is contained in the National Marine Planning Framework (NMPF) (Department of Housing, Local Government and Heritage (DHLGH), 2021) and the Draft Offshore Renewable Energy Development Plan II (OREDP) (Department of the Environment, Climate and Communications (DECC), 2023). A summary of the policy provisions relevant to offshore ornithology are provided in Table 12.1 and Table 12.2, with other relevant policy provisions set out Table 12.4.

12.2.1.2 The relative position of the Irish offshore wind industry compared with that of other European countries such as the UK means that there is no specific statutory guidance in Ireland on ornithology impact assessment for offshore windfarms. Therefore, the well-developed UK guidance, produced by NatureScot and Natural England has been used for this assessment. An Ornithology Method Statement (Method Statement – Offshore Wind Ornithology Assessment for East Coast Phase 1 Projects (Revision: 1.0), setting out the technical details for conducting the assessment was produced jointly by the Irish Phase 1 east coast windfarm projects (Arklow Bank Wind Park 2, Codling Wind Park, Oriel Windfarm, Dublin Array, North Irish Sea Array). This was submitted to the National Parks and Wildlife Service (NPWS) for review (see section 12.3 for details). The approach outlined in the Joint Method Statement and the comments received has formed the basis for this assessment.

Table 12.1: Summary of regulatory background

Publisher	Name of document incl. reference	Key provisions
Statutory		
Legislation		
European Commission, 2011	European Communities (Marine Strategy Framework) Regulations 2011 (S.I. No. 249 of 2011);	Transposes European Union (EU) Directive 2008/56/EC (Marine Strategy Framework Directive) into Irish law.
Planning Policy and Development Control		
DECC, 2022	Strategic Environmental Assessment (SEA) of the Offshore Renewable Energy Development Plan (OREDP I and OREDPII) in Ireland: Environmental Report https://www.gov.ie/en/publication/e13f49-offshore-renewable-energy-development-plan/ https://www.gov.ie/en/publication/71e36-offshore-renewable-energy-development-plan-ii-oredp-ii/#environmental-assessments	Contains the AA screening process and SEA scoping report of the Maritime area associated with OREDPII. This resource has some important information on existing baseline conditions in the maritime area.
DHLGH, 2021	National Marine Planning Framework (NMPF)	Sets out Ireland's National Marine Spatial Plan. **Biodiversity Policy 1** Proposals incorporating features that enhance or facilitate species adaptation or migration, or natural native habitat connectivity will be supported, subject to the outcome of statutory environmental assessment processes and subsequent decision by the competent authority, and where they contribute to the policies and objectives of this NMPF. Proposals that may have significant adverse impacts on

Publisher	Name of document incl. reference	Key provisions
		species adaptation or migration, or on natural native habitat connectivity must demonstrate that they will, in order of preference and in accordance with legal requirements: a) avoid, b) minimise, or c) mitigate significant adverse impacts on species adaptation or migration, or on natural native habitat connectivity. These have been considered in section 12.9. **Biodiversity Policy 2** Proposals that protect, maintain, restore and enhance the distribution and net extent of important habitats and distribution of important species will be supported, subject to the outcome of statutory environmental assessment processes and subsequent decision by the competent authority, and where they contribute to the policies and objectives of this NMPF. Proposals must avoid significant reduction in the distribution and net extent of important habitats and other habitats that important species depend on, including avoidance of activity that may result in disturbance or displacement of habitats. These have been considered in section 12.9. **Biodiversity Policy 3** Where marine or coastal natural capital assets are recognised by Government:

Publisher	Name of document incl. reference	Key provisions
		• Proposals must seek to enhance marine or coastal natural capital assets where possible. • Proposals must demonstrate that they will in order of preference, and in accordance with legal requirements: a) avoid, b) minimise, or c) mitigate significant adverse impacts on marine or coastal natural capital assets, or d) if it is not possible to mitigate significant adverse impacts on marine or coastal natural capital assets proposals must set out the reasons for proceeding. These have been considered in section 12.9. **Biodiversity Policy 4** Proposals must demonstrate that they will, in order of preference and in accordance with legal requirements: a) avoid, b) minimise, or c) mitigate significant disturbance to, or displacement of, highly mobile species. These have been considered in section 12.9.
Guidelines and technical standards		

Publisher	Name of document incl. reference	Key provisions
CIEEM (2022)	Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal and Marine version 1.1.	This presents the most relevant Environmental Impact Assessment (EIA) guidance for offshore ornithology assessment.
Natural England (Parker *et al.* 2022 a, b, c)	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. Offshore Wind Marine Environmental Assessments: Best Practice Advice for Evidence and Data Standards. Phase II: Expectations for pre-application engagement and best practice advice for the evidence plan process. 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	Best practice methods for data collection, analysis, presentation and impact assessment for use on English projects
NatureScot (2023)	Advice on marine renewables development	Best practice methods for data collection, analysis, presentation and impact assessment for use on Scottish projects
EPA, 2022	Guidelines on the Information to be Contained in Environmental Impact Assessment Reports https://www.epa.ie/publications/monitoring--assessment/assessment/EIAR_Guidelines_2022_Web.pdf	These Guidelines apply to the preparation of all Environmental Impact Assessment Reports undertaken in the State (Ireland)

12.3 Consultation

Table 12.2: Summary of consultation relating to Offshore ornithology

Date	Consultation type	Consultation and key issue raised	Section where provision is addressed
December 2018	Birdwatch Ireland – consultation meeting	Discussion of proposed project design, data sources and methods for defining the project baseline, identification of sensitive receptors and assessing potential impacts.	Data sources and methods for defining the baseline are presented in section 12.5.2. Potential impacts are assessed in section 12.8.
January 2019	National Parks and Wildlife Service – consultation meeting	Discussion of proposed project design, data sources and methods for defining the project baseline, identification of sensitive receptors and assessing potential impacts.	Data sources and methods for defining the baseline are presented in section 12.5.2. Potential impacts are assessed in section 12.8.
September 2019	National Parks and Wildlife Service – consultation meeting	Discussion of detailed impact assessment methods (e.g. collision risk modelling) and approach to Natura Impact Assessment.	Impact assessment methodology is presented in section 12.612.6. Potential impacts are assessed in section 12.8.
May 2020	National Parks and Wildlife Service – consultation meeting	Discussion of preliminary results of impact assessment and proposed next steps.	Potential impacts are assessed in section 12.8.
October 2020	Department of Agriculture, Environment and Rural Affairs (Northern Ireland) (DAERA) – Scoping response	Agreement that proposed approach to data collection and analysis and assessment methodologies are appropriate.	Data sources and methods for defining the baseline are presented in section 12.5.2. Impact assessment methodology is presented in section 12.6.
November 2022	National Parks and Wildlife Service – consultation meeting	Update on assessment under the Maritime Area Planning Act 2021 (MAP Act), queries about technical approach to assessment and proposed next steps.	Relevant legislation and guidance applied in this assessment is discussed in section 12.2 Methods have taken account of requests as appropriate.

Date	Consultation type	Consultation and key issue raised	Section where provision is addressed
November 2023	National Parks and Wildlife Service – review of Phase 1 Projects Joint Ornithology Method Statement	Detailed report considering the technical details for assessing ornithological impacts of the windfarms.	Responses to the points raised are provided in section 12.3.1 and Table 12.3
August 2023	Meeting with National Parks and Wildlife Service	Discussion on environmental assessment process undertaken for ABWP2 and coastal SPA colonies.	See Section 12.6
February 2024	Meeting with National Parks and Wildlife Service	Update on environmental assessments including Wicklow Head SPA and surveys.	See Section 12.6

12.3.1 Phase 1 Projects Joint Ornithology Method Statement

12.3.1.1 The east coast Irish Phase 1 Projects (Arklow Bank Wind Park 2; Codling Wind Park; Oriel Windfarm; Dublin Array and North Irish Sea Array) worked together to produce an Offshore Ornithology Assessment Methodology Note. This was prepared in order to align the methods across the Phase 1 projects and reduce the number of documents from individual Phase 1 projects seeking agreement with NPWS (within similar project timeframes) on the approaches and input parameters for ornithological assessment within the jurisdiction of the Republic of Ireland. The Method Statement was submitted to NPWS in December 2022.

12.3.1.2 The methods adopted best practice, evidence based approaches from the UK Offshore Windfarm Industry which themselves have developed over a period of almost 20 years. The note covered impact assessment methods for collision risk modelling and displacement analysis as well as definitions for biological seasons (e.g. identification of species specific breeding seasons), age class subdivisions (e.g. proportions of juvenile, immature and adults in the populations) and approach to PVA for estimating population consequences from windfarm development.

12.3.1.3 The NPWS commissioned a review of the Method Statement (hereafter ‘the NPWS review’) from ABPMer which was provided to the Phase 1 Projects in November 2023. The NPWS review gave consideration to the species to be assessed and the proposed impact assessment methods (collision risk modelling, displacement analysis). The points raised are summarised in Table 12.3 along with the Developer’s responses and the sections of the assessment where further details have been provided.

Table 12.3: Summary of NPWS commissioned review of Phase 1 Projects Joint Ornithology Method Statement, the Developer responses and sections where addressed

Review section heading	Topic	Summary of review comment	The Developer response and section where provision is addressed (if appropriate)
1.2.2	Ornithological receptors	A high level review of seabird species with potential to be encountered in the Phase 1 windfarms was presented based on seabird colony counts (Mitchell *et al.* 2004). This suggested 20 species could be recorded.	The Joint Method Statement did not list all species recorded across all projects but rather focussed on the ones expected to be of primary interest, based on experience from UK assessments. Importantly, the species considered in the assessment for the Proposed Development were those recorded in the baseline surveys (Table 12.7), most of which were in fact included in this list. Other evidence, such as shore based surveys and older monitoring data has also been used throughout this assessment and is referenced wherever appropriate.
1.2.2	Determining connectivity	Methods for refining the list of potential receptors for assessment should consider tracking studies where available	An industry standard approach has been adopted, whereby connectivity is determined using available evidence, underpinned by reviews of foraging studies (Woodward *et al.* 2019).
2.1	Collision Risk	The review advised that the stochastic (i.e. randomised input values) version of the Band (2012) collision model should be used rather than the original deterministic one.	The stochastic Band model (sCRM) has been used for the assessment of the Proposed Development. However it should be noted that both stochastic and deterministic versions return the same mean values as the former is simply the latter run multiple times with randomised inputs and does not functionally differ.
2.1	Collision Risk	In response to a commitment from the Phase 1 Projects to present a mean output for combining across projects (in their cumulative assessments) a	This request appears to misunderstand the Joint Method Statement. The point was that to ensure that each Phase 1 Project provided comparable

Review section heading	Topic	Summary of review comment	The Developer response and section where provision is addressed (if appropriate)
		rationale was requested for why 'only' the mean would be presented.	central place values to be summed for the cumulative assessments. Each Phase 1 Project will also present measures of uncertainty around those central values, but it is not appropriate to sum measures of variance around those central values (e.g. 95% confidence intervals) in the cumulative assessment. The collision modelling results are presented and assessed in section 12.9.8, 12.9.9 and 12.9.10 and cumulatively in section 12.11.4.
2.1	Collision Risk	Selection of flight height data and other seabird parameters should be fully justified.	The collision risk modelling methods and input parameter values used have followed UK best practice and also made reference to new evidence where appropriate (sections 12.9.8, 12.9.9 and 12.9.10 and Technical Appendix 12.04).
2.1	Collision Risk	Species included in the CRM	Species have been assessed on the basis of both their presence in the survey data and an understanding of their risks to collision based on many years of assessment in the UK and elsewhere. A precautionary approach has been taken, with species screened in where the risks cannot be ruled out (section 12.9.8).
2.1	Collision vs displacement	Queries about how windfarm avoidance was to be applied to the collision risk and displacement assessment for gannet	The avoidance and displacement rates for gannet have followed UK best practice guidance (Parker *et al.* 2022) and are set out in sections 12.9.8, 12.9.9 and 12.9.10.

Review section heading	Topic	Summary of review comment	The Developer response and section where provision is addressed (if appropriate)
2.2	Disturbance and displacement	Suggestion that Individual Based Models (IBMs) should be used for the displacement assessment, rather than the displacement matrix method proposed.	While the merits of IBMs are acknowledged, these methods require long term detailed studies of individual birds. Such data are not available for any of the seabird colonies connected to the Phase 1 windfarms (nor indeed to more than a few windfarms anywhere) and therefore such approaches are not applicable here.
2.2	Mortality rates	There is a need to clarify what mortality rates are to be used and the evidence that underpins them.	The source document for mortality rates is provided throughout the relevant sections of the assessment. Mortality rates for displaced birds of up to 10% have been considered in the assessment.
2.2	Density data	There is a need to clarify how the weights would be calculated for the proposed weighted mean approach	This referred to giving consideration to how cumulative effects during the nonbreeding season might need to take account of apparent movements of birds between different windfarms, to avoid double counting of peaks occurring sequentially across windfarms as birds move through the course of the season. This approach has not been used in this assessment as no pattern of this nature was apparent in the shared data.
2.2	Density data	Request to provide evidence that kittiwake and Manx shearwater are not at risk of displacement effects, the latter with particular reference to Dundalk Bay.	Monitoring conducted at UK windfarms has found very little evidence that kittiwake are displaced by offshore windfarms (MacArthur Green 2023, Degraer *et al.* 2023). With respect to Manx shearwater and their association with Dundalk Bay, the Proposed Development is located a

Review section heading	Topic	Summary of review comment	The Developer response and section where provision is addressed (if appropriate)
			considerable distance from Dundalk Bay (>100km) and is not located between the bay any colonies. Therefore, there is no justification for screening this species into the displacement assessment unless it was recorded during the surveys, in the same manner that other species have been screened in or out of the assessment (section 12.9.2). References in support of the screening decisions for the displacement assessment are provided in section 12.9.2.
2.2.4	Barrier effects	Details on how individual Projects may consider barrier effects (over and above displacement) was requested	The Proposed Development is not considered to present a barrier to movement, either alone or cumulatively with the other Phase 1 projects, therefore no specific consideration of barrier effects has been necessary.
2.3	Breeding seasons	Request for additional evidence to justify departure from season definitions in Furness (2015)	The Developer has used the Furness (2015) seasonal definitions in this assessment.
2.4	Apportionment	Clarification of aspects of breeding season definitions, population sizes and apportioning methods.	This aspect is relevant to assessment of effects on individual Special Protection Areas (SPAs) provided in the Natura Impact Statement (where these comments are considered further)
2.6	Migratory non-seabirds and seabirds	Use of the SOSS approach may be replaced when the results of work commissioned by Marine Scotland is available.	The Marine Scotland work was to review and update the SOSS methods, not replace them. Preliminary results indicate the two methods are largely the same, however the new tools are not currently available or endorsed for use in the UK,

Review section heading	Topic	Summary of review comment	The Developer response and section where provision is addressed (if appropriate)
			therefore the SOSS tool remains the most appropriate option.
3	Responses to questions	Further explanation for rationale for species included in or omitted from the CRM	This has been provided in sections 12.9.8, 12.9.9 and 12.9.10.
		Further review and consideration of parameters used in the CRM (e.g. flight speed)	This has been provided in sections 12.9.8, 12.9.9 and 12.9.10.
		Further information is necessary to establish whether the displacement risk species and parameters are reasonable.	This has been provided in section 12.9.2.

12.4 Study area

12.4.1.1 The Offshore Ornithology Study Area was defined through consideration of potential impacts on offshore ornithological receptors and the suitability of this area for the purpose of EIAR. The Offshore Ornithology Study Area was consulted through consultation with the NPWS. It is not considered feasible or realistic to define a precise Study Area appropriate to all ornithological receptors which may have connectivity to the Proposed Development. Instead this has been defined in approximate geographical terms as the Irish Sea and adjoining marine area (and seabird colonies therein) that are understood from studies of different seabird species' ecology and movement patterns to have some degree of connectivity with the Proposed Development. For example, a proportion of the gannet which breed at colonies along the west coast of Scotland are expected to pass through the Irish Sea on migration in spring and autumn, and therefore connectivity would be assumed. However, other species which may breed at the same Scottish colonies, such as herring gull, would not be expected to travel such distances or have any appreciable connectivity.

12.4.1.2 The Offshore Ornithology Study Area includes the Array Area surrounded by a 2 km and a 4 km buffer (Figure 12.1). The Cumulative Offshore Ornithology Study Area includes all offshore windfarm projects around Ireland and the UK (primarily focussed on the Irish Sea) where effect-receptor pathways with the Proposed Development have been assumed present. This included operational and consented offshore windfarms, those in the planning phase for which suitable data were available in the public domain, or for which the data were provided by those projects for use in the assessment.

12.4.1.3 The Intertidal Ornithology Study Area (Volume III, Appendix 12.11: Arklow Bank Wind Park 2 Onshore Cable Corridor and Landfall – Baseline Bird Survey) includes the total area of inshore waters that could be seen from Vantage Points (VPs) located onshore to provide views of the area of sea and adjacent intertidal land at the landfall location (Volume III, Appendix 12.11: Arklow Bank Wind Park 2 Onshore Cable Corridor and Landfall – Baseline Bird Survey, Figure 1).

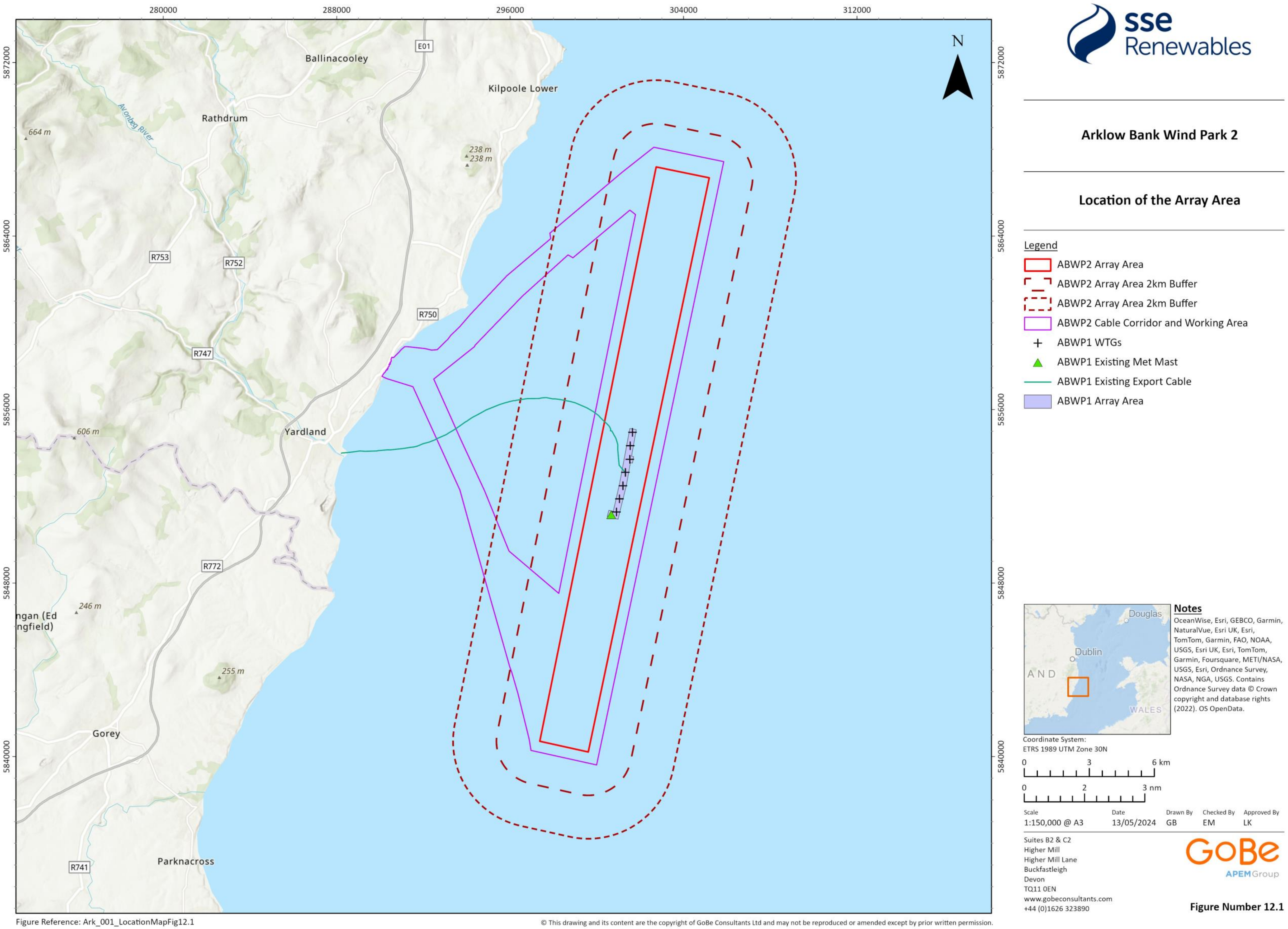

Figure 12.1: Study Area including the Array Area surrounded by a 2 km and a 4 km buffer

12.5 Methodology

12.5.1 Methodology to inform the baseline

Desktop studies

12.5.1.1 Information on seabird ecology and distribution within the Offshore Ornithology Study Area as well as potential impacts of windfarms on seabirds was collected through a detailed desktop review of existing studies and datasets.

12.5.1.2 The desk-based assessment has drawn on a wide variety of published literature, covering both peer reviewed scientific literature and the 'grey literature' such as windfarm project submissions and reports. The key topics for which the literature has been examined are summarised at Table 12.4 below.

Table 12.4: Summary of key desktop reports and data resources

Title	Source	Year	Author
Relevant literature on population sizes, migration routes and foraging ranges			
Seabird Populations of Britain and Ireland	T. and A.D. Poyser, London	2004	Mitchell *et al.*
Nonbreeding season populations of seabirds in UK waters: Population sizes for Biologically Defined Minimum Population Scales (BDMPS)	Natural England Commissioned Report Number 164. 389 pp	2015	Furness
Birds in Europe: population estimates, trends and conservation status	Birdlife Conservation Series No. 12. Cambridge, UK.	2004	BirdLife International
Population estimates on birds in Great Britain and the United Kingdom	British Birds, 106, 64–100	2013	Musgrove *et al.*
Waterbirds in the UK 2018/19: The Wetland Bird Survey	Available at: https://www.bto.org/our-science/projects/wetland-bird-survey/publications/webs-annual-report/waterbirds-in-the-uk	2020	Frost *et al.*
Desk-based revision of seabird foraging ranges used for Habitats Regulations Assessment (HRA) screening	BTO Report 724 for The Crown Estate	2019	Woodward *et al.*

Title	Source	Year	Author
Foraging ranges of northern gannets *Morus bassanus* in relation to proposed offshore windfarms in the UK: 2010-2012	Report to the Department of Energy and Climate Change (DECC). Reference DECC URN:13D/306	2010	Langston *et al.*
The Birds of the Western Palearctic	Oxford University Press, Oxford	1977 - 1994	Cramp and Simmons
Handbook of the Birds of the World	Lynx Editions, Madrid	1992 - 2011	Del Hoyo *et al.*
An atlas of seabird distribution in north-west European waters	Joint Nature Conservation Committee (JNCC), Peterborough	1995	Stone *et al.*
Birds in Ireland	T and AD Poyser, London	2010	Hutchinson
The Migration Atlas: Movements of the birds of Britain and Ireland.	T and AD Poyser, London	2002	Wernham *et al.*
Seabird Population Trends and Causes of Change: 1986-2018 Report	https://jncc.gov.uk/our-work/smp-report-1986-2018 JNCC, Peterborough	2018	JNCC
Effects of offshore windfarms on the energy demands of seabirds	University of Aberdeen report to the Department of Energy and Climate Change	2009	Speakman *et al.*
ObSERVE aerial seabird survey data collected between 2015 and 2016 across all Exclusive Economic Zone (EEZ) waters surrounding the Republic of Ireland	Available at: https://www.dccae.gov.ie/en-ie/natural-resources/topics/Oil-Gas-Exploration-Production/observe-programme/Pages/ObSERVE-Programme.aspx	2015 to 2016	Department of Communications, Climate Action and Environment in partnership with the Department of Culture, Heritage and the Gaeltacht.
Assessing the impacts of windfarms on birds	Ibis, 148 (Suppl. 1), 4-7	2006	Drewitt and Langston
Trapped within the corridor of the southern North Sea: the potential impact of offshore windfarms on seabirds	Birds and Windfarms. de Lucas, M., Janss, G.F.E. and Ferrer, M. (Eds). Quercus, Madrid	2007	Stienen *et al.*

Title	Source	Year	Author
Vulnerability of Scottish seabirds to offshore wind turbines	Report to Marine Scotland	2012	Furness and Wade
Rare breeding birds in the United Kingdom in 2009	British Birds, 104, 476–537	2011	Holling *et al.*
An analysis of the numbers and distribution of seabirds within the British Fishery Limit aimed at identifying areas that qualify as possible marine Special Protection Area (SPAs)	JNCC Report, No. 431. JNCC, Peterborough	2010	Kober *et al.*
Seabirds Count: a census of breeding seabirds in Britain and Ireland (2015–2021)	Lynx Nature Books, Barcelona	2023	Burnell *et al.*
The Status of Ireland's Breeding Seabirds: Birds Directive Article 12 Reporting 2013 – 2018	Irish Wildlife Manuals, No. 114. National Parks and Wildlife Service, Department of Culture, Heritage and the Gaeltacht, Ireland	2019	Cummins *et al.*
Relevant literature on collision risk, flight heights and avoidance rates			
Using a collision risk model to assess bird collision risks for offshore windfarms	The Crown Estate Strategic Ornithological Support Services (SOSS) report SOSS-02	2012	Band
Assessing the risk of offshore windfarm development to migratory birds designated as features of UK Special Protection Area (and other Annex I species)	Strategic Ornithological Support Services. Project SOSS-05. BTO Research Report No. 592.	2012	Wright *et al.*
Modelling flight heights of marine birds to more accurately assess collision risk with offshore wind turbines	Journal of Applied Ecology, 51, 31-41	2014 a	Johnston *et al.*
Corrigendum	Journal of Applied Ecology, 51, doi: 10.1111/1365-2664.12260	2014 b	Johnston *et al.*

Title	Source	Year	Author
The Avoidance Rates of Collision Between Birds and Offshore Turbines	Scottish Marine and Freshwater Science Volume 5 Number 16. Available at: http://www.gov.scot/resource/0046/00464979.pdf	2014	Cook *et al.*
Strategic assessment of collision risk of Scottish offshore windfarms to migrating birds	Scottish Marine and Freshwater Science Report Vol 5 No 12	2013	Wildfowl and Wetlands Trust (WWT Consulting) Ltd and MacArthur Green
Joint Response from the Statutory Nature Conservation Bodies to the Marine Scotland Science Avoidance Rate Review		2014	Statutory Nature Conservation Bodies (SNCBs): Natural Resources Wales (NRW), Natural England, Northern Ireland Environment Agency (NIEA), JNCC and Scottish Natural Heritage (SNH)
Relevant literature on disturbance and displacement			
Interim Displacement Advice Note	Available at: http://jncc.defra.gov.uk/pdf/Joint_SNCB_Interim_Displacement_AdviceNote_2017.pdf	2017	SNCBs: Natural Resources Wales (NRW), Department of Agriculture, Environment and Rural Affairs / Northern Ireland Environment Agency (DAERA/NIEA), Natural England, Scottish Natural Heritage (SNH) and Joint Nature Conservation Committee (JNCC) Joint SNCB
Displacement Note: Joint Natural England and JNCC Interim Advice Note: Presenting information to inform assessment of the potential magnitude and consequences of displacement of seabirds in relation of Offshore Windfarm Developments		2012	Natural England and JNCC
Scaling possible adverse effects of marine windfarms on seabirds:	Journal of Applied Ecology, 41, 724-734	2004	Garthe and Hüppop

Title	Source	Year	Author
developing and applying a vulnerability index			
Assessing vulnerability of marine bird populations to offshore windfarms	Journal of Environmental Management, 119, 56-66	2013	Furness *et al.*

Site-specific surveys

12.5.1.3 In order to inform the EIAR, site-specific surveys were undertaken. A summary of the surveys used to inform the offshore ornithology impact assessment is outlined in Table 12.5 below.

Table 12.5: Site specific surveys

Data source	Date(s) of survey	Overview of survey	Survey contractor	Reference to further information
Digital aerial ornithology survey	March 2018 to April 2020 (monthly)	Offshore aerial surveys undertaken over a period of 25 months to assess the temporal and spatial abundance and distribution of birds	HiDef Aerial Surveying Limited. Bird surveyors were: • Richard Schofield: European Seabirds at Sea (ESAS) certified, over 40 years ornithological technical expertise; • Pete Ullrich: over 10 years ornithology surveying of UK offshore windfarm sites and 40 years ornithological technical expertise; • Micky Maher: over 15 years undertaking work for the RSPB, JNCC, NatureScot, National Trust and Scottish Wildlife Trusts, authored several bird identification scientific papers;	Volume III, Appendix 12.1: Offshore Ornithology Technical Report
Shore bird survey of candidate Cable Corridor and Working Area landfall locations	November 2019 to March 2020	Baseline survey to assess the bird species likely to occur in the area during the winter period. Potential breeding habitat for seabirds was also assessed.	Dixon Brosnan	Volume III, Appendix 12.11 Onshore Cable Route and Landfall – Baseline Bird Survey

Identification of designated sites

12.5.1.4 All designated sites within the offshore ornithology Study Area (see section 12.3.1 for how this has been defined) and the qualifying interests that could be affected by the construction, operational and maintenance, and decommissioning phases of the Proposed Development were identified using the three-step process described below:

- Step 1: All designated sites of international, national and local importance within the offshore ornithology Study Area were identified using a number of sources. These included the Environmental Protection Agency (EPA) and NPWS websites, as well as UK sources of similar information.
- Step 2: Information was compiled on the relevant qualifying interest for each of these sites which may make them a sensitive receptor in terms of offshore ornithology. For example, risk of collisions with rotating turbines.
- Step 3: Using the above information and expert judgement, sites were included for further consideration if:
  - A designated site directly overlaps with the Proposed Development; or
  - Sites and associated qualifying interests were located within the potential Zone of Influence (ZoI) for impacts associated with the Proposed Development. Note that, as discussed above (Section 12.4) the ZoI has not been defined in strict distance terms but rather on a species-specific basis and taking into account seabird movement patterns.

Table 12.6: Designated sites and relevant qualifying interests for the offshore ornithology

Designated Site	Closest Distance to the Array Area (km)	Closest Distance to the Cable Corridor and Working Area (km)	Relevant Qualifying Interest
Wicklow Head SPA	6.0	5.2	Kittiwake (Rissa tridactyla)
The Murrough SPA*	8.0	12.9	Little tern (*Sterna albifrons*) , Red-throated diver (*Gavia stellata*)
The Raven SPA	34.3	33.8	Little tern
Dalkey Islands SPA	40.2	39.3	Arctic tern (*Sterna paradisaea)* Common tern (*Sterna hirundo*) Roseate tern (Sterna dougallii)
Wexford Harbour and Slobs SPA	41.6	41	Cormorant (*Phalacrocorax car*bo) Lesser black-backed gull (*Larus fuscus*) Little tern
South Dublin Bay and River Tolka Estuary SPA	44.5	43.6	Arctic tern Black-headed gull (*Chroicocephalus ridibundus*) Common tern Roseate tern
North-West Irish Sea cSPA	47.1	52.1	Common scoter (*Melanitta nigra*) Red-throated diver (*Gavia stellata*) Great Northern diver (*Gavia immer)* Fulmar (*Fulmarus glacialis*) Manx shearwater (*Puffinus puffinus*)

Designated Site	Closest Distance to the Array Area (km)	Closest Distance to the Cable Corridor and Working Area (km)	Relevant Qualifying Interest
			Shag (*Gulosus aristotelis*) Cormorant Little gull (*Larus minutus*) Kittiwake Black-headed gull Common gull (*Larus canus*) Lesser black-backed gull Herring gull Great black-backed gull (*Larus marinus*) Little tern Roseate tern Common tern Arctic tern Puffin (*Fratercula arctica*) Razorbill Guillemot
Howth Head Coast SPA	49.6	48.6	Kittiwake
Ireland's Eye SPA	53.7	52.8	Cormorant Guillemot (*Uria aalge*) Herring gull (*Larus argentatus*) Kittiwake Razorbill (*Alca torda*)
Lady's Island Lake SPA	57.7	57.1	Arctic tern Black-headed gull Common tern Roseate tern Sandwich tern (Sterna sandvicensis)
Lambay Island SPA	62.5	61.6	Cormorant Fulmar Guillemot Herring gull Kittiwake Lesser black-backed gull Puffin Razorbill Shag
Aberdaron Coast and Bardsey Island / Glannau Aberdaron and Ynys Enlli SPA	65.9	65.4	Manx shearwater
Saltee Islands SPA	70.9	70.4	Cormorant Fulmar Gannet (*Morus bassanus*) Guillemot Herring gull Kittiwake Lesser black-backed gull

Designated Site	Closest Distance to the Array Area (km)	Closest Distance to the Cable Corridor and Working Area (km)	Relevant Qualifying Interest
			Puffin Razorbill Shag
Rockabill SPA	71.9	71	Arctic tern Common tern Roseate tern
Keeragh Islands SPA	72.9	72.3	Cormorant
Skerries Island SPA	73.0	72	Cormorant Herring gull Shag
Seas off Wexford SPA	74.9	86.2	Red-throated Diver Fulmar Manx Shearwater Gannet Cormorant Shag Common Scoter Mediterranean Gull Black-headed Gull Lesser Black-backed Gull Herring Gull Kittiwake Sandwich Tern Roseate Tern Common Tern Arctic Tern Little Tern Guillemot Razorbill Puffin
Anglesey Terns / Morwenoliaid Ynys Môn SPA	82.5	81.6	Arctic tern Common tern Roseate tern Sandwich tern
River Nanny Estuary and Shore SPA	83.7	82.7	Herring gull
Boyne Estuary SPA	91.5	90.6	Little tern
Irish Sea Front SPA	93.9	92.9	Manx shearwater
North Cardigan Bay SPA	99.0	98.5	Red-throated diver
Grassholm SPA	107.6	107	Gannet

** Note that these distances have been measured from the seaward boundary of the Murrough SPA which has been extended although the statutory instrument has not been revised correspondingly (https://experience.arcgis.com/experience/edf34d92e28040fd87d3d14f55d8d95f and https://www.npws.ie/protected-sites/spa/004186).*

12.5.2 Baseline environment

Important Ecological Features

SPECIES RECORDED IN THE OFFSHORE ORNITHOLOGY STUDY AREA

12.5.2.1 A technical report has been prepared to provide a detailed characterisation of the receiving baseline (Volume III Appendix 12.1). A review of the key findings from that study has been incorporated into the description of the receiving environment.

12.5.2.2 The following bird species (Table 12.7) were recorded during digital aerial surveys within the Array Area as well as within the Array Area 2 km and 4 km buffers only (i.e. the buffers without the Array Area).

Table 12.7: Bird species recorded during digital aerial surveys within the Array Area, the 2 km buffer only and the 4 km buffer only

Species	Array Area	2 km buffer only	4 km buffer only
Arctic skua			X
Arctic tern	X	X	X
Black headed gull	X	X	X
Common gull	X	X	X
Common scoter	X		
Common tern	X	X	X
Cormorant	X		
Fulmar	X		
Gannet	X	X	X
Great black-backed gull	X	X	
Great northern diver	X		
Guillemot	X	X	X
Herring gull	X	X	X
Kittiwake	X	X	X
Lesser black-backed gull	X		X
Little gull	X	X	X
Manx shearwater	X	X	X
Puffin	X	X	X
Razorbill	X	X	X

Species	Array Area	2 km buffer only	4 km buffer only
Red-throated diver	X	X	X
Sandwich tern	X	X	X
Shag	X	X	X

SEASONAL BIRD ABUNDANCE

12.5.2.3 Bird abundances and assemblages have been estimated from the site-specific surveys carried out for the Proposed Development. These abundance estimates and how they were estimated are presented in detail in Volume III, Appendices 12.1 and 12.3 and are not repeated here.

12.5.2.4 Impacts have been assessed for each species recorded from the site-specific surveys in relation to relevant biological seasons (Table 12.8) as defined by Furness (2015).

12.5.2.5 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). Note that for the latter, where months contain overlapping seasons (for example breeding and migration), these have been assigned to breeding, since for almost all species, the Array Area is located within species-specific foraging ranges (refer to Woodward *et al.*, 2019) of breeding colonies. The exceptions to this are Arctic tern, common tern, Sandwich tern and razorbill colonies which are beyond foraging distance of the Proposed Development.

Table 12.8: Species-specific seasonal definitions have been taken from Furness (2015) and Snow and Perrins (1998). Shaded cells indicate the appropriate nonbreeding season periods used in the assessment for each species.

Species	Breeding	Migration - autumn	Winter	Migration – spring	Nonbreeding
Arctic skua	May-Jul	Aug-Oct	-	Apr-May	-
Arctic tern	May-Aug	Jul-Sep	-	Apr-May	-
Black-headed gull[a]	May-Aug	-	-		Sep-Apr
Common gull[a]	May-Aug	-	-	-	Sep-Apr
Common scoter[a]	May-Aug	Sep-Dec	-	Feb-May	-
Common tern	May-Aug	Jul-Sep	-	Apr-May	-
Cormorant	Apr-Aug	Aug-Oct	-	Feb-Apr	Sep-Mar
Fulmar	Jan-Aug	Sep-Oct	Nov	Dec-Mar	-
Gannet	Mar-Sep	Sep-Nov	-	Dec-Mar	-
Great black-backed gull	Mar-Aug	Aug-Nov	Dec	Jan-Apr	Sep-Mar

Species	Breeding	Migration - autumn	Winter	Migration – spring	Nonbreeding
Great northern diver	-	Sep-Nov	Dec-Feb	Mar-May	Sep-May
Guillemot	Mar-Jul	Jul-Oct	Nov	Dec-Feb	Aug-Feb
Herring gull	Mar-Aug	Aug-Nov	Dec	Jan-Apr	Sep-Feb
Kittiwake[b]	Mid-Apr-Aug	Aug-Dec	-	Jan-mid Apr	-
Lesser black-backed gull	Apr-Aug	Aug-Oct	Nov-Feb	Mar-Apr	-
Little gull[a]	Apr-Jul	-	-	-	Aug-Apr
Manx shearwater	Apr-Aug	Aug-early Oct	Nov-Feb	Mar-May	Sept-Mar
Puffin	Apr-Aug	Jul-Aug	Sep-Feb	Mar-Apr	Mid-Aug-Mar
Razorbill	Apr-Jul	Aug-Oct	Nov-Dec	Jan-Mar	-
Red-throated diver	Mar-Aug	Sep-Nov	Dec-Jan	Feb-Apr	-
Sandwich tern	Apr-Aug	Jul-Sep	-	Mar-May	Sep-Mar
Shag	Feb-Aug	Aug-Oct	Nov	Dec-Feb	Sep-Jan

a Not included in Furness (2015). Seasons taken from the Birds of the Western Palearctic (Snow and Perrins 1998).

b https://www.nature.scot/sites/default/files/2018-11/Guidance%20-%20Suggested%20seasonal%20definitions%20for%20birds%20in%20the%20Scottish%20Marine%20Environment.pdf

12.5.2.6 The seasonal peak abundance within species-specific seasons (as defined in Table 12.8) calculated individually for seabirds recorded within the Array Area are provided in Table 12.9 (note these abundances do not include birds observed in the 2 km or 4 km buffer around the Array Area).

12.5.2.7 The method used to calculate the seasonal peaks for the Proposed Development was as follows:

- The population density and abundance for each survey was calculated using design-based estimation methods, with 95% confidence intervals calculated using non-parametric bootstrapping (this is a standard statistical method for estimating uncertainty by randomly resampling from a dataset to obtain multiple replicate versions of the data; see Volume III, Appendix 12.1: Offshore Ornithology Technical Report for further details); and
- The abundance for each calendar month was calculated as the mean of estimates for each month (i.e. this was the average of two values for all months with the exception of July, for which three surveys were conducted).

12.5.2.8 The seasonal peak was taken as the highest of the monthly estimates from those months which fall within each season. In some cases, the peak was recorded in a month which is included in overlapping seasons (e.g. for some species March or April is identified as both a migration month and a breeding month, as noted in section 12.5.2.5) and therefore the same value has been reported in both seasons. These have been highlighted in italics in Table 12.9. The migration-free breeding season comprises months when all breeding individuals of that species are considered to be at breeding colonies and not on migration. For example, in the case of gannet, the full breeding season covers March to September, but as March is also included in the spring migration period and September in the autumn migration period, the migration-free months are April to August.

12.5.2.9 A summary of the observations for each species within the Array Area is provided in Volume III, Appendix 12.1: Offshore Ornithology Technical Report.

12.5.2.10 Note that some species, such as skuas, terns and little gull are likely to be poorly represented in the survey data (e.g. due to infrequent passage movements) and therefore the impact assessments for these species draw on additional sources of information with regards their anticipated movements and utilise methods developed for migratory species (e.g. Wildfowl and Wetlands Trust (WWT) and MacArthur Green, 2013).

Table 12.9: Seasonal peak population and 95% confidence intervals within the Array Area (not including buffer). The population size (including birds in flight and on the water) in each calendar month was calculated as the mean of the individual surveys conducted in that month and the values shown in the table are the highest from all months in each season. Numbers in italics identify occasions when the same peak was recorded in different seasons due to overlapping months

Species	Breeding (full period)		Breeding (migration – free)		Migration - autumn		Winter		Migration – spring		Nonbreeding	
	Peak	95% c.i.	Peak	95% c.i.	Peak	95% c.i.	Peak	95% c.i.	Peak	95% c.i.	Peak	95% c.i.
Arctic skua	0	0-0	0	0-0	0	0-0	-	-	0	0-0	-	
Arctic tern	*3,230*	*827.5-5,474*	0	0-0	*3,230*	*827.5-5,474*	-	-	285	82.38-565.25	-	-
Black-headed gull	5	0-15	5	0-15	-	-	-	-			600	147.38-1,235.12
Common gull	*30*	*0-75.75*	*30*	*0-75.75*	-	-	-	-	-	-	2230	716.62-5219.5
Common scoter	10	0-30	-	-	-	-	-	-	-	-	20	0-55.25
Common tern	*870*	*404.75-1,330.5*	0	0-0	*870*	*404.75-1,330.5*	-	-	65	25-120.25	-	-
Cormorant	0	0-0	-	-	-	-	-	-	-	-	10	0-30
Fulmar	*5*	*0-15*	*5*	*0-15*	10	0-30	0	0-0	0	0-0	-	-
Gannet	*30*	*5-62.62*	*30*	*5-62.62*	35	0-87.62	-	-	20	0-50	-	-

Species	Breeding (full period)		Breeding (migration – free)		Migration - autumn		Winter		Migration – spring		Nonbreeding	
	Peak	95% c.i.	Peak	95% c.i.	Peak	95% c.i.	Peak	95% c.i.	Peak	95% c.i.	Peak	95% c.i.
Great black-backed gull	0	0-0	0	0-0	*15*	*0-45*	5	0-15	20	0-50	*15*	*0-45*
Great northern diver	-	-	-	-	0	0-0	*10*	*0-30*	0	0-0	*10*	*0-30*
Guillemot	*736.84*	*417.6-1,112.83*	736.84	417.6-1,112.83	2,085.52	1,361.18-2,962.83	1875	857.4-3,331.91	*4,197.37*	*2,801.81-6,369.9*	*4197.37*	*2,801.81-6,369.9*
Herring gull	0	0-0	0	0-0	*15*	*0-40*	0	0-0	10	0-35	*15*	*0-40*
Kittiwake	1880	755.38-3,042.88	735	229.25-1,383.38	3240	455.75-6,864.62	-	-	7390	2,895.5-12,815.62	-	-
Lesser black-backed gull	0	0-0	0	0-0	0	0-0	0	0-0	5	0-15	-	-
Little gull	0	0-0	0	0-0	-	-	-	-	-	-	1,045	166.12-2389.88
Manx shearwater	*1,015*	*127.38-2,387.25*	475	112.38-1,053.5	*1015*	*127.38-2,387.25*	0	0-0	410	77.38-857.62	*110*	*0-330*
Puffin	*10*	*0-30*	*10*	*0-30*	*5*	*0-17.62*	10	0-30	*20*	*0-60*	*20*	*0-60*

Species	Breeding (full period)		Breeding (migration – free)		Migration - autumn		Winter		Migration – spring		Nonbreeding	
	Peak	95% c.i.	Peak	95% c.i.	Peak	95% c.i.	Peak	95% c.i.	Peak	95% c.i.	Peak	95% c.i.
Razorbill	*66.26*	*12.05-144.88*	*66.26*	*12.05-144.88*	1186.74	403.02-2,202.86	1602.41	824.4-2,906.33	3,313.25	1,718.53 - 5,006.92	-	-
Red-throated diver	35	0-87.62	25	5-55	45	10-92.62	115	29.75-227.62	90	24.75-165.0	-	-
Sandwich tern	10	0-30	0	0-0	*15*	*5-30*	-	-	5	0-15	*15*	*5-30*
Shag	*35*	*5-77.62*	10	0-30	10	0-30	5	0-17.62	*35*	*5-77.62*	25	0-72.62

Nature conservation value

12.5.2.11 Species included in the impact assessment are those which were recorded during surveys and which are considered to be at potential risk from the Proposed Development either due to their abundance, potential sensitivity to windfarm impacts or due to biological characteristics which make them potentially susceptible (e.g. commonly fly at rotor height). The conservation status of each assessed species is provided in Table 12.10 based on the Birds of Conservation Concern in Ireland (BoCCI) criteria in Gilbert *et al.* (2021). The locations of all species observed are shown in Volume III, Appendix 12.8: Offshore Ornithology Technical Report – Seabird Spatial Distribution Maps.

Table 12.10: Summary of nature conservation value of species considered at potential risk of impacts

Species	Conservation status
Arctic skua	BoCCI Green listed, Birds Directive Migratory Species
Arctic tern	BoCCI Amber listed, Birds Directive Migratory Species, Birds Directive Annex 1
Black-headed gull	BoCCI Amber listed, Birds Directive Migratory Species
Common gull	BoCCI Amber listed, Birds Directive Migratory Species
Common scoter	BoCCI Red listed, Birds Directive Migratory Species
Common tern	BoCCI Amber listed, Birds Directive Migratory Species, Birds Directive Annex 1
Cormorant	BoCCI Amber listed, Birds Directive Migratory Species
Fulmar	BoCCI Amber listed, Birds Directive Migratory Species
Gannet	BoCCI Amber listed, Birds Directive Migratory Species
Great black-backed gull	BoCCI Green listed, Birds Directive Migratory Species
Great northern diver	BoCCI Amber listed, Birds Directive Migratory Species, Birds Directive Annex 1
Guillemot	BoCCI Amber listed, Birds Directive Migratory Species
Herring gull	BoCCI Amber listed, Birds Directive Migratory Species
Kittiwake	BoCCI Red listed, Birds Directive Migratory Species
Lesser black-backed gull	BoCCI Amber listed, Birds Directive Migratory Species
Little gull	BoCCI Amber listed, Birds Directive Migratory Species
Manx shearwater	BoCCI Amber listed, Birds Directive Migratory Species
Puffin	BoCCI Red listed, Birds Directive Migratory Species
Razorbill	BoCCI Red listed, Birds Directive Migratory Species
Red-throated diver	BoCCI Amber listed, Birds Directive Migratory Species, Birds Directive Annex 1

Species	Conservation status
Sandwich tern	BoCCI Amber listed, Birds Directive Migratory Species, Birds Directive Annex 1
Shag	BoCCI Amber listed, Birds Directive Migratory Species

Reference breeding populations

12.5.2.12 For the breeding period, the population size for each species assessed was estimated as follows:

- The adult population was derived as the sum of the individuals in the most recent counts for colonies within mean maximum foraging range plus one standard deviation (Woodward *et al.* 2019);
- Two alternative methods for estimating the associated number of immature birds were used. The first is based on demography, with the adult population divided by their estimated proportion in the population (Table 12.13) to give the estimated total population for all age classes. The second incorporates the presence of immature birds which remain within the region from the preceding nonbreeding period (e.g. spring or nonbreeding, depending on how each species' seasons were defined in Furness 2015).

12.5.2.13 These two breeding season estimates allow for uncertainty in the population at risk to be incorporated into the assessments (Table 12.11). Where relevant these have also taken account of the timing of migration (i.e. to give consideration to overlapping breeding and migration months) and the other populations that may be passing through, and also to the potential presence of nonbreeding individuals (e.g. including immature and juvenile birds, failed breeders and individuals on 'sabbatical', i.e. those taking a break from breeding). Since the relevant breeding season reference populations are dependent on varying combinations of these different factors, they have not been defined here, but are considered in the relevant sections of the impact assessment for each species.

Reference nonbreeding populations

12.5.2.14 For the nonbreeding period, the population estimates have been calculated using the seasons and regions defined by Furness (2015), with adjustment to incorporate up to date Irish counts (e.g. Cummins *et al.* 2019). This was achieved by first removing the Irish components from the Furness (2015) figures, then estimating the values for Irish colonies derived from recent surveys (Cummins *et al.* 2019) and adding these back on to obtain figures for the Irish Sea which explicitly include connectivity with colonies in both the UK and Ireland (Table 12.11).

Table 12.11: BDMPS populations (individuals) across seasons

Species	Spring migration	Breeding		Autumn Migration	Winter	Nonbreeding
		Colony based	Colony + BDMPS immatures			
Arctic tern	69,867	33	23,637	69,867	-	-
Common tern	71,030	1,684	30,254	71,030	-	-
Cormorant	-	304	13,177	-	-	22,049
Fulmar	836,611	8,416	516,426	836,611	564,784	-
Gannet	536,011	420,257	517,233	644,745	-	-

Species	Spring migration	Breeding		Autumn Migration	Winter	Nonbreeding
		Colony based	Colony + BDMPS immatures			
Great black-backed gull	-	2,041	33,032	-	--	51,589
Great northern diver	872	-	-	872	751	-
Guillemot	-	319,052	915,761	-	-	1,567,463
Herring gull	-	213,51	122,755	-	-	196,791
Kittiwake	928,207	134,247	405,701	708,156	-	-
Lesser black-backed gull	165,635	65,563	112,297	165,635	45,785	-
Manx shearwater	1,580,895	2,736,28 8	2,122,774	1,580,895	-	-
Puffin	304,356	95,044	190,699	304,356	304,356	-
Razorbill	642,676	38,462	320,632	642,676	377,184	-
Red-throated diver	12,717	-	-	12,717	4,148	-
Roseate tern	6,190	0	2,550	6,190	-	-
Sandwich tern	13,574	0	4,751	13,574	-	-
Shag	21,664	358	9,776	21,664	21,664	-

12.5.2.15 The biogeographic populations with connectivity to UK waters (i.e. the total number of birds in the UK population plus each overseas population known to visit UK waters either to winter or during migration to winter quarters elsewhere) have also been considered in the assessment where appropriate, these are provided in Table 12.12.

Table 12.12: Biogeographic population sizes taken from definitions in Furness (2015) unless otherwise stated

Species	Biogeographic population with connectivity to UK Waters (adults and immatures)
Arctic skua	229,000
Arctic tern	628,000
Black-headed gull[a] (Not included in Furness, 2015)	4,250,000

Species	Biogeographic population with connectivity to UK Waters (adults and immatures)
Common gull[a] (Not included in Furness, 2015)	1,725,000
Common scoter[a] (Not included in Furness, 2015)	550,000
Common tern	480,000
Cormorant	324,000
Fulmar	8,055,000
Gannet	1,180,000
Great black-backed gull	235,000
Great northern diver	430,000
Guillemot	4,125,000
Herring gull	1,098,000
Kittiwake	5,100,000
Lesser black-backed gull	864,000
Little gull[b] (Not included in Furness, 2015)	75,000
Manx shearwater	2,000,000
Puffin	11,840,000
Razorbill	1,707,000
Red-throated diver	27,000
Sandwich tern	148,000
Shag	106,000

a Nonbreeding biogeographic population taken from Stroud et al., 2016 (http://data.jncc.gov.uk/data/d1b21876-d5a4-42b9-9505-4c399fe47d7e/ukspa3-status-uk-spas-2000s-web.pdf)

b Estimated passage population taken from Steinen et al., 2007.

Baseline mortality rates

12.5.2.16 The impact of additional mortality due to windfarm 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. These were calculated using the different rates for each age class and their relative proportions in the population. Only those species for which impacts have been assessed (i.e. those scoped in for specific impacts in section 12.8 have been included.

12.5.2.17 Demographic rates for each species were taken from Horswill and Robinson (2015) and entered into a matrix population model. This was used to calculate the expected stable proportions in each age class (note, to obtain robust stable age class distributions for less well studied species such as divers it was necessary to adjust the rates in order to obtain a stable population size). Each age class survival rate was multiplied by its stable age proportion and the total for all ages summed to give the weighted average survival rate for all ages. Taking this value from 1 gives the average mortality rate. The demographic rates, and the age class proportions and average mortality rates calculated from them, are presented in Table 12.13.

Table 12.13: Average mortality across all age classes. Average mortality calculated using age specific demographic rates and age class proportions. Note that for some species (e.g. little gull) there are only estimates for adult survival

Species	Parameter	Survival (age class)							
		0-1	1-2	2-3	3-4	5-6	Adult	Productivity	Average mortality
Arctic tern	Demographic rate	-	-	-	-	-	0.837	0.38	0.163
	Population age ratio	-	-	-	-	-		-	
Black-headed gull	Demographic rate	-	-	-	-	-	0.825	0.625	0.175
	Population age ratio	-	-	-	-	-		-	
Common gull	Demographic rate	0.41	0.71	-	-	-	0.828	0.543	0.258
	Population age ratio	0.182	0.082	-	-	-	0.736	-	
Common tern[a]	Demographic rate	0.441	0.441	0.85	-	-	0.883	0.764	0.263
	Population age ratio	0.223	0.103	0.048	-	-	0.626	-	
Gannet	Demographic rate	0.424	0.829	0.891	0.895	-	0.912	0.7	0.191
	Population age ratio	0.191	0.081	0.067	0.06	-	0.6	-	
Great black-backed gull	Demographic rate	0.815	0.815	0.815	0.815		0.885	0.53	0.144
	Population age ratio	0.137	0.112	0.093	0.076		0.581	-	
Guillemot	Demographic rate	0.56	0.792	0.917	0.939	0.939	0.939	0.672	0.14
	Population age ratio	0.168	0.091	0.069	0.062	0.056	0.552	-	
Herring gull	Demographic rate	0.798	0.834	0.834	0.834		0.834	0.92	0.172
	Population age ratio	0.178	0.141	0.117	0.097		0.467		

Species	Parameter	Survival (age class)							
		0-1	1-2	2-3	3-4	5-6	Adult	Productivity	Average mortality
Kittiwake	Demographic rate	0.79	0.854	0.854	0.854		0.854	0.69	0.156
	Population age ratio	0.155	0.123	0.105	0.089		0.53	-	
Lesser black-backed gull	Demographic rate	0.82	0.885	0.885	0.885		0.885	0.53	0.124
	Population age ratio	0.134	0.109	0.095	0.083		0.579	-	
Little gull	Demographic rate	-	-	-	-	-	0.8	-	0.2
	Population age ratio	-	-	-	-	-		-	
Puffin[b]	Demographic rate	0.709	0.709	0.76	0.805	-	0.906	0.617	0.167
	Population age ratio	0.162	0.115	0.082	0.063	-	0.577	-	
Razorbill[c]	Demographic rate	0.63	0.63	0.895	0.895	-	0.895	0.57	0.174
	Population age ratio	0.159	0.102	0.065	0.059	-	0.613	-	
Red-throated diver	Demographic rate	0.6	0.62	-	-	-	0.84	0.571	0.228
	Population age ratio	0.179	0.145	-	-	-	0.676	-	

a Common tern have a combined survival rate from 0 to 2 of 0.441, giving an annual rate of 0.66.

b Puffin have a combined survival rate from 0 to 3 of 0.709, giving an annual rate of 0.89.

c Razorbill have a combined survival rate from 0 to 2 of 0.63, giving an annual rate of 0.79.

Intertidal ornithology

12.5.2.18 Bird species present within the intertidal zone during the nonbreeding season (November 2019 to March 2020) were recorded from the site-specific surveys carried out for the Proposed Development. A summary of the results is provided below, full details are presented in Volume III, Appendix 12.11: Arklow Bank Wind Park Phase 2 Onshore Cable Route and Landfall – Baseline Bird Survey and are not repeated here.

12.5.2.19 During winter surveys, a total of 11 bird species comprising divers, waders and gulls were recorded in low numbers from the two Vantage Point (VP) locations with a view of the landfall. Breeding season surveys confirmed the low value of the coastline for breeding seabirds, with no breeding activity recorded, with only a single cormorant and two herring gulls recorded.

12.5.2.20 Overall, the Intertidal Ornithology Study Area is not considered of high value for either seabirds or terrestrial species. The coastal habitat consists of low vegetated cliffs which are unsuitable for seabird nesting interspersed with small sand/gravel beaches which are unsuitable for wintering waders. Birds recorded were primarily gulls (the majority of which were black-headed gull and common gull). Small numbers of cormorant, shag, guillemot and red-throated diver were also recorded. Red-throated diver is listed on Annex 1 of the Birds Directive and two Red Listed gull species (black-headed gull and herring gull) were recorded during the site surveys (refer to Table 12.10 for conservation status). However, none of these species were seen in more than very small numbers and impacts at the landfall have been scoped out of further assessment (see section 12.6.2).

12.5.3 'Do nothing' scenario

12.5.3.1 Annex IV of the EIA Directive sets out the information required to be included in an EIAR. This includes "a description of the relevant aspects of the current state of the environment (baseline scenario) and an outline of the likely evolution thereof without implementation of the Project as far as natural changes from the baseline scenario can be assessed with reasonable effort on the basis of the availability of environmental information and scientific knowledge". In the event that the Proposed Development does not proceed, an assessment of the future baseline conditions has been carried out and is described within this section.

12.5.3.2 Key drivers of seabird population size in western Europe are climate change (Sandvik *et al.*, 2012; Frederiksen *et al.*, 2004, 2013; Burthe *et al.*, 2014; Macdonald *et al.*, 2015; Furness, 2016; JNCC, 2016) and fisheries (Tasker *et al.*, 2000; Frederiksen *et al.*, 2004; Ratcliffe, 2004; Carroll *et al.*, 2017; Sydeman *et al.*, 2017). Pollutants (including oil, persistent organic pollutants, plastics), alien mammal predators at colonies, disease, and loss of nesting habitat also impact on seabird populations but are generally much less important and often more localised in their effect (Ratcliffe, 2004; Votier *et al.*, 2005, 2008; JNCC, 2016).

12.5.3.3 Trends in seabird numbers in breeding populations are better known, and better understood, than trends in numbers at sea within any particular area. Breeding numbers are regularly monitored at many colonies (JNCC, 2016), and in the British Isles (including Ireland) there have been four comprehensive censuses of breeding seabirds in 1969-70, 1985-88, 1998-2002 and 2015-2021 (Mitchell *et al.*, 2004, Burnell *et al.* 2023). Surveys in Ireland between 2015-21 have updated the breeding estimates for key colonies and species. The European Seabirds at Sea (ESAS) database is incomplete, and since 2000 relatively few data have been added, so that current trends in numbers at sea in areas of the Irish Sea are not so easy to assess. However, visual aerial surveys of the western Irish Sea in the 2015 and 2016 winters have provided a partial update on wintering distributions and abundance.

12.5.3.4 Breeding numbers of many seabird species in the British Isles are declining, although these are more pronounced in the North Sea than in western regions, including Ireland (Macdonald *et al.*, 2015). These trends seem likely to continue in the short to medium term future.

12.5.3.5 Climate change is likely to be the strongest influence on seabird populations in coming years, with anticipated deterioration in conditions for breeding and survival for most species of seabirds (Burthe *et al.*, 2014; Macdonald *et al.*, 2015; Capuzzo *et al.*, 2018) and therefore further declines in numbers of most of our seabird populations are anticipated. It is therefore highly likely that breeding numbers of most of our seabird species will continue to decline under a scenario with continuing climate change due to increasing levels of greenhouse gases (Prosser *et al.* 2023).

12.5.3.6 Fisheries management is also likely to influence future numbers in seabird populations. The Common Fisheries Policy (CFP) Landings Obligation ('discard ban') will likely reduce an unnaturally high level of available food as a result from discard from fishing practices that has been a food supply for scavenging seabirds such as great black-backed gulls, lesser black-backed gulls, herring gulls, fulmars, kittiwakes and gannets (Votier *et al.*, 2004; Bicknell *et al.*, 2013; Votier *et al.*, 2013; Foster *et al.*, 2017). Recent changes in fisheries management that aid recovery of predatory fish stock biomass are likely to further reduce food supply for seabirds that feed primarily on small fish such as sandeels, as those small fish are major prey of large predatory fish. Therefore, anticipated future increases in predatory fish abundance resulting from improved management to constrain fishing mortality on those commercially important species at more sustainable levels than in the past are likely to cause further declines in stocks of small pelagic seabird 'food-fish' such as sandeels (Frederiksen *et al.*, 2007; Macdonald *et al.*, 2015).

12.5.3.7 Future decreases in kittiwake breeding numbers are likely to be particularly pronounced, as kittiwakes are very sensitive to climate change (Frederiksen *et al.*, 2013; Carroll *et al.*, 2015) and to fishery impacts on sandeel stocks near breeding colonies (Frederiksen *et al.*, 2004; Carroll *et al.*, 2017), and additionally, the species may not be able to feed on a readily available food supply from fishery discards since the Landings Obligation came into effect (i.e. quota fish can no longer be discarded at sea but must now be landed in order to be counted against quotas). Gannet numbers may continue to increase for some years, but evidence suggests that this increase is already slowing, and numbers may peak not too far into the future. While the Landings Obligation will reduce discard availability to gannets in European waters, in recent years increasing proportions of adult gannets have wintered in west African waters rather than in UK waters (Kubetzki *et al.*, 2009), probably because there are large amounts of fish discarded by west African trawl fisheries and decreasing amounts available in the North Sea (Kubetzki *et al.*, 2009; Garthe *et al.*, 2012). It appears that the flexible behaviour and diet of gannets makes this species comparatively robust to changes in fishery practices or to climate change impacts on fish communities (Garthe *et al.*, 2012).

12.5.3.8 Fulmars, terns, common guillemot, razorbill and puffin appear to be highly vulnerable to climate change, so numbers may decline over the next few decades (Burthe *et al.*, 2014). Strong declines in shag numbers are likely to continue as they are adversely affected by climate change, by low abundance of sandeels and especially by stormy and wet weather conditions in winter (Burthe *et al.*, 2014; Frederiksen *et al.*, 2008). Most of the red-throated divers wintering in the Irish Sea are expected to originate from breeding areas at high latitudes in Greenland (Furness, 2015). Numbers of red-throated divers wintering in the Irish Sea may possibly decrease in future if warming conditions make the seas around Greenland more favourable as a wintering area so that they do not need to migrate as far as British and Irish waters. There has been a trend of increasing numbers of seaducks remaining in the Baltic Sea overwinter (Mendel *et al.*, 2008; Fox *et al.*, 2016; Ost *et al.*, 2016) and decreasing numbers coming to the British Isles (Austin and Rehfisch, 2005; Pearce-Higgins and Holt, 2013), and that trend is likely to continue, although to an uncertain extent.

12.5.3.9 Baseline surveys were undertaken prior to presence and widespread effects of highly pathogenic avian influenza virus (HPAIV) within seabird populations across the UK and western Europe, which have been particularly noteworthy since 2021. The current strain of HPAIV is more infectious than previous strains, and so infections have continued beyond the normal winter period and affected seabird breeding colonies in 2022 and 2023, including species which are not normally affected such as gannets, great skuas, terns, guillemots and black-headed gulls. The scale of mortality has been unprecedented with significant losses of adult birds and even larger mortality of chicks reported.

12.5.3.10 For the purposes of this assessment, all reference populations used have been estimated from data collected prior to the most widespread effects of HPAIV on seabirds in 2022-23, and therefore because the baseline aerial survey data were also collected prior to the outbreak, the predicted magnitudes of impacts on seabird populations should remain consistent with current populations (i.e. it is assumed that the proportion of the population affected by an impact will be similar before and after HPAIV impacts, with numbers of birds recorded within the study area declining proportionately with population sizes). Consequently, no adjustments to account for impacts of HPAIV on populations are considered necessary for the assessment.

12.5.4 Data limitations

12.5.4.1 The marine environment is highly variable, both spatially and temporally. The baseline site characterisation for the offshore ornithology impact assessment is based on two years of survey data collected within the Offshore Ornithology Study Area which are considered to provide representative seabird usage for the purposes of impact assessment.

12.5.4.2 During the baseline surveys for the Proposed Development, it was not possible to undertake a digital aerial survey in April 2019 due to adverse weather conditions. However, an extra survey was carried out in July 2019 and the second April survey was carried out in 2020 to address the data gap for this month (refer to Volume III, Appendix 12.1: Offshore Ornithology Technical Report). It is not unusual for at least one survey to be affected by unsuitable or unsafe weather conditions for surveying in this manner over the course of the two years of data collection, and the approach for addressing this is similarly appropriate.

12.6 Impact assessment methodology

12.6.1 Key parameters for assessment

12.6.1.1 The assessment of significance of effects has been carried out on both of the two discrete Project Design Options detailed in Volume II, Chapter 4, Description of Development. This approach has allowed for a robust and full assessment of the Proposed Development.

12.6.1.2 The two Project Design Options and parameters relevant to each potential impact are detailed in Table 12.14 and Table 12.15. Note that Project Design Option 1 (Table 12.14) has two variants (identified as 1a and 1b) which differ only in the blade chord width and the average rotation speed. As these parameters can result in different predicted collision risks both 1a and 1b have been assessed.

12.6.1.3 The Project Design Options identified in Table 12.14 and Table 12.15 have been assessed for their potential effects on identified receptors or receptor groups (a receptor group is defined as multiple species which share ecological features that put them at similar risk of impacts). These scenarios are a summary of the full project parameters provided in Chapter 4: Description of Development.

Table 12.14: Project design parameters and impacts assessed – Project Design Option 1 (WTG model 1a and 1b).

Potential impact	Phase C	Phase O	Phase D	Project Design Options 1 (WTG model 1a and 1b)
Disturbance and displacement	✓	✓	✓	**Construction phase** Disturbance and displacement from construction activity, including increased vessel and helicopter activity: • Installation of 56 Wind Turbine Generators (WTGs) and 2 OSPs within the Array Area; • Maximum of 1 foundation installed at any one time (within any 24 hour period); • Maximum of 69 installation vessels in the Array Area at any one time (including 12 installation vessels along the Cable Corridor and Working Area at any one time, and maximum of 7 installation vessels in the vicinity of the landfall at any one time); • Maximum of 3 helicopters in the Array Area at any one time; and • Maximum construction schedule of 24 hours a day, 7 days a week for a maximum construction period of 5 years. Within this period, offshore export cable installation may take place over a period of 12 months. **Operational and maintenance phase** Disturbance and displacement from operational and maintenance activity, including increased vessel and helicopter activity: • Presence of 58 (i.e. 56 x WTG + 2 x OSP) monopile foundations with base diameter between 7 – 11 m for WTGs and 7-14 m for OSPs and associated scour protection; • Presence of associated cable protection for between 110 – 122 km inter-array cables, 25-28 km interconnector and between 35 – 40 km offshore export cables. Assumes a maximum of 15% of inter-array cable route, 50% of interconnector and 20% of offshore export cable route may require cable protection; • Minimum spacing of 500 m between turbine blade tips; • A maximum of 1,359 vessel return trips per annum for supporting windfarm operations comprised of crew transfer vessels, jack-up vessels, cable repair vessels and other vessels; • A maximum of 485 helicopter movements making return trips per annum for supporting windfarm operations; and • Operational phase of up to 36.5 years. **Decommissioning phase** Disturbance is anticipated to be similar in nature but of lower magnitude than during construction.
Indirect disturbance and displacement	✓	✓	✓	**Construction phase** Parameters as described in Chapter 9: Benthic Subtidal and Intertidal Ecology for the following impacts:

Potential impact	Phase C	O	D	Project Design Options 1 (WTG model 1a and 1b)
resulting from changes to prey and habitats				• Temporary subtidal habitat loss/disturbance; • Increased suspended sediment concentrations and associated sediment deposition; and • Accidental pollution. Parameters as described in Chapter 10: Fish, Shellfish and Sea Turtle Ecology for the following impacts: • Injury and/or disturbance to fish and shellfish from underwater noise and vibration. **Operational and maintenance phase** Parameters as described in Chapter 9: Benthic Subtidal and Intertidal Ecology for the following impacts: • Temporary subtidal habitat loss/disturbance; • Increased suspended sediment concentrations and associated sediment deposition; • Accidental pollution; • Long-term subtidal habitat loss; and • Alteration of seabed habitats arising from effects on physical processes. **Decommissioning phase** As above for construction phase. There would be limited noise disturbance to prey (as no piling).
Collision risk	×	✓	×	**Operational and maintenance phase** • Presence of 56 wind turbines within the Array Area: • Hub height of 155 m above Lowest Astronomical Tide (LAT); • Lower blade tip height of 37 m above LAT; • Upper blade tip height of 273 m above LAT; and • Rotor diameter of 236 m. • Average rotation speed (RPM) 6.34 (1a) and 5.73 (1b) Further details are provided in Volume III, Appendix 12.4: Offshore Ornithology: Collision Risk Input Parameters
Barrier effect	×	✓	×	**Operational and maintenance phase** • Presence of 56 wind turbines within an Array Area of 63.4 km^2 with a minimum spacing of 500 m between turbine blade tips; and • Presence of two OSPs.

Table 12.15: Project design parameters and impacts assessed - Project Design Option 2

Potential impact	Phase			Project Design Option 2
	C	O	D	
Disturbance and displacement	✓	✓	✓	**Construction phase** Disturbance and displacement from construction activity, including increased vessel and helicopter activity and confirmatory surveys (see EIAR Chapter 4 Description of Development Table 4.10): • Installation of 47 WTGs and 2 x OSPs within the Array Area; A maximum of 1 foundation installed at any one time (within any 24 hour period); • A maximum of 69 installation vessels in the Array Area at any one time (including 12 installation vessels along the Cable Corridor and Working Area at any one time, and 7 installation vessels in the vicinity of the landfall at any one time); • A maximum of 3 helicopters in the Array Area at any one time; and • Maximum construction schedule of 24 hours a day, 7 days a week for a maximum construction period of 5 years. Within this period, offshore export cable installation may take place over a period of 12 months. **Operational and maintenance phase** Disturbance and displacement from operational and maintenance activity, including increased vessel and helicopter activity: • Presence of 49 (i.e. 47 x WTG + 2 x OSP) monopile foundations with base diameter between 7 – 11 m for WTGs and 7 - 14 m for OSPs and associated scour protection; • Presence of associated cable protection for between 110 – 122 km inter-array cables, 25-28 km interconnector and between 35 – 40 km offshore export cables. Assumes a maximum of 15% of inter-array cable route, 50% of interconnector and 20% of offshore export cable route may require cable protection; • Minimum spacing of 500 m between turbine blade tips; • A maximum of 1,359 vessel return trips per annum for supporting windfarm operations comprised of crew transfer vessels, jack-up vessels, cable repair vessels and other vessels; • A maximum of 485 helicopter movements making return trips per annum for supporting windfarm operations; and • Operational phase of up to 36.5 years. **Decommissioning phase** Disturbance is anticipated to be similar in nature but of lower magnitude than during construction.

<table>
<tr><th rowspan="2">Potential impact</th><th colspan="3">Phase</th><th rowspan="2">Project Design Option 2</th></tr>
<tr><th>C</th><th>O</th><th>D</th></tr>
<tr><td>Indirect disturbance and displacement resulting from changes to prey and habitats</td><td>✓</td><td>✓</td><td>✓</td><td>Construction phase
Parameters as described in Chapter 9: Benthic Subtidal and Intertidal Ecology for the following impacts:
Temporary subtidal habitat loss/disturbance;
Increased suspended sediment concentrations and associated sediment deposition; and
Accidental pollution.
Parameters as described in Chapter 10: Fish, Shellfish and Sea Turtle Ecology for the following impacts:
Injury and/or disturbance to fish and shellfish from underwater noise and vibration.
Operational and maintenance phase
Parameters as described in Chapter 9: Benthic Subtidal and Intertidal Ecology for the following impacts:
Temporary subtidal habitat loss/disturbance;
Increased suspended sediment concentrations and associated sediment deposition;
Accidental pollution;
Long-term subtidal habitat loss; and
Alteration of seabed habitats arising from effects on physical processes.
Decommissioning phase
As above for construction phase. There would be limited noise disturbance to prey (as no piling).</td></tr>
<tr><td>Collision risk</td><td>×</td><td>✓</td><td>×</td><td>Operational and maintenance phase
Presence of 47 wind turbines within the Array Area:
Hub height of 162 m above Lowest Astronomical Tide (LAT);
Lower blade tip height of 37 m above LAT;
Upper blade tip height of 287 m above LAT; and
Rotor diameter of 250 m.</td></tr>
<tr><td>Barrier effect</td><td>×</td><td>✓</td><td>×</td><td>Operational and maintenance phase
Presence of 47 wind turbines within an Array Area of 63.4 km2 with a minimum spacing of 500 m between turbine blade tips; and
Presence of two OSPs.</td></tr>
</table>

12.6.2 Impacts scoped out of the assessment

12.6.2.1 On the basis of the baseline environment and the description of development outlined in Chapter 4: Description of Development, a number of impacts are proposed to be scoped out of the assessment for offshore ornithology. These impacts are outlined, together with a justification for scoping them out, in Table 12.16.

Table 12.16: Impacts scoped out of the assessment for offshore ornithology

Potential impact	Justification
Indirect impacts on prey species and habitat along the Cable Corridor and Working Area during the operational and maintenance phase	Maintenance or repair operations will be localised and infrequent.
Accidental pollution during construction, operation and decommissioning phases	The Marine Pollution Contingency Plan (MPCP) provides the pollution response arrangements for the Proposed Development, and therefore this impact can be scoped out for all phases (see Volume III, Appendix 25.1: Environmental Management Plan, Annex 2 Marine Pollution Contingency Plan).
Disturbance and displacement (maintenance vessels)	During the operational and maintenance phase, the presence of vessels and personnel undertaking routine operations and maintenance activity at the windfarm and along the offshore export cable route may cause localised, temporary disturbance and displacement. However, due to the nature of this impact (temporary/localised), any displaced birds may readily redistribute to areas of lower or no activity on site without impacting on fitness. It is therefore proposed that this impact is scoped out of the EIAR.
Collision risk to migrating passerines	Consideration of passage movements, population sizes, flight patterns (e.g. altitudes) and the relative size of the Proposed Development mean that the risks to migrating passerine species are considered negligible and have been scoped out. This is consistent with the standard approach to assessment of ornithological impacts applied to UK offshore windfarms.
Impacts on seabirds and terrestrial bird species at the offshore export cable landfall.	The Intertidal Ornithology Study Area is not considered of high value for either seabirds or terrestrial species. The coastal habitat consists of low vegetated cliffs which are unsuitable for seabird nesting interspersed with small sand/gravel beaches which are unsuitable for wintering waders. Birds recorded were primarily gulls (the majority of which were black-headed gull and common gull). Small numbers of cormorant, shag, guillemot and red-throated diver were also recorded. Red-throated diver is listed on Annex 1 of the Birds Directive and two Red Listed gull species (black-headed gull and herring gull) were recorded during the site surveys (refer to Table 12.10 for conservation status). However, none of these species were seen in more than very small numbers and

Potential impact	Justification
	impacts at the landfall have been scoped out of further assessment.
Lighting during construction and operation	Lighting of construction sites, vessels and other structures at night may potentially attract birds (phototaxis). Phototaxis can be a serious hazard for fledglings of some seabird species, particularly those that nest in burrows such as petrels and shearwaters (Deppe *et al.*, 2017; Raine *et al.*, 2007; Rodríguez *et al.*, 2015). Research indicates that this impact occurs over short distances in response to bright light close to breeding colonies. It is not seen over large distances or in older (adult and immature) seabirds. Since the Proposed Development is not close to any breeding colonies for burrow nesting species this risk has been scoped out. Phototaxis of nocturnal migrating birds can be a problem, especially in autumn during conditions of poor visibility, but is generally seen where birds are exposed to intense white lighting such as from lighthouses; light from construction sites will be much less powerful than that from lighthouses, and therefore this can be scoped out. A review of the potential effects of operational lighting on turbines on birds considered available evidence to investigate potential impacts across eight categories (MacArthur Green, 2018). This suggested that lights on offshore wind turbines in European shelf seas are extremely unlikely to have any detectable effect on birds as a consequence of any of the processes listed above. The effects of operational lighting are therefore scoped out.

12.7 Methodology for assessing the significance of effects

12.7.1 Overview

12.7.1.1 The offshore ornithology impact assessment has followed the methodology set out in Volume II, Chapter 5: EIA Methodology. Specific to the offshore ornithology impact assessment, the following guidance documents have also been considered:

- Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater, Marine and Coastal published by the Chartered Institute of Ecology and Environmental Management (CIEEM, 2018);
- Assessment methodologies for offshore windfarms (Maclean *et al.*, 2009);
- Guidance on ornithological cumulative impact assessment for offshore wind developers (King *et al.*, 2009);
- Advice on assessing displacement of birds from offshore windfarms (JNCC *et al.*, 2017);
- Collision Risk Modelling (CRM) to assess bird collision risks for offshore windfarms (Band, 2012);
- Assessing the risk of offshore windfarm development to migratory birds (Wright *et al.*, 2012);
- Vulnerability of seabirds to offshore windfarms (Furness and Wade, 2012; Furness *et al.*, 2013; Wade *et al.*, 2016);
- Mapping seabird sensitivity to Offshore Windfarms (Bradbury *et al.*, 2014);
- The avoidance rates of collision between birds and offshore turbines (Cook *et al.*, 2014);

- Offshore Wind Marine Environmental Assessments: Best Practice Advice for Evidence and Data Standards (Parker *et al.* 2022a,b,c); and
- Joint Response from the Statutory Nature Conservation Bodies to the Marine Scotland Science Avoidance Rate Review (JNCC *et al.*, 2014).

12.7.1.2 The impact assessment methodology applied in this Chapter has also been consulted on with NPWS and Birdwatch Ireland through the Scoping Report and previous consultation (see Volume III Appendix 3.1 Consultation Report) and, due to the more developed nature of statutory guidance in the UK than Ireland, follows the industry standard approaches used for UK offshore windfarm assessment.

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

- Birds Directive – Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds (Codified version);
- The European Communities (Birds and Natural Habitats Regulations 2011 (S. I. No. 477 of 2011); and
- Wildlife Acts 1976 to 2012 (as amended).

12.7.2 Impact assessment criteria

12.7.2.1 This section describes the criteria applied in this Chapter to assign values to the sensitivity of the receptors and the magnitude of potential impacts. The terms used to define magnitude and sensitivity are based on those which are described in further detail in Volume II, Chapter 5: EIA Methodology of the EIAR.

Sensitivity

Table 12.17: Definitions of sensitivity of the receptor

Receptor sensitivity	Definition
High	Adaptability: The bird species has no capacity to adapt to an impact. Tolerance: Bird species has very limited tolerance to source of impact. Recoverability: The effect on the bird species is anticipated to be of permanent (>50 years) or long-lasting duration (15-50 years). Value: A species for which individuals at risk can be clearly connected to a particular SPA
Medium	Adaptability: The bird species has limited capacity to adapt to an impact. Tolerance: Bird species has limited tolerance to source of impact Recoverability: The effect on the bird species is anticipated to be long-lasting (15-50 years). Value: 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 windfarm

Receptor sensitivity	Definition
Low	Adaptability: The bird species has some capacity to adapt to an impact. Tolerance: Bird species has some tolerance to source of impact Recoverability: The effect on the bird species is anticipated to be of medium-term duration (up to 15 years) Value: A species for which it is not possible to identify the SPAs from which individuals on the windfarm have been drawn, or for which no SPAs are designated
Negligible	Adaptability: The bird species has high levels of adaptability to an impact. Tolerance: Bird species is generally tolerant to source of impact Recoverability: The effect on the bird species is anticipated to be of no more than short term duration (up to 5 years) Value: A species which is not a designated feature of any SPAs

Magnitude

Table 12.18: Example definition of terms relating to the magnitude of an impact. Note that for any given level of magnitude not all the definitions are necessarily expected to be met for any given impact (e.g. frequency may be high, while consequence is low) and expert judgement has been used in their application to impacts

Magnitude	Definition
High	Extent: A large change in the size or distribution of the relevant biogeographic population or interest feature of a designated site. Duration: Short to long term, recovery from the change predicted in the long-term (>5 years) following cessation of activity. Frequency: Impact is ongoing throughout lifetime of the Proposed Development. Probability: Highly likely to occur. Consequences: Irreversibly alter the population in the short to long term and alter the long-term viability of a population or the integrity of a designated site (guide >5% increase in background mortality).
Medium	Extent: A medium change in the size or distribution of the relevant biogeographic population or interest feature of a designated site. Duration: Short to long term, recovery from the change predicted in the medium-term (<5 years) following cessation of activity. Frequency: Impact is ongoing throughout lifetime of the Proposed Development. Probability: Likely to occur. Consequences: Affects the population in the short to long term but reversible on cessation of the impact and not predicted to affect the long-term viability of the

Magnitude	Definition
	population or the integrity of a designated site (guide between 1-5% increase in background mortality).
Low	Extent: A small change in the size or distribution of the relevant biogeographic population or interest feature of a designated site. Duration: Short to long term, recovery from the change predicted in the short-term (<1 years) following cessation of activity. Frequency: Impact is ongoing throughout lifetime of the Proposed Development. Probability: Low likelihood of occurrence. Consequences: Affects the population in the short to long term but reversible on cessation of the impact and not predicted to affect the medium or long-term viability of the population or the integrity of a designated site (guide between 0.1-1% increase in background mortality).
Negligible	Extent: Very small change in the size or distribution of the relevant biogeographic population or interest feature of a designated site. Duration: Short to long term, recovery from the change predicted to be rapid (<0.5 years) following cessation of activity. Frequency: Impact may be ongoing throughout lifetime of the Proposed Development, or a one-off short-term effect. Probability: Very low likelihood of occurrence. Consequences: Unlikely to affect the population in the short to long term, fully reversible with a short period on cessation of the impact and not predicted to affect the medium or long-term viability of the population or the integrity of a designated site (guide <0.1% increase in background mortality).

Significance of effect

12.7.2.2 The significance of the effect upon ornithology receptors is determined by correlating the magnitude of the impact and the sensitivity of the receptor. The particular method employed for this assessment is presented in Table 12.19. Where a range of significance of effect is presented in Table 12.19, the final assessment for each effect is based upon expert judgement.

Table 12.19: Significance of effect matrix

			Baseline Environment - Sensitivity			
			High	Medium	Low	Negligible
Description of Impact - Magnitude	Adverse Impact	High	Profound or Very Significant (significant)	Significant	Moderate*	Imperceptible
		Medium	Significant	Moderate*	Slight	Imperceptible
		Low	Moderate*	Slight	Slight	Imperceptible
	Neutral Impact	Negligible	Not Significant	Not Significant	Not Significant	Imperceptible
	Positive Impact	Low	Moderate*	Slight	Slight	Imperceptible
		Medium	Significant	Moderate*	Slight	Imperceptible
		High	Profound or Very Significant (significant)	Significant	Moderate*	Imperceptible

**Moderate levels of effect have the potential, subject to the assessor's professional judgement to be significant or not significant. Moderate will be considered as significant or not significant in EIA terms, depending on the sensitivity and magnitude of change factors evaluated. These evaluations are explained as part of the assessment, where they occur.*

12.7.3 Factored in measures

12.7.3.1 The Project Design Options set out in Volume II, Chapter 4: Description of Development include a number of designed-in measures and management measures (or controls) which have been factored into the Proposed Development and are committed to be delivered by the Developer as part of the Proposed Development.

12.7.3.2 These factored-in measures are standard measures applied to offshore wind development, including lighting and marking of the Proposed Development, use of 'soft-starts' for piling operations etc, to reduce the potential for impacts across receptor groups and also standard best practice for vessel management, in particular with reference to preventing fuel and oil spillage. Factored-in measures relevant to the assessment on offshore ornithology are presented in Table 12.20. These measures are integrated into the description of development and have therefore been considered in the impact assessment (i.e. the determination of magnitude and therefore significance assumes implementation of these measures). These measures are considered standard industry practice for this type of development. This approach is in line with EPA guidance which states that 'in an EIAR it may be useful to describe avoidance measures that have been integrated into the proposed proposal' (EPA, 2022).

Table 12.20: Factored in measures

Factored in measures	Justification
An Environmental Management Plan (EMP) has been prepared and will be implemented during the construction, operational and maintenance and decommissioning phases of the Proposed Development. The EMP includes mitigation/monitoring measures and commitments made within the EIAR and a Marine Pollution Contingency Plan (MPCP) which will include key emergency contact details (e.g. EPA). An EMP is included in Volume III, Appendix 25.1: Environmental Management Plan.	Measures will be implemented to ensure that the potential for release of pollutants from construction, operational and maintenance, and decommissioning plant is minimised.
An Environmental Vessel Management Plan (EVMP) has been submitted as part of the application (Volume III, Appendix 25.10)	The EVMP: • Minimises the risk of collision and injury to marine wildlife; • Minimises the risk of disturbance to marine wildlife; • Offers guidance to contractors conducting activities on behalf of the Proposed Development in proximity to wildlife; and • Provides contractors with the procedures for reporting vessel collisions with marine mammals.
Maximum number of wind turbines of 56.	The number of wind turbines has been refined to minimise the potential collision risk impacts (see Chapter 3: Consideration of Alternatives).
Minimum lower blade tip height of 37 m above LAT	Minimises potential seabird collision risks since the abundance of birds decreases with increasing height above the sea surface.
Best practice vessel and marine machinery operation, including but not limited to: • All hazardous substances stored in a dedicated storage room; • Substances categorized as "Danger" will be stored in a locker and may only be used with a Permit To Work; • Updated Material Data Safety Sheet (MDSS) will be readily accessible in storage rooms; • The amount of hazardous material is kept to a minimum; • Hazardous substances stored, handled and disposed of in accordance with the regulations in force; • All storage facilities and handling equipment will be in good working order and designed in such a way as to prevent and contain any spillage as far as practicable; • Use appropriate and certified hoses only;	The identified measures have been proposed specifically to prevent diminution of water quality and associated deterioration of Annex I habitat types or accidental spillages of oil products from causing a reduction in prey biomass of qualifying species or oiling of seabirds.

Factored in measures	Justification
• Procedures in case of bunkering, spillage, SOPEP, discussed in a toolbox before each bunker operation; • Identified personnel trained in the use of equipment; • Regular drills; • Spill kits located near hydrocarbon storage areas and replenished if required; and, • Retention around the work area	
The Developer confirms and commits that it will not carry out any works in respect of the Proposed Development under the planning permission (if granted) at the same time as any activities the subject of the Foreshore Licence for Site Investigations (FS007339).	The Developer was granted a Foreshore Licence (FS007339) for Site Investigations (associated with the Proposed Development) from the Minister for Housing, Local Government and Heritage in May 2022. The Developer confirms and commits that it will not carry out any works in respect of the Proposed Development under the planning permission (if granted) at the same time as any activities the subject of the Foreshore Licence for Site Investigations (FS007339) being carried out. As such there is no temporal overlap between the activities consented in this Foreshore Licence and the Proposed Development and there will be no potential for cumulative effects.
The Developer confirms and commits that it will not carry out any works in respect of the Proposed Development under the planning permission (if granted) at the same time as any activities the subject of the Foreshore Licence Application for Site Surveys FS007555 (should a licence be granted) are being carried out.	The Developer submitted a Foreshore Licence Application for Site Surveys to the Minister for Housing, Local Government and Heritage in April 2023 (FS007555) and this application is pending determination. The Developer confirms and commits that it will not carry out any works in respect of the Proposed Development under the planning permission (if granted) at the same time as any activities the subject of the Foreshore Licence Application for Site Surveys FS007555 (should a licence be granted) are being carried out. As such there is no temporal overlap between the activities proposed in the Foreshore Licence Application and the Proposed Development.

12.8 Assessment of the significance of effects

12.8.1.1 The impacts of the construction, operational and maintenance and decommissioning phases of both Project Design Options forming the Proposed Development on offshore ornithological features have been assessed. The potential impacts arising from the construction, operational and maintenance and decommissioning phases of the Proposed Development are listed in Table 12.14 and Table 12.15, along with the project parameters against which each impact has been assessed.

12.8.1.2 A description of the potential effect on offshore ornithology receptors caused by each identified impact is provided in Section 12.9 and Section 12.11.

12.9 Assessment of Project Design Option 1 (WTG models 1a and 1b) and Project Design Option 2

12.9.1.1 A description of the potential effect on offshore ornithology receptors caused by each identified impact due to construction traffic and operational WTGs, as well as barriers is given below.

12.9.2 Impact 1 – Project Design Option 1a Direct disturbance and displacement

Construction phase

12.9.2.1 Construction activities within the Array Area and along the Cable Corridor and Working Area, including the installation of foundations, WTGs, OSPs, offshore export cables, interconnector cables, inter-array cables and associated vessel and helicopter traffic, have the potential to directly affect bird populations through disturbance, leading to displacement of birds. This would effectively result in temporary habitat loss through a reduction in the area available for bird activities (e.g. feeding, loafing and moulting). The project design (Table 12.14) describes the elements of the Proposed Development considered within this assessment.

12.9.2.2 The maximum duration of offshore construction for the Proposed Development is five years, which would overlap with a maximum of five breeding seasons, five winter periods and up to ten migration periods, although it is important to note that construction activity would not be continuous nor widespread throughout this period but instead would occur in discrete phases and localised areas. For example, no more than one foundation is expected to be installed at any one time. Consequently, the effects will occur only in the vicinity of vessels which are operating at any given point and not across the entire Array Area.

12.9.2.3 Any impacts resulting from disturbance and displacement from construction activities are considered likely to be short term, temporary and reversible in nature, lasting only for the duration of construction activity, with birds expected to return to the area once construction activities have ceased.

12.9.2.4 Construction related disturbance and displacement is most likely to be of concern for breeding birds whilst foraging, since at other times of year birds are expected to be less constrained and will be more able to exploit alternative locations.

12.9.2.5 Some species are more susceptible to disturbance than others. Gulls are not considered susceptible to disturbance, as they are often associated with fishing boats (e.g. Camphuysen, 1995; Hüppop and Wurm, 2000) and have been noted in association with construction vessels at the Greater Gabbard offshore windfarm (GGOWL, 2011) and close to active foundation piling activity at the Offshore Windfarm Egmond aan Zee (OWEZ), where they showed no noticeable reactions to the works (Leopold and Camphuysen, 2007). However, species such as divers and scoters have been noted to avoid shipping by several kilometres (Mitschke *et al.*, 2001 from Exo *et al.*, 2003; Garthe and Hüppop, 2004; Schwemmer *et al.*, 2011) and recent work in relation to German offshore windfarms has reported displacement extending up to 10 km in late winter (Vilela *et al.*, 2020).

12.9.2.6 There are a number of different measures used to assess bird disturbance and displacement from areas of sea in response to activities associated with an offshore windfarm. Garthe and Hüppop (2004) developed a scoring system for such disturbance factors, which is used widely in offshore windfarm EIAs. Furness and Wade (2012) developed disturbance ratings for particular species, alongside scores for habitat flexibility and conservation importance. These factors were used to define an index value that highlights the sensitivity of a species to disturbance and displacement. As many of these references relate to disturbance from helicopter and vessel activities, these are considered relevant to this assessment. Although, all else being equal, a helicopter may constitute a more pronounced source of disturbance than a vessel, the combination of higher speed (and hence briefer presence) and greater distance to the sea surface means that helicopter disturbance is considered to be the same or lower than that resulting from vessel movements. Thus, the following assessment is based on disturbance due to vessels and it has been assumed that this also encompasses disturbance due to helicopters.

12.9.2.7 Birds recorded during the species-specific spring and autumn migration periods are assumed to be moving through the area between breeding and wintering areas. As these individuals will be present in the site for a short time only and the potential zone of construction displacement will be small (i.e. that located around up to two foundations and around individual installation vessels), it is likely that the assessment presented below for the migration periods will over-estimate population impacts and in that regard presents a conservative assessment.

12.9.2.8 In order to focus the assessment of disturbance and displacement, a screening exercise was undertaken to identify those species most likely to be at risk (Table 12.21), presented in order of sensitivity to disturbance and displacement). Any species with a low sensitivity to displacement or recorded only in very small numbers within the Array Area and along the Cable Corridor and Working Area was screened out of further assessment.

Table 12.21: Construction disturbance and displacement screening

Receptor	General sensitivity to disturbance and displacement (Garthe and Hüppop, 2004; Furness and Wade, 2012, Wade *et al.*, 2016, Dierschke *et al.*, 2016)	Screening Result (IN or OUT)
Red-throated diver	Very High	**Screened IN** as has potentially very high sensitivity to disturbance and displacement within the Array Area and the Cable Corridor and Working Area. Peak population is moderate within the Array Area and low along the Cable Corridor and Working Area.
Common scoter	Very High	**Screened OUT** due to very low peak population recorded in Array Area and absence from Cable Corridor and Working Area, although has a very high sensitivity to disturbance and displacement.
Great northern diver	Very High	**Screened OUT** due to very low peak population recorded in Array Area and Cable Corridor and Working Area, although has a very high sensitivity to disturbance and displacement.
Cormorant	High	**Screened OUT** due to very low peak population recorded in Array Area and absence from Cable Corridor and Working Area, although has high sensitivity to disturbance and displacement.

Receptor	General sensitivity to disturbance and displacement (Garthe and Hüppop, 2004; Furness and Wade, 2012, Wade *et al.*, 2016, Dierschke *et al.*, 2016)	Screening Result (IN or OUT)
Guillemot	Medium	**Screened IN** due to high peak population in Array Area and moderate peak in Cable Corridor and Working Area, and has medium sensitivity to disturbance and displacement.
Razorbill	Medium	**Screened IN** due to moderately high peak population in Array Area and Cable Corridor and Working Area, and has medium sensitivity to disturbance and displacement.
Shag	Medium	**Screened OUT** due to moderately low peak population recorded in Array Area and absence from Cable Corridor and Working Area, and has medium sensitivity to disturbance and displacement.
Puffin	Low to Medium	**Screened OUT** due to low peak population recorded in Array Area and Cable Corridor and Working Area; also has low to medium sensitivity to disturbance and displacement.
Fulmar	Considered Low in some studies, but possibly high according to Dierschke *et al.,* (2016)	**Screened OUT** due to very low peak population recorded in Array Area and absence from Cable Corridor and Working Area, is generally considered to have a low sensitivity to disturbance and displacement and is not known to avoid vessels.
Gannet	Considered Low in some studies, but possibly high according to Dierschke *et al.,* (2016)	**Screened OUT** due to low peak population recorded in Array Area and absence from Cable Corridor and Working Area, is generally considered to have a low sensitivity to disturbance and displacement and is not known to avoid vessels.
Arctic tern	Low	**Screened OUT** due to low sensitivity to disturbance and displacement, although has low to moderate peak population in Array Area and Cable Corridor and Working Area.
Common tern	Low	**Screened OUT** due to low peak population recorded in Array Area and Cable Corridor and Working Area; has low to medium sensitivity to disturbance and displacement.
Sandwich tern	Low	**Screened OUT** due to low peak population recorded in Array Area and Cable Corridor and Working Area; has low to medium sensitivity to disturbance and displacement.
Arctic skua	Low	**Screened OUT** as has low sensitivity to disturbance and displacement and no birds recorded within Array Area or Cable Corridor and Working Area.

Receptor	General sensitivity to disturbance and displacement (Garthe and Hüppop, 2004; Furness and Wade, 2012, Wade *et al.*, 2016, Dierschke *et al.*, 2016)	Screening Result (IN or OUT)
Black-headed gull	Low	**Screened OUT** as has low sensitivity to disturbance and displacement.
Common gull	Low	**Screened OUT** as has low sensitivity to disturbance and displacement.
Great black-backed gull	Low	**Screened OUT** as has low sensitivity to disturbance and displacement.
Herring gull	Low	**Screened OUT** as has low sensitivity to disturbance and displacement.
Kittiwake	Low	**Screened OUT** as is generally considered to have a low sensitivity to disturbance and displacement and is not known to avoid vessels although this species does have a high peak population in the Array Area.
Lesser Black-backed gull	Low	**Screened OUT** as has low sensitivity to disturbance and displacement.
Little gull	Low	**Screened OUT** as has low sensitivity to disturbance and displacement.
Manx shearwater	Low	**Screened OUT** as has low sensitivity to disturbance and displacement.

RED-THROATED DIVER

CABLE CORRIDOR AND WORKING AREA

12.9.2.9 There is potential for disturbance and displacement of red-throated diver during autumn migration, winter, and spring migration red-throated divers resulting from the presence of vessels installing the offshore cables along the Cable Corridor and Working Area.

12.9.2.10 In order to calculate the number of red-throated divers that would potentially be at risk of displacement from the Cable Corridor and Working Area during the cable laying process, the density of red-throated divers present in the Cable Corridor and Working Area was estimated from the site-specific surveys carried out for the Proposed Development (refer to section 12.5.2.7 and Volume III, Appendix 12.1: Offshore Ornithology Technical Report). The method used to estimate the density within the Cable Corridor and Working Area was the same as that for the Array Area itself; the number recorded in the sections of the digital aerial survey transects which crossed the Cable Corridor and Working Area was divided by the area of these overlapping sections.

12.9.2.11 Red-throated divers were recorded within the Cable Corridor and Working Area generally in low numbers during the nonbreeding season in November, January, February, March and May, although moderately high numbers were recorded in December, with a peak in that month (3.3 birds/km^2).

12.9.2.12 Red-throated divers were not recorded in the Cable Corridor and Working Area in April and June to October. Although March, April and May were identified as breeding months in Furness (2015), this species does not breed in the Irish Sea, nor onshore in proximity to the Array Area and individuals recorded at this time are considered to be part of the spring migration population (February to April; Furness, 2015).

12.9.2.13 The area from which birds could be displaced has been defined for the purposes of this assessment as a circle with a 2 km radius around each cable laying vessel as a precautionary assumption, which is an area of 12.56 km^2. This assessment also assumes that there would be 100% displacement of red-throated divers within the 2 km buffer surrounding one cable laying vessel. This 100% displacement from vessels is consistent with Garthe and Hüppop (2004) and Schwemmer *et al.* (2011) since they suggested that all red-throated divers present fly away from approaching vessels at a distance of often more than 1 km.

12.9.2.14 It is assumed that the mortality of displaced red-throated divers will be between 1% and 10%, following the approach recommended by Natural England (Parker *et al.* 2022) for offshore windfarm assessment.

12.9.2.15 However, previous studies have shown that mortality rate of displaced red-throated divers is likely to be less than 10% (Dierschke *et al.*, 2017, MacArthur Green, 2019a; see section 12.9.2.140 for further details). Definitive mortality rates associated with displacement for red-throated divers, or for any other seabird species, are not currently known and a degree of precaution is therefore appropriate. The mechanism by which mortality due to displacement could occur would be most likely due to increased density in unaffected areas, resulting in increased competition for food (Dierschke *et al.*, 2017). However, there is no evidence that birds displaced from windfarms are at risk of mortality as a consequence of displacement and the available evidence suggests that red-throated divers are unlikely to be affected by density-dependent competition for resources during the non-breeding period (Dierschke *et al.*, 2017).

12.9.2.16 On this basis, impacts are considered likely to be small or negligible (i.e. below the 10% mortality rate assumed by Natural England), and below levels that could be quantified. Impacts of displacement are also likely to be context dependent. In years when food supply has been severely depleted, as for example by unsustainably high fishing mortality of sandeel stocks as has occurred several times in recent decades (ICES, 2013), displacement of sandeel-dependent seabirds from optimal habitat may increase mortality. In contrast, in years when food supply is good, displacement is unlikely to have any negative effect on seabird populations. Red-throated divers may feed on sandeels, but take a wide diversity of small fish prey, so would be buffered to an extent from fluctuations in abundance of individual fish species.

12.9.2.17 MacArthur Green (2019a) undertook a review of available evidence for red-throated diver displacement and concluded there would be little or no effect of displacement on diver survival. Consequently, this assessment presents red-throated diver mortality resulting from displacement as being between 1 and 10%, but with the most likely impact at the lower end of this scale.

MAGNITUDE OF IMPACT

All nonbreeding seasons

12.9.2.18 The impact of displacement and disturbance caused by construction disturbance and associated vessel traffic on red-throated divers during the autumn migration, mid-winter period and spring migration is predicted to be of short term duration as a result of the Proposed Development with a high probability of occurrence.

12.9.2.19 During the autumn migration at a seasonal peak density of 0.57 birds/km^2 (corridor 1) and 0.65 birds/km^2 (corridor 2) with a 2 km radius of disturbance around a cable laying vessel (12.56 km^2), a maximum of 8.2 individuals (0.65 x 12.56), could be at risk of displacement. This means that between 0.08 (1%) to 0.8 (10%) birds are at risk of mortality (Table 12.22).

12.9.2.20 During the winter at a seasonal peak density of 3.3 birds/km^2 with a 2 km radius of disturbance around a cable laying vessel (12.56 km^2), a maximum of 41.4 individuals (3.3 x 12.56) could be at risk of displacement. This means that between 0.4 (1%) and 4 (10%) birds are at risk of mortality (Table 12.22).

12.9.2.21 During the spring migration at a seasonal peak density of 0.25 birds/km^2 in December with a 2 km radius of disturbance around a cable laying vessel (12.56 km2), a maximum of 3 individuals (0.28 x 12.56) could be at risk of displacement. This means that between 0.03 (1%) and 0.3 (10%) birds are at risk of mortality (Table 12.22).

12.9.2.22 Across all nonbreeding seasons combined 53 individuals would be predicted to be at risk of displacement. This means that between 0.53 (1%) and 5.3 (10%) birds are at risk of mortality in both corridors (Table 12.22).

12.9.2.23 Assessed against the seasonal BDMPS populations, these levels of mortality would result in increases of between 0.001 and 0.44 (Table 12.22). Increases of less than 1% are considered undetectable against natural variations (Parker *et al.* 2022).

12.9.2.24 The impact of displacement and disturbance caused by construction activities and associated vessel traffic on red-throated divers during autumn migration, the mid-winter period, spring migration and combined across all three is predicted to be of local spatial extent, short term duration, occurring only once but with a high probability. However, the increase in mortality associated with this impact is considered to have an undetectable effect on the population, therefore the consequence will be very small. Overall therefore, the magnitude is considered to be Negligible to Low.

SENSITIVITY OF RED-THROATED DIVERS

12.9.2.25 Red-throated divers are considered to have little tolerance for disturbance and displacement as they are notoriously shy and prone to avoiding disturbed areas (Garthe and Hüppop, 2004; Petersen *et al.*, 2006; Furness and Wade, 2012; Percival, 2014; Dierschke *et al.*, 2016; Dierschke *et al.*, 2017). Any losses due to construction disturbance would be short term with rapid recovery following cessation of construction activity.

12.9.2.26 Red-throated divers are considered to have a medium conservation value as some of those migrating through the Irish Sea are likely to be connected to the Murrough SPA, the Raven SPA and Northern Cardigan Bay SPA (8 km, 34 km and 99 km from the Array Area respectively) which are all designated for nonbreeding red-throated diver populations.

12.9.2.27 With respect to construction disturbance and associated vessel traffic, overall red-throated divers are considered to be of High sensitivity. This is due to a combination of low adaptability and low tolerance to disturbance, medium recoverability following cessation of the effect and medium conservation value since, as noted above, a proportion of the red-throated divers present may be connected to SPA populations.

SIGNIFICANCE OF THE EFFECT

12.9.2.28 Overall, for the maximum of two years of cable installation (including two winter periods and four migration seasons) the magnitude of the impact has been assessed as **Negligible** to **Low** and the sensitivity of red-throated divers is considered to be **High**. The effect across the nonbreeding period will therefore be **Not Significant** to **Moderate.** Overall in EIA terms this is considered to be **not significant.**

12.9.2.29 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above.

Table 12.22: Magnitude of construction impact for red-throated divers in the Cable Corridor and Working Area

Season	Autumn	Winter	Spring	All Seasons
Peak density in each cable corridor (birds/km^2)[a]	0.65	3.3	0.25	-
No of individuals at risk of displacement [b]	8.2	41.4	3.1	52.7
No of individuals at risk of mortality (1 – 10%)[c]	0.08 – 0.8	0.4 – 4.0	0.03 – 0.3	0.53 – 5.3
BDMPS (individuals)[d]	12,717	4,148	12,717	12,717
Baseline mortality rate[e]	0.228	0.228	0.228	0.228
Natural mortality [f]	2,899	946	2,899	2,899
Increase in mortality rate (%)[g]	0.003-0.03	0.04-0.44	0.001-0.01	0.02-0.18
Magnitude	Negligible to Low	Negligible to Low	Negligible to Low	Negligible to Low
Sensitivity	High	High	High	High
Effect of Significance	Not Significant to Moderate	Not Significant to Moderate	Not Significant to Moderate	Not Significant to Moderate
Overall in EIA terms	Not Significant	Not Significant	Not Significant	Not Significant

a Seasonal peak density within the Cable Corridor and Working Area. Peak month is specified in parentheses for each season.
b Number of birds at risk of displacement in each season is calculated as the peak density multiplied by the area around one cable laying vessel with a 2 km radius (12.56 km^2). Number of birds at risk of displacement in All Seasons is a sum of each season.
c Risk of mortality is calculated as 1 and 10% of the number of birds at risk of displacement.
d Refer to Table 12.11.
e Refer to Table 12.13 for baseline mortality rates
f Natural mortality is calculated as the BDMPS multiplied by the baseline mortality rate.
g Increase in mortality rate is calculated as the % increase in the natural mortality rate caused by the additional mortality.

ARRAY AREA

ALL NONBREEDING SEASONS

12.9.2.30 Red-throated divers were recorded in the Array Area in low numbers between January to May and October to December with none present between June to September. Density in the Array Area peaked in January (1.77 birds/km^2).

12.9.2.31 There is potential for disturbance and displacement of red-throated divers due to construction activity within the Array Area, including wind turbine installation and associated vessel traffic. However, construction will not occur across the whole of the Array Area simultaneously or every day but will be phased with a maximum of one foundation expected to be installed at any one time. Consequently, the effects will occur only in the areas where vessels are operating at any given point and not across the entire Array Area.

12.9.2.32 As a precautionary assumption, the area from which birds could be displaced has been defined as a circle with a 2 km radius around a foundation, which is 12.56 km^2. This assumes that there would be 100% displacement of red-throated divers within the 2 km buffer surrounding a construction location (Garthe and Hüppop 2004; Schwemmer *et al.*, 2011) and that between 1% (evidence based precautionary rate, MacArthur Green 2019a) and 10% (Natural England's preferred precautionary value) of displaced individuals could be at risk of mortality as a result of displacement by construction disturbance.

Magnitude of impact

12.9.2.33 The impact of displacement and disturbance caused by construction disturbance and associated vessel traffic on red-throated divers during the autumn migration, mid-winter period and spring migration is predicted to be of short term duration as a result of the Proposed Development with a high probability of occurrence.

12.9.2.34 During the autumn migration at a seasonal peak density of 0.7 birds/km^2 in October with a 2 km radius of disturbance in the Array Area (12.56 km^2), a maximum of nine individuals (0.7 x 12.56). This means that between 0.009 (1%) and 0.9 (10%) birds are at risk of mortality (Table 12.23).

12.9.2.35 During the winter at a seasonal peak density of 1.77 birds/km^2 in January with a 2 km radius of disturbance in the Array Area (12.56 km^2), a maximum of 22 individuals (1.77 x 12.56). This means that between 0.22 (1%) and 2.2 (10%) birds are at risk of mortality (Table 12.23).

12.9.2.36 During the spring migration at a seasonal peak density of 1.39 birds/km^2 in February with a 2 km radius of disturbance in the Array Area (12.56 km^2), a maximum of 17 individuals (1.39 x 12.56). This means that between 0.17 (1%) and 1.7 (10%) birds are at risk of mortality (Table 12.23).

12.9.2.37 Across all nonbreeding seasons combined 48 individuals would be predicted to be at risk of displacement. This means that between 0.48 (1%) and 4.8 (10%) birds are at risk of mortality (Table 12.23).

12.9.2.38 Assessed against the seasonal BDMPS populations, these levels of mortality would result in increases of between 0.03 and 0.23 (Table 12.23). Increases of less than 1% are considered undetectable against natural variations (Parker *et al.* 2022).

12.9.2.39 During autumn migration, the mid-winter period, spring migration and combined across all three the increase in mortality rate associated with displacement and disturbance is below the predicted 1% threshold for detectability (Table 12.23). Thus, even using a highly precautionary 10% mortality rate for displaced birds the effect would be undetectable against background variations.

12.9.2.40 The impact of displacement and disturbance caused by construction activities and associated vessel traffic on red-throated divers during autumn migration, the mid-winter period and spring migration is predicted to be of local spatial extent, short term duration, occurring only once but with a high probability. However, the increase in mortality associated with this impact is considered to have an undetectable effect on the population, therefore the consequence will be very small. Overall therefore, the magnitude is considered to be Negligible to Low.

Sensitivity of red-throated divers

12.9.2.41 Red-throated divers are considered to have little tolerance for disturbance and displacement as they are notoriously shy and prone to avoiding disturbed areas (Garthe and Hüppop, 2004; Petersen *et al.*, 2006; Furness and Wade, 2012; Percival, 2014; Dierschke *et al.*, 2016; Dierschke *et al.*, 2017). Any losses due to construction disturbance would be short term with rapid recovery following cessation of construction activity.

12.9.2.42 Red-throated divers are considered to have a medium conservation value as some of those migrating through the Irish Sea are likely to be connected to the Murrough SPA, the Raven SPA and Northern Cardigan Bay SPA (10 km, 34 km and 99 km from the Array Area respectively) which are all designated for nonbreeding red-throated diver populations.

12.9.2.43 With respect to construction disturbance and associated vessel traffic, overall red-throated divers are considered to be of High sensitivity. This is due to a combination of low adaptability and low tolerance to disturbance, medium recoverability following cessation of the effect and medium conservation value since, as noted above, a proportion of the red-throated divers present may be connected to SPA populations.

Significance of the effect

12.9.2.44 Overall, for the maximum of two years of turbine installation (including two winter periods and four migration seasons) the magnitude of the impact has been assessed as **Negligible** to **Low** and the sensitivity of red-throated divers is considered to be **High**. The effect will, therefore, be **Not Significant** to **Moderate.** Overall in EIA terms this is considered to be **not significant.**

12.9.2.45 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above.

Table 12.23: Magnitude of construction impact for red-throated divers in the Array Area

Season	Autumn	Winter	Spring	All Seasons
Peak density (birds/km^2)[a]	0.70 (October)	1.77 (January)	1.39 (February)	1.77 (January)
No of individuals at risk of displacement [b]	9	22	17	48
No of individuals at risk of mortality (1 – 10%)[c]	0.09 - 0.9	0.22 – 2.2	0.17 – 1.7	0.48 - 4.8
BDMPS (individuals)[d]	12,717	4,148	12,717	12,717
Baseline mortality rate[e]	0.228	0.228	0.228	0.228
Natural mortality [f]	2,899	946	2,899	2,899
Increase in mortality rate (%)[g]	0.03	0.23	0.06	0.17
Magnitude	Negligible to Low	Low	Negligible to Low	Low
Sensitivity	High	High	High	High
Effect of Significance	Not Significant to Moderate	Moderate	Not Significant to Moderate	Moderate
Overall in EIA terms	Not Significant	Not Significant	Not Significant	Not Significant

a Seasonal peak density within the Array Area. Peak month is specified in parentheses for each season.
b Number of birds at risk of displacement in each season is calculated as the peak density multiplied by the area around one construction location with a 2 km radius (12.56 km^2). Number of birds at risk of displacement in All Seasons is a sum of each season.
c Risk of mortality is calculated as 1 and 10% of the number of birds at risk of displacement.
d Refer to Table 12.11.

e Refer to Table 12.13 for baseline mortality rates
f Natural mortality is calculated as the BDMPS multiplied by the baseline mortality rate.
g Increase in mortality rate is calculated as the % increase in the natural mortality rate caused by the additional mortality.

GUILLEMOT

CABLE CORRIDOR AND WORKING AREA

12.9.2.46 There is potential for disturbance and displacement of nonbreeding guillemots resulting from the presence of vessels installing the export cables along the Cable Corridor and Working Area. Guillemots were recorded within the Cable Corridor and Working Area in all months, although numbers were low outside of the nonbreeding season.

12.9.2.47 In order to calculate the number of guillemots that potentially would be at risk of displacement from the Cable Corridor and Working Area during the cable laying process, the density of this species in the Cable Corridor and Working Area (corridor 1 and corridor 2) was estimated from the site-specific surveys carried out for the Proposed Development (refer to section 12.5.2.7 and Volume III, Appendix 12.1: Offshore Ornithology Technical Report). Site-specific surveys indicated that guillemot densities within the Cable Corridor and Working Area peaked in November. Peak guillemot density was 27.3 birds/km^2 in corridor 1 and 12.6 birds/km^2 in corridor 2.

12.9.2.48 As a precautionary assumption, the area from which birds could be displaced is defined as a circle with a 2 km radius around each primary cable laying vessel, which is 12.56 km^2. Natural England and NatureScot differ in the predicted rates of displacement and mortality recommended for assessing potential impacts on auks. Natural England assume there would be 100% displacement of auks within the 2 km buffer surrounding the cable laying vessel combined with consequent mortalities for displaced birds between 1% and 10%. In contrast, NatureScot, with respect to displacement from array areas, recommend an auk displacement rate of 60% and consequent mortality (for displaced individuals) of 1-3% in the nonbreeding season and 3-5% in the breeding season.

12.9.2.49 MacArthur Green (2019b) undertook a review of available evidence for auk displacement which concluded that precautionary rates of displacement and mortality from operational windfarms would be 50% and 1% respectively. These figures are also considered suitably precautionary for the potential displacement around construction vessels. Therefore, the assessment presents estimates using a 60% displacement rate and a 1% mortality rate in order to ensure the assessment conclusions are conservative in this regard.

MAGNITUDE OF IMPACT

Nonbreeding season

12.9.2.50 During the nonbreeding season (August to February), at a seasonal peak density of 27.3 birds/ km^2 (corridor 1) and 12.6 birds/ km^2 (corridor 2) and with a 2 km radius of disturbance around a cable laying vessel (12.56 km^2), a maximum of 206 individuals (27.3 x 12.56 x 60%) could be at risk of displacement along corridor 1 and 95 (12.6 x 12.56 x 60%) along corridor 2, 301 in total. This means that three individuals (1%) would be at risk of mortality due to cable installation (Table 12.24).

12.9.2.51 Assessed against the seasonal BDMPS population (1,567,463), this level of mortality would result in an increase of 0.001% in the background rate (Table 12.24). Increases of less than 1% are considered undetectable against natural variations.

12.9.2.52 The impact of displacement and disturbance on guillemots within the Cable Corridor and Working Area during nonbreeding season is predicted to be of local spatial extent, short term duration, occurring only once but with a high probability. However, the increase in mortality associated with this impact is considered to have an undetectable effect on the population, therefore the consequence will be very small. Overall therefore, the magnitude is considered to be Negligible.

Breeding season

12.9.2.53 During the breeding season (March to July), at a seasonal peak density of 2.9 birds/ km^2 (corridor 1) and 3.3 birds/ km^2 (corridor 2) and with a 2 km radius of disturbance around a cable laying vessel (12.56 km^2), a maximum of 22 individuals (2.9 x 12.56 x 60%) could be at risk of displacement along corridor 1 and 25 (3.3 x 12.56 x 60%) along corridor 2, 47 in total. This means that 0.47 individuals (1%) would be at risk of mortality due to cable installation (Table 12.24).

12.9.2.54 Assessed against the seasonal BDMPS populations (319,052 to 915,761), this level of mortality would result in an increase of no more than 0.001% in the background rate (Table 12.24). Increases of less than 1% are considered undetectable against natural variations.

12.9.2.55 The impact of displacement and disturbance on guillemots within the Cable Corridor and Working Area during breeding season is predicted to be of local spatial extent, short term duration, occurring only once but with a high probability. However, the increase in mortality associated with this impact is considered to have an undetectable effect on the population, therefore the consequence will be very small. Overall therefore, the magnitude is considered to be Negligible.

All seasons

12.9.2.56 Across breeding and nonbreeding seasons combined 348 individuals would be predicted to be at risk of displacement (Table 12.24). Assessed against the largest BDMPS population (1,567,463), this level of mortality would result in an increase of 0.002% in the background rate (Table 12.24). Increases of less than 1% are considered undetectable against natural variations.

12.9.2.57 The impact of displacement and disturbance on guillemots within the Cable Corridor and Working Area across all seasons is predicted to be of local spatial extent, short term duration, occurring only once but with a high probability. However, the increase in mortality associated with this impact is considered to have an undetectable effect on the population, therefore the consequence will be very small. Overall therefore, the magnitude is considered to be Negligible.

SENSITIVITY OF GUILLEMOTS

12.9.2.58 Guillemots are considered to have a medium tolerance for the disturbance and displacement as they show some sensitivity to ship and helicopter traffic (Garthe and Hüppop 2004; Furness and Wade 2012; Furness *et al.*, 2013 and Bradbury *et al.*, 2014). Dierschke *et al.*, (2016) categorized guillemot as 'weakly avoiding offshore windfarms' based on a review of numbers inside and outside of operational offshore windfarms; their behavioural response to construction is likely to be similar and probably slightly stronger than during operation. However, any losses due to construction disturbance would be short term with rapid recovery following cessation of construction activity.

12.9.2.59 Guillemots are considered to have a high conservation value as many of those present in the Cable Corridor and Working Area are likely to be connected to the Ireland's Eye SPA and Lambay Island SPA (54 km and 62 km from the Array Area respectively) which are designated sites for breeding guillemot populations and are within mean maximum foraging range of the Proposed Development.

12.9.2.60 With respect to cable installation for all seasons, overall guillemots are considered to be of Medium sensitivity. This is due to a combination of low adaptability and low tolerance to vessel disturbance, rapid recoverability following cessation of the effect and medium to high conservation value since, as noted above, a proportion of the guillemots present in the Cable Corridor and Working Area may be connected to SPA populations.

SIGNIFICANCE OF THE EFFECT

12.9.2.61 Overall, for the maximum of two years of construction (including two breeding and nonbreeding seasons) the magnitude of the impact has been assessed as **Negligible** and the sensitivity of guillemots is considered to be **Medium**. The effect will, therefore, be **Not Significant** in EIA terms.

12.9.2.62 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above.

Table 12.24: Magnitude of construction impact for guillemots in the Cable Corridor and Working Area

Season	Breeding	Nonbreeding	All Seasons
Peak density (birds/km^2)[a]	2.9 and 3.3	27.3 and 12.6	-
No of individuals at risk of displacement[b]	47	301	348
No of individuals at risk of mortality (1%)[c]	0.47	3.01	3.48
BDMPS (individuals)[d]	319,052 – 915,761	1,567,463	1,567,463
Baseline mortality rate[e]	0.140	0.140	0.140
Natural mortality[f]	44,667 – 128,206	219,436	219,436
Increase in mortality rate (%)[g]	0.001-<0.001	0.001	0.002
Magnitude	Negligible	Negligible	Negligible
Sensitivity	Medium	Medium	Medium
Effect of Significance	Not Significant	Not Significant	Not Significant
Overall in EIA terms	Not Significant	Not Significant	Not Significant

a Seasonal peak density within the Cable Corridors and Working Areas. Peak month is specified in parentheses for each season.
b Number of birds at risk of displacement in each season is calculated as the peak density multiplied by the area one cable laying vessel with a 2 km radius (12.56 km^2) multiplied by 60%. Number of birds at risk of displacement in All Seasons is a sum of each season.
c Risk of mortality is calculated as 1% of the number of birds at risk of displacement.
d Refer to Table 12.11.
e Refer to *Table 12.13* for baseline mortality rates.
f Natural mortality is calculated as the BDMPS multiplied by the baseline mortality rate.
g Increase in mortality rate is calculated as the % increase in the natural mortality rate caused by the additional mortality.

ARRAY AREA

12.9.2.63 There is potential for disturbance and displacement of guillemot due to construction activity within the Array Area, including wind turbine installation and associated vessel traffic. However, construction will not occur across the whole of the Array Area simultaneously or every day but will be phased with a maximum of one construction site (i.e. foundation location) expected to be active at any one time. Consequently, the effects will occur only in the areas where vessels are operating at any given point and not across the entire Array Area.

12.9.2.64 As a precautionary assumption, the area from which birds could be displaced has been defined as a circle with a 2 km radius around one foundation location, which is 12.56 km^2. For guillemots this assumes that 60% of auks will be at risk of displacement within the 2 km buffer surrounding a construction location and that the mortality of displaced birds will be 1% (NatureScot recommend auk displacement rates of 60% and consequent mortality for displaced individuals of 1%) in order to ensure the assessment conclusions are conservative in this regard.

12.9.2.65 Guillemots were recorded in the Array Area in all calendar months, with density peaking in January (64.8 birds/km^2) and at its lowest in March (0.2 birds/km^2).

MAGNITUDE OF IMPACT

Nonbreeding season

12.9.2.66 During the nonbreeding seasonal peak density of 64.83 birds/km^2 in January with a 2 km radius of disturbance in the Array Area (12.56 km^2), a maximum of 489 individuals (64.83 x 12.56 x 60%) could be at risk of displacement. This means that 48.9 individuals (1%) would be at risk of mortality due to construction displacement (Table 12.25).

12.9.2.67 Assessed against the seasonal BDMPS populations (1,567,463), this level of mortality would result in an increase of 0.002% in the background rate (Table 12.25). Increases of less than 1% are considered undetectable against natural variations.

12.9.2.68 The impact of displacement and disturbance caused by construction activities and associated vessel traffic on guillemots during the nonbreeding season is predicted to be of local spatial extent, short term duration, occurring only once but with high probability. However, the increase in mortality associated with this impact is considered to have an undetectable effect on the population (i.e. a less than 1% increase in mortality rate Table 12.25). therefore, the consequence will be very small. Overall therefore, the magnitude is considered to be Negligible.

Breeding season

12.9.2.69 During the breeding season at a seasonal peak density of 11.38 birds/km^2 in October with a 2 km radius of disturbance in the Array Area (12.56 km^2), a maximum of 86 individuals (11.38 x 12.56 x 60%) could be at risk of displacement. This means that 0.86 individuals (1%) would be at risk of mortality due to construction displacement (Table 12.25).

12.9.2.70 Assessed against the seasonal BDMPS populations (319,052 to 915,761), this level of mortality would result in an increase of no more than 0.002% in the background rate (Table 12.25). Increases of less than 1% are considered undetectable against natural variations.

12.9.2.71 The impact of displacement and disturbance caused by construction activities and associated vessel traffic on guillemots during the breeding season is predicted to be of local spatial extent, short term duration, occurring only once but with high probability. However, the increase in mortality associated with this impact is considered to have an undetectable effect on the population (i.e. a less than 1% increase in mortality rate Table 12.25). therefore, the consequence will be very small. Overall therefore, the magnitude is considered to be Negligible.

All seasons

12.9.2.72 Across all seasons combined 575 individuals would be predicted to be at risk of displacement (Table 12.25). Assessed against the largest BDMPS populations (1,567,463), this level of mortality would result in an increase of 0.003% in the background rate (Table 12.25). Increases of less than 1% are considered undetectable against natural variations (Parker *et al.* 2022).

12.9.2.73 The impact of displacement and disturbance caused by construction activities and associated vessel traffic on guillemots during the breeding, nonbreeding and across all seasons is predicted to be of local spatial extent, short term duration, occurring only once but with high probability. However, the increase in mortality associated with this impact is considered to have an undetectable effect on the population (i.e. a less than 1% increase in mortality rate Table 12.25). therefore, the consequence will be very small. Overall therefore, the magnitude is considered to be Negligible.

SENSITIVITY OF GUILLEMOTS

12.9.2.74 Guillemots are considered to have a medium tolerance for disturbance and displacement as they show some sensitivity to ship and helicopter traffic (Garthe and Hüppop 2004; Furness and Wade 2012; Furness *et al.*, 2013 and Bradbury *et al.*, 2014). Dierschke *et al.*, (2016) categorized guillemot as 'weakly avoiding offshore windfarms' based on a review of numbers inside and outside of operational offshore windfarms; their behavioural response to construction is likely to be similar and probably slightly stronger than during operation. However, any losses due to construction disturbance would be short term with rapid recovery following cessation of construction activity.

12.9.2.75 Guillemots are considered to have a high conservation value as many of those present in the Array Area and 2 km buffer during the breeding season may be connected to the Ireland's Eye SPA and Lambay Island SPA (54 km and 62 km from the Array Area respectively) which are all designated sites for breeding guillemot populations and are within mean maximum foraging range of the Proposed Development for this species.

12.9.2.76 With respect to construction disturbance and associated vessel traffic, overall guillemots are considered to be of Medium sensitivity. This is due to a combination of low adaptability and low tolerance to disturbance, rapid recoverability following cessation of the effect and medium conservation value since, as noted above, a proportion of the guillemots present in the Cable Corridor and Working Area may be connected to SPA populations.

SIGNIFICANCE OF THE EFFECT

12.9.2.77 Overall, for the maximum of two years of turbine installation (including two breeding and nonbreeding seasons) the magnitude of the impact has been assessed as **Negligible** and the sensitivity of guillemots is considered to be **Medium**. The effect will, therefore, be **Not Significant** in EIA term.

12.9.2.78 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above.

Table 12.25: Magnitude of construction impact for guillemots in the Array Area

Season	Breeding	Nonbreeding	All Seasons
Peak density (birds/km^2)[a]	11.38 (May)	64.83 (January)	64.83 (January)
No of individuals at risk of displacement[b]	86	489	575

Season	Breeding	Nonbreeding	All Seasons
No of individuals at risk of mortality (1%)[c]	0.9	4.9	5.8
BDMPS (individuals)[d]	319,052 – 915,761	1,567,463	1,567,463
Baseline mortality rate[e]	0.140	0.140	0.140
Natural mortality[f]	44,667 – 128,206	219,436	219,436
Increase in mortality rate (%)[g]	0.002- <0.001	0.002	0.003
Magnitude	Negligible	Negligible	Negligible
Sensitivity	Medium	Medium	Medium
Effect of Significance	Not Significant	Not Significant	Not Significant
Overall in EIA terms	Not Significant	Not Significant	Not Significant

a Seasonal peak density within the Array Area. Peak month is specified in parentheses for each season.
b Number of birds at risk of displacement in each season is calculated as the peak density multiplied by the area around one construction location with a 2 km radius (12.56 km^2). Number of birds at risk of displacement in All Seasons is a sum of each season.
c Risk of mortality is calculated as 1 and 10% of the number of birds at risk of displacement.
d Refer to Table 12.11.
e Refer to Table 12.13 for baseline mortality rates
f Natural mortality is calculated as the BDMPS multiplied by the baseline mortality rate.
g Increase in mortality rate is calculated as the % increase in the natural mortality rate caused by the additional mortality.

RAZORBILL

CABLE CORRIDOR AND WORKING AREA

12.9.2.79 There is potential for disturbance and displacement of razorbills during breeding, autumn, winter and spring periods resulting from the presence of vessels installing the export cables along the Cable Corridor and Working Area.

12.9.2.80 Razorbills were recorded in most months except February, March and June in corridor 1, and February, April and June in corridor 2, and numbers were low outside of the nonbreeding season.

12.9.2.81 In order to calculate the number of razorbills that potentially would be at risk of displacement from the Cable Corridor and Working Area during the cable laying process, the density of this species in the Cable Corridor and Working Area (corridor 1 and corridor 2) was estimated from the site-specific surveys carried out for the Proposed Development (refer to section 12.5.2.7 and Volume III, Appendix 12.1: Offshore Ornithology Technical Report). Site-specific surveys indicated that razorbill densities within the Cable Corridor and Working Area peaked in November. Peak razorbill density was 9.5 birds/km^2 in Corridor 1 and 5.0 birds/km^2 in corridor 2.

12.9.2.82 As a precautionary assumption, the area from which birds could be displaced is defined as a circle with a 2 km radius around each primary cable laying vessel, which is 12.56 km^2. Natural England and NatureScot differ in the predicted rates of displacement and mortality recommended for assessing potential impacts on auks. Natural England assume there would be 100%

displacement of auks within the 2 km buffer surrounding the cable laying vessel combined with consequent mortalities for displaced birds between 1% and 10%. In contrast, NatureScot, with respect to displacement from array areas, recommend an auk displacement rate of 60% and consequent mortality (for displaced individuals) of 1-3% in the nonbreeding season and 3-5% in the breeding season.

12.9.2.83 MacArthur Green (2019b) undertook a review of available evidence for auk displacement which concluded that precautionary rates of displacement and mortality from operational windfarms would be 50% and 1% respectively. These figures are also considered suitably precautionary for the potential displacement around construction vessels. Therefore, the assessment presents estimates using a 60% displacement rate and a 1% mortality rate in order to ensure the assessment conclusions are conservative in this regard.

MAGNITUDE OF IMPACT

Autumn migration

12.9.2.84 During the autumn migration (August to October), at a seasonal peak density of 3.2 birds/ km^2 (corridor 1) and 4.5 birds/ km^2 (corridor 2), with a 2 km radius of disturbance around a cable laying vessel (12.56 km^2), a maximum of 48 individuals (3.2 x 12.56 x 60%) could be at risk of displacement along corridor 1 and 34 (4.5 x 12.56 x 60%) along corridor 2, 82 in total. This means that 0.82 individuals (1%) are at risk of mortality due to cable installation (Table 12.26).

12.9.2.85 Assessed against the seasonal BDMPS population (642,680), this level of mortality would result in an increase of 0.001% in the background rate (Table 12.26). Increases of less than 1% are considered undetectable against natural variations.

12.9.2.86 The impact of displacement and disturbance on razorbills within the Cable Corridor and Working Area during the autumn migration is predicted to be of local spatial extent, short term duration, continuous and high reversibility, occurring only once but with a high probability. However, the increase in mortality associated with this impact is considered to have an undetectable effect on the population, therefore the consequence will be very small. Overall therefore, the magnitude is considered to be Negligible.

Winter season

12.9.2.87 During the winter period (November and December), at a seasonal peak density of 9.5 birds/ km^2 (corridor 1) and 5.0 birds/ km^2 (corridor 2), with a 2 km radius of disturbance around a cable laying vessel (12.56 km^2), a maximum of 72 individuals (9.5 x 12.56 x 60%) could be at risk of displacement along corridor 1 and 38 (5.0 x 12.56 x 60%) along corridor 2, 110 in total. This means that 1.1 individuals (1%) are at risk of mortality due to cable installation (Table 12.26).

12.9.2.88 Assessed against the seasonal BDMPS population (377,188), this level of mortality would result in an increase of 0.002% in the background rate (Table 12.26). Increases of less than 1% are considered undetectable against natural variations.

12.9.2.89 The impact of displacement and disturbance on razorbills within the Cable Corridor and Working Area during the winter period is predicted to be of local spatial extent, short term duration, continuous and high reversibility, occurring only once but with a high probability. However, the increase in mortality associated with this impact is considered to have an undetectable effect on the population, therefore the consequence will be very small. Overall therefore, the magnitude is considered to be Negligible.

Spring season

12.9.2.90 During the spring migration (January to March), at a seasonal peak density of 0.7 birds/ km^2 (corridor 1) and 0.3 birds/ km^2 (corridor 2), with a 2 km radius of disturbance around a cable laying vessel (12.56 km^2), a maximum of five individuals (0.7 x 12.56 x 60%) could be at risk of displacement along corridor 1 and two (0.3 x 12.56 x 60%) along corridor 2, seven in total. This means that 0.07 individuals (1%) are at risk of mortality due to cable installation (Table 12.26).

12.9.2.91 Assessed against the seasonal BDMPS population (642,680), this level of mortality would result in an increase of <0.001% in the background rate (Table 12.26). Increases of less than 1% are considered undetectable against natural variations.

12.9.2.92 The impact of displacement and disturbance on razorbills within the Cable Corridor and Working Area during the spring migration is predicted to be of local spatial extent, short term duration, continuous and high reversibility, occurring only once but with a high probability. However, the increase in mortality associated with this impact is considered to have an undetectable effect on the population, therefore the consequence will be very small. Overall therefore, the magnitude is considered to be Negligible.

Breeding season

12.9.2.93 During the breeding season (April to July), at a seasonal peak density of 0.3 birds/ km^2 (corridor 1) and 0.3 birds/ km^2 (corridor 2) in November, with a 2 km radius of disturbance around a cable laying vessel (12.56 km^2), a maximum of 2 individuals (0.3 x 12.56 x 60%) could be at risk of displacement along corridor 1 and 2 (0.3 x 12.56 x 60%) along corridor 2, 4 in total. This means that 0.04 individuals (1%) are at risk of mortality due to cable installation (Table 12.26).

12.9.2.94 Assessed against the seasonal BDMPS populations (38,462 – 320,632), this level of mortality would result in an increase of no more than 0.006% in the background rate (Table 12.26). Increases of less than 1% are considered undetectable against natural variations (Parker *et al.* 2022). Overall therefore, the magnitude is considered to be Negligible.

All seasons

12.9.2.95 Across all nonbreeding seasons combined 203 individuals would be predicted to be at risk of displacement (Table 12.26). Assessed against the largest BDMPS population (642,680), this level of mortality would result in an increase of 0.002% in the background rate (Table 12.26). Increases of less than 1% are considered undetectable against natural variations (Parker *et al.* 2022).

12.9.2.96 The impact of displacement and disturbance on razorbills within the Cable Corridor and Working Area all seasons is predicted to be of local spatial extent, short term duration, continuous and high reversibility, occurring only once but with a high probability. However, the increase in mortality associated with this impact is considered to have an undetectable effect on the population, therefore the consequence will be very small. Overall therefore, the magnitude is considered to be Negligible.

SENSITIVITY OF RAZORBILLS

12.9.2.97 Razorbills are considered to have a medium tolerance for the disturbance and displacement, based on their sensitivity to ship and helicopter traffic in Garthe and Hüppop (2004), Langston (2010), interpretation of the Furness and Wade (2012) species concern index value in the context of disturbance and/or displacement from a habitat, and the meta-analysis of avoidance and attraction responses of seabirds to offshore windfarms by Dierschke *et al.*, (2016). However, any losses due to construction disturbance would be short term with rapid recovery following cessation of construction activity.

12.9.2.98 Razorbills are considered to have a high conservation value as many of those present in the Cable Corridor and Working Area may be connected to the Ireland's Eye SPA, Lambay Island SPA and Saltee Islands SPA (54 km, 62 km and 80 km from the Array Area respectively) which are all designated sites for breeding razorbill populations and are within mean maximum foraging range of the Proposed Development.

12.9.2.99 With respect to cable installation, overall razorbills are considered to be of Medium sensitivity. This is due to a combination of low adaptability and low tolerance to vessel disturbance, rapid recoverability following cessation of the effect and medium conservation value since, as noted above, a proportion of the razorbills present in the Cable Corridor and Working Area may be connected to SPA populations.

SIGNIFICANCE OF THE EFFECT

12.9.2.100 Overall, for the maximum of two years of construction (including two winter periods, two breeding seasons and four migration seasons) the magnitude of the impact has been assessed as **Negligible** and the sensitivity razorbills is considered to be **Medium**. The effect will, therefore, be **Not Significant** in EIA terms.

12.9.2.101 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above.

Table 12.26: Magnitude of impact for razorbills in the Cable Corridor and Working Area

Season	Breeding	Autumn	Winter	Spring	All Seasons
Peak density (birds/km^2)[a]	0.3 and 0.3	3.2 and 4.5	9.5 and 5.0	0.7 and 0.3	-
No of individuals at risk of displacement[b]	4	82	110	7	203
No of individuals at risk of mortality (1%)[c]	0.04	0.82	1.1	0.07	2
BDMPS (individuals)[d]	38,462 – 320,632	642,680	377,188	642,680	642,680
Baseline mortality rate[e]	0.174	0.174	0.174	0.174	0.174
Natural mortality[f]	6,692 – 55,790	111826	65631	111826	111826
Increase in mortality rate (%)[g]	0.006-0.001	0.001	0.002	<0.001	0.002
Magnitude	Negligible	Negligible	Negligible	Negligible	Negligible
Sensitivity	Medium	Medium	Medium	Medium	Medium
Effect of Significance	Not Significant	Not Significant	Not Significant	Not Significant	Not Significant
Overall in EIA terms	Not Significant	Not Significant	Not Significant	Not Significant	Not Significant

a Seasonal peak density within the Cable Corridors and Woking Areas. Peak month is specified in parentheses for each season.
b Number of birds at risk of displacement in each season is calculated as the peak density multiplied by the area one cable laying vessel with a 2 km radius (12.56 km^2) multiplied by 60%. Number of birds at risk of displacement in All Seasons is a sum of each season.
c Risk of mortality is calculated as 1% of the number of birds at risk of displacement.
d Refer to Table 12.11.
e Refer to *Table 12.13* for baseline mortality rates.
f Natural mortality is calculated as the BDMPS multiplied by the baseline mortality rate.

g Increase in mortality rate is calculated as the % increase in the natural mortality rate caused by the additional mortality.

ARRAY AREA

12.9.2.102 There is potential for disturbance and displacement of razorbill due to construction activity within the Array Area, including wind turbine installation and associated vessel traffic. However, construction will not occur across the whole of the Array Area simultaneously or every day but will be phased with a maximum of one construction site (i.e. foundation location) expected to be active at any one time. Consequently, the effects will occur only in the areas where vessels are operating at any given point and not across the entire Array Area.

12.9.2.103 As a precautionary assumption, the area from which birds could be displaced has been defined as a circle with a 2 km radius around one foundation location, which is 12.56 km^2. For razorbills this assumes that 60% of auks will be at risk of displacement within the 2 km buffer surrounding a construction location and that the mortality of displaced birds will be 1% (NatureScot recommend auk displacement rates of 60% and consequent mortality for displaced individuals of 1%).

12.9.2.104 MacArthur Green (2019b) undertook a review of available evidence for auk displacement which concluded that precautionary rates of displacement and mortality from operational windfarms would be 50% and 1% respectively (i.e. very similar to those advised by NatureScot). These figures are also considered suitably precautionary for the potential displacement around construction vessels. Therefore, the assessment presents estimates using a 60% displacement rate and a 1% mortality rate in order to ensure the assessment conclusions are conservative in this regard.

12.9.2.105 Razorbills were recorded in the Array Area in all calendar months, with density peaking in January (51.17 birds/km^2) and at its lowest in July (0.1 birds/km^2).

MAGNITUDE OF IMPACT

Autumn migration

12.9.2.106 During the autumn migration peak density of 18.32 birds/km^2 in January with a 2 km radius of disturbance in the Array Area (12.56 km^2), a maximum of 138 individuals (18.32 x 12.56 x 60%). This means that 1.4 individuals (1%) would be at risk of mortality due to cable installation (Table 12.27).

12.9.2.107 Assessed against the seasonal BDMPS population (642,680), this level of mortality would result in an increase of 0.001% in the background rate (Table 12.27). Increases of less than 1% are considered undetectable against natural variations.

12.9.2.108 The impact of displacement and disturbance caused by construction activities and associated vessel traffic during the autumn migration is predicted to be of local spatial extent, short term duration, continuous and high reversibility, occurring only once but with a high probability. However, the increase in mortality associated with this impact is considered to have an undetectable effect on the population, therefore the consequence will be very small. Overall therefore, the magnitude is considered to be Negligible.

Winter season

12.9.2.109 During the winter period peak density of 24.75 birds/km^2 in January with a 2 km radius of disturbance in the Array Area (12.56 km^2), a maximum of 186 individuals (24.75 x 12.56 x 60%). This means that 1.9 individuals (1%) would be at risk of mortality due to cable installation (Table 12.27).

12.9.2.110 Assessed against the seasonal BDMPS population (377,188), this level of mortality would result in an increase of 0.003% in the background rate (Table 12.27). Increases of less than 1% are considered undetectable against natural variations.

12.9.2.111 The impact of displacement and disturbance caused by construction activities and associated vessel traffic during the winter period is predicted to be of local spatial extent, short term duration, continuous and high reversibility, occurring only once but with a high probability. However, the increase in mortality associated with this impact is considered to have an undetectable effect on the population, therefore the consequence will be very small. Overall therefore, the magnitude is considered to be Negligible.

Spring season

12.9.2.112 During the spring period peak density of 51.17 birds/km^2 in January with a 2 km radius of disturbance in the Array Area (12.56 km^2), a maximum of 386 individuals (51.17 x 12.56 x 60%). This means that 3.9 individuals (1%) would be at risk of mortality due to cable installation (Table 12.27).

12.9.2.113 Assessed against the seasonal BDMPS population (642,680), this level of mortality would result in an increase of 0.003% in the background rate (Table 12.27). Increases of less than 1% are considered undetectable against natural variations (Parker *et al.* 2022).

12.9.2.114 The impact of displacement and disturbance caused by construction activities and associated vessel traffic during the spring migration is predicted to be of local spatial extent, short term duration, continuous and high reversibility, occurring only once but with a high probability. However, the increase in mortality associated with this impact is considered to have an undetectable effect on the population, therefore the consequence will be very small. Overall therefore, the magnitude is considered to be Negligible.

Breeding season

12.9.2.115 During the breeding season peak density of 1.02 birds/km^2 in January with a 2 km radius of disturbance in the Array Area (12.56 km^2), a maximum of 8 individuals (1.02 x 12.56 x 60%). This means that 0.08 individuals (1%) would be at risk of mortality due to cable installation (Table 12.27).

12.9.2.116 Assessed against the seasonal BDMPS populations (38,462 – 320,632), this level of mortality would result in an increase of no more than 0.001% in the background rate (Table 12.27). Increases of less than 1% are considered undetectable against natural variations (Parker *et al.* 2022).

12.9.2.117 The impact of displacement and disturbance caused by construction activities and associated vessel traffic during the spring migration is predicted to be of local spatial extent, short term duration, continuous and high reversibility, occurring only once but with a high probability. However, the increase in mortality associated with this impact is considered to have an undetectable effect on the population, therefore the consequence will be very small. Overall therefore, the magnitude is considered to be Negligible.

All seasons

12.9.2.118 Across all nonbreeding seasons combined 718 individuals would be predicted to be at risk of displacement (Table 12.27). Assessed against the largest BDMPS population (642,680), this level of mortality would result in an increase of 0.006% in the background rate (Table 12.27). Increases of less than 1% are considered undetectable against natural variations.

12.9.2.119 The impact of displacement and disturbance caused by construction activities and associated vessel traffic on razorbills during the breeding season, autumn migration, winter period and spring migration and across seasons is predicted to be of local spatial extent, short term duration, occurring only once but with high probability. However, the increase in mortality associated with this impact is considered to have an undetectable effect on the population (i.e. a less than 1% increase in mortality rate Table 12.27), therefore the consequence will be very small. Overall therefore, the magnitude is considered to be Negligible.

SENSITIVITY OF RAZORBILLS

12.9.2.120 Razorbills are considered to have a medium tolerance for disturbance and displacement, based on their sensitivity to ship and helicopter traffic in Garthe and Hüppop (2004), Langston (2010), an interpretation of the Furness and Wade (2012) species concern index value in the context of disturbance and/or displacement from a habitat, and the meta-analysis of avoidance and attraction responses of seabirds to offshore windfarms by Dierschke *et al.*, (2016). However, any losses due to construction disturbance would be short term with rapid recovery following cessation of construction activity.

12.9.2.121 Razorbills are considered to have a high conservation value as many of those present in the Array Area and 2 km buffer may be connected to the Ireland's Eye SPA, Lambay Island SPA and Saltee Islands SPA (54 km, 62 km and 80 km from the Array Area respectively) which are all designated sites for breeding razorbill populations and are within mean maximum foraging range of the Proposed Development.

12.9.2.122 With respect to construction disturbance and associated vessel traffic, overall razorbills are considered to be of Medium sensitivity. This is due to a combination of low adaptability and low tolerance to disturbance, rapid recoverability following cessation of the effect and medium conservation value since, as noted above, a proportion of the razorbills present in the Cable Corridor and Working Area may be connected to SPA populations.

SIGNIFICANCE OF THE EFFECT

12.9.2.123 Overall, for the maximum of two years of construction (including two winter periods, two breeding seasons and four migration seasons) the magnitude of the impact has been assessed as **Negligible** and the sensitivity of razorbills is considered to be **Medium**. The effect will, therefore, be **Not Significant** in EIA terms.

12.9.2.124 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above.

Table 12.27: Magnitude of impact for razorbills in the Array Area

Season	Breeding	Autumn	Winter	Spring	All Seasons
Peak density (birds/km^2)[a]	1.02 (April)	18.32 (August)	24.75 (Nov)	51.17 (Jan)	51.17 (Jan)
No of individuals at risk of displacement[b]	8	138	186	386	718
No of individuals at risk of mortality (1%)[c]	0.08	1.4	1.9	3.9	7.2
BDMPS (individuals)[d]	38,462 – 320,632	642,680	377,188	642,680	642,680
Baseline mortality rate[e]	0.174	0.174	0.174	0.174	0.174
Natural mortality[f]	6,692 – 55,790	111,826	65,631	111,826	111,826

Season	Breeding	Autumn	Winter	Spring	All Seasons
Increase in mortality rate (%)[g]	0.001-<0.001	0.001	0.003	0.003	0.006
Magnitude	Negligible	Negligible	Negligible	Negligible	Negligible
Sensitivity	Medium	Medium	Medium	Medium	Medium
Effect of Significance	Not Significant	Not Significant	Not Significant	Not Significant	Not Significant
Overall in EIA terms	Not Significant	Not Significant	Not Significant	Not Significant	Not Significant

a Seasonal peak density within the Array Area. Peak month is specified in parentheses for each season.
b Number of birds at risk of displacement in each season is calculated as the peak density multiplied by the area around one construction location with a 2 km radius (12.56 km^2). Number of birds at risk of displacement in All Seasons is a sum of each season.
c Risk of mortality is calculated as 1 and 10% of the number of birds at risk of displacement.
d Refer to Table 12.11.
e Refer to Table 12.13 for baseline mortality rates
f Natural mortality is calculated as the BDMPS multiplied by the baseline mortality rate.
g Increase in mortality rate is calculated as the % increase in the natural mortality rate caused by the additional mortality.

Operational and maintenance phase

12.9.2.125 Vessel and helicopter activity during the operational and maintenance phase within the Array Area has the potential to directly affect bird populations through disturbance, leading to displacement of birds from the Array Area.

12.9.2.126 However, any effects generated during the operational phase from vessel and helicopter activity alone are expected to be of a reduced magnitude compared with those generated during the construction phase, as vessel activity will be of a lower level than that associated with turbine construction.

12.9.2.127 The impact of disturbance and displacement resulting from maintenance activities (including vessel and helicopter activity) combined with that from the operational turbines themselves are assessed below.

12.9.2.128 The presence of operational infrastructure has the potential to directly displace birds from important areas for feeding, moulting and loafing during the operational and maintenance phase. The consequence of such displacement could potentially result in a loss of fitness, lower reproductive success and reduced survival. This would be unlikely for seabirds that have large area of alternative habitat available but might be more likely to affect seabirds with highly specialised habitat requirements that are limited in availability (Furness *et al.*, 2013; Bradbury *et al.*, 2014).

12.9.2.129 The impact of operational infrastructure and maintenance activities may continuously affect breeding and nonbreeding birds foraging within the Array Area but may only affect passage birds intermittently during migration.

12.9.2.130 Seabird species vary in their reactions to the presence of operational infrastructure and to the maintenance activities (particularly ship and helicopter traffic) that are associated with them. For example, vessel activity and the lights on wind turbines and associated ancillary structures can directly attract (or repel) certain species of birds and affect migratory behaviour on a local scale. Garthe and Hüppop (2004) presented a scoring system for disturbance factors such as ship and helicopter traffic, which is used widely in offshore windfarm EIAs. Dierschke *et al.*, (2016) reviewed all available evidence from operational offshore windfarms on the extent of displacement or attraction of seabirds in relation to these structures. They found strong avoidance of operational offshore windfarms by great crested grebe, red-throated diver, black-throated diver and gannet. They found weak avoidance by long-tailed duck, common scoter, fulmar, Manx shearwater, razorbill, guillemot, little gull and Sandwich tern. They found no evidence of any consistent response by eider, kittiwake, common tern and Arctic tern, and evidence of weak attraction to operating offshore windfarms for common gull, black-headed gull, great black-backed gull, herring gull, lesser black-backed gull and red-breasted merganser, and strong attraction for shags and cormorants. Dierschke *et al*., (2016) suggested that strong avoidance would lead to some habitat loss for those species, while attracted birds appear to benefit from increases in food abundance within operational offshore windfarms.

12.9.2.131 Post-construction monitoring of the Beatrice windfarm (MacArthur Green 2023) has found no indication of windfarm avoidance behaviour in breeding kittiwake, guillemot, razorbill and puffin from the nearby East Caithness Cliffs SPA, however gannet abundance in the windfarm was markedly reduced following turbine installation.

12.9.2.132 There are a number of different measures used to determine bird displacement from areas of sea in response to activities associated with an offshore windfarm. Furness *et al*., (2013), for example, use disturbance ratings for particular species, alongside scores for habitat flexibility and conservation importance to define an index value that highlights the sensitivity to disturbance and displacement. These authors also recognise that displacement may contribute to individual birds experiencing fitness consequences, which at an extreme level could lead to the mortality of individuals.

12.9.2.133 As offshore windfarms are a relatively new feature in the marine environment, there is limited empirical data on displacement of foraging seabirds from offshore windfarms; the consequence is that assessment of the amount of displacement arising from new developments can be speculative. However, displacement advice is available from the UK Statutory Nature Conservation Bodies (SNCBs) who issued a joint Interim Displacement Advice Note (JNCC *et al*., 2017) providing recommendations on how to present information to enable the assessment of displacement effects in relation to offshore windfarm developments. This advice note has been used in the assessment provided below.

12.9.2.134 The methodology presented in JNCC *et al.* (2017) recommends that a matrix is presented for each key species for the most relevant biological periods showing bird losses at differing rates of displacement and mortality. This assessment uses the range of predicted losses, in association with the scientific evidence available from post-construction monitoring studies, to quantify the level of displacement and the potential losses as a consequence of the Proposed Development. These losses are then placed in the context of the relevant population (e.g. SPA, BDMPS or biogeographic) to determine the magnitude of effect.

12.9.2.135 The population estimate used for each species to assess the displacement effects was the relevant seasonal peak within a biological season (i.e. the highest value for the months within each season). The seasonal peaks were calculated as follows; first the density for each calendar month was calculated (as the average of the density in each survey undertaken in that month), then the highest value from the months within each season extracted. As per JNCC *et al.* (2017), for divers, the assessment used all data recorded within the 4 km buffer, for all other species the assessment used all data recorded within the 2 km buffer (although it should be noted that the evidence reviews in MacArthur Green 2019a and 2019b indicate that these buffer distances are highly precautionary for both divers and auks).

12.9.2.136 Birds are considered to be most at risk from operational disturbance and displacement effects when they are resident in an area (e.g. during the breeding season or wintering season). The small risk of impact to migrating birds is better considered in terms of potential barrier effects. However, JNCC (2017) suggests that migration periods should also be assessed using the matrix approach and this has been undertaken where appropriate.

12.9.2.137 The focus of this section is on the disturbance and displacement of birds due to the presence and operation of wind turbines, other offshore infrastructure (e.g. the offshore substation platforms) and any maintenance operations associated with these structures. Following installation of the inter-array, interconnector and offshore export cables, the required operational and maintenance activities (in relation to the cable) may have short-term and localised disturbance and displacement impacts on birds using the Array Area. However, disturbance from operational cable activities (e.g. maintenance) would be temporary and localised, and is unlikely to result in detectable effects at either the local or regional population level. Therefore, no impact due to cable operation and maintenance is predicted.

12.9.2.138 In order to focus the assessment of disturbance and displacement, a screening exercise was undertaken to identify those species most likely to be at risk (Table 12.28) focussing on the main species described in Volume III Appendix 12.1: Offshore Ornithology Technical Report. The species identified as at risk were then assessed within the biological seasons within which effects were potentially likely to occur. Species with a low sensitivity to displacement or recorded only in very small numbers within the Array Area during the breeding and wintering seasons, were screened out of further assessment (Table 12.28) on the basis of the general sensitivity to disturbance and displacement for each species (ordered according to their sensitivity to disturbance and displacement).

Table 12.28: Operational disturbance and displacement screening

Receptor	Sensitivity to Disturbance and Displacement (Garthe and Hüppop, 2004; Furness and Wade, 2012, Wade *et al.,* 2016, Dierschke *et al.,* 2016)	Biological Season(s) with peak number within the Array Area	Screening Result (IN or OUT)
Common scoter	Very High	Nonbreeding season	**Screened OUT** as present in very low numbers in few months.
Red-throated diver	Very High	Nonbreeding and spring migration	**Screened IN** for potential effects during autumn migration, mid-winter and spring migration as very high sensitivity to disturbance.
Great northern diver	Very High	Nonbreeding season	**Screened OUT** as present in very low numbers in few months.
Cormorant	High	Nonbreeding season	**Screened OUT** as present in very low numbers in few months.
Fulmar	Considered Low in some studies, but possibly high according to Dierschke *et al.,* (2016)	Autumn migration	**Screened OUT** as present in very low numbers and the species has a very high habitat flexibility score (Furness and Wade, 2012), due to species utilising a wide range of habitats over large areas.
Gannet	Considered Low in some studies, but possibly high according to Dierschke *et al.,* (2016)	Autumn migration	**Screened IN** for autumn and spring migration seasons, as has a high macro avoidance rate.

Receptor	Sensitivity to Disturbance and Displacement (Garthe and Hüppop, 2004; Furness and Wade, 2012, Wade *et al.*, 2016, Dierschke *et al.*, 2016)	Biological Season(s) with peak number within the Array Area	Screening Result (IN or OUT)
Guillemot	Medium	Migration periods	**Screened IN** as present in moderate numbers in nonbreeding season and due to medium sensitivity to disturbance and displacement.
Razorbill	Medium	Spring migration season	**Screened IN** as present in moderate numbers during nonbreeding season and due to medium sensitivity to disturbance and displacement.
Shag	Medium	Breeding season	**Screened OUT** as present in very low numbers in few months.
Puffin	Low to medium	Spring migration season	**Screened OUT** as present in low numbers and due to low sensitivity to disturbance and displacement.
Arctic tern	Low to medium	Autumn migration	**Screened OUT** as has low sensitivity to disturbance and displacement and presence indicative of migratory movements.
Common tern	Low to medium	Autumn migration	**Screened OUT** as has low sensitivity to disturbance and displacement and presence indicative of migratory movements.
Sandwich tern	Low to medium	Autumn migration	**Screened OUT** as present in low numbers.
Arctic skua	Low	N/A	**Screened OUT** as has low sensitivity to disturbance and displacement and no birds recorded within Array Area.
Black-headed gull	Low	Nonbreeding	**Screened OUT** as has low sensitivity to disturbance and displacement.
Common gull	Low	Nonbreeding	**Screened OUT** as has low sensitivity to disturbance and displacement.
Little gull	Low	Nonbreeding	**Screened OUT** as has low sensitivity to disturbance and displacement.
Kittiwake	Low	Nonbreeding	**Screened OUT** as not known to avoid wind turbines (low macro avoidance rate) and shows low displacement at operational windfarms.

Receptor	Sensitivity to Disturbance and Displacement (Garthe and Hüppop, 2004; Furness and Wade, 2012, Wade *et al.*, 2016, Dierschke *et al.*, 2016)	Biological Season(s) with peak number within the Array Area	Screening Result (IN or OUT)
Lesser black-backed gull	Low	N/A	**Screened OUT** as present in very low numbers in all seasons and not known to avoid wind turbines (low macro avoidance rate).
Herring gull	Low	Migration periods	**Screened OUT** as present in low numbers in all seasons and not known to avoid wind turbines (low macro avoidance rate).
Great black-backed gull	Low	Nonbreeding season	**Screened OUT** as present in low numbers and not known to avoid wind turbines (low macro avoidance rate).
Manx shearwater	Low	Breeding	**Screened OUT** as has low sensitivity to disturbance and displacement.

RED-THROATED DIVER

12.9.2.139 The assumption for red-throated diver is that displacement will occur at a constant level to a distance of 4 km from the Array Area and that within this area, 100% of birds will be displaced and mortality of displaced birds will be up to 10% in line with guidance (JNCC *et al*., 2017).

12.9.2.140 However, this approach to displacement assessment is considered to be over-precautionary since it combines high values for three aspects of the assessment: the distance over which birds will be affected (4 km), the rate of displacement within this distance (100%) and the mortality rate of displaced individuals (10%). Further consideration of these aspects for red-throated divers are provided below.

12.9.2.141 Monitoring studies of red-throated divers at the Kentish Flats offshore windfarm found an observable shift of birds away from the turbines, particularly within 500 m of the site (Percival, 2010). This is consistent with a study of pre-construction and post-construction abundance and distribution of birds conducted at Horns Rev, Denmark. This study found that red-throated divers avoided areas of sea that were apparently suitable (favoured habitat, suitable depth and abundant food sources) following the construction of an offshore windfarm, and that this effect remained for a period of three years (Petersen *et al*., 2006). Further pre-construction and post-construction abundance and distribution studies published more recently on red-throated divers at the Kentish Flats site (Percival, 2014) have provided displacement values for both the site footprint and within distance bands away from the site boundary and indicate how displacement has changed over the periods following construction.

12.9.2.142 Studies at Kentish Flats and Thanet have provided evidence that red-throated divers are displaced to a decreasing extent with increasing distance from wind turbines (Percival, 2013, 2014). Percival (2014) reported that at Kentish Flats, while displacement within the windfarm boundary was around 80% (compared to pre-construction), this declined to 10% at 1 km from the windfarm and was 0% from 2 km. A similar within windfarm reduction in density was reported at Thanet, but there was no detectable displacement beyond the windfarm boundary (Percival, 2013). Displacement rates of 60% to 80% were reported for OWEZ (Leopold *et al*., 2011) and the review by Dierschke *et al.*, (2016) also suggested a figure in this range. The 4 km exclusion distance is greater than the evidence suggests is required for this species, and it is therefore considered over-precautionary to combine this with a displacement rate as high as 100%.

12.9.2.143 A review of evidence undertaken by a panel of experts brought together by JNCC concluded that mortality associated with displacement of red-throated divers may well be zero (Dierschke *et al.*, 2017) and is certainly very unlikely to be as high as 10%. This conclusion is also supported by modelling of individual energy budgets (Topping and Petersen, 2011).

12.9.2.144 MacArthur Green (2019a) undertook a comprehensive literature review investigating displacement impacts on red-throated divers. On the basis of the evidence, this review advocated a displacement rate of 90% extending 2 km from the windfarm boundary with a consequent maximum mortality rate of 1%.

12.9.2.145 Therefore, this assessment presents displacement across a range from 90% displaced and 1% mortality (evidence based) to 100% displaced and 10% mortality. It should be noted that the evidence-based values still retain precaution, not only in the interpretation of the evidence to derive the rates, but also in the use of a 4 km buffer around the windfarm, despite the evidence that 2 km would be a sufficiently precautionary distance.

12.9.2.146 The displacement matrices in Table 12.29 to Table 12.31 have been populated with data for red-throated diver during the autumn migration, nonbreeding and spring migration periods within the Array Area and 4 km buffer. These tables present displacement from 0 to 100% at 10% increments and mortality from 0 to 100% at 1% increments up to 10% and larger gaps thereafter. Shading has been used to highlight the 90 to 100% displacement and 1 to 10% mortality ranges.

AUTUMN MIGRATION

MAGNITUDE OF IMPACT DURING AUTUMN MIGRATION

12.9.2.147 Using the seasonal peak autumn migration abundance within the Array Area and 4 km buffer of 45 birds, the predicted number of individual red-throated divers which could potentially be at risk of mortality as a consequence of displacement has been estimated to be between zero (90% displaced and 1% mortality) and five (100% displaced and 10% mortality) individuals (Table 12.29).

Table 12.29: Displacement matrix presenting the number of red-throated divers within the Array Area and 4 km buffer during the autumn migration season that may be subject to mortality (shaded)

Mortality (%)	Displacement (%)									
	10	20	30	40	50	60	70	80	90	100
1	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	1	1	1	1	1
3	0	0	0	1	1	1	1	1	1	1
4	0	0	1	1	1	1	1	1	2	2
5	0	0	1	1	1	1	2	2	2	2
6	0	1	1	1	1	2	2	2	2	3
7	0	1	1	1	2	2	2	3	3	3
8	0	1	1	1	2	2	3	3	3	4
9	0	1	1	2	2	2	3	3	4	4
10	0	1	1	2	2	3	3	4	4	5
20	1	2	3	4	5	5	6	7	8	9

Mortality (%)	Displacement (%)									
	10	20	30	40	50	60	70	80	90	100
30	1	3	4	5	7	8	9	11	12	14
50	2	5	7	9	11	14	16	18	20	23
75	3	7	10	14	17	20	24	27	30	34
100	5	9	14	18	23	27	32	36	41	45

12.9.2.148 The autumn migration red-throated diver population was estimated to be 12,717 (Table 12.11). At the average baseline mortality rate for red-throated diver of 0.228 (Table 12.13), the natural mortality for this population is 2,899 (12,717 x 0.228). The addition of a maximum of five individuals to this would increase the mortality rate by up to 0.17% which would be undetectable.

12.9.2.149 The impact of displacement and disturbance from offshore infrastructure on red-throated divers during autumn migration is predicted to occur across the Array Area and 4km buffer and, assuming this species does not habituate to the presence of WTGs, would occur throughout the lifetime of the Proposed Development with a high probability. However, the increase in mortality associated with this impact is considered to have an undetectable effect on the population, therefore the consequence will be very small. Overall therefore, the magnitude is considered to be Low.

SENSITIVITY OF RED-THROATED DIVERS

12.9.2.150 Red-throated divers are considered to have little tolerance for disturbance and displacement as they are notoriously shy and prone to avoiding disturbed areas (Garthe and Hüppop, 2004; Petersen *et al.*, 2006; Furness and Wade, 2012; Percival, 2014; Dierschke *et al.*, 2016; Dierschke *et al.*, 2017). However, although this species is likely to be disturbed and displaced within the Array Area, the degree of effect decreases with distance, with much lower levels of disturbance in areas further than 1 km from the Array Area (Percival, 2013, 2014; Dierschke *et al.*, 2016; Leopold *et al.*, 2011).

12.9.2.151 Red-throated divers are considered to have a medium conservation value as some of those migrating through the Irish Sea during autumn are likely to be connected to the Murrough SPA, the Raven SPA and Northern Cardigan Bay SPA (10 km, 34 km and 99 km from the Array Area respectively) which are all designated for nonbreeding red-throated diver populations.

12.9.2.152 With respect to operational disturbance and displacement during autumn migration, overall red-throated divers are considered to be of Medium sensitivity. This is due to a combination of low adaptability and tolerance to disturbance, medium recoverability following cessation of the effect and medium conservation value since, as noted above, a proportion of the red-throated divers present may be connected to SPA populations.

SIGNIFICANCE OF THE EFFECT DURING AUTUMN MIGRATION

12.9.2.153 Overall, for displacement and disturbance from offshore infrastructure during autumn migration the magnitude has been assessed as **Low** and the sensitivity of red-throated diver is considered to be **Medium**. The effect will, therefore, **Slight adverse**, which is **not significant** in EIA terms.

12.9.2.154 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above.

WINTER SEASON

MAGNITUDE OF IMPACT DURING THE WINTER SEASON

12.9.2.155 Using the winter season peak abundance within the Array Area and 4 km buffer of 165 birds, the predicted number of individual red-throated divers which could potentially be at risk of mortality as a consequence of displacement has been estimated to be between one (90% displaced and 1% mortality) and 17 (100% displaced and 10% mortality) individuals (Table 12.30).

Table 12.30: Displacement matrix presenting the number of red-throated divers within the Array Area and 4 km buffer during the winter period that may be subject to mortality (shaded)

Mortality (%)	Displacement (%)									
	10	20	30	40	50	60	70	80	90	100
1	0	0	0	1	1	1	1	1	1	2
2	0	1	1	1	2	2	2	3	3	3
3	0	1	1	2	2	3	3	4	4	5
4	1	1	2	3	3	4	5	5	6	7
5	1	2	2	3	4	5	6	7	7	8
6	1	2	3	4	5	6	7	8	9	10
7	1	2	3	5	6	7	8	9	10	12
8	1	3	4	5	7	8	9	11	12	13
9	1	3	4	6	7	9	10	12	13	15
10	2	3	5	7	8	10	12	13	15	17
20	3	7	10	13	17	20	23	26	30	33
30	5	10	15	20	25	30	35	40	45	50
50	8	17	25	33	41	50	58	66	74	83
75	12	25	37	50	62	74	87	99	111	124
100	17	33	50	66	83	99	116	132	149	165

12.9.2.156 The winter red-throated diver population was estimated to be 4,148 (Table 12.11). At the average baseline mortality rate for red-throated diver of 0.228 (Table 12.13), the natural mortality for this population is 946 (4,148 x 0.228). At the maximum predicted impact of 10% mortality, an additional 17 individuals would be at risk of mortality, which would raise the background rate by 1.8%. However, at a displacement mortality rate of 4% to 5% (i.e. half of the maximum advised by Natural England), the consequence of displacement would increase the background mortality rate by no more than 1% (i.e. would be undetectable). It is of note that in a review of evidence for red-throated diver displacement effects, a mortality rate for displaced birds of 1% was considered precautionary (MacArthur Green 2019a). Therefore, it is considered that the predicted magnitude of increase in mortality would not materially alter the background mortality of the population and would be undetectable.

12.9.2.157 The impact of displacement and disturbance from offshore infrastructure on red-throated divers during the mid-winter period is predicted to occur across the Array Area and 4km buffer and, assuming this species does not habituate to the presence of WTGs, would occur throughout the lifetime of the Proposed Development with a high probability. However, the increase in mortality associated with this impact is considered to have an undetectable effect on the population, therefore the consequence will be very small. Overall therefore, the magnitude is considered to be Medium.

SENSITIVITY OF RED-THROATED DIVERS

12.9.2.158 Red-throated divers are considered to have little tolerance for disturbance and displacement as they are notoriously shy and prone to avoiding disturbed areas (section 12.9.2.150).

12.9.2.159 Red-throated divers are considered to have a medium conservation value as some of those present during the winter period may be connected to the Murrough SPA, the Raven SPA and Northern Cardigan Bay SPA (10 km, 34 km and 99 km from the Array Area respectively) which are all designated for nonbreeding red-throated diver populations.

12.9.2.160 With respect to operational disturbance and displacement during mid-winter, overall red-throated divers are considered to be of Medium sensitivity. This is due to a combination of low adaptability and tolerance to disturbance, medium recoverability following cessation of the effect and medium conservation value since, as noted above, a proportion of the red-throated divers present may be connected to SPA populations.

SIGNIFICANCE OF THE EFFECT THE WINTER SEASON

12.9.2.161 Overall, for displacement and disturbance from offshore infrastructure during the mid-winter period the magnitude has been assessed as **Medium** and the sensitivity of red-throated diver is considered to be **Medium**. The effect will, therefore, **Moderate**, which is considered **not significant** in EIA terms.

12.9.2.162 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above.

SPRING SEASON

MAGNITUDE OF IMPACT DURING SPRING MIGRATION

12.9.2.163 Using the seasonal peak spring migration abundance within the Array Area and 4 km buffer of 130 birds, the predicted number of individual red-throated divers which could potentially be at risk of mortality as a consequence of displacement has been estimated to be between one (90% displaced and 1% mortality) and 13 (100% displaced and 10% mortality) individuals (Table 12.31).

12.9.2.164 The spring red-throated diver population was estimated to be 12,717 (Table 12.11). At the average baseline mortality rate for red-throated diver of 0.228 (Table 12.13) the natural mortality for this population is 2,899 (12,717 x 0.228). The addition of a maximum of 13 individuals to this would increase the mortality rate by 0.45% which would be undetectable.

Table 12.31: Displacement matrix presenting the number of red-throated divers within the Array Area and 4 km buffer during spring migration that may be subject to mortality (shaded)

Mortality (%)	Displacement (%)									
	10	20	30	40	50	60	70	80	90	100
1	0	0	0	1	1	1	1	1	1	1
2	0	1	1	1	1	2	2	2	2	3
3	0	1	1	2	2	2	3	3	4	4
4	1	1	2	2	3	3	4	4	5	5
5	1	1	2	3	3	4	5	5	6	7
6	1	2	2	3	4	5	5	6	7	8
7	1	2	3	4	5	5	6	7	8	9
8	1	2	3	4	5	6	7	8	9	10

Mortality (%)	Displacement (%)									
	10	20	30	40	50	60	70	80	90	100
9	1	2	4	5	6	7	8	9	11	12
10	1	3	4	5	7	8	9	10	12	13
20	3	5	8	10	13	16	18	21	23	26
30	4	8	12	16	20	23	27	31	35	39
50	7	13	20	26	33	39	46	52	59	65
75	10	20	29	39	49	59	68	78	88	98
100	13	26	39	52	65	78	91	104	117	130

12.9.2.165 The impact of displacement and disturbance from offshore infrastructure on red-throated divers during spring migration is predicted to occur across the Array Area and 4 km buffer and, assuming this species does not habituate to the presence of WTGs, would occur throughout the lifetime of the Proposed Development with a high probability. However, the increase in mortality associated with this impact is considered to have an undetectable effect on the population, therefore the consequence will be very small. Overall therefore, the magnitude is considered to be Low.

SENSITIVITY OF RED-THROATED DIVERS

12.9.2.166 Red-throated divers are considered to have little tolerance for disturbance and displacement as they are notoriously shy and prone to avoiding disturbed areas (section 12.9.2.150).

12.9.2.167 Red-throated divers are considered to have a medium conservation value as some of those migrating through the Irish Sea during spring are likely to be connected to the Murrough SPA, the Raven SPA and Northern Cardigan Bay SPA (10 km, 34 km and 99 km from the Array Area respectively) which are all designated for nonbreeding red-throated diver populations.

12.9.2.168 With respect to operational disturbance and displacement during spring migration, overall red-throated divers are considered to be of Medium sensitivity. This is due to a combination of low adaptability and tolerance to disturbance, medium recoverability following cessation of the effect and medium conservation value since, as noted above, a proportion of the red-throated divers present may be connected to SPA populations.

SIGNIFICANCE OF THE EFFECT DURING SPRING MIGRATION

12.9.2.169 Overall, for displacement and disturbance from offshore infrastructure during spring migration the magnitude has been assessed as **Low** and the sensitivity of receptor is considered to be **Medium**. The effect will, therefore, **Slight adverse**, which is **not significant** in EIA terms.

12.9.2.170 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above.

ALL SEASONS

MAGNITUDE OF IMPACT DURING ALL SEASONS

12.9.2.171 The estimated total number of red-throated divers subject to mortality combined across the mid-winter season, autumn migration and spring migration periods due to operational disturbance from the Array Area and 4 km buffer is between 3 and 34 individuals, although this total is likely to include an unknown degree of double counting of individuals present in more than one of these periods (Table 12.32).

12.9.2.172 At the average baseline mortality rate for red-throated divers of 0.228 (Table 12.13), the number of individuals from the larger BDMPS population expected to be at risk of mortality across all seasons is 2,899 (12,717 x 0.228). The addition of a maximum of 34 to this would increase the mortality rate by 1.17%, while the evidence-based estimate (3) would result in an increase in mortality of 0.1%. The biogeographic population for red-throated divers is 27,000 (Furness, 2015). The number of individuals from the biogeographic population expected to be at risk of mortality across all seasons is 6,156 (27,000 x 0.228). The addition of 34 to this increases the mortality rate by 0.6%, while the evidence-based estimate (3) would result in an increase in mortality of 0.05%. Furthermore, if displacement mortality is no more than 6% this would result in an undetectable increase even at the upper displacement of 34. Therefore, given that the 1% threshold is only exceeded through a combination of highly precautionary assumptions about displacement, it is considered that operational displacement of red-throated diver summed across the entire nonbreeding period would have an undetectable effect on the population.

Table 12.32: Displacement matrix presenting the number of red-throated divers within the Array Area and 4 km buffer during all seasons that may be subject to mortality (shaded)

Mortality (%)	Displacement (%)									
	10	20	30	40	50	60	70	80	90	100
1	0	1	1	1	2	2	2	3	3	3
2	1	1	2	3	3	4	5	5	6	7
3	1	2	3	4	5	6	7	8	9	10
4	1	3	4	5	7	8	10	11	12	14
5	2	3	5	7	9	10	12	14	15	17
6	2	4	6	8	10	12	14	16	18	20
7	2	5	7	10	12	14	17	19	21	24
8	3	5	8	11	14	16	19	22	24	27
9	3	6	9	12	15	18	21	24	28	31
10	3	7	10	14	17	20	24	27	31	34
20	7	14	20	27	34	41	48	54	61	68
30	10	20	31	41	51	61	71	82	92	102
50	17	34	51	68	85	102	119	136	153	170
75	26	51	77	102	128	153	179	204	230	255
100	34	68	102	136	170	204	238	272	306	340

12.9.2.173 The impact of operational disturbance and associated vessel traffic on red-throated divers across all seasons is predicted to occur across the Array Area and 4km buffer and, assuming this species does not habituate to the presence of WTGs, would occur throughout the lifetime of the Proposed Development with a high probability. However, the increase in mortality associated with this impact is considered to have an undetectable effect on the population, therefore the consequence will be very small. Overall therefore, the magnitude is considered to be Negligible to Low.

SENSITIVITY OF RED-THROATED DIVERS

12.9.2.174 Red-throated divers are considered to have little tolerance for disturbance and displacement as they are notoriously shy and prone to avoiding disturbed areas (section 12.9.2.150).

12.9.2.175 Red-throated divers are considered to have a medium conservation value as some of those migrating through the Irish Sea during spring and autumn and present in mid-winter may be connected to the Murrough SPA, the Raven SPA and Northern Cardigan Bay SPA (10 km, 34 km and 99 km from the Array Area respectively) which are all designated for nonbreeding red-throated diver populations.

12.9.2.176 With respect to operational disturbance and displacement including all seasons, overall red-throated divers are considered to be of Medium sensitivity. This is due to a combination of low adaptability and tolerance to disturbance, medium recoverability following cessation of the effect and medium conservation value since, as noted above, a proportion of the red-throated divers present may be connected to SPA populations.

SIGNIFICANCE OF THE EFFECT DURING ALL SEASONS

12.9.2.177 Overall, for operational disturbance and displacement across all seasons the magnitude has been assessed as **Negligible** to **Low** and the sensitivity of red-throated divers is considered to be **Medium**. The effect will, therefore, be **Not Significant** to **Slight**, which is **not significant** in EIA terms.

12.9.2.178 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above.

GANNET

12.9.2.179 The assumption for gannet is that displacement will occur at a constant level to a distance of 2 km in line with guidance (JNCC *et al.* 2017), and that within this area, 80% of birds will be displaced and mortality of displaced birds will be 1%.

12.9.2.180 Empirical evidence shows that between 60% to 80% of gannets may be displaced from operational windfarms; a detailed study (Krijgsveld *et al.*, 2011) using radar and visual observations to monitor the post-construction effects of the OWEZ established that 64% of gannets avoided entering the windfarm (macro-avoidance). A similar result (80% macro avoidance) was also observed during a study at the Thanet windfarm (Skov *et al.*, 2018). Leopold *et al.*, (2013) reported that most gannets avoided Dutch offshore windfarms and did not forage within these. Dierschke *et al.*, (2016) concluded that gannets show high avoidance of offshore windfarms despite showing little avoidance of ships.

12.9.2.181 The most likely mortality rate for displaced gannets during nonbreeding seasons is assumed to be no more than 1% as they have the maximum score for habitat flexibility which means that they are able to use a wide range of habitats over a large area, and usually with a relatively wide range of foods (Furness and Wade, 2012).

12.9.2.182 It should be noted that the inclusion of birds within the 2 km buffer to determine the total number of birds subject to displacement is precautionary, since in reality the avoidance rate is likely to fall with distance from the Array Area, as demonstrated in a study of gannet distribution in relation to the Greater Gabbard windfarm (APEM, 2014).

12.9.2.183 The displacement matrices in Table 12.33 to Table 12.35 have been populated with data for gannets during the autumn migration, spring migration and breeding season within the Array Area and 2 km buffer. These tables present displacement rates between 10 and 100% at 10% increments, which have been combined with mortality between 1 and 100% at varying increments. Shading has been used to highlight the 60 to 80% displacement and 1% mortality ranges.

BREEDING SEASON

MAGNITUDE OF IMPACT DURING THE BREEDING SEASON

12.9.2.184 Using the seasonal peak breeding season abundance within the Array Area and 2 km buffer of 90 birds, the predicted number of individual gannets which could potentially be at risk of mortality as a consequence of displacement has been estimated to be one individual (Table 12.33).

Table 12.33: Displacement matrix presenting the number of gannets within the Array Area and 2 km buffer during the breeding season that may be subject to mortality (shaded)

Mortality (%)	Displacement (%)									
	10	20	30	40	50	60	70	80	90	100
1	0	0	0	0	0	1	1	1	1	1
2	0	0	1	1	1	1	1	1	2	2
3	0	1	1	1	1	2	2	2	2	3
4	0	1	1	1	2	2	3	3	3	4
5	0	1	1	2	2	3	3	4	4	5
6	1	1	2	2	3	3	4	4	5	5
7	1	1	2	3	3	4	4	5	6	6
8	1	1	2	3	4	4	5	6	6	7
9	1	2	2	3	4	5	6	6	7	8
10	1	2	3	4	5	5	6	7	8	9
20	2	4	5	7	9	11	13	14	16	18
30	3	5	8	11	14	16	19	22	24	27
50	5	9	14	18	23	27	32	36	41	45
75	7	14	20	27	34	41	47	54	61	68
100	9	18	27	36	45	54	63	72	81	90

12.9.2.185 The breeding gannet population was estimated to be between 420,257 and 517,233 (Table 12.11). At the average baseline mortality rate for gannets of 0.191 (Table 12.13), the natural mortality for this population is between 80,269 (420,257 x 0.191) and 98,792 (517,233 x 0.191). The addition of a maximum of one individual to this would increase the mortality rate by 0.001% which would be undetectable.

12.9.2.186 The impact of displacement and disturbance from offshore infrastructure on gannets during the breeding season is predicted to occur across the Array Area and 4km buffer and, assuming this species does not habituate to the presence of WTGs, would occur throughout the lifetime of the Proposed Development with a high probability. However, the increase in mortality associated with this impact is considered to have an undetectable effect on the population, therefore the consequence will be very small. Overall therefore, the magnitude is considered to be Negligible.

SENSITIVITY OF GANNETS

12.9.2.187 Although gannets are considered to show high macro-avoidance of windfarms (Krijgsveld *et al*., 2011; Leopold *et al*., 2013; Dierschke *et al*., 2016; Skov *et al*., 2018), which would suggest a high sensitivity score, this has been accounted for in the assessment in the application of a precautionary level of displacement (60 to 80%).

12.9.2.188 Gannets are considered to have a high conservation value as many of those present in the Irish Sea are likely to be connected to Irish SPA sites which contain gannet breeding colonies (Little Skellig, Bull Rock, Great Saltee, Ireland's Eye, Lambay Island) as well as UK SPA sites at Grassholm and Ailsa Craig.

12.9.2.189 With respect to operational disturbance and displacement during breeding season, overall gannets are considered to be of Medium sensitivity. This is due to a combination of a low tolerance of offshore windfarms but high adaptability due to their large foraging ranges and varied prey, medium recoverability following cessation of the effect and high conservation value since, as noted above, a proportion of the gannets present may be connected to SPA populations.

Significance of the effect during breeding season

12.9.2.190 Overall, for displacement and disturbance from offshore infrastructure during the breeding season the magnitude has been assessed as **Negligible** and the sensitivity of gannets is considered to be **Medium**. The effect will, therefore, be **Not Significant** in EIA terms.

12.9.2.191 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above.

AUTUMN MIGRATION

MAGNITUDE OF IMPACT DURING AUTUMN MIGRATION

12.9.2.192 Using the seasonal peak autumn migration abundance within the Array Area and 2 km buffer of 40 birds, the predicted number of individual gannets which could potentially be at risk of mortality as a consequence of displacement has been estimated to be 0 individuals (Table 12.34).

Table 12.34: Displacement matrix presenting the number of gannets within the Array Area and 2 km buffer during the autumn migration season that may be subject to mortality (shaded)

Mortality (%)	Displacement (%)									
	10	20	30	40	50	60	70	80	90	100
1	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	1	1	1	1
3	0	0	0	0	1	1	1	1	1	1
4	0	0	0	1	1	1	1	1	1	2
5	0	0	1	1	1	1	1	2	2	2
6	0	0	1	1	1	1	2	2	2	2
7	0	1	1	1	1	2	2	2	3	3
8	0	1	1	1	2	2	2	3	3	3
9	0	1	1	1	2	2	3	3	3	4
10	0	1	1	2	2	2	3	3	4	4
20	1	2	2	3	4	5	6	6	7	8
30	1	2	4	5	6	7	8	10	11	12
50	2	4	6	8	10	12	14	16	18	20
75	3	6	9	12	15	18	21	24	27	30
100	4	8	12	16	20	24	28	32	36	40

12.9.2.193 As no individuals are expected to be at risk of mortality as a result of displacement during autumn migration, there would be no change to the background mortality of the population.

12.9.2.194 The impact of displacement and disturbance from offshore infrastructure on gannets during autumn migration is predicted to occur across the Array Area and 4 km buffer and, assuming this species does not habituate to the presence of WTGs, would occur throughout the lifetime of the Proposed Development with a high probability. However, the increase in mortality associated with this impact is considered to have an undetectable effect on the population, therefore the consequence will be very small. Overall therefore, the magnitude is considered to be Negligible.

SENSITIVITY OF GANNETS

12.9.2.195 Although gannets are considered to show high macro-avoidance of windfarms (Krijgsveld *et al.*, 2011; Leopold *et al.*, 2013; Dierschke *et al.*, 2016; Skov *et al.*, 2018), which would suggest a high sensitivity score, this has been accounted for in the assessment in the application of a precautionary level of displacement (60 to 80%).

12.9.2.196 Gannets are considered to have a high conservation value as many of those migrating through the Irish Sea are likely to be connected to Irish SPA sites which contain gannet breeding colonies (Little Skellig, Bull Rock, Great Saltee, Ireland's Eye, Lambay Island) as well as UK SPA sites at Grassholm and Ailsa Craig.

12.9.2.197 With respect to operational disturbance and displacement during autumn migration, overall gannets are considered to be of Medium sensitivity. This is due to a combination of a low tolerance of offshore windfarms but high adaptability due to their large foraging ranges and varied prey, medium recoverability following cessation of the effect and high conservation value since, as noted above, a proportion of the gannets present may be connected to SPA populations.

SIGNIFICANCE OF THE EFFECT DURING AUTUMN MIGRATION

12.9.2.198 Overall, for displacement and disturbance from offshore infrastructure during autumn migration the magnitude has been assessed as **Negligible** and the sensitivity of gannets is considered to be **Medium**. The effect will, therefore, be **Not Significant** in EIA terms.

12.9.2.199 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above.

SPRING MIGRATION

MAGNITUDE OF IMPACT DURING SPRING MIGRATION

12.9.2.200 Using the seasonal peak spring migration abundance within the Array Area and 2 km buffer of 30 birds, the predicted number of individual gannets which could potentially be at risk of mortality as a consequence of displacement has been estimated to be 0 individuals (Table 12.35).

Table 12.35: Displacement matrix presenting the number of gannets within the Array Area and 2 km buffer during the spring migration season that may be subject to mortality (shaded)

Mortality (%)	Displacement (%)									
	10	20	30	40	50	60	70	80	90	100
1	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	1	1
3	0	0	0	0	0	1	1	1	1	1
4	0	0	0	0	1	1	1	1	1	1
5	0	0	0	1	1	1	1	1	1	2
6	0	0	1	1	1	1	1	1	2	2
7	0	0	1	1	1	1	1	2	2	2

Mortality (%)	Displacement (%)									
	10	20	30	40	50	60	70	80	90	100
8	0	0	1	1	1	1	2	2	2	2
9	0	1	1	1	1	2	2	2	2	3
10	0	1	1	1	2	2	2	2	3	3
20	1	1	2	2	3	4	4	5	5	6
30	1	2	3	4	5	5	6	7	8	9
50	2	3	5	6	8	9	11	12	14	15
75	2	5	7	9	11	14	16	18	20	23
100	3	6	9	12	15	18	21	24	27	30

12.9.2.201 As no individuals are expected to be at risk of mortality as a result of displacement during spring migration, there would be no change to the background mortality of the population.

12.9.2.202 The impact of displacement and disturbance from offshore infrastructure on gannets during spring migration is predicted to occur across the Array Area and 4 km buffer and, assuming this species does not habituate to the presence of WTGs, would occur throughout the lifetime of the Proposed Development with a high probability. However, the increase in mortality associated with this impact is considered to have an undetectable effect on the population, therefore the consequence will be very small. Overall therefore, the magnitude is considered to be Negligible.

SENSITIVITY OF GANNETS

12.9.2.203 Although gannets are considered to show high macro-avoidance of windfarms (Krijgsveld *et al*., 2011; Leopold *et al*., 2013; Dierschke *et al*., 2016; Skov *et al*., 2018), which would suggest a high sensitivity score, this has been accounted for in the assessment in the application of a precautionary level of displacement (60 to 80%).

12.9.2.204 Gannets are considered to have a high conservation value as many of those migrating through the Irish Sea are likely to be connected to Irish SPA sites which contain gannet breeding colonies (Little Skellig, Bull Rock, Great Saltee, Ireland's Eye, Lambay Island) as well as UK SPA sites at Grassholm and Ailsa Craig.

12.9.2.205 With respect to operational disturbance and displacement during spring migration, overall gannets are considered to be of Medium sensitivity. This is due to a combination of a low tolerance of offshore windfarms but high adaptability due to their large foraging ranges and varied prey, medium recoverability following cessation of the effect and high conservation value since, as noted above, a proportion of the gannets present may be connected to SPA populations.

SIGNIFICANCE OF THE EFFECT DURING SPRING MIGRATION

12.9.2.206 Overall, for displacement and disturbance from offshore infrastructure during spring migration the magnitude has been assessed as **Negligible** and the sensitivity of gannets is considered to be **Medium**. The effect will, therefore, be **Not Significant** in EIA terms.

12.9.2.207 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above.

ALL SEASONS

MAGNITUDE OF IMPACT DURING ALL SEASONS

12.9.2.208 Within the range of 60 to 80% displacement and 1% mortality, the maximum number of individual gannets which could potentially be at risk of mortality as a consequence of displacement from the Array Area and 2 km buffer during the breeding, autumn migration and spring migration periods combined has been estimated as one individual (Table 12.36).

Table 12.36: Displacement matrix presenting the number of gannets within the Array Area and 2 km buffer during all seasons that may be subject to mortality (shaded)

Mortality (%)	Displacement (%)									
	10	20	30	40	50	60	70	80	90	100
1	0	0	0	1	1	1	1	1	1	2
2	0	1	1	1	2	2	2	3	3	3
3	0	1	1	2	2	3	3	4	4	5
4	1	1	2	3	3	4	4	5	6	6
5	1	2	2	3	4	5	6	6	7	8
6	1	2	3	4	5	6	7	8	9	10
7	1	2	3	4	6	7	8	9	10	11
8	1	3	4	5	6	8	9	10	12	13
9	1	3	4	6	7	9	10	12	13	14
10	2	3	5	6	8	10	11	13	14	16
20	3	6	10	13	16	19	22	26	29	32
30	5	10	14	19	24	29	34	38	43	48
50	8	16	24	32	40	48	56	64	72	80
75	12	24	36	48	60	72	84	96	108	120
100	16	32	48	64	80	96	112	128	144	160

12.9.2.209 At the average baseline mortality rate for gannets of 0.191 (Table 12.13), the number of individuals from the larger BDMPS population expected to be at risk of mortality across all seasons is 123,146 (644,745 x 0.191). The addition of a maximum of one to this would increase the mortality rate by <0.001%. The biogeographic population for gannets is 1,180,000 (Furness, 2015). The number of individuals from the biogeographic population expected to be at risk of mortality across all seasons is 225,380 (1,180,000 x 0.191). The addition of one to this increases the mortality rate <0.001%.

12.9.2.210 The impact of displacement and disturbance from offshore infrastructure on gannets during all seasons combined is predicted to occur across the Array Area and 4 km buffer and, assuming this species does not habituate to the presence of WTGs, would occur throughout the lifetime of the Proposed Development with a high probability. However, the increase in mortality associated with this impact is considered to have an undetectable effect on the population, therefore the consequence will be very small. Overall therefore, the magnitude is considered to be Negligible.

SENSITIVITY OF GANNETS

12.9.2.211 Although gannets are considered to show high macro-avoidance of windfarms (Krijgsveld *et al*., 2011; Leopold *et al*., 2013; Dierschke *et al*., 2016; Skov *et al*., 2018), which would suggest a high sensitivity score, this has been accounted for in the assessment in the application of a precautionary level of displacement (60 to 80%).

12.9.2.212 Gannets are considered to have a high conservation value as many of those in the Irish Sea are likely to be connected to Irish SPA sites which contain gannet breeding colonies (Little Skellig, Bull Rock, Great Saltee, Ireland's Eye, Lambay Island) as well as UK SPA sites at Grassholm and Ailsa Craig.

12.9.2.213 With respect to operational disturbance and displacement throughout the year, overall gannets are considered to be of Medium sensitivity. This is due to a combination of a low tolerance of offshore windfarms but high adaptability due to their large foraging ranges and varied prey, medium recoverability following cessation of the effect and high conservation value since, as noted above, a proportion of the gannets present may be connected to SPA populations.

SIGNIFICANCE OF THE EFFECT DURING ALL SEASONS

12.9.2.214 Overall, for displacement and disturbance from offshore infrastructure during all seasons combined the magnitude has been assessed as **Negligible** and the sensitivity of gannets is considered to be **Medium**. The effect will, therefore, be **Not Significant** in EIA terms.

12.9.2.215 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above.

GUILLEMOTS AND RAZORBILLS

12.9.2.216 The assumption for guillemots and razorbills is that displacement will occur at a constant level to a distance of 2 km in line with guidance (JNCC *et al.* 2017) and that within this area, 30% to 70% of birds will be displaced and mortality of displaced birds will be between 1% and 10%.

12.9.2.217 Empirical evidence indicates that auk (guillemots and razorbills) displacement from windfarms is likely to be lower than 70%, although pre- and post-construction monitoring data have yielded variable results. Auks may be displaced to some extent by some windfarms, although displacement is partial and apparently negligible in some sites (Dierschke *et al.*, 2016). Several studies have reported displacement: guillemots were displaced at Blighbank (Vanermen *et al.*, 2012), were displaced only in a minority of surveys at two Dutch windfarms (OWEZ and Princess Amalia Windpark (PAWP); Leopold *et al.*, 2011; Krijgsveld *et al.*, 2011), and were not significantly displaced at Horns Rev (although the data suggest that slight displacement was probably occurring; Petersen *et al.*, 2006) or Thornton Bank (Vanermen *et al.*, 2012). However, while at least some of these studies have recorded changes in abundance and reported these as displacement, these results should be treated with caution due to limits on their power to distinguish natural inter-annual variation from windfarm effects, as noted in recent re-evaluation of some of these studies (Zuur 2018).

12.9.2.218 The 10% mortality rate for auks is unconfirmed and this magnitude of impact is not supported in the literature. Given that this is equivalent to the existing natural adult annual mortality for razorbill from all other sources of mortality (baseline mortality is 10.5%; Table 12.13) and nearly double the rate for guillemot (baseline mortality is 6% Table 12.13), it is highly improbable that such an effect would occur. Mortality due to displacement might arise if displacement increased competition for resources in the remaining areas of auk habitat outside the windfarm. However, it should be recognised that the mortality rate due to displacement may well be 0% since the increase in density of auks outside the windfarm area will be negligible (because the rest of the available habitat is vast), and is very unlikely to be as high as 10%.

12.9.2.219 MacArthur Green (2019b) undertook a review of available evidence for auk displacement and concluded that precautionary rates of displacement and mortality from operational windfarms would be 50% and 1% respectively. Thus, this assessment presents displacement in the range from 30% displaced and 1% mortality to 70% displaced and 10% mortality, with a focus on the evidence-based rates of 50% displaced and 1% mortality.

12.9.2.220 The displacement matrices below have been populated with data for guillemots (Table 12.37 to Table 12.39) and razorbills (Table 12.40 to Table 12.44) during appropriate breeding and nonbreeding periods within the Array Area and 2 km buffer. These tables present displacement rates between 10% and 100% at 10% increments which have been combined with mortality between 1 and 100% at varying increments. Shading has been used to highlight the 30 to 70% displacement and 1 to 10% mortality ranges.

GUILLEMOT

BREEDING SEASON

MAGNITUDE OF IMPACT DURING THE BREEDING SEASON

12.9.2.221 Using the seasonal peak breeding season abundance within the Array Area and 2 km buffer of 3,033 birds, the predicted number of individual guillemots which could potentially be at risk of mortality as a consequence of displacement has been estimated to be between nine and 212 individuals, with the evidence based estimate (50% displaced. 1% mortality) of 15 (Table 12.37).

Table 12.37: Displacement matrix presenting the number of guillemots within the Array Area and 2 km buffer during the breeding season that may be subject to mortality (shaded)

Mortality (%)	Displacement (%)									
	10	20	30	40	50	60	70	80	90	100
1	3	6	9	12	15	18	21	24	27	30
2	6	12	18	24	30	36	42	49	55	61
3	9	18	27	36	45	55	64	73	82	91
4	12	24	36	49	61	73	85	97	109	121
5	15	30	45	61	76	91	106	121	136	152
6	18	36	55	73	91	109	127	146	164	182
7	21	42	64	85	106	127	149	170	191	212
8	24	49	73	97	121	146	170	194	218	243
9	27	55	82	109	136	164	191	218	246	273
10	30	61	91	121	152	182	212	243	273	303
20	61	121	182	243	303	364	425	485	546	607
30	91	182	273	364	455	546	637	728	819	910
50	152	303	455	607	758	910	1062	1213	1365	1517
75	227	455	682	910	1137	1365	1592	1820	2047	2275
100	303	607	910	1213	1517	1820	2123	2426	2730	3033

12.9.2.222 The BDMPS for guillemots during the breeding season was estimated at between 319,052 and 915,761 individuals (Table 12.11). At the average baseline mortality rate for guillemot of 0.140 (Table 12.13) the number of individuals expected to be at risk of mortality in the breeding season is between 44,667 and 128,206. The addition of 15 individuals to this would increase the mortality rate by 0.01% to 0.03%. As the background mortality rate would not be increased by more than 1% (the threshold below which additional mortality is considered to have an undetectable effect), this magnitude of increase in mortality would not materially alter the background mortality of the population and would be undetectable.

12.9.2.223 The impact of displacement and disturbance from offshore infrastructure on guillemots during the breeding season is predicted to occur across the Array Area and 2 km buffer and, assuming this species does not habituate to the presence of WTGs, would occur throughout the lifetime of the Proposed Development with a high probability. However, the increase in mortality associated with this impact is considered to have an undetectable effect on the population, therefore the consequence will be very small. Overall therefore, the magnitude is considered to be Negligible.

SENSITIVITY OF GUILLEMOTS

12.9.2.224 Guillemots are considered to have a medium vulnerability to disturbance and displacement, based on their sensitivity to ship and helicopter traffic in Garthe and Hüppop (2004), Langston (2010), an interpretation of the Furness and Wade (2012) species concern index value in the context of disturbance and/or displacement from a habitat, and the meta-analysis of avoidance and attraction responses of seabirds to offshore windfarms by Dierschke *et al.*, (2016).

12.9.2.225 Guillemots are considered to have a high conservation value as many of those present in the Array Area and 2 km buffer during the breeding season are likely to be connected to the Ireland's Eye SPA and Lambay Island SPA (54 km and 62 km from the Array Area respectively) which are designated sites for breeding guillemot populations and are within mean maximum foraging range of the Proposed Development for this species.

12.9.2.226 With respect to operational disturbance and displacement during the breeding season, overall guillemots are considered to be of High sensitivity. This is due to a combination of low adaptability and tolerance to disturbance, high recoverability following cessation of the effect and high conservation value since, as noted above, a proportion of the guillemots present may be connected to SPA populations.

SIGNIFICANCE OF THE EFFECT DURING BREEDING SEASON

12.9.2.227 Overall, displacement and disturbance from offshore infrastructure during the breeding season the magnitude has been assessed as **Negligible** and the sensitivity of guillemots is considered to be **High**. The effect will, therefore, be **Not Significant** in EIA terms.

12.9.2.228 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above.

NONBREEDING SEASON

MAGNITUDE OF IMPACT DURING THE NONBREEDING SEASON

12.9.2.229 Using the seasonal peak nonbreeding season abundance within the Array Area and 2 km buffer of 5,079 birds, the predicted number of individual guillemots which could potentially be at risk of mortality as a consequence of displacement has been estimated to be between 15 and 356 individuals, with the evidence based estimate (50% displaced. 1% mortality) of 25 (Table 12.38).

Table 12.38: Displacement matrix presenting the number of guillemots within the Array Area and 2 km buffer during the nonbreeding season that may be subject to mortality (shaded)

Mortality (%)	Displacement (%)									
	10	20	30	40	50	60	70	80	90	100
1	5	10	15	20	25	30	36	41	46	51
2	10	20	30	41	51	61	71	81	91	102

Mortality (%)	Displacement (%)									
	10	20	30	40	50	60	70	80	90	100
3	15	30	46	61	76	91	107	122	137	152
4	20	41	61	81	102	122	142	163	183	203
5	25	51	76	102	127	152	178	203	229	254
6	30	61	91	122	152	183	213	244	274	305
7	36	71	107	142	178	213	249	284	320	356
8	41	81	122	163	203	244	284	325	366	406
9	46	91	137	183	229	274	320	366	411	457
10	51	102	152	203	254	305	356	406	457	508
20	102	203	305	406	508	609	711	813	914	1016
30	152	305	457	609	762	914	1067	1219	1371	1524
50	254	508	762	1016	1270	1524	1778	2032	2286	2540
75	381	762	1143	1524	1905	2286	2666	3047	3428	3809
100	508	1016	1524	2032	2540	3047	3555	4063	4571	5079

12.9.2.230 The BDMPS for guillemots during the nonbreeding season was estimated at 1,567,463 individuals (Table 12.11). At the average baseline mortality rate for guillemot of 0.140 (Table 12.13), the number of individuals expected to be at risk of mortality in the nonbreeding season is 219,445 (1,567,463 x 0.14). The addition of 25 individuals to this would increase the mortality rate by 0.01%. As the background mortality rate would not be increased by more than 1% (the threshold below which additional mortality is considered to have an undetectable effect), this magnitude of increase in mortality would not materially alter the background mortality of the population and would be undetectable.

12.9.2.231 The impact of displacement and disturbance from offshore infrastructure on guillemots during the nonbreeding season is predicted to occur across the Array Area and 2 km buffer and, assuming this species does not habituate to the presence of WTGs, would occur throughout the lifetime of the Proposed Development with a high probability. However, the increase in mortality associated with this impact is considered to have an undetectable effect on the population, therefore the consequence will be very small. Overall therefore, the magnitude is considered to be Negligible.

SENSITIVITY OF GUILLEMOTS

12.9.2.232 Guillemots are considered to have a medium vulnerability to disturbance and displacement, based on their sensitivity to ship and helicopter traffic in Garthe and Hüppop (2004), Langston (2010), an interpretation of the Furness and Wade (2012) species concern index value in the context of disturbance and/or displacement from a habitat, and the meta-analysis of avoidance and attraction responses of seabirds to offshore windfarms by Dierschke *et al.*, (2016).

12.9.2.233 With respect to operational disturbance and displacement during the nonbreeding season, overall guillemots are considered to be of Medium sensitivity. This is due to a combination of low adaptability and tolerance to disturbance, high recoverability following cessation of the effect and medium conservation value.

SIGNIFICANCE OF THE EFFECT DURING NONBREEDING SEASON

12.9.2.234 Overall, for displacement and disturbance from offshore infrastructure during nonbreeding season the magnitude has been assessed as **Negligible** and the sensitivity of guillemots is considered to be **Medium.** The effect will, therefore, be **Not Significant** in EIA terms.

12.9.2.235 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above.

ALL SEASONS

MAGNITUDE OF IMPACT DURING ALL SEASONS

12.9.2.236 The estimated number of guillemots subject to mortality combined across both the breeding and nonbreeding seasons due to displacement from the Array Area and 2 km buffer is between 24 and 568 individuals, with the evidence based estimate (50% displaced, 1% mortality) of 41 (Table 12.39).

Table 12.39: Displacement matrix presenting the number of guillemots within the Array Area and 2 km buffer combined across the breeding and nonbreeding seasons that may be subject to mortality (shaded)

Mortality (%)	Displacement (%)									
	10	20	30	40	50	60	70	80	90	100
1	8	16	24	32	41	49	57	65	73	81
2	16	32	49	65	81	97	114	130	146	162
3	24	49	73	97	122	146	170	195	219	243
4	32	65	97	130	162	195	227	260	292	324
5	41	81	122	162	203	243	284	324	365	406
6	49	97	146	195	243	292	341	389	438	487
7	57	114	170	227	284	341	397	454	511	568
8	65	130	195	260	324	389	454	519	584	649
9	73	146	219	292	365	438	511	584	657	730
10	81	162	243	324	406	487	568	649	730	811
20	162	324	487	649	811	973	1136	1298	1460	1622
30	243	487	730	973	1217	1460	1704	1947	2190	2434
50	406	811	1217	1622	2028	2434	2839	3245	3650	4056
75	608	1217	1825	2434	3042	3650	4259	4867	5476	6084
100	811	1622	2434	3245	4056	4867	5678	6490	7301	8112

12.9.2.237 At the average baseline mortality rate for guillemot of 0.140 (Table 12.13), the number of individuals from the largest BDMPS population expected to be at risk of mortality across all seasons is 219,445 (1,567,463 x 0.14). The addition of 41 to this increases the mortality rate by 0.02%. The biogeographic population for guillemots is 4,125,000 (Furness, 2015). The number of individuals from the biogeographic population expected to be at risk of mortality across all seasons is 577,500 (4,125,000 x 0.140). The addition of 41 to this increases the mortality rate by less than 0.01%. Thus, the increase in background mortality is between less than 0.01% and 0.02%. This magnitude of increase in mortality would not materially alter the background mortality of the population and would be undetectable.

12.9.2.238 The impact of displacement and disturbance from offshore infrastructure on guillemots across all seasons is predicted to occur across the Array Area and 2 km buffer and, assuming this species does not habituate to the presence of WTGs, would occur throughout the lifetime of the Proposed Development with a high probability. However, the increase in mortality associated with this impact is considered to have an undetectable effect on the population, therefore the consequence will be very small. Overall therefore, the magnitude is considered to be Negligible.

SENSITIVITY OF GUILLEMOTS

12.9.2.239 Guillemots are considered to have a medium vulnerability to disturbance and displacement, based on their sensitivity to ship and helicopter traffic in Garthe and Hüppop (2004), Langston (2010), an interpretation of the Furness and Wade (2012) species concern index value in the context of disturbance and/or displacement from a habitat, and the meta-analysis of avoidance and attraction responses of seabirds to offshore windfarms by Dierschke *et al.*, (2016).

12.9.2.240 With respect to operational disturbance and displacement, overall guillemots are considered to be of High sensitivity. This is due to a combination of low adaptability and tolerance to disturbance, high recovery following cessation of the effect and medium conservation value .

SIGNIFICANCE OF THE EFFECT DURING ALL SEASONS

12.9.2.241 Overall, for displacement and disturbance from offshore infrastructure during all seasons combined (including the breeding and nonbreeding seasons) the magnitude has been assessed as **Negligible** and the sensitivity of guillemots is considered to be **Medium.** The effect will, therefore, be **Not Significant** in EIA terms.

12.9.2.242 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above.

RAZORBILL

BREEDING SEASON

MAGNITUDE OF IMPACT DURING THE BREEDING SEASON

12.9.2.243 Using the seasonal peak breeding season abundance within the Array Area and 2 km buffer of 211 birds, the predicted number of individual razorbills which could potentially be at risk of mortality as a consequence of displacement has been estimated to be between one and 15 individuals, with the evidence based estimate (50% displaced. 1% mortality) of one (Table 12.40).

Table 12.40: Displacement matrix presenting the number of razorbills within the Array Area and 2 km buffer during the breeding season that may be subject to mortality (shaded)

Mortality (%)	Displacement (%)									
	10	20	30	40	50	60	70	80	90	100
1	0	0	1	1	1	1	1	2	2	2
2	0	1	1	2	2	3	3	3	4	4
3	1	1	2	3	3	4	4	5	6	6
4	1	2	3	3	4	5	6	7	8	8
5	1	2	3	4	5	6	7	8	9	11
6	1	3	4	5	6	8	9	10	11	13
7	1	3	4	6	7	9	10	12	13	15

Mortality (%)	Displacement (%)									
	10	20	30	40	50	60	70	80	90	100
8	2	3	5	7	8	10	12	14	15	17
9	2	4	6	8	9	11	13	15	17	19
10	2	4	6	8	11	13	15	17	19	21
20	4	8	13	17	21	25	30	34	38	42
30	6	13	19	25	32	38	44	51	57	63
50	11	21	32	42	53	63	74	84	95	106
75	16	32	47	63	79	95	111	127	142	158
100	21	42	63	84	106	127	148	169	190	211

12.9.2.244 The BDMPS for razorbills during the breeding season was estimated at between 38,462 and 320,632 individuals (Table 12.11). At the average baseline mortality rate for razorbill of 0.174 (Table 12.13), the number of individuals expected to be at risk of mortality in the breeding season is between 6,692 and 55,790. The addition of a maximum of one individual to this would increase the mortality rate between 0.002 and 0.015%. As the background mortality rate would not be increased by more than 1% (the threshold below which additional mortality is considered to have an undetectable effect), this magnitude of increase in mortality would not materially alter the background mortality of the population and would be undetectable.

12.9.2.245 The impact of displacement and disturbance from offshore infrastructure on razorbills during the breeding season is predicted to occur across the Array Area and 2 km buffer and, assuming this species does not habituate to the presence of WTGs, would occur throughout the lifetime of the Proposed Development with a high probability. However, the increase in mortality associated with this impact is considered to have an undetectable effect on the population, therefore the consequence will be very small. Overall therefore, the magnitude is considered to be Negligible.

SENSITIVITY OF RAZORBILLS

12.9.2.246 Razorbills are considered to have a medium vulnerability to disturbance and displacement, based on their sensitivity to ship and helicopter traffic in Garthe and Hüppop (2004), Langston (2010), an interpretation of the Furness and Wade (2012) species concern index value in the context of disturbance and/or displacement from a habitat, and the meta-analysis of avoidance and attraction responses of seabirds to offshore windfarms by Dierschke *et al.*, (2016).

12.9.2.247 Razorbills are considered to have a high conservation value due to potential connectivity between the Array Area and Ireland's east coast SPA sites (e.g. Ireland's Eye, Lambay Island and Saltee Islands SPAs).

12.9.2.248 With respect to operational disturbance and displacement during the breeding season, overall razorbills are considered to be of High sensitivity. This is due to a combination of a low tolerance and low adaptability of offshore windfarms, but high recoverability following cessation of the effect and high conservation value since, as noted above, a proportion of the razorbills present may be connected to SPA populations.

SIGNIFICANCE OF THE EFFECT DURING BREEDING SEASON

12.9.2.249 Overall, for displacement and disturbance from offshore infrastructure during breeding season the magnitude has been assessed as **Negligible** and the sensitivity of razorbills is considered to be **High**. The effect will, therefore, be **Not Significant** in EIA terms.

12.9.2.250 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above.

AUTUMN MIGRATION

MAGNITUDE OF IMPACT DURING AUTUMN MIGRATION

12.9.2.251 Using the seasonal peak autumn migration abundance within the Array Area and 2 km buffer of 2,319 birds, the predicted number of individual razorbills which could potentially be at risk of mortality as a consequence of displacement has been estimated to be between seven and 162 individuals, with the evidence based estimate (50% displaced. 1% mortality) of 12 (Table 12.41).

Table 12.41: Displacement matrix presenting the number of razorbills within the Array Area and 2 km buffer during autumn migration that may be subject to mortality (shaded)

Mortality (%)	Displacement (%)									
	10	20	30	40	50	60	70	80	90	100
1	2	5	7	9	12	14	16	19	21	23
2	5	9	14	19	23	28	32	37	42	46
3	7	14	21	28	35	42	49	56	63	70
4	9	19	28	37	46	56	65	74	83	93
5	12	23	35	46	58	70	81	93	104	116
6	14	28	42	56	70	83	97	111	125	139
7	16	32	49	65	81	97	114	130	146	162
8	19	37	56	74	93	111	130	148	167	186
9	21	42	63	83	104	125	146	167	188	209
10	23	46	70	93	116	139	162	186	209	232
20	46	93	139	186	232	278	325	371	417	464
30	70	139	209	278	348	417	487	557	626	696
50	116	232	348	464	580	696	812	928	1044	1160
75	174	348	522	696	870	1044	1217	1391	1565	1739
100	232	464	696	928	1160	1391	1623	1855	2087	2319

12.9.2.252 The BDMPS for razorbills during the autumn migration was estimated at 642,676 individuals (Table 12.11). At the average baseline mortality rate for razorbill of 0.174 (Table 12.13), the number of individuals expected to be at risk of mortality during autumn migration is 111,826. The addition of 12 individuals to this would increase the mortality rate by 0.01%. This magnitude of increase in mortality would not materially alter the background mortality of the population and would be undetectable.

12.9.2.253 The impact of displacement and disturbance from offshore infrastructure on razorbills during autumn migration is predicted to occur across the Array Area and 2km buffer and, assuming this species does not habituate to the presence of WTGs, would occur throughout the lifetime of the Proposed Development with a high probability. However, the increase in mortality associated with this impact is considered to have an undetectable effect on the population, therefore the consequence will be very small. Overall therefore, the magnitude is considered to be Negligible.

SENSITIVITY OF RAZORBILLS

12.9.2.254 Razorbills are considered to have a medium vulnerability to disturbance and displacement, based on their sensitivity to ship and helicopter traffic in Garthe and Hüppop (2004), Langston

(2010), an interpretation of the Furness and Wade (2012) species concern index value in the context of disturbance and/or displacement from a habitat, and the meta-analysis of avoidance and attraction responses of seabirds to offshore windfarms by Dierschke *et al.*, (2016).

12.9.2.255 Razorbills are considered to have a medium conservation value due to potential connectivity between the Array Area and Ireland's east coast SPA sites (e.g. Ireland's Eye, Lambay Island and Saltee Islands SPAs).

12.9.2.256 With respect to operational disturbance and displacement during the autumn migration, overall razorbills are considered to be of Medium sensitivity. This is due to a combination of a low tolerance of offshore windfarms but medium adaptability, medium recoverability following cessation of the effect and medium conservation value. .

SIGNIFICANCE OF THE EFFECT DURING AUTUMN MIGRATION

12.9.2.257 Overall, for displacement and disturbance from offshore infrastructure during autumn migration the magnitude has been assessed as **Negligible** and the sensitivity of razorbills is considered to be **Medium**. The effect will, therefore, be **Not Significant** in EIA terms.

12.9.2.258 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above.

WINTER SEASON

MAGNITUDE OF IMPACT DURING THE WINTER SEASON

12.9.2.259 Using the seasonal peak winter season abundance within the Array Area and 2 km buffer of 2,072 birds, the predicted number of individual razorbills which could potentially be at risk of mortality as a consequence of displacement has been estimated to be between six and 145 individuals, with the evidence based estimate (50% displaced. 1% mortality) of ten (Table 12.42).

Table 12.42: Displacement matrix presenting the number of razorbills within the Array Area and 2 km buffer during the winter season that may be subject to mortality (shaded)

Mortality (%)	Displacement (%)									
	10	20	30	40	50	60	70	80	90	100
1	2	4	6	8	10	12	15	17	19	21
2	4	8	12	17	21	25	29	33	37	41
3	6	12	19	25	31	37	44	50	56	62
4	8	17	25	33	41	50	58	66	75	83
5	10	21	31	41	52	62	73	83	93	104
6	12	25	37	50	62	75	87	99	112	124
7	15	29	44	58	73	87	102	116	131	145
8	17	33	50	66	83	99	116	133	149	166
9	19	37	56	75	93	112	131	149	168	186
10	21	41	62	83	104	124	145	166	186	207
20	41	83	124	166	207	249	290	332	373	414
30	62	124	186	249	311	373	435	497	559	622
50	104	207	311	414	518	622	725	829	932	1036
75	155	311	466	622	777	932	1088	1243	1399	1554
100	207	414	622	829	1036	1243	1450	1658	1865	2072

12.9.2.260 The BDMPS for razorbills during winter was estimated at 377,184 individuals (Table 12.11). At the average baseline mortality rate for razorbill of 0.174 (Table 12.13) the number of individuals expected to be at risk of mortality during the winter season is 65,630 (377,184 x 0.174). The addition of ten individuals to these would increase the mortality rate by 0.02%. This magnitude of increase in mortality would not materially alter the background mortality of the population and would be undetectable.

12.9.2.261 The impact of displacement and disturbance from offshore infrastructure on razorbills during the winter season is to occur across the Array Area and 2 km buffer and, assuming this species does not habituate to the presence of WTGs, would occur throughout the lifetime of the Proposed Development with a high probability. However, the increase in mortality associated with this impact is considered to have an undetectable effect on the population, therefore the consequence will be very small. Overall therefore, the magnitude is considered to be Negligible.

SENSITIVITY OF RAZORBILLS

12.9.2.262 Razorbills are considered to have a medium vulnerability to disturbance and displacement, based on their sensitivity to ship and helicopter traffic in Garthe and Hüppop (2004), Langston (2010), an interpretation of the Furness and Wade (2012) species concern index value in the context of disturbance and/or displacement from a habitat, and the meta-analysis of avoidance and attraction responses of seabirds to offshore windfarms by Dierschke *et al*., (2016).

12.9.2.263 Razorbills are considered to have a medium conservation value due to potential connectivity between the Array Area and Ireland's east coast SPA sites (e.g. Ireland's Eye, Lambay Island and Saltee Islands SPAs).

12.9.2.264 With respect to operational disturbance and displacement during mid-winter, overall razorbills are considered to be of Medium sensitivity. This is due to a combination of a low tolerance of offshore windfarms but medium adaptability, medium recoverability following cessation of the effect and medium conservation value.

SIGNIFICANCE OF THE EFFECT DURING THE WINTER SEASON

12.9.2.265 Overall, for displacement and disturbance from offshore infrastructure during mid-winter the magnitude has been assessed as **Negligible** and the sensitivity of razorbills is considered to be **Medium**. The effect will, therefore, be **Not Significant** in EIA terms.

12.9.2.266 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above.

SPRING MIGRATION

MAGNITUDE OF IMPACT DURING SPRING MIGRATION

12.9.2.267 Using the seasonal peak spring migration abundance within the Array Area and 2 km buffer of 3,711 birds, the predicted number of individual razorbills which could potentially be at risk of mortality as a consequence of displacement has been estimated to be between 11 and 260 individuals, with the evidence based estimate (50% displaced. 1% mortality) of 19 (Table 12.43).

Table 12.43: Displacement matrix presenting the number of razorbills within the Array Area and 2 km buffer during spring migration that may be subject to mortality (shaded)

Mortality (%)	Displacement (%)									
	10	20	30	40	50	60	70	80	90	100
1	4	7	11	15	19	22	26	30	33	37
2	7	15	22	30	37	45	52	59	67	74

Mortality (%)	Displacement (%)									
	10	20	30	40	50	60	70	80	90	100
3	11	22	33	45	56	67	78	89	100	111
4	15	30	45	59	74	89	104	119	134	148
5	19	37	56	74	93	111	130	148	167	186
6	22	45	67	89	111	134	156	178	200	223
7	26	52	78	104	130	156	182	208	234	260
8	30	59	89	119	148	178	208	238	267	297
9	33	67	100	134	167	200	234	267	301	334
10	37	74	111	148	186	223	260	297	334	371
20	74	148	223	297	371	445	520	594	668	742
30	111	223	334	445	557	668	779	891	1002	1113
50	186	371	557	742	928	1113	1299	1484	1670	1856
75	278	557	835	1113	1392	1670	1948	2227	2505	2783
100	371	742	1113	1484	1856	2227	2598	2969	3340	3711

12.9.2.268 The BDMPS for razorbills during the spring migration was estimated at 642,676 individuals (Table 12.11). At the average baseline mortality rate for razorbill of 0.174 (Table 12.13), the number of individuals expected to be at risk of mortality during spring migration is 111,826 (642,676 x 0.174). The addition of 19 individuals to these would increase the mortality rate by 0.02%. This magnitude of increase in mortality would not materially alter the background mortality of the population and would be undetectable.

12.9.2.269 The impact of displacement and disturbance from offshore infrastructure on razorbills during spring migration is predicted to occur across the Array Area and 2 km buffer and, assuming this species does not habituate to the presence of WTGs, would occur throughout the lifetime of the Proposed Development with a high probability. However, the increase in mortality associated with this impact is considered to have an undetectable effect on the population, therefore the consequence will be very small. Overall therefore, the magnitude is considered to be Negligible.

SENSITIVITY OF RAZORBILLS

12.9.2.270 Razorbills are considered to have a medium vulnerability to disturbance and displacement, based on their sensitivity to ship and helicopter traffic in Garthe and Hüppop (2004), Langston (2010), an interpretation of the Furness and Wade (2012) species concern index value in the context of disturbance and/or displacement from a habitat, and the meta-analysis of avoidance and attraction responses of seabirds to offshore windfarms by Dierschke *et al.*, (2016).

12.9.2.271 Razorbills are considered to have a medium conservation value due to potential connectivity between the Array Area and Ireland's east coast SPA sites (e.g. Ireland's Eye, Lambay Island and Saltee Islands SPAs).

12.9.2.272 With respect to operational disturbance and displacement during spring migration, overall razorbills are considered to be of Medium sensitivity. This is due to a combination of a low tolerance of offshore windfarms but medium adaptability, medium recoverability following cessation of the effect and medium conservation value.

SIGNIFICANCE OF THE EFFECT DURING SPRING MIGRATION

12.9.2.273 Overall, for displacement and disturbance from offshore infrastructure during spring migration the magnitude has been assessed as **Negligible** and the sensitivity of razorbills is considered to be **Medium**. The effect will, therefore, be **Not Significant** in EIA terms.

12.9.2.274 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above.

ALL SEASONS

MAGNITUDE OF IMPACT DURING ALL SEASONS

12.9.2.275 The estimated number of razorbills subject to mortality combined across the breeding season, winter season, autumn and spring migration periods due to displacement from the Array Area and 2 km buffer (Table 12.44) is between 25 and 582 individuals, with the evidence based estimate (50% displaced. 1% mortality) of 42.

Table 12.44: Displacement matrix presenting the number of razorbills within the Array Area and 2 km buffer combined across the breeding and nonbreeding seasons that may be subject to mortality (shaded)

Mortality (%)	Displacement (%)									
	10	20	30	40	50	60	70	80	90	100
1	8	17	25	33	42	50	58	67	75	83
2	17	33	50	67	83	100	116	133	150	166
3	25	50	75	100	125	150	175	200	224	249
4	33	67	100	133	166	200	233	266	299	333
5	42	83	125	166	208	249	291	333	374	416
6	50	100	150	200	249	299	349	399	449	499
7	58	116	175	233	291	349	407	466	524	582
8	67	133	200	266	333	399	466	532	599	665
9	75	150	224	299	374	449	524	599	673	748
10	83	166	249	333	416	499	582	665	748	831
20	166	333	499	665	831	998	1164	1330	1496	1663
30	249	499	748	998	1247	1496	1746	1995	2245	2494
50	416	831	1247	1663	2078	2494	2910	3325	3741	4157
75	623	1247	1870	2494	3117	3741	4364	4988	5611	6235
100	831	1663	2494	3325	4157	4988	5819	6650	7482	8313

12.9.2.276 At the average baseline mortality rate for razorbill of 0.174 (Table 12.13), the number of individuals from the largest BDMPS population expected to be at risk of mortality across all seasons is 111,826 (642,676 x 0.174). The addition of 42 to this increases the mortality rate by 0.04%. The biogeographic population for razorbills is 1,707,000 (Furness, 2015). The number of individuals from the biogeographic population expected to be at risk of mortality across all seasons is 297,018 (1,707,000 x 0.174). The addition of 42 to this increases the mortality rate by 0.01%. Thus, the increase in background mortality is between 0.01% and 0.04%. This magnitude of increase in mortality would not materially alter the background mortality of the population and would be undetectable.

12.9.2.277 The impact of displacement and disturbance from offshore infrastructure on razorbills during all seasons is predicted to occur across the Array Area and 2 km buffer and, assuming this species does not habituate to the presence of WTGs, would occur throughout the lifetime of the Proposed Development with a high probability. However, the increase in mortality associated with this impact is considered to have an undetectable effect on the population, therefore the consequence will be very small. Overall therefore, the magnitude is considered to be Negligible.

SENSITIVITY OF RAZORBILLS

12.9.2.278 Razorbills are considered to have a medium vulnerability to disturbance and displacement, based on their sensitivity to ship and helicopter traffic in Garthe and Hüppop (2004), Langston (2010), an interpretation of the Furness and Wade (2012) species concern index value in the context of disturbance and/or displacement from a habitat, and the meta-analysis of avoidance and attraction responses of seabirds to offshore windfarms by Dierschke *et al.*, (2016).

12.9.2.279 Razorbills are considered to have a medium conservation value due to potential connectivity between the Array Area and Ireland's east coast SPA sites (e.g. Ireland's Eye, Lambay Island and Saltee Islands SPAs).

12.9.2.280 With respect to operational disturbance and displacement throughout the year, overall razorbills are considered to be of Medium sensitivity. This is due to a combination of a low tolerance of offshore windfarms but medium adaptability, medium recoverability following cessation of the effect and medium conservation value.

SIGNIFICANCE OF THE EFFECT DURING ALL SEASONS

12.9.2.281 Overall, for displacement and disturbance from offshore infrastructure during all seasons combined the magnitude has been assessed as **Negligible** and the sensitivity of razorbills is considered to be **Medium**. The effect will, therefore, be **Not Significant** in EIA terms.

12.9.2.282 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above.

Decommissioning phase

12.9.2.283 The Rehabilitation Schedule sets out the process for decommissioning. This proposes decommissioning which is largely a reversal of construction and will take place over a period of up to two years.

12.9.2.284 During the decommissioning phase, direct disturbance and displacement of red-throated divers, gannet, guillemots and razorbills is likely to occur due to the presence of working vessels and crews and the movement and noise associated with these within the Array Area.

MAGNITUDE OF IMPACT

12.9.2.285 Such activities have already been assessed in the construction section above and have been found to be of Low or Negligible magnitude.

12.9.2.286 As for the construction phase, the impact of displacement and disturbance is predicted to be of local spatial extent, short term duration, continuous and high reversibility. It is predicted that the impact will affect seabirds directly. The magnitude is therefore, considered to be Negligible.

SENSITIVITY OF SEABIRDS

12.9.2.287 As for the construction phase, razorbills, guillemots and red-throated divers are deemed to be of medium to high vulnerability, medium to high recoverability and high value. The sensitivity of the receptors is therefore, considered to be Medium to High.

SIGNIFICANCE OF THE EFFECT

12.9.2.288 The magnitude of the impact has been assessed as **Negligible** and the sensitivity of seabird species is considered to range between **Medium** to **High**. The effect will, therefore, be **Not Significant** in EIA terms.

12.9.2.289 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above.

12.9.3 Impact 1 – Project Design Option 1b Direct disturbance and displacement

12.9.3.1 The extent of the Array Area and the construction programme are identical for Design Options 1a and 1b, therefore Impact 1 is also identical for all receptors, as detailed in section 12.9.2.

12.9.4 Impact 1 – Project Design Option 2 Direct disturbance and displacement

12.9.4.1 The extent of the Array Area and the construction programme for Project Design Option 2 is identical to that for Project Design Option 1a and 1b, therefore Impact 1 is also identical for all receptors, as detailed in section 12.9.2.

12.9.5 Impact 2 – Project Design Option 1 (WTG model 1a) Indirect disturbance and displacement resulting from changes to prey species and habitats

Construction phase

12.9.5.1 Birds may be indirectly disturbed and displaced during the construction phase if there are direct impacts on prey species and the habitats of prey species. An impact that reduces prey availability within the Array Area or along the Cable Corridor and Working Area could potentially result in indirectly displacing birds by changing foraging movements and other behavioural activities; this in turn could result in a loss of fitness and a reduction in survival chances of some seabird species.

12.9.5.2 During construction, the production of underwater noise (e.g. during piling) and the generation of suspended sediments (e.g. during sand wave clearance activities) may disturb and displace prey benthic invertebrates and fish species by altering their behaviour or availability. Underwater noise may cause fish and mobile invertebrates to avoid the construction area and also affect their physiology and behaviour. Suspended sediments may cause fish and mobile invertebrates to avoid the construction area and may smother and hide immobile benthic prey and potentially reduce visibility of prey in the water column for visual predators. These mechanisms could result in less prey being available within the construction area to foraging seabirds.

12.9.5.3 Such potential effects on benthic habitats and fish are assessed in Chapter 9: Benthic Subtidal and Intertidal Ecology and Chapter 10: Fish, Shellfish and Sea Turtle Ecology. The main fish prey species considered in this EIAR to be important to seabirds include herring, sprat and sandeel (refer to Chapter 10: Fish, Shellfish and Sea Turtle Ecology).

12.9.5.4 The conclusions of the assessments presented in Chapter 9: Benthic Subtidal and Intertidal Ecology and Chapter 10: Fish, Shellfish and Sea Turtle Ecology inform this assessment of indirect effects on ornithological receptors.

MAGNITUDE OF IMPACT

12.9.5.5 With regard to the influence of underwater noise on fish prey species important for seabirds, the assessment in Chapter 10: Fish, Shellfish and Sea Turtle Ecology concluded that underwater noise would not cause physical injury or behavioural changes to fish and therefore, noise was considered to have minor or negligible effect on disturbance and displacement of these fish species. It is concluded that a minor or negligible adverse direct impact on fish prey species will have an undetectable indirect impact on seabird species.

12.9.5.6 With regard to changes increases in suspended sediment levels and associated deposition, the assessment in Chapter 6: Coastal Processes concluded that the magnitude of the impact would be of local spatial extent, short term duration, intermittent and of high reversibility. The consequent indirect impact on benthic ecology and the main prey fish species important for seabirds through habitat loss was considered to be of low magnitude and of slight adverse significance, which is not significant in EIA terms (see Chapter 9: Benthic Subtidal and Intertidal Ecology and Chapter 10: Fish, Shellfish and Sea Turtle Ecology). It is concluded that a slight or imperceptible adverse direct impact on fish prey species will have an undetectable indirect impact on seabird species.

12.9.5.7 The impact of indirect effects of displacement and disturbance caused by construction activities and associated vessel traffic on seabirds is predicted to be of local spatial extent, short term duration, occurring only once but with a high probability. However, the increase in mortality associated with this impact is considered to have an undetectable effect on the population, therefore the consequence will be very small. Overall therefore, the magnitude is considered to be Negligible.

SENSITIVITY OF SEABIRDS

12.9.5.8 The vulnerability of seabirds to indirect impacts of disturbance and displacement will vary depending on their habitat requirements. Seabirds with highly specialised habitat requirements that are limited in availability are likely to be more vulnerable to indirect impacts of disturbance and displacement on prey species, whereas seabirds that have large areas of alternative habitat available are expected be less vulnerable (Furness *et al.*, 2013; Bradbury *et al.*, 2014).

12.9.5.9 Due to the proximity of the Array Area to land, some breeding seabird species (i.e. guillemot, gannet and kittiwake) are considered to have a high conservation value (Table 12.10) due to their connectivity with Irish SPA sites designated for breeding birds that are within foraging range of the Array Area (e.g. Wicklow Head, Howth Head Coast, Ireland's Eye, Lambay Island and Saltee Islands). Red-throated divers are also considered to have a high conservation value as they may pass through the Array Area on their way to their nonbreeding designated sites at Murrough SPA, the Raven SPA and Northern Cardigan Bay SPA.

12.9.5.10 With respect to indirect construction disturbance, overall seabirds are considered to be of low to high sensitivity. This is due to combinations of low to high adaptability and low to high tolerance, predicted rapid recoverability following cessation of the effect and medium to high conservation value since, as noted above, a proportion of the seabirds present in the Array Area may be connected to SPA populations.

SIGNIFICANCE OF THE EFFECT

12.9.5.11 Overall, for the indirect construction disturbance the magnitude of the impact has been assessed as **Negligible** and the sensitivity of seabird species is considered to range between **Low** to **High.** The effect will, therefore, be **Not Significant** in EIA terms.

12.9.5.12 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above

Operational and maintenance phase

12.9.5.13 Birds may be indirectly disturbed and displaced during the operational and maintenance phase if there are direct impacts on prey species and the habitats of prey species within the Array Area or along the Cable Corridor and Working Area.

12.9.5.14 During operation, the production of underwater noise (e.g. through the turning of the wind turbines), loss of habitat, electro-magnetic fields (EMF) and the generation of suspended sediments (e.g. due to scour or maintenance activities) may alter the behaviour or availability of bird prey species. Underwater noise and EMF may cause fish and mobile invertebrates to avoid the operational area and also affect their physiology and behaviour. Suspended sediments may cause fish and mobile invertebrates to avoid the operational area and may smother and hide immobile benthic prey. These mechanisms could result in less prey being available within the operational area to foraging seabirds. Changes in fish and invertebrate communities due to the presence of hard substrate (resulting in colonisation by epifauna and provision of novel habitat providing shelter for fish and invertebrates) may also occur, and changes in fishing activity could influence the communities present.

12.9.5.15 Such potential effects on benthic invertebrates and fish have been assessed in Chapter 9: Benthic Subtidal and Intertidal Ecology and Chapter 10: Fish, Shellfish and Sea Turtle Ecology. The main fish prey species considered in this EIAR to be important to seabirds include herring, sprat and sandeel (refer to Chapter 10: Fish, Shellfish and Sea Turtle Ecology).

12.9.5.16 The conclusions of the assessments in Chapter 9: Benthic Subtidal and Intertidal Ecology and Chapter 10: Fish, Shellfish and Sea Turtle Ecology inform this assessment of indirect effects on ornithological receptors.

MAGNITUDE OF IMPACT

12.9.5.17 With regard to the influence of underwater noise on fish and shellfish prey species important for seabirds, the assessment in Chapter 10: Fish, Shellfish and Sea Turtle Ecology concluded that the sensitivity of fish and shellfish to operational noise is considered to be low and the magnitude of effect negligible. It is concluded that a minor or negligible adverse direct impact on fish prey species will have an undetectable indirect impact on seabird species within the Array Area or along the Cable Corridor and Working Area.

12.9.5.18 With regard to changes to the seabed and to suspended sediment levels, the assessment in Chapter 6: Coastal Processes concluded that the small quantities of sediment released due to scour processes or cable maintenance activities would rapidly settle within a few hundred metres of each wind turbine/cable protection structure or cable repair/reburial site. The consequent indirect impact on benthic ecology and the main prey fish species important for seabirds through smothering due to increased suspended sediment during operation was considered to be of low or negligible magnitude and of slight or imperceptible adverse significance, which is not significant in EIA terms (see Chapters 9: Benthic Subtidal and Intertidal Ecology and Chapter 10: Fish, Shellfish and Sea Turtle Ecology). It is concluded that a slight or imperceptible adverse direct impact on fish prey species will have an undetectable indirect impact on seabird species.

12.9.5.19 With regard to EMF effects, these are identified as highly localised, with the majority of cables being buried to a minimum of 1 m depth, further reducing the effect of EMF (see Chapter 10: Fish, Shellfish and Sea Turtle Ecology).

12.9.5.20 Potential changes in benthic communities due to colonisation of hard substrate within the Array Area and along the Cable Corridor and Working Area is assessed in Chapter 10: Benthic Subtidal and Intertidal Ecology. Whilst the impact of the colonisation of introduced hard substrate is assessed to be of slight adverse significance in terms of benthic ecology (as it is a change from the baseline conditions), the consequences for seabirds may be positive or negative locally but are unlikely to be significant at a wider scale. Dierschke *et al.*, (2016) concluded that cormorants (both cormorant and shag) tend to be attracted to offshore windfarms because the structures provide an opportunity for cormorants to roost and to dry their wings so extend their potential foraging habitat further offshore. Several gull species and red-breasted mergansers were found to tend to increase in abundance at offshore windfarms, which Dierschke *et al.*, (2016) interpreted as most likely to be responses to increased foraging opportunities resulting from higher abundance of fish and invertebrates associated with offshore windfarm structures and possibly the reduction in fishing activity.

12.9.5.21 Overall, the impact of displacement and disturbance is predicted to be of local spatial extent, long term duration, continuous and high reversibility. It is predicted that the impact will affect seabirds indirectly. Overall therefore, the magnitude is considered to be Negligible.

SENSITIVITY OF SEABIRDS

12.9.5.22 As for during construction, seabirds are deemed to be of low to high vulnerability, medium to high recoverability and medium to high value. The sensitivity of the receptor is therefore, considered to be Low to High.

SIGNIFICANCE OF THE EFFECT

12.9.5.23 Overall, the magnitude of the impact has been assessed as **Negligible** and the sensitivity of seabird species is considered to range between **Low** to **High**. The effect will, therefore be **Not Significant** in EIA terms.

12.9.5.24 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above

Decommissioning phase

12.9.5.25 The Rehabilitation Schedule sets out the process for decommissioning. This proposes decommissioning which is largely a reversal of construction and will take place over a period of up to two years.

12.9.5.26 During the decommissioning phase, indirect effects such as displacement of seabird prey species are likely to occur as structures are removed from the Array Area.

MAGNITUDE OF IMPACT

12.9.5.27 Any effects on seabirds resulting from disturbance and displacement to prey fish and shellfish species caused by underwater noise, changes to the seabed and suspended sediment levels are expected to be similar, or of reduced magnitude, to those generated during the construction phase.

12.9.5.28 As for the construction phase, the impact of displacement and disturbance is predicted to be of local spatial extent, short term duration, continuous and high reversibility. It is predicted that the impact will affect seabirds indirectly. The magnitude is therefore, considered to be Negligible.

SENSITIVITY OF SEABIRDS

12.9.5.29 As for the construction phase, seabirds are deemed to be of low to high vulnerability, medium to high recoverability and medium to high value. The sensitivity of the receptor is therefore, considered to be Low to High.

SIGNIFICANCE OF THE EFFECT

12.9.5.30 The magnitude of the impact has been assessed as **Negligible** and the sensitivity of seabird species is considered to range between **Low** to **High**. The effect will, therefore, be **Not Significant** in EIA terms.

12.9.5.31 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above

12.9.6 Impact 2 – Project Design Option 1 (WTG model 1b) Indirect disturbance and displacement resulting from changes to prey species and habitats

12.9.6.1 All impacts for Impact 2 – Indirect disturbance and displacement resulting from changes to prey species and habitats for Project Design Option 1b are identical with Project Design Option 1a as the Array Area is not affected by the different Design Options (section 12.9.5).

12.9.7 Impact 2 – Project Design Option 2 Indirect disturbance and displacement resulting from changes to prey species and habitats

12.9.7.1 All impacts for Impact 2 – Indirect disturbance and displacement resulting from changes to prey species and habitats for Project Design Option 2 are identical with Project Design Option 1a as the Array Area is not affected by the different Design Options in section 12.9.5.

12.9.8 Impact 3 – Project Design Option 1 (WTG model 1a) Collision risk

Operational and maintenance phase

12.9.8.1 There is a potential risk of collision with the wind turbine rotors and associated infrastructure resulting in injury or fatality to birds which fly through the Array Area whilst foraging for food or commuting between breeding sites and foraging areas.

12.9.8.2 Initial screening for species to include in the collision risk assessment is presented Table 12.45. Species were screened in following consideration of their predicted susceptibility to collisions and their abundance in flight (estimated from the baseline aerial surveys).

Table 12.45: Collision risk screening

Receptor	Risk of collisions (Garthe and Hüppop, 2004; Furness and Wade, 2012, Wade *et al.*, 2016)	Estimated density of birds in flight within the Array Area	Screening Result (IN or OUT)
Arctic skua	Medium	None	OUT
Arctic tern	Low	Medium	IN
Black headed gull	Medium	Medium	IN
Common gull	Medium	Medium	IN
Common scoter	Very low	Low	OUT
Common tern	Low	Low	IN
Cormorant	N/A	Very low	OUT
Fulmar	Low	Low	IN
Gannet	Medium	Low	IN
Great black-backed gull	High	Low	IN
Great northern diver	Low	Very low	OUT

Receptor	Risk of collisions (Garthe and Hüppop, 2004; Furness and Wade, 2012, Wade *et al.*, 2016)	Estimated density of birds in flight within the Array Area	Screening Result (IN or OUT)
Guillemot	Very low	High	OUT
Herring gull	High	Low	IN
Kittiwake	Medium	High	IN
Lesser black-backed gull	High	Low	IN
Little gull	Medium	Medium	IN
Manx shearwater	Very low	Medium	OUT
Puffin	Very low	Low	OUT
Razorbill	Very low	Medium	OUT
Red-throated diver	Low	Low	OUT
Sandwich tern	Low	Low	IN
Shag	Very low	Low	OUT

12.9.8.3 Collision Risk Modelling (CRM) has been used to estimate the collision risk mortality to birds recorded within the Array Area using Option 2 of the Band model (Band, 2012) run as a stochastic simulation using sCRM (Caneco and Humphries 2022). Option 2 uses generic estimates of flight height for each species (Johnston *et al.*, 2014 a,b) to estimate the Proportion of birds at Collision Height (PCH). The approach to CRM is summarised here and further details are provided in Volume III, Appendix 12.1: Offshore Ornithology Technical Report.

12.9.8.4 The stochastic CRM is a simulation model designed to run multiple times (e.g. n = 1,000) using randomly generated values for key input parameters on each iteration, thereby generating n estimates of collision risk, explicitly accounting for parameter uncertainty, from which the mean and standard deviation (or 95% confidence intervals) can be obtained.

12.9.8.5 The model was run with a monthly time step (i.e. collision estimates are estimated for each month), incorporating variation in seabird density and collision avoidance rate for all species, and variation in body length, wingspan, flight speed and nocturnal activity factor (NAF) for those species where variance estimates are available (see Volume III, Appendix 12.1: Offshore Ornithology Technical Report for details).

12.9.8.6 For each species, 1,000 estimates the mean monthly Collision risks were calculated with input parameter values using the monthly density values (mean and standard deviations).. Parameter values used for each species were those advised by Natural England (Table 12.46); and proportions at collision height were those in the generic dataset in Johnston *et al.* (2014a, 2014b).

12.9.8.7 The input parameters for the collision modelling are provided in Volume III, Appendix 12.4: Offshore Ornithology Technical Report – Collision Risk Input Parameters and the outputs are presented in full in Volume III, Appendix 12.5: Offshore Ornithology Technical Report – Seabird Collision Modelling Tabulated Results.

12.9.8.8 It should be noted that estimation of seabird avoidance rates at offshore windfarms is an area of ongoing research. For example, a study on gannet behaviour in relation to offshore windfarms (APEM, 2014) gathered evidence which suggests this species may exhibit a higher avoidance rate than the current recommended rate of 98.9%. This work, conducted during the autumn migration period, indicated an overall wind turbine avoidance rate of 100%, although a precautionary rate of 99.5% was proposed (for the autumn period at least). Over the last few years avoidance rates for almost all species have gradually risen as the evidence for very high levels of avoidance has accumulated. Most recently Ozsanlav-Harris *et al.* (2023) conducted a review on behalf of JNCC which recommended that collision avoidance rates for all species for which data could be obtained should be higher than the current UK SNCB advice. These higher rates have resulted in SNCB advice to increase avoidance for some species, although notably not as high as the values recommended by Ozsanlav-Harris *et al.* (2023). Thus, the collision modelling presented here, which has followed UK SNCB guidance, remains precautionary compared with the most recent available evidence on seabird collisions.

12.9.8.9 Similar work has highlighted that levels of nocturnal activity in most seabirds are considerably lower than had previously been assumed, and adjustments for this would also reduce predicted collision rates (but are not currently advised by UK SNCBs). This further highlights the precaution inherent in the assessment.

12.9.8.10 The risk of collisions for non-seabird migrants was considered using the migrant collision Band (2012) model in conjunction with population estimates and migration routes presented in Wright *et al.*, (2012). The full analysis is presented in Volume III, Appendix 12.7: Offshore Ornithology Technical Report – Migrant Non-Seabird Collision Risk Modelling.

12.9.8.11 Seasonal mortality predictions have been assessed in relation to the relevant BDMPS populations (Table 12.11) and the predicted increases in background mortality have been estimated. The following sections provide a summary of the outputs of the assessment, using the seasons defined in Table 12.8. Seasonal and annual collision risk estimates for all species assessed are presented in (Table 12.47).

Table 12.46: Parameter values used in the stochastic CRM

Receptor	Parameter values used				
	Avoidance rate (%; SD)	Nocturnal activity rate (%; SD)	Flight speed (m/s; SD)	Bodylength (m; SD)	Wingpsan (m; SD)
Arctic tern	99.1 (0.04)	0	10.5 (0)	0.33 (0)	0.87 (0)
Black headed gull	99.5 (0.02)	25 (0)	11.9 (0)	0.37 (0)	1.1 (0)
Common gull	99.5 (0.02)	25 (0)	13.4 (0)	0.42 (0)	1.3 (0)
Common tern	99.1 (0.04)	0	10.5 (0)	0.33 (0)	0.87 (0)
Fulmar	99.1 (0.04)	75 (0)	13 (0)	0.48 (0)	1.07 (0)
Gannet*	99.79 (0.03)	8 (10)	14.9 (0)	0.94 (0.0325)	1.72 (0.0375)

Receptor	Parameter values used				
	Avoidance rate (%; SD)	Nocturnal activity rate (%; SD)	Flight speed (m/s; SD)	Bodylength (m; SD)	Wingpsan (m; SD)
Great Black-backed gull	99.4 (0.04)	37.5 (6.375)	13.7 (1.2)	0.71 (0.035)	1.58 (0.0375)
Herring gull	99.4 (0.04)	37.5 (6.375)	12.8 (1.8)	0.6 (0.0225)	1.44 (0.03)
Kittiwake	99.3 (0.03)	37.5 (6.375)	8.71 (0.4)	0.39 (0.05)	1.08 (0.0625)
Lesser Black-backed gull	99.4 (0.04)	37.5 (6.375)	13.1 (1.9)	0.58 (0.03)	1.42 (0.0375)
Little gull	99.5 (0.02)	25 (0)	12.2 (0)	0.26 (0)	0.78 (0)
Sandwich tern	99.1 (0.04)	0	10.3 (3.4)	0.39 (0.005)	1.0 (0.04)

** the gannet avoidance rate incorporates overall windfarm avoidance ('macro') at a rate of 75% as per current Natural England advice.*

12.9.8.12 The seasonal and annual collision risk estimates for Project Design Option 1a are presented in Table 12.47. Several species had very low predicted annual collision risks (Table 12.47). These were fulmar (Design 1a: 0), great black-backed gull (Design 1a: 1.2), herring gull (Design 1a: 1.0), lesser black-backed gull (Design 1a: 0.5) and Sandwich tern (Design 1a: 0.2). As the magnitudes of predicted impact for these species were so small, no further assessment is considered necessary for these species.

12.9.8.13 The species with more than 1.5 predicted collisions per year for which assessment has been undertaken are Arctic tern, black-headed gull, common gull, common tern, gannet, kittiwake and little gull.

Table 12.47: Seasonal Collision Risk Estimates for Project Design Option 1a. Values are the Mean Number of Predicted Collisions and 95% Confidence Intervals Derived From upper and lower confidence intervals of seabird densities

Species	Breeding season	Autumn migration	Winter	Spring Migration	Nonbreeding	Annual
Arctic tern	4.4 (1-7.7)	0.1 (0-0.2)		0.6 (0.1-1.3)		5.1 (1.1-9.3)
Black-headed gull	0.1 (0-0.3)				22.7 (3.5-45.4)	22.8 (3.5-45.6)
Common gull	1.9 (0.1-4.4)				115.3 (16-229.6)	117.2 (16.2-234)
Common tern	6 (2.1-9.9)	0.7 (0.2-1.3)		0.5 (0.1-0.9)		7.2 (2.4-12.1)
Fulmar	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)		0 (0-0)
Gannet	0.6 (0-1.3)	0.3 (0-0.6)		0 (0-0.1)		0.9 (0.1-2.2)
Great black-headed gull	0 (0-0)				1.6 (0.2-3.9)	1.6 (0.2-3.9)
Herring gull	0 (0-0)				1.3 (0.1-3.3)	1.3 (0.1-3.3)
Kittiwake	16.7 (3.5-30.7)	42.8 (6.2-83.9)		127.3 (43.1-217.9)		186.8 (52.9-332.4)
Lesser black-backed gull	0 (0-0)	0 (0-0)	0 (0-0)	0.7 (0-1.6)		0.7 (0-1.6)
Little gull	0 (0-0)				42.6 (5.3-87.6)	42.6 (5.3-87.6)
Sandwich tern	0.2 (0-0.4)	0.1 (0-0.2)		0 (0-0)		0.3 (0-0.6)

ARCTIC TERN

BREEDING SEASON

MAGNITUDE OF IMPACT DURING THE BREEDING SEASON

12.9.8.14 An estimate of 4.4 Arctic terns were predicted to be at collision risk in the breeding season. The Arctic tern breeding season mean maximum foraging range is estimated as 26 km (Woodward *et al.*, 2019), while the nearest breeding colony SPA to the Array Area for this species is 40 km (Dalkey Islands SPA). Furthermore, the breeding season collision estimate (4.4) was mostly due to the August prediction (4.2) and probably reflects post-breeding passage movements, should be considered against the nonbreeding population. Therefore the BDMPS reference population for the breeding season of 23,637 is considered appropriate for assessment (Table 12.11).

12.9.8.15 At the average baseline mortality rate for Arctic tern of 0.163 (Table 12.13), the number of individuals expected to be at risk of mortality in the breeding season is 3,853 (23,637 x 0.163). The addition of 4.4 individuals to this would increase the mortality rate by 0.11%. increases in mortality of less than 1% are considered undetectable against background variations and therefore this indicates that this level of mortality would be undetectable against natural variation.

12.9.8.16 The collision risk for Arctic terns during the breeding season would occur throughout the lifetime of the Proposed Development with a high probability but would result in an undetectable effect on the population when considered against background variations. Therefore, the magnitude is considered to be Low.

SENSITIVITY OF ARCTIC TERN

12.9.8.17 With respect to collision risk with WTG during breeding season, overall Arctic terns are considered to be of Medium sensitivity. This is due to a combination of a medium tolerance and adaptability to offshore windfarms, high recoverability following cessation of the effect and medium conservation value.

SIGNIFICANCE OF THE EFFECT DURING THE BREEDING SEASON

12.9.8.18 Overall, for collision risk with WTG during breeding season the magnitude has been assessed as **Low** and the sensitivity of Arctic terns is considered to be **Medium**. The effect will, therefore, **Slight adverse**, which is **not significant** in EIA terms.

12.9.8.19 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above

AUTUMN MIGRATION

MAGNITUDE OF IMPACT DURING THE AUTUMN MIGRATION

12.9.8.20 An estimate of 0.1 Arctic terns were predicted to be at collision risk in the autumn migration. The BDMPS reference population for the autumn migration period is 69,867 (Table 12.11).

12.9.8.21 At the average baseline mortality rate for Arctic tern of 0.163 (Table 12.12), the number of individuals expected to be at risk of mortality in the autumn migration is 11,388 (69,867 x 0.163). The addition of 0.1 individuals to this would increase the mortality rate by 0.001%. Increases in mortality of less than 1% are considered undetectable against background variations and therefore this indicates that this level of mortality would be undetectable against natural variation (Parker *et al.* 2022).

12.9.8.22 The collision risk for Arctic terns during the autumn migration period season would occur throughout the lifetime of the Proposed Development with a high probability but would result in an undetectable effect on the population when considered against background variations. Therefore, the magnitude is considered to be Negligible.

SENSITIVITY OF ARCTIC TERN

12.9.8.23 With respect to collision risk with WTG during autumn migration, overall Arctic terns are considered to be of Medium sensitivity. This is due to a combination of a medium tolerance and adaptability to offshore windfarms, high recoverability following cessation of the effect and medium conservation.

SIGNIFICANCE OF THE EFFECT DURING THE AUTUMN MIGRATION

12.9.8.24 Overall, for collision risk with WTG during autumn migration the magnitude has been assessed as **Negligible** and the sensitivity of Arctic terns is considered to be **Medium**. The effect will, therefore, be **Not Significant** in EIA terms.

12.9.8.25 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above

SPRING MIGRATION

MAGNITUDE OF IMPACT DURING THE SPRING MIGRATION

12.9.8.26 An estimate of 0.6 Arctic terns were predicted to be at collision risk in the spring migration. The BDMPS reference population for the autumn migration period is 69,867 (Table 12.11).

12.9.8.27 At the average baseline mortality rate for Arctic tern of 0.163 (Table 12.12), the number of individuals expected to be at risk of mortality in the spring migration is 11,388 (69,867 x 0.163). The addition of 0.6 individuals to this would increase the mortality rate by 0.005%. Increases in mortality of less than 1% are considered undetectable against background variations and therefore this indicates that this level of mortality would be undetectable against natural variation (Parker *et al.* 2022).

12.9.8.28 The collision risk for Arctic terns during the spring migration period season would occur throughout the lifetime of the Proposed Development with a high probability but would result in an undetectable effect on the population when considered against background variations. Therefore, the magnitude is considered to be Negligible.

SENSITIVITY OF ARCTIC TERNS

12.9.8.29 With respect to collision risk with WTG during spring migration, overall Arctic terns are considered to be of Medium sensitivity. This is due to a combination of a low tolerance and adaptability to offshore windfarms, high recoverability following cessation of the effect and medium conservation.

SIGNIFICANCE OF THE EFFECT DURING THE SPRING MIGRATION

12.9.8.30 Overall, for collision risk with WTG during spring migration the magnitude has been assessed as **Negligible** and the sensitivity of Arctic terns is considered to be **Medium**. The effect will, therefore, be **Not Significant** in EIA terms.

12.9.8.31 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above

ALL SEASONS

MAGNITUDE OF IMPACT DURING ALL SEASONS

12.9.8.32 An estimate of 5.1 arctic terns were predicted to be at collision risk across all seasons. At the average baseline mortality rate for Arctic terns of 0.163 (Table 12.13), the number of individuals from the largest BDMPS population expected to be at risk of mortality across all seasons is 11,388 (69,867 x 0.163). The addition of 5.1 to this increases the mortality rate by 0.05%. The biogeographic population for arctic terns is 628,000 (Furness, 2015). The number of individuals from the biogeographic population expected to be at risk of mortality across all seasons is 102,364 (628,000 x 0.163). The addition of 5.1 to this increases the mortality rate by 0.005%. Thus, the increase in background mortality is between 0.005% and 0.05%. This magnitude of increase in mortality (less than 1%) would not materially alter the background mortality of the population and would be undetectable (Parker *et al.* 2022).

12.9.8.33 The collision risk for Arctic terns during all seasons would occur throughout the lifetime of the Proposed Development with a high probability but would result in an undetectable effect on the population when considered against background variations. Therefore, the magnitude is considered to be Negligible.

SENSITIVITY OF ARCTIC TERNS

12.9.8.34 With respect to collision risk with WTG during all seasons, overall Arctic terns are considered to be of Medium sensitivity. This is due to a combination of a low tolerance and adaptability to offshore windfarms, high recoverability following cessation of the effect and medium conservation.

SIGNIFICANCE OF THE EFFECT DURING ALL SEASONS

12.9.8.35 Overall, for collision risk with WTG throughout the year the magnitude has been assessed as **Negligible** and the sensitivity of Arctic terns is considered to be **Medium**. The effect will, therefore, be **Not Significant** in EIA terms.

12.9.8.36 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above.

BLACK-HEADED GULL

BREEDING SEASON

12.9.8.37 Almost no black-headed gull collisions were predicted in the breeding season (0.1) therefore this level of impact does not require further assessment and is considered to be **Not Significant** in EIA terms.

12.9.8.38 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above.

NONBREEDING SEASON

MAGNITUDE OF IMPACT DURING THE NONBREEDING SEASON

12.9.8.39 An estimate of 23.1 black-headed gulls were predicted to be at collision risk in the nonbreeding season. The biogeographic reference population for the nonbreeding season is 4,250,000 (Table 12.12).

12.9.8.40 At the average baseline mortality rate for black-headed gulls of 0.175 (Table 12.13), the number of individuals from the biogeographic population expected to be at risk of mortality during the nonbreeding season is 743,750 (4,250,000 x 0.175). The addition of 23.1 to this increases the mortality rate by 0.003%. This magnitude of increase in mortality would not materially alter the background mortality of the population and would be undetectable.

12.9.8.41 Thus, while the proportion of the biogeographic population which is present in the Irish Sea during the winter is not known with certainty, even if only a small percentage (e.g. <5%) of the total wintering population is present, the effect would remain undetectable.

12.9.8.42 The collision risk for black-headed gulls during the nonbreeding season would occur throughout the lifetime of the Proposed Development with a high probability but would result in an undetectable effect on the population when considered against background variations. Therefore, the magnitude is considered to be Negligible.

SENSITIVITY OF BLACK-HEADED GULL

12.9.8.43 With respect to collision risk with WTG during nonbreeding season, overall black-headed gulls are considered to be of Low sensitivity. This is due to a combination of a medium tolerance and adaptability to offshore windfarms, high recoverability following cessation of the effect and low conservation value.

SIGNIFICANCE OF THE EFFECT DURING THE NONBREEDING SEASON

12.9.8.44 Overall, for collision risk with WTG during nonbreeding season the magnitude has been assessed as **Negligible** and the sensitivity of black-headed gulls is considered to be **Low**. The effect will, therefore, be **Not Significant** in EIA terms.

12.9.8.45 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above

COMMON GULL

BREEDING SEASON

12.9.8.46 The biogeographic reference population for common gull is 1,725,000 (Table 12.12). An estimate of 1.5 common gulls were predicted to be at collision risk in the breeding season. At the average baseline mortality rate for common tern of 0.258 (Table 12.13), the number of individuals expected to be at risk of mortality in the breeding season is 445,050 (1,725,000 x 0.258). The addition of 1.5 individuals to this would increase the mortality rate by <0.001%. increases in mortality of less than 1% are considered undetectable against background variations and therefore this indicates that this level of mortality would be undetectable against natural variation (Parker *et al.* 2022).

12.9.8.47 The collision risk for common gulls during the nonbreeding season would occur throughout the lifetime of the Proposed Development with a high probability. However, since the Irish Sea wintering population is not known with certainty, the magnitude is considered to be Negligible to Low.

SENSITIVITY OF COMMON GULL

12.9.8.48 With respect to collision risk with WTG during the nonbreeding season, overall common gulls are considered to be of Low sensitivity. This is due to a combination of a high tolerance and adaptability to offshore windfarms, high recoverability following cessation of the effect and medium conservation value.

SIGNIFICANCE OF THE EFFECT DURING THE BREEDING SEASON

12.9.8.49 Overall, for collision risk with WTG during nonbreeding season the magnitude has been assessed as **Negligible** and the sensitivity of common gulls is considered to be **Low**. The effect will, therefore, be **Not Significant** in EIA terms.

12.9.8.50 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above.

NONBREEDING SEASON

MAGNITUDE OF IMPACT DURING THE NONBREEDING SEASON

12.9.8.51 An estimate of 119.3 common gulls were predicted to be at collision risk in the nonbreeding season. The biogeographic reference population for common gull is 1,725,000 (Table 12.12). Common gulls are present throughout the Irish Sea during the nonbreeding period. Jessopp *et al.*, (2018) presented a combined common gull and herring gull estimate (due to the difficulty of separating these species by eye during surveys) of up to 35,000 along the Irish Sea east coast. Large numbers of common gulls migrate from Scandinavia and northern continental Europe to Britain and Ireland during the winter, leading Wright *et al.*, (2012) to estimate the total wintering population (of Britain and Ireland) as 700,000. Although no regional breakdown was provided, this indicates that the population in the Irish Sea in winter is likely to be large, and probably considerably higher than that estimated by Jessopp *et al.*, (2018). If the Irish Sea hosts only 10% or more of the wintering population estimate (i.e. 10% of 700,000 = 70,000), which is very likely to be a precautionary value, then the predicted background mortality of the wintering population would be at least 18,410 at an average mortality rate of 0.258 (Table 12.13). The addition of 119.3 individuals would increase the mortality by less than 1%, which would be considered undetectable.

12.9.8.52 The collision risk for common gulls during the nonbreeding season would occur throughout the lifetime of the Proposed Development with a high probability. However, since the Irish Sea wintering population is not known with certainty, the magnitude is considered to be Negligible to Low.

SENSITIVITY OF COMMON GULL

12.9.8.53 With respect to collision risk with WTG during nonbreeding season, overall common gulls are considered to be of Low sensitivity. This is due to a combination of a high tolerance and adaptability of offshore windfarms, high recoverability following cessation of the effect and medium conservation value.

SIGNIFICANCE OF THE EFFECT DURING THE NONBREEDING SEASON

12.9.8.54 Overall, for collision risk with WTG during nonbreeding season the magnitude has been assessed as **Negligible** to **Low** and the sensitivity of common gulls is considered to be **Low**. The effect will, therefore, be of **Negligible** to **Slight adverse** significance, which is **not significant** in EIA terms.

12.9.8.55 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above.

COMMON TERN

BREEDING SEASON

MAGNITUDE OF IMPACT DURING THE BREEDING SEASON

12.9.8.56 An estimate of 6.3 common terns were predicted to be at collision risk in the breeding season. The BDMPS reference population for the breeding season is 30,254 (Table 12.11).

12.9.8.57 At the average baseline mortality rate for common tern of 0.263 (Table 12.13), the number of individuals expected to be at risk of mortality in the breeding season is 7,957 (30,254 x 0.263). The addition of 6.3 individuals to this would increase the mortality rate by 0.08%. increases in mortality of less than 1% are considered undetectable against background variations and therefore this indicates that this level of mortality would be undetectable against natural variation (Parker *et al.* 2022).

12.9.8.58 The collision risk for common terns for the breeding season would occur throughout the lifetime of the Proposed Development with a high probability but would result in an undetectable effect on the population when considered against background variations. Therefore, the magnitude is considered to be Negligible.

SENSITIVITY OF COMMON TERN

12.9.8.59 With respect to collision risk with WTG during the breeding season, overall common terns are considered to be of Medium sensitivity. This is due to a combination of a medium tolerance and adaptability to offshore windfarms, high recoverability following cessation of the effect and medium conservation value.

SIGNIFICANCE OF THE EFFECT DURING THE BREEDING SEASON

12.9.8.60 Overall, for collision risk with WTG during breeding season the magnitude has been assessed as **Negligible** and the sensitivity of common terns is considered to be **Medium**. The effect will, therefore, be **Not Significant** in EIA terms.

12.9.8.61 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above.

AUTUMN MIGRATION

MAGNITUDE OF IMPACT DURING THE AUTUMN MIGRATION

12.9.8.62 An estimate of 0.8 common terns were predicted to be at collision risk in the autumn migration. The BDMPS reference population for the autumn migration period is 71,030 (Table 12.11).

12.9.8.63 At the average baseline mortality rate for common tern of 0.263 (Table 12.12), the number of individuals expected to be at risk of mortality in the autumn migration is 18,681 (71,030 x 0.263). The addition of 0.8 individuals to this would increase the mortality rate by 0.004%. Increases in mortality of less than 1% are considered undetectable against background variations and therefore this indicates that this level of mortality would be undetectable against natural variation (Parker *et al.* 2022).

12.9.8.64 The collision risk for common terns during the autumn migration period would occur throughout the lifetime of the Proposed Development with a high probability but would result in an undetectable effect on the population when considered against background variations. Therefore, the magnitude is considered to be Negligible.

SENSITIVITY OF COMMON TERN

12.9.8.65 With respect to collision risk with WTG during autumn migration, overall common terns are considered to be of Medium sensitivity. This is due to a combination of a medium tolerance and adaptability to offshore windfarms, high recoverability following cessation of the effect and medium conservation value.

SIGNIFICANCE OF THE EFFECT DURING THE AUTUMN MIGRATION

12.9.8.66 Overall, for collision risk with WTG during autumn migration the magnitude has been assessed as **Negligible** and the sensitivity of common terns is considered to be **Medium**. The effect will, therefore, be **Not Significant** in EIA terms.

12.9.8.67 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above.

SPRING MIGRATION

MAGNITUDE OF IMPACT DURING THE SPRING MIGRATION

12.9.8.68 An estimate of 0.5 common terns were predicted to be at collision risk in the spring migration. The BDMPS reference population for the autumn migration period is 71,030 (Table 12.11).

12.9.8.69 At the average baseline mortality rate for common tern of 0.263 (Table 12.12), the number of individuals expected to be at risk of mortality in the spring migration is 18,681 (71,030 x 0.263). The addition of 0.5 individuals to this would increase the mortality rate by 0.003%. Increases in mortality of less than 1% are considered undetectable against background variations and therefore this indicates that this level of mortality would be undetectable against natural variation (Parker *et al.* 2022).

12.9.8.70 The collision risk for common terns during the spring migration period would occur throughout the lifetime of the Proposed Development with a high probability but would result in an undetectable effect on the population when considered against background variations. Therefore, the magnitude is considered to be Negligible.

SENSITIVITY OF COMMON TERNS

12.9.8.71 With respect to collision risk with WTG during spring migration, overall common terns are considered to be of Medium sensitivity. This is due to a combination of a medium tolerance and adaptability to offshore windfarms, high recoverability following cessation of the effect and medium conservation value.

SIGNIFICANCE OF THE EFFECT DURING THE SPRING MIGRATION

12.9.8.72 Overall, for collision risk with WTG during spring migration the magnitude has been assessed as **Negligible** and the sensitivity of common terns is considered to be **Medium**. The effect will, therefore, be **Not Significant** in EIA terms.

12.9.8.73 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above.

ALL SEASONS

MAGNITUDE OF IMPACT DURING ALL SEASONS

12.9.8.74 An estimate of 7.6 common terns were predicted to be at collision risk across all seasons.

12.9.8.75 At the average baseline mortality rate for common terns of 0.263 (Table 12.13), the number of individuals from the largest BDMPS population expected to be at risk of mortality across all seasons is 18,681 (71,030 x 0.263). The addition of 7.6 to this increases the mortality rate by 0.04%. The biogeographic population for common terns is 480,000 (Furness, 2015). The number of individuals from the biogeographic population expected to be at risk of mortality across all seasons is 126,240 (480,000 x 0.263). The addition of 7.6 to this increases the mortality rate by 0.006%. Thus, the increase in background mortality is between 0.006% and 0.04%. This magnitude of increase in mortality would not materially alter the background mortality of the population and would be undetectable.

12.9.8.76 The collision risk for common terns during all seasons would occur throughout the lifetime of the Proposed Development with a high probability but would result in an undetectable effect on the population when considered against background variations. Therefore, the magnitude is considered to be Negligible.

SENSITIVITY OF COMMON TERNS

12.9.8.77 With respect to collision risk with WTG during all seasons, overall common terns are considered to be of Medium sensitivity. This is due to a combination of a medium tolerance and adaptability to offshore windfarms, high recoverability following cessation of the effect and medium conservation value.

SIGNIFICANCE OF THE EFFECT DURING ALL SEASONS

12.9.8.78 Overall, for collision risk with WTG throughout the year the magnitude has been assessed as **Negligible** and the sensitivity of common terns is considered to be **Medium**. The effect will, therefore, be **Not Significant** in EIA terms.

12.9.8.79 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above.

GANNET

BREEDING SEASON

MAGNITUDE OF IMPACT DURING THE BREEDING SEASON

12.9.8.80 An estimate of 1.8 gannets were predicted to be at collision risk in the breeding season. The breeding gannet population was estimated to be between 420,257 and 517,233 (Table 12.11). At the average baseline mortality rate for gannets of 0.191 (Table 12.13) the natural mortality for this population is between 80,269 and 98,792. The addition of 1.8 to this would increase the mortality rate by 0.002% which would be undetectable.

12.9.8.81 The impact of collision risk with WTG on gannets during the breeding season, would occur throughout the lifetime of the Proposed Development with a high probability. However, the increase in mortality associated with this impact is considered to have an undetectable effect on the population, therefore the consequence will be very small. Overall therefore, the magnitude is considered to be Negligible.

SENSITIVITY OF THE GANNET

12.9.8.82 With respect to collision risk with WTG during breeding season, overall gannets are considered to be of Medium sensitivity. This is due to a combination of a low tolerance to offshore windfarms but high adaptability due to their large foraging ranges and varied prey, medium recoverability following cessation of the effect and high conservation value since a proportion of the gannets present may be connected to SPA populations.

SIGNIFICANCE OF THE EFFECT DURING THE BREEDING SEASON

12.9.8.83 Overall, for collision risk with WTG during breeding season the magnitude has been assessed as **Negligible** and the sensitivity of gannets is considered to be **Medium**. The effect will, therefore, be **Not Significant** in EIA terms.

12.9.8.84 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above.

AUTUMN MIGRATION

MAGNITUDE OF IMPACT DURING THE AUTUMN MIGRATION

12.9.8.85 An estimate of 0.7 gannets were predicted to be at collision risk in the autumn period. Very large numbers of gannets pass through the Irish Sea on migration and the autumn population was estimated to be 644,745 (Table 12.11). At the average baseline mortality rate for gannets of 0.191 (Table 12.13) the natural mortality for this population is 123,146. The addition of 0.7 to this would increase the mortality rate by <0.001% which would be undetectable.

12.9.8.86 The impact of collision risk with WTG on gannets during the autumn, would occur throughout the lifetime of the Proposed Development with a high probability. However, the increase in mortality associated with this impact is considered to have an undetectable effect on the population, therefore the consequence will be very small. Overall therefore, the magnitude is considered to be Negligible.

SENSITIVITY OF THE RECEPTOR

12.9.8.87 With respect to collision risk with WTG during the autumn, overall gannets are considered to be of Medium sensitivity. This is due to a combination of a low tolerance of offshore windfarms but high adaptability due to their large foraging ranges and varied prey, medium recoverability following cessation of the effect and high conservation value since, as noted above, a proportion of the gannets present may be connected to SPA populations.

SIGNIFICANCE OF THE EFFECT DURING THE AUTUMN MIGRATION

12.9.8.88 Overall, for collision risk with WTG during nonbreeding season the magnitude has been assessed as **Negligible** and the sensitivity of gannets is considered to be **Medium**. The effect will, therefore, be **Not Significant** in EIA terms.

12.9.8.89 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above.

SPRING MIGRATION

MAGNITUDE OF IMPACT DURING THE SPRING MIGRATION

12.9.8.90 An estimate of 0.3 gannets were predicted to be at collision risk in the autumn period. Very large numbers of gannets pass through the Irish Sea on migration and the autumn population was estimated to be 536,011 (Table 12.11). At the average baseline mortality rate for gannets of 0.191 (Table 12.13) the natural mortality for this population is 102,378. The addition of 0.3 to this would increase the mortality rate by <0.001% which would be undetectable.

12.9.8.91 The impact of collision risk with WTG on gannets during the autumn, would occur throughout the lifetime of the Proposed Development with a high probability. However, the increase in mortality associated with this impact is considered to have an undetectable effect on the population, therefore the consequence will be very small. Overall therefore, the magnitude is considered to be Negligible.

SENSITIVITY OF THE RECEPTOR

12.9.8.92 With respect to collision risk with WTG during the spring, overall gannets are considered to be of Medium sensitivity. This is due to a combination of a low tolerance of offshore windfarms but high adaptability due to their large foraging ranges and varied prey, medium recoverability following cessation of the effect and high conservation value since, as noted above, a proportion of the gannets present may be connected to SPA populations.

SIGNIFICANCE OF THE EFFECT DURING THE SPRING MIGRATION

12.9.8.93 Overall, for collision risk with WTG during nonbreeding season the magnitude has been assessed as **Negligible** and the sensitivity of gannets is considered to be **Medium**. The effect will, therefore, be **Not Significant** in EIA terms.

12.9.8.94 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above.

ALL SEASONS

MAGNITUDE OF IMPACT DURING ALL SEASONS

12.9.8.95 An estimate of 2.8 gannets were predicted to be at collision risk across all seasons combined. At the average baseline mortality rate for gannets of 0.191 (Table 12.13), the number of individuals from the larger BDMPS population expected to be at risk of mortality across all seasons is 123,145 (644,745,233 x 0.191). The addition of a maximum of one to this would increase the mortality rate by 0.002%. The biogeographic population for gannets is 1,180,000 (Furness, 2015). The number of individuals from the biogeographic population expected to be at risk of mortality across all seasons is 225,380 (1,180,000 x 0.191). The addition of 2.8 to this increases the mortality rate 0.001%.

12.9.8.96 The impact of collision risk with WTG on gannets during all seasons combined would occur throughout the lifetime of the Proposed Development with a high probability. However, the increase in mortality associated with this impact is considered to have an undetectable effect on the population, therefore the consequence will be very small. Overall therefore, the magnitude is considered to be Negligible.

SENSITIVITY OF THE RECEPTOR

12.9.8.97 With respect to collision risk with WTG during the autumn, overall gannets are considered to be of Medium sensitivity. This is due to a combination of a low tolerance of offshore windfarms but high adaptability due to their large foraging ranges and varied prey, medium recoverability following cessation of the effect and high conservation value since, as noted above, a proportion of the gannets present may be connected to SPA populations.

SIGNIFICANCE OF THE EFFECT DURING ALL SEASONS

12.9.8.98 Overall, for collision risk with WTG during nonbreeding season the magnitude has been assessed as **Negligible** and the sensitivity of gannets is considered to be **Medium**. The effect will, therefore, be **Not Significant** in EIA terms.

12.9.8.99 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above.

KITTIWAKE

BREEDING SEASON

MAGNITUDE OF IMPACT DURING THE BREEDING SEASON

12.9.8.100 An estimate of 17.5 kittiwakes were predicted to be at collision risk in the breeding season. The BDMPS reference population for the breeding season is between 134,247 and 405,701 (Table 12.11).

12.9.8.101 At the average baseline mortality rate for kittiwake of 0.156 (Table 12.13), the number of individuals expected to be at risk of mortality in the breeding season is between 20,630 and 63,289. The addition of 17.5 individuals to this would increase the mortality rate by between 0.03% to 0.08%. Increases in mortality of less than 1% are considered to be undetectable against background variations.

12.9.8.102 The collision risk for kittiwakes during the breeding season would occur throughout the lifetime of the Proposed Development with a high probability but would result in an undetectable effect on the population when considered against background variations. Therefore, the magnitude is considered to be Negligible.

SENSITIVITY OF KITTIWAKE

12.9.8.103 With respect to collision risk with WTG during breeding season, overall kittiwakes are considered to be of Medium to high sensitivity. This is due to a combination of a low tolerance and adaptability to offshore windfarms, medium recoverability following cessation of the effect and high conservation value since a proportion of the kittiwakes present may be connected to SPA populations.

SIGNIFICANCE OF THE EFFECT DURING THE BREEDING SEASON

12.9.8.104 Overall, for collision risk with WTG during breeding season the magnitude has been assessed as **Negligible** and the sensitivity of kittiwakes is considered to be **Medium** to **High**. The effect will therefore be **Not Significant** in EIA terms.

12.9.8.105 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above.

AUTUMN MIGRATION

MAGNITUDE OF IMPACT DURING THE AUTUMN MIGRATION

12.9.8.106 An estimate of 44 kittiwakes were predicted to be at collision risk in the autumn migration. The BDMPS for the autumn migration is 708,156 (Table 12.11). At the average baseline mortality rate for kittiwake of 0.156 (Table 12.12), the number of individuals expected to be at risk of mortality in the autumn migration is 110,472. The addition of 44 individuals to this would increase the mortality rate by 0.04%. Increases in mortality of less than 1% are considered undetectable against background variations and therefore this indicates that this level of mortality would be undetectable against natural variation.

12.9.8.107 The collision risk for kittiwakes during the autumn migration period would occur throughout the lifetime of the Proposed Development with a high probability but would result in an undetectable effect on the population when considered against background variations. Therefore, the magnitude is considered to be Negligible.

SENSITIVITY OF KITTIWAKE

12.9.8.108 With respect to collision risk with WTG during autumn migration, overall kittiwakes are considered to be of Medium sensitivity. This is due to a combination of a low tolerance and adaptability of offshore windfarms, medium recoverability following cessation of the effect and high conservation value since a proportion of the kittiwakes present may be connected to SPA populations.

SIGNIFICANCE OF THE EFFECT DURING THE AUTUMN MIGRATION

12.9.8.109 Overall, for collision risk with WTG during autumn migration the magnitude has been assessed as **Negligible** and the sensitivity of kittiwakes is considered to be **Medium**. The effect will, therefore, be **Not Significant** in EIA terms.

12.9.8.110 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above.

SPRING MIGRATION

MAGNITUDE OF IMPACT DURING THE SPRING MIGRATION

12.9.8.111 An estimate of 138.2 kittiwakes were predicted to be at collision risk in the spring migration. The BDMPS for the spring migration is 928,207 (Table 12.11). At the average baseline mortality rate for kittiwake of 0.156 (Table 12.12), the number of individuals expected to be at risk of mortality in the spring migration is 144,800 (928,207 x 0.056). The addition of 138.2 individuals to this would increase the mortality rate by 0.1%. Increases in mortality of less than 1% are considered undetectable against background variations and therefore this indicates that this level of mortality would be undetectable against natural variation.

12.9.8.112 The collision risk for kittiwakes during the spring migration period would occur throughout the lifetime of the Proposed Development with a high probability but would result in an undetectable effect on the population when considered against background variations. Therefore, the magnitude is considered to be Negligible.

SENSITIVITY OF KITTIWAKE

12.9.8.113 With respect to collision risk with WTG during spring migration, overall kittiwakes are considered to be of Medium sensitivity. This is due to a combination of a low tolerance and adaptability to offshore windfarms, medium recoverability following cessation of the effect and high conservation value since a proportion of the kittiwakes present may be connected to SPA populations.

SIGNIFICANCE OF THE EFFECT DURING THE SPRING MIGRATION

12.9.8.114 Overall, for collision risk with WTG during spring migration the magnitude has been assessed as **Negligible** and the sensitivity of kittiwakes is considered to be **Low**. The effect will, therefore, be **Not Significant** in EIA terms.

12.9.8.115 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above.

ALL SEASONS

MAGNITUDE OF IMPACT DURING ALL SEASONS

12.9.8.116 An estimate of 199.7 kittiwakes were predicted to be at collision risk across all seasons. At the average baseline mortality rate for kittiwake of 0.156 (Table 12.13), the number of individuals from the largest BDMPS population expected to be at risk of mortality across all seasons is 144,800 (928,207 x 0.156). The addition of 199.7 to this increases the mortality rate by 0.14%. The biogeographic population for kittiwakes is 5,100,000 (Furness, 2015). The number of individuals from the biogeographic population expected to be at risk of mortality across all seasons is 795,600 (5,100,000 x 0.174). The addition of 199.7 to this increases the mortality rate by 0.03%. Thus, the increase in background mortality is between 0.03% and 0.14%. This magnitude of increase in mortality would not materially alter the background mortality of the population and would be undetectable.

12.9.8.117 The collision risk for kittiwakes during all seasons would occur throughout the lifetime of the Proposed Development with a high probability but would result in an undetectable effect on the population when considered against background variations. Therefore, the magnitude is considered to be Negligible to Low.

SENSITIVITY OF KITTIWAKE

12.9.8.118 With respect to collision risk with WTG across the whole year, overall kittiwakes are considered to be of Medium sensitivity. This is due to a combination of a low tolerance and adaptability to offshore windfarms, medium recoverability following cessation of the effect and high conservation value since a proportion of the kittiwakes present may be connected to SPA populations.

SIGNIFICANCE OF THE EFFECT DURING ALL SEASONS

12.9.8.119 Overall, for collision risk with WTG throughout the year the magnitude has been assessed as **Negligible** to **Low** and the sensitivity of kittiwakes is considered to be **Medium**. The effect will, therefore, be **Not Significant** to **Slight** which is **not significant** in EIA terms.

12.9.8.120 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above.

LITTLE GULL

BREEDING SEASON

12.9.8.121 No little gull collisions were predicted in the breeding season therefore no assessment is required.

NONBREEDING SEASON

MAGNITUDE OF IMPACT DURING THE NONBREEDING SEASON

12.9.8.122 An estimate of 37.4 little gulls were predicted to be at collision risk in the nonbreeding season. The biogeographic reference population for the breeding season is 75,000 (Table 12.12).

12.9.8.123 At the average baseline mortality rate for little gulls of 0.2 (Table 12.13), the number of individuals from the biogeographic population expected to be at risk of mortality during the nonbreeding season is 15,000 (75,000 x 0.2). The addition of 37.4 to this increases the mortality rate by 0.3%. This magnitude of increase in mortality would not materially alter the background mortality of the population and would be undetectable.

12.9.8.124 The collision risk for little gulls during the nonbreeding season would occur throughout the lifetime of the Proposed Development with a high probability. However, since the Irish Sea wintering population is not known with certainty, the magnitude is considered to be Low.

SENSITIVITY OF LITTLE GULL

12.9.8.125 With respect to collision risk with WTG during nonbreeding season, overall little gulls are considered to be of Low sensitivity. This is due to a combination of a high tolerance and adaptability of offshore windfarms, high recoverability following cessation of the effect and low conservation value, since SPA connectivity is expected to be low.

Significance of the effect during the nonbreeding season

12.9.8.126 Overall, for collision risk with WTG during nonbreeding season the magnitude has been assessed as **Low** and the sensitivity of little gulls is considered to be **Low**. The effect will, therefore, be **Slight adverse** significance, which is **not significant** in EIA terms.

12.9.8.127 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above.

12.9.9 Impact 3 – Project Design Option 1 (WTG model 1b) Collision risk

Operational and maintenance phase

12.9.9.1 There is a potential risk of collision with the wind turbine rotors and associated infrastructure resulting in injury or fatality to birds which fly through the Array Area whilst foraging for food or commuting between breeding sites and foraging areas. The species screened in and parameters used in the collision risk modelling are provided in section 12.9.8.

12.9.9.2 The species considered further in relation to collision risks are gannet, kittiwake, lesser black-backed gull, great black-backed gull and herring gull. The seasonal collision estimates for these species are presented in Table 12.48.

Table 12.48: Seasonal Collision Risk Estimates for Project Design Option 1b. Values are the Mean Number of Predicted Collisions and 95% Confidence Intervals Derived From upper and lower confidence intervals of seabird densities

Species	Breeding season	Autumn migration	Winter	Spring Migration	Nonbreeding	Annual
Arctic tern	5.3 (1.3-9.6)	0.1 (0-0.2)	0 (0-0.1)	0.7 (0.1-1.4)	0.8 (0.1-1.7)	6.1 (1.4-11.3)
Black-headed gull	0.1 (0-0.3)				26.3 (3.1-53.4)	26.4 (3.1-53.8)
Common gull	2.2 (0.2-5.2)				134.8 (17.6-269.3)	137 (17.8-274.5)
Common tern	7.2 (2.5-11.9)	0.9 (0.2-1.5)		0.6 (0.1-1)		8.6 (2.8-14.5)
Fulmar	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)		0 (0-0)
Gannet	0.6 (0-1.5)	0.3 (0-0.6)		0 (0-0.1)		1 (0.1-2.4)
Great black-headed gull	0 (0-0)	0 (0-0)	0 (0-0)	1.8 (0.1-4.2)	0 (0-0)	1.8 (0.1-4.2)
Herring gull	0 (0-0)	0.8 (0-1.8)	0 (0-0)	0.7 (0.1-1.7)	1.5 (0.1-3.5)	1.5 (0.1-3.5)
Kittiwake	18.8 (4.1-35.7)	47.3 (6.1-94.8)		142.9 (47.7-252.6)		209.1 (57.8-383.1)
Lesser black-backed gull	0 (0-0)	0 (0-0)	0 (0-0)	0.7 (0.1-1.7)	0 (0-0)	0.7 (0.1-1.7)
Little gull	0 (0-0)				50.4 (6.1-103.3)	50.4 (6.1-103.3)
Sandwich tern	0.2 (0-0.5)	0.1 (0-0.3)		0 (0-0)	0.1 (0-0.3)	0.3 (0-0.7)

ARCTIC TERN

BREEDING SEASON

MAGNITUDE OF IMPACT DURING THE BREEDING SEASON

12.9.9.3 An estimate of 5.1 Arctic terns were predicted to be at collision risk in the breeding season. The Arctic tern breeding season mean maximum foraging range is estimated as 26 km (Woodward *et al.*, 2019), while the nearest SPA to the Array Area for this species is 40 km (Dalkey Islands SPA). Furthermore, the breeding season collision estimate (5.1) was mostly due to the August prediction (4.8) and probably reflects post-breeding passage movements, should be considered against the nonbreeding population. Therefore the BDMPS reference population for the breeding season of 23,637 is considered appropriate for assessment (Table 12.11).

12.9.9.4 At the average baseline mortality rate for Arctic tern of 0.163 (Table 12.13), the number of individuals expected to be at risk of mortality in the breeding season is 3,853 (23,637 x 0.163). The addition of 5.1 individuals to this would increase the mortality rate by 0.13%. increases in mortality of less than 1% are considered undetectable against background variations and therefore this indicates that this level of mortality would be undetectable against natural variation.

12.9.9.5 The collision risk for Arctic terns during the breeding season would occur throughout the lifetime of the Proposed Development with a high probability but would result in an undetectable effect on the population when considered against background variations. Therefore, the magnitude is considered to be Low.

SENSITIVITY OF ARCTIC TERN

12.9.9.6 With respect to collision risk with WTG during breeding season, overall Arctic terns are considered to be of Medium sensitivity. This is due to a combination of a medium tolerance and adaptability to offshore windfarms, high recoverability following cessation of the effect and medium conservation value.

SIGNIFICANCE OF THE EFFECT DURING THE BREEDING SEASON

12.9.9.7 Overall, for collision risk with WTG during breeding season the magnitude has been assessed as **Low** and the sensitivity of Arctic terns is considered to be **Medium**. The effect will, therefore, **Slight adverse**, which is **Not Significant** in EIA terms.

12.9.9.8 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above.

AUTUMN MIGRATION

MAGNITUDE OF IMPACT DURING THE AUTUMN MIGRATION

12.9.9.9 An estimate of 0.1 Arctic terns were predicted to be at collision risk in the autumn migration. The BDMPS reference population for the autumn migration period is 69,867 (Table 12.11).

12.9.9.10 At the average baseline mortality rate for Arctic tern of 0.163 (Table 12.12), the number of individuals expected to be at risk of mortality in the autumn migration is 11,388 (69,867 x 0.163). The addition of 0.1 individuals to this would increase the mortality rate by 0.001%. Increases in mortality of less than 1% are considered undetectable against background variations and therefore this indicates that this level of mortality would be undetectable against natural variation.

12.9.9.11 The collision risk for Arctic terns during the autumn migration period season would occur throughout the lifetime of the Proposed Development with a high probability but would result in an undetectable effect on the population when considered against background variations. Therefore, the magnitude is considered to be Negligible.

SENSITIVITY OF ARCTIC TERN

12.9.9.12 With respect to collision risk with WTG during autumn migration, overall Arctic terns are considered to be of Medium sensitivity. This is due to a combination of a low tolerance and adaptability to offshore windfarms, high recoverability following cessation of the effect and medium conservation.

SIGNIFICANCE OF THE EFFECT DURING THE AUTUMN MIGRATION

12.9.9.13 Overall, for collision risk with WTG during autumn migration the magnitude has been assessed as **Negligible** and the sensitivity of Arctic terns is considered to be **Medium**. The effect will, therefore, be **Not Significant** in EIA terms.

12.9.9.14 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above

SPRING MIGRATION

MAGNITUDE OF IMPACT DURING THE SPRING MIGRATION

12.9.9.15 An estimate of 0.7 Arctic terns were predicted to be at collision risk during spring migration. The BDMPS reference population for the autumn migration period is 69,867 (Table 12.11).

12.9.9.16 At the average baseline mortality rate for Arctic tern of 0.163 (Table 12.12), the number of individuals expected to be at risk of mortality in the spring migration is 11,388 (69,867 x 0.163). The addition of 0.7 individuals to this would increase the mortality rate by 0.006%. Increases in mortality of less than 1% are considered undetectable against background variations and therefore this indicates that this level of mortality would be undetectable against natural variation.

12.9.9.17 The collision risk for Arctic terns during the spring migration period season would occur throughout the lifetime of the Proposed Development with a high probability but would result in an undetectable effect on the population when considered against background variations. Therefore, the magnitude is considered to be Negligible.

SENSITIVITY OF ARCTIC TERNS

12.9.9.18 With respect to collision risk with WTG during spring migration, overall Arctic terns are considered to be of Medium sensitivity. This is due to a combination of a low tolerance and adaptability to offshore windfarms, high recoverability following cessation of the effect and medium conservation.

SIGNIFICANCE OF THE EFFECT DURING THE SPRING MIGRATION

12.9.9.19 Overall, for collision risk with WTG during spring migration the magnitude has been assessed as **Negligible** and the sensitivity of Arctic terns is considered to be **Medium**. The effect will, therefore, be **Not Significant** in EIA terms.

12.9.9.20 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above.

ALL SEASONS

MAGNITUDE OF IMPACT DURING ALL SEASONS

12.9.9.21 An estimate of 5.9 arctic terns were predicted to be at collision risk across all seasons. At the average baseline mortality rate for Arctic terns of 0.163 (Table 12.13), the number of individuals from the largest BDMPS population expected to be at risk of mortality across all seasons is 11,388 (69,867 x 0.163). The addition of 5.9 to this increases the mortality rate by 0.05%. The biogeographic population for arctic terns is 628,000 (Furness, 2015). The number of individuals from the biogeographic population expected to be at risk of mortality across all seasons is 102,364 (628,000 x 0.163). The addition of 5.9 to this increases the mortality rate by 0.006%. Thus, the increase in background mortality is between 0.006% and 0.05%. This magnitude of increase in mortality would not materially alter the background mortality of the population and would be undetectable.

12.9.9.22 The collision risk for Arctic terns during all seasons would occur throughout the lifetime of the Proposed Development with a high probability but would result in an undetectable effect on the population when considered against background variations. Therefore, the magnitude is considered to be Negligible.

SENSITIVITY OF ARCTIC TERNS

12.9.9.23 With respect to collision risk with WTG during all seasons, overall Arctic terns are considered to be of Medium sensitivity. This is due to a combination of a low tolerance and adaptability to offshore windfarms, high recoverability following cessation of the effect and medium conservation.

SIGNIFICANCE OF THE EFFECT DURING ALL SEASONS

12.9.9.24 Overall, for collision risk with WTG throughout the year the magnitude has been assessed as **Negligible** and the sensitivity of Arctic terns is considered to be **Medium**. The effect will, therefore, be **Not Significant** in EIA terms.

12.9.9.25 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above.

BLACK-HEADED GULL

BREEDING SEASON

12.9.9.26 Almost no black-headed gull collisions were predicted in the breeding season (0.1) therefore this level of impact does not require further assessment and is considered to be **Not Significant** in EIA terms.

12.9.9.27 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above.

NONBREEDING SEASON

MAGNITUDE OF IMPACT DURING THE NONBREEDING SEASON

12.9.9.28 The biogeographic reference population for the nonbreeding season is 4,250,000 (Table 12.12). An estimate of 26.9 black-headed gulls were predicted to be at collision risk in the nonbreeding season.

12.9.9.29 At the average baseline mortality rate for black-headed gulls of 0.175 (Table 12.13), the number of individuals from the biogeographic population expected to be at risk of mortality during the nonbreeding season is 743,750 (4,250,000 x 0.175). The addition of 26.9 to this increases the mortality rate by 0.004%. This magnitude of increase in mortality would not materially alter the background mortality of the population and would be undetectable.

12.9.9.30 Thus, while the proportion of the biogeographic population which is present in the Irish Sea during the winter is not known with certainty, even if only a small percentage (e.g. <5%) of the total wintering population is present, the effect would remain undetectable.

12.9.9.31 The collision risk for black-headed gulls during the nonbreeding season would occur throughout the lifetime of the Proposed Development with a high probability but would result in an undetectable effect on the population when considered against background variations. Therefore, the magnitude is considered to be Negligible.

SENSITIVITY OF BLACK-HEADED GULL

12.9.9.32 With respect to collision risk with WTG during nonbreeding season, overall black-headed gulls are considered to be of Low sensitivity. This is due to a combination of a medium tolerance and adaptability to offshore windfarms, high recoverability following cessation of the effect and low conservation value.

SIGNIFICANCE OF THE EFFECT DURING THE NONBREEDING SEASON

12.9.9.33 Overall, for collision risk with WTG during nonbreeding season the magnitude has been assessed as **Negligible** and the sensitivity of black-headed gulls is considered to be **Low**. The effect will, therefore, be **Not Significant** in EIA terms.

12.9.9.34 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above.

COMMON GULL

BREEDING SEASON

12.9.9.35 The biogeographic reference population for common gull is 1,725,000 (Table 12.12). An estimate of 1.8 common gulls were predicted to be at collision risk in the breeding season. At the average baseline mortality rate for common tern of 0.258 (Table 12.13), the number of individuals expected to be at risk of mortality in the breeding season is 445,050 (1,725,000 x 0.258). The addition of 1.8 individuals to this would increase the mortality rate by <0.001%. increases in mortality of less than 1% are considered undetectable against background variations and therefore this indicates that this level of mortality would be undetectable against natural variation (Parker *et al.* 2022).

12.9.9.36 The collision risk for common gulls during the breeding season would occur throughout the lifetime of the Proposed Development with a high probability. However, since the Irish Sea wintering population is not known with certainty, the magnitude is considered to be Negligible to Low.

SENSITIVITY OF COMMON GULL

12.9.9.37 With respect to collision risk with WTG during nonbreeding season, overall common gulls are considered to be of Low sensitivity. This is due to a combination of a high tolerance and adaptability to offshore windfarms, high recoverability following cessation of the effect and medium conservation value.

SIGNIFICANCE OF THE EFFECT DURING THE BREEDING SEASON

12.9.9.38 Overall, for collision risk with WTG during nonbreeding season the magnitude has been assessed as **Negligible** and the sensitivity of common gulls is considered to be **Low**. The effect will, therefore, be **Not Significant** in EIA terms.

12.9.9.39 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above.

NONBREEDING SEASON

MAGNITUDE OF IMPACT DURING THE NONBREEDING SEASON

12.9.9.40 An estimate of 119.3 common gulls were predicted to be at collision risk in the nonbreeding season. The biogeographic reference population for common gull is 1,725,000 (Table 12.12). Common gulls are present throughout the Irish Sea during the nonbreeding period. Jessopp *et al.*, (2018) presented a combined common gull and herring gull estimate (due to the difficulty of separating these species by eye during surveys) of up to 35,000 along the Irish Sea east coast. Large numbers of common gulls migrate from Scandinavia and northern continental Europe to Britain and Ireland during the winter, leading Wright *et al.*, (2012) to estimate the total wintering population (of Britain and Ireland) as 700,000. Although no regional breakdown was provided, this indicates that the population in the Irish Sea in winter is likely to be large, and probably considerably higher than that estimated by Jessopp *et al.*, (2018). If the Irish Sea hosts only 10% or more of the wintering population estimate (i.e. 10% of 700,000 = 70,000), which is very likely to be a precautionary value, then the predicted background mortality of the wintering population would be at least 18,410 at an average mortality rate of 0.258 (Table 12.13). The addition of 119.3 individuals would increase the mortality by less than 1%, which would be considered undetectable (Parker *et al.* 2022).

12.9.9.41 The collision risk for common gulls during the nonbreeding season would occur throughout the lifetime of the Proposed Development with a high probability. However, since the Irish Sea wintering population is not known with certainty, the magnitude is considered to be Negligible to Low.

SENSITIVITY OF COMMON GULL

12.9.9.42 With respect to collision risk with WTG during nonbreeding season, overall common gulls are considered to be of Low sensitivity. This is due to a combination of a high tolerance and adaptability to offshore windfarms, high recoverability following cessation of the effect and medium conservation value.

SIGNIFICANCE OF THE EFFECT DURING THE NONBREEDING SEASON

12.9.9.43 Overall, for collision risk with WTG during nonbreeding season the magnitude has been assessed as **Negligible** to **Low** and the sensitivity of common gulls is considered to be **Low**. The effect will, therefore, be of **Negligible** to **Slight adverse** significance, which is **not significant** in EIA terms.

12.9.9.44 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above.

COMMON TERN

BREEDING SEASON

MAGNITUDE OF IMPACT DURING THE BREEDING SEASON

12.9.9.45 An estimate of 7.3 common terns were predicted to be at collision risk in the breeding season. The BDMPS reference population for the breeding season is 30,254 (Table 12.11).

12.9.9.46 At the average baseline mortality rate for common tern of 0.263 (Table 12.13), the number of individuals expected to be at risk of mortality in the breeding season is 7,957 (30,254 x 0.263). The addition of 7.3 individuals to this would increase the mortality rate by 0.09%. increases in mortality of less than 1% are considered undetectable against background variations and therefore this indicates that this level of mortality would be undetectable against natural variation (Parker *et al.* 2022).

12.9.9.47 The collision risk for common terns for the breeding season would occur throughout the lifetime of the Proposed Development with a high probability but would result in an undetectable effect on the population when considered against background variations. Therefore, the magnitude is considered to be Negligible.

SENSITIVITY OF COMMON TERN

12.9.9.48 With respect to collision risk with WTG during the breeding season, overall common terns are considered to be of Medium sensitivity. This is due to a combination of a medium tolerance and adaptability to offshore windfarms, high recoverability following cessation of the effect and medium conservation value.

SIGNIFICANCE OF THE EFFECT DURING THE BREEDING SEASON

12.9.9.49 Overall, for collision risk with WTG during breeding season the magnitude has been assessed as **Negligible** and the sensitivity of common terns is considered to be **Medium**. The effect will, therefore, be **Not Significant** in EIA terms.

12.9.9.50 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above.

AUTUMN MIGRATION

MAGNITUDE OF IMPACT DURING THE AUTUMN MIGRATION

12.9.9.51 An estimate of 0.9 common terns were predicted to be at collision risk in the autumn migration. The BDMPS reference population for the autumn migration period is 71,030 (Table 12.11).

12.9.9.52 At the average baseline mortality rate for common tern of 0.263 (Table 12.12), the number of individuals expected to be at risk of mortality in the autumn migration is 18,681 (71,030 x 0.263). The addition of 0.9 individuals to this would increase the mortality rate by 0.005%. Increases in mortality of less than 1% are considered undetectable against background variations and therefore this indicates that this level of mortality would be undetectable against natural variation (Parker *et al.* 2022).

12.9.9.53 The collision risk for common terns during the autumn migration period would occur throughout the lifetime of the Proposed Development with a high probability but would result in an undetectable effect on the population when considered against background variations. Therefore, the magnitude is considered to be Negligible.

SENSITIVITY OF COMMON TERN

12.9.9.54 With respect to collision risk with WTG during autumn migration, overall common terns are considered to be of Medium sensitivity. This is due to a combination of a medium tolerance and adaptability to offshore windfarms, high recoverability following cessation of the effect and medium conservation value.

SIGNIFICANCE OF THE EFFECT DURING THE AUTUMN MIGRATION

12.9.9.55 Overall, for collision risk with WTG during autumn migration the magnitude has been assessed as **Negligible** and the sensitivity of common terns is considered to be **Medium**. The effect will, therefore, be **Not Significant** in EIA terms.

12.9.9.56 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above.

SPRING MIGRATION

MAGNITUDE OF IMPACT DURING THE SPRING MIGRATION

12.9.9.57 An estimate of 0.6 common terns were predicted to be at collision risk in the spring migration. The BDMPS reference population for the autumn migration period is 71,030 (Table 12.11).

12.9.9.58 At the average baseline mortality rate for common tern of 0.263 (Table 12.12), the number of individuals expected to be at risk of mortality in the spring migration is 18,681 (71,030 x 0.263). The addition of 0.6 individuals to this would increase the mortality rate by 0.003%. Increases in mortality of less than 1% are considered undetectable against background variations and therefore this indicates that this level of mortality would be undetectable against natural variation (Parker *et al.* 2022).

12.9.9.59 The collision risk for common terns during the spring migration period would occur throughout the lifetime of the Proposed Development with a high probability but would result in an undetectable effect on the population when considered against background variations. Therefore, the magnitude is considered to be Negligible.

SENSITIVITY OF COMMON TERNS

12.9.9.60 With respect to collision risk with WTG during spring migration, overall common terns are considered to be of Medium sensitivity. This is due to a combination of a medium tolerance and adaptability to offshore windfarms, high recoverability following cessation of the effect and medium conservation value.

SIGNIFICANCE OF THE EFFECT DURING THE SPRING MIGRATION

12.9.9.61 Overall, for collision risk with WTG during spring migration the magnitude has been assessed as **Negligible** and the sensitivity of common terns is considered to be **Medium**. The effect will, therefore, be **Not Significant** in EIA terms.

12.9.9.62 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above.

ALL SEASONS

MAGNITUDE OF IMPACT DURING ALL SEASONS

12.9.9.63 An estimate of 8.8 common terns were predicted to be at collision risk across all seasons.

12.9.9.64 At the average baseline mortality rate for common terns of 0.263 (Table 12.13), the number of individuals from the largest BDMPS population expected to be at risk of mortality across all seasons is 18,681 (71,030 x 0.263). The addition of 8.8 to this increases the mortality rate by 0.05%. The biogeographic population for common terns is 480,000 (Furness, 2015). The number of individuals from the biogeographic population expected to be at risk of mortality across all seasons is 126,240 (480,000 x 0.263). The addition of 8.8 to this increases the mortality rate by 0.007%. Thus, the increase in background mortality is between 0.007% and 0.05%. This magnitude of increase in mortality would not materially alter the background mortality of the population and would be undetectable (Parker *et al.* 2022).

12.9.9.65 The collision risk for common terns during all seasons would occur throughout the lifetime of the Proposed Development with a high probability but would result in an undetectable effect on the population when considered against background variations. Therefore, the magnitude is considered to be Negligible.

SENSITIVITY OF COMMON TERNS

12.9.9.66 With respect to collision risk with WTG during all seasons, overall common terns are considered to be of Medium sensitivity. This is due to a combination of a medium tolerance and adaptability to offshore windfarms, high recoverability following cessation of the effect and medium conservation value.

SIGNIFICANCE OF THE EFFECT DURING ALL SEASONS

12.9.9.67 Overall, for collision risk with WTG throughout the year the magnitude has been assessed as **Negligible** and the sensitivity of common terns is considered to be **Medium**. The effect will, therefore, be **Not Significant** in EIA terms.

12.9.9.68 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above.

GANNET

BREEDING SEASON

MAGNITUDE OF IMPACT DURING THE BREEDING SEASON

12.9.9.69 An estimate of two gannets were predicted to be at collision risk in the breeding season. The breeding gannet population was estimated to be between 420,257 and 517,233 (Table 12.11). At the average baseline mortality rate for gannets of 0.191 (Table 12.13) the natural mortality for this population is between 80,269 and 98,792. The addition of two to this would increase the mortality rate by 0.002% which would be undetectable.

12.9.9.70 The impact of collision risk with WTG on gannets during the breeding season, would occur throughout the lifetime of the Proposed Development with a high probability. However, the increase in mortality associated with this impact is considered to have an undetectable effect on the population, therefore the consequence will be very small. Overall therefore, the magnitude is considered to be Negligible.

SENSITIVITY OF THE GANNET

12.9.9.71 With respect to collision risk with WTG during breeding season, overall gannets are considered to be of Medium sensitivity. This is due to a combination of a low tolerance to offshore windfarms but high adaptability due to their large foraging ranges and varied prey, medium recoverability following cessation of the effect and high conservation value since a proportion of the gannets present may be connected to SPA populations.

SIGNIFICANCE OF THE EFFECT DURING THE BREEDING SEASON

12.9.9.72 Overall, for collision risk with WTG during breeding season the magnitude has been assessed as **Negligible** and the sensitivity of gannets is considered to be **Medium**. The effect will, therefore, be **Not Significant** in EIA terms.

12.9.9.73 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above.

AUTUMN MIGRATION

MAGNITUDE OF IMPACT DURING THE AUTUMN MIGRATION

12.9.9.74 An estimate of 0.8 gannets were predicted to be at collision risk in the autumn period. Very large numbers of gannets pass through the Irish Sea on migration and the autumn population was estimated to be 644,745 (Table 12.11). At the average baseline mortality rate for gannets of 0.191 (Table 12.13) the natural mortality for this population is 123,146. The addition of 0.8 to this would increase the mortality rate by <0.001% which would be undetectable.

12.9.9.75 The impact of collision risk with WTG on gannets during the autumn, would occur throughout the lifetime of the Proposed Development with a high probability. However, the increase in mortality associated with this impact is considered to have an undetectable effect on the population, therefore the consequence will be very small. Overall therefore, the magnitude is considered to be Negligible.

SENSITIVITY OF THE RECEPTOR

12.9.9.76 With respect to collision risk with WTG during the autumn, overall gannets are considered to be of Medium sensitivity. This is due to a combination of a low tolerance to offshore windfarms but high adaptability due to their large foraging ranges and varied prey, medium recoverability following cessation of the effect and high conservation value since, as noted above, a proportion of the gannets present may be connected to SPA populations.

SIGNIFICANCE OF THE EFFECT DURING THE AUTUMN MIGRATION

12.9.9.77 Overall, for collision risk with WTG during nonbreeding season the magnitude has been assessed as **Negligible** and the sensitivity of gannets is considered to be **Medium**. The effect will, therefore, be **Not Significant** in EIA terms.

12.9.9.78 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above.

SPRING MIGRATION

MAGNITUDE OF IMPACT DURING THE SPRING MIGRATION

12.9.9.79 An estimate of 0.3 gannets were predicted to be at collision risk in the autumn period. Very large numbers of gannets pass through the Irish Sea on migration and the autumn population was estimated to be 536,011 (Table 12.11). At the average baseline mortality rate for gannets of 0.191 (Table 12.13) the natural mortality for this population is 102,378. The addition of 0.3 to this would increase the mortality rate by <0.001% which would be undetectable.

12.9.9.80 The impact of collision risk with WTG on gannets during the autumn, would occur throughout the lifetime of the Proposed Development with a high probability. However, the increase in mortality associated with this impact is considered to have an undetectable effect on the population, therefore the consequence will be very small. Overall therefore, the magnitude is considered to be Negligible.

SENSITIVITY OF THE RECEPTOR

12.9.9.81 With respect to collision risk with WTG during the spring, overall gannets are considered to be of Medium sensitivity. This is due to a combination of a low tolerance to offshore windfarms but high adaptability due to their large foraging ranges and varied prey, medium recoverability following cessation of the effect and high conservation value since, as noted above, a proportion of the gannets present may be connected to SPA populations.

SIGNIFICANCE OF THE EFFECT DURING THE SPRING MIGRATION

12.9.9.82 Overall, for collision risk with WTG during nonbreeding season the magnitude has been assessed as **Negligible** and the sensitivity of gannets is considered to be **Medium**. The effect will, therefore, be **Not Significant** in EIA terms.

12.9.9.83 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above.

ALL SEASONS

MAGNITUDE OF IMPACT DURING ALL SEASON

12.9.9.84 An estimate of 3.1 gannets were predicted to be at collision risk across all seasons combined. At the average baseline mortality rate for gannets of 0.191 (Table 12.13), the number of individuals from the larger BDMPS population expected to be at risk of mortality across all seasons is 123,145 (644,745 x 0.191). The addition of a maximum of 3.1 to this would increase the mortality rate by 0.002%. The biogeographic population for gannets is 1,180,000 (Furness, 2015). The number of individuals from the biogeographic population expected to be at risk of mortality across all seasons is 225,380 (1,180,000 x 0.191). The addition of 3.1 to this increases the mortality rate 0.001%.

12.9.9.85 The impact of collision risk with WTG on gannets during all seasons combined would occur throughout the lifetime of the Proposed Development with a high probability. However, the increase in mortality associated with this impact is considered to have an undetectable effect on the population, therefore the consequence will be very small. Overall therefore, the magnitude is considered to be Negligible.

SENSITIVITY OF THE RECEPTOR

12.9.9.86 With respect to collision risk with WTG during the autumn, overall gannets are considered to be of Medium sensitivity. This is due to a combination of a low tolerance to offshore windfarms but high adaptability due to their large foraging ranges and varied prey, medium recoverability following cessation of the effect and high conservation value since, as noted above, a proportion of the gannets present may be connected to SPA populations.

SIGNIFICANCE OF THE EFFECT DURING ALL SEASON

12.9.9.87 Overall, for collision risk with WTG during nonbreeding season the magnitude has been assessed as **Negligible** and the sensitivity of gannets is considered to be **Medium**. The effect will, therefore, be **Not Significant** in EIA terms.

12.9.9.88 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above.

KITTIWAKE

BREEDING SEASON

MAGNITUDE OF IMPACT DURING THE BREEDING SEASON

12.9.9.89 An estimate of 19.7 kittiwakes were predicted to be at collision risk in the breeding season. The BDMPS reference population for the breeding season is between 134,247 and 405,701 (Table 12.11).

12.9.9.90 At the average baseline mortality rate for kittiwake of 0.156 (Table 12.13), the number of individuals expected to be at risk of mortality in the breeding season is between 20,630 and 63,289. The addition of 19.7 individuals to this would increase the mortality rate by between 0.03% to 0.09%. Increases in mortality of less than 1% are considered to be undetectable against background variations (Parker *et al.* 2022).

12.9.9.91 The collision risk for kittiwakes during the breeding season would occur throughout the lifetime of the Proposed Development with a high probability but would result in an undetectable effect on the population when considered against background variations. Therefore, the magnitude is considered to be Negligible.

SENSITIVITY OF KITTIWAKE

12.9.9.92 With respect to collision risk with WTG during breeding season, overall kittiwakes are considered to be of Medium to high sensitivity. This is due to a combination of a low tolerance and adaptability to offshore windfarms, medium recoverability following cessation of the effect and high conservation value since a proportion of the kittiwakes present may be connected to SPA populations.

SIGNIFICANCE OF THE EFFECT DURING THE BREEDING SEASON

12.9.9.93 Overall, for collision risk with WTG during breeding season the magnitude has been assessed as **Negligible** and the sensitivity of kittiwakes is considered to be **Medium** to **High**. The effect will therefore be **Not Significant** in EIA terms.

12.9.9.94 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above.

AUTUMN MIGRATION

MAGNITUDE OF IMPACT DURING THE AUTUMN MIGRATION

12.9.9.95 An estimate of 49.4 kittiwakes were predicted to be at collision risk in the autumn migration. The BDMPS for the autumn migration is 708,156 (Table 12.11). At the average baseline mortality rate for kittiwake of 0.156 (Table 12.12), the number of individuals expected to be at risk of mortality in the autumn migration is 110,472. The addition of 49.4 individuals to this would increase the mortality rate by 0.05%. Increases in mortality of less than 1% are considered undetectable against background variations and therefore this indicates that this level of mortality would be undetectable against natural variation (Parker *et al.* 2022).

12.9.9.96 The collision risk for kittiwakes during the autumn migration period would occur throughout the lifetime of the Proposed Development with a high probability but would result in an undetectable effect on the population when considered against background variations. Therefore, the magnitude is considered to be Negligible.

SENSITIVITY OF KITTIWAKE

12.9.9.97 With respect to collision risk with WTG during autumn migration, overall kittiwakes are considered to be of Medium sensitivity. This is due to a combination of a low tolerance and adaptability to offshore windfarms, medium recoverability following cessation of the effect and high conservation value since a proportion of the kittiwakes present may be connected to SPA populations.

SIGNIFICANCE OF THE EFFECT DURING THE AUTUMN MIGRATION

12.9.9.98 Overall, for collision risk with WTG during autumn migration the magnitude has been assessed as **Negligible** and the sensitivity of kittiwakes is considered to be **Medium**. The effect will, therefore, be **Not Significant** in EIA terms.

12.9.9.99 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above.

SPRING MIGRATION

MAGNITUDE OF IMPACT DURING THE SPRING MIGRATION

12.9.9.100 An estimate of 155.3 kittiwakes were predicted to be at collision risk in the spring migration. The BDMPS for the spring migration is 928,207 (Table 12.11).

12.9.9.101 At the average baseline mortality rate for kittiwake of 0.156 (Table 12.12), the number of individuals expected to be at risk of mortality in the spring migration is 144,800 (928,207 x 0.056). The addition of 155.3 individuals to this would increase the mortality rate by 0.1%. Increases in mortality of less than 1% are considered undetectable against background variations and therefore this indicates that this level of mortality would be undetectable against natural variation (Parker *et al.* 2022).

12.9.9.102 The collision risk for kittiwakes during the spring migration period would occur throughout the lifetime of the Proposed Development with a high probability but would result in an undetectable effect on the population when considered against background variations. Therefore, the magnitude is considered to be Negligible.

SENSITIVITY OF KITTIWAKE

12.9.9.103 With respect to collision risk with WTG during spring migration, overall kittiwakes are considered to be of Medium sensitivity. This is due to a combination of a low tolerance and adaptability to offshore windfarms, medium recoverability following cessation of the effect and high conservation value since a proportion of the kittiwakes present may be connected to SPA populations.

SIGNIFICANCE OF THE EFFECT DURING THE SPRING MIGRATION

12.9.9.104 Overall, for collision risk with WTG during spring migration the magnitude has been assessed as **Negligible** and the sensitivity of kittiwakes is considered to be **Medium**. The effect will, therefore, be **Not Significant** in EIA terms.

12.9.9.105 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above.

ALL SEASONS

MAGNITUDE OF IMPACT DURING ALL SEASONS

12.9.9.106 An estimate of 224.5 kittiwakes were predicted to be at collision risk across all seasons. At the average baseline mortality rate for kittiwake of 0.156 (Table 12.13), the number of individuals from the largest BDMPS population expected to be at risk of mortality across all seasons is 144,800 (928,207 x 0.156). The addition of 224.5 to this increases the mortality rate by 0.15%. The biogeographic population for kittiwakes is 5,100,000 (Furness, 2015). The number of individuals from the biogeographic population expected to be at risk of mortality across all seasons is 795,600 (5,100,000 x 0.174). The addition of 224.5 to this increases the mortality rate by 0.03%. Thus, the increase in background mortality is between 0.03% and 0.15%. This magnitude of increase in mortality would not materially alter the background mortality of the population and would be undetectable.

12.9.9.107 The collision risk for kittiwakes during all seasons would occur throughout the lifetime of the Proposed Development with a high probability but would result in an undetectable effect on the population when considered against background variations. Therefore, the magnitude is considered to be Negligible to Low.

SENSITIVITY OF KITTIWAKE

12.9.9.108 With respect to collision risk with WTG across the whole year, overall kittiwakes are considered to be of Medium sensitivity. This is due to a combination of a low tolerance and adaptability to offshore windfarms, medium recoverability following cessation of the effect and high conservation value since a proportion of the kittiwakes present may be connected to SPA populations.

SIGNIFICANCE OF THE EFFECT DURING ALL SEASONS

12.9.9.109 Overall, for collision risk with WTG throughout the year the magnitude has been assessed as **Negligible** to **Low** and the sensitivity of kittiwakes is considered to be **Medium**. The effect will, therefore, be **Not Significant** to **Slight** which is **not significant** in EIA terms.

12.9.9.110 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above.

LITTLE GULL

BREEDING SEASON

12.9.9.111 No little gull collisions were predicted in the breeding season therefore no assessment is required.

NONBREEDING SEASON

MAGNITUDE OF IMPACT DURING THE NONBREEDING SEASON

12.9.9.112 The biogeographic reference population for the breeding season is 75,000 (Table 12.12). An estimate of 44.4 little gulls were predicted to be at collision risk in the nonbreeding season.

12.9.9.113 At the average baseline mortality rate for little gulls of 0.2 (Table 12.13), the number of individuals from the biogeographic population expected to be at risk of mortality during the nonbreeding season is 15,000 (75,000 x 0.2). The addition of 44.4 to this increases the mortality rate by 0.3%. This magnitude of increase in mortality would not materially alter the background mortality of the population and would be undetectable.

12.9.9.114 The collision risk for little gulls during the nonbreeding season would occur throughout the lifetime of the Proposed Development with a high probability. However, since the Irish Sea wintering population is not known with certainty, the magnitude is considered to be Low.

SENSITIVITY OF LITTLE GULL

12.9.9.115 With respect to collision risk with WTG during nonbreeding season, overall little gulls are considered to be of low sensitivity. This is due to a combination of a high tolerance and adaptability to offshore windfarms, high recoverability following cessation of the effect and low conservation value, since SPA connectivity is expected to be Low.

SIGNIFICANCE OF THE EFFECT DURING THE NONBREEDING SEASON

12.9.9.116 Overall, for collision risk with WTG during nonbreeding season the magnitude has been assessed as **Low** and the sensitivity of little gulls is considered to be **Low**. The effect will, therefore, be **Slight adverse** significance, which is **not significant** in EIA terms.

12.9.9.117 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above.

12.9.10 Impact 3 – Project Design Option 2 Collision risk

12.9.10.1 There is a potential risk of collision with the wind turbine rotors and associated infrastructure resulting in injury or fatality to birds which fly through the Array Area whilst foraging for food or commuting between breeding sites and foraging areas. The species screened in and parameters used in the collision risk modelling are provided in section 12.9.8.

12.9.10.2 The species considered further in relation to worst case collision risks are gannet, kittiwake, lesser black-backed gull, great black-backed gull and herring gull. The seasonal collision estimates for these species are presented in Table 12.49.

Table 12.49: Seasonal Collision Risk Estimates for Project Design Option 2. Values are the Mean Number of Predicted Collisions and 95% Confidence Intervals Derived From upper and lower confidence intervals of seabird densities

Species	Breeding season	Autumn migration	Winter	Spring Migration	Nonbreeding	Annual
Arctic tern	4.7 (1-8.2)	0.1 (0-0.2)	0 (0-0.1)	0.6 (0.1-1.3)	0.7 (0.1-1.6)	5.4 (1.1-9.8)
Black-headed gull	0.1 (0-0.3)				23.1 (3.5-46.4)	23.2 (3.5-46.7)
Common gull	2 (0.1-4.6)				117.2 (18.7-234.5)	119.2 (18.8-239.1)
Common tern	6.3 (2.1-10.4)	0.8 (0.2-1.4)		0.5 (0.1-0.9)		7.6 (2.4-12.8)
Fulmar	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)		0 (0-0)
Gannet	0.6 (0-1.4)	0.2 (0-0.6)		0 (0-0.1)		0.9 (0.1-2.2)
Great black-headed gull	0 (0-0)	0 (0-0)	0 (0-0)	1.5 (0.1-3.5)	0 (0-0)	1.5 (0.1-3.5)
Herring gull	0 (0-0)	0.7 (0-1.7)	0 (0-0)	0.7 (0-1.6)	1.3 (0.1-3.2)	1.3 (0.1-3.2)
Kittiwake	16.8 (3.5-31.8)	43.2 (6.3-87.9)		128.7 (37.7-223.6)		188.8 (47.5-343.3)
Lesser black-backed gull	0 (0-0)	0 (0-0)	0 (0-0)	0.6 (0-1.5)		0.6 (0-1.5)
Little gull	0 (0-0)				44.1 (4.7-89.5)	44.1 (4.7-89.5)
Sandwich tern	0.2 (0-0.4)	0.1 (0-0.2)		0 (0-0)	0.1 (0-0.2)	0.3 (0-0.6)

Arctic tern

BREEDING SEASON

MAGNITUDE OF IMPACT DURING THE BREEDING SEASON

12.9.10.3 An estimate of 4.6 Arctic terns were predicted to be at collision risk in the breeding season. The Arctic tern breeding season mean maximum foraging range is estimated as 26 km (Woodward *et al.*, 2019), while the nearest breeding colony SPA to the Array Area for this species is 40 km (Dalkey Islands SPA). Furthermore, the breeding season collision estimate (4.6) was mostly due to the August prediction (4.3) and probably reflects post-breeding passage movements, should be considered against the nonbreeding population. Therefore the BDMPS reference population for the breeding season of 23,637 is considered appropriate for assessment (Table 12.11).

12.9.10.4 At the average baseline mortality rate for Arctic tern of 0.163 (Table 12.13), the number of individuals expected to be at risk of mortality in the breeding season is 3,853 (23,637 x 0.163). The addition of 4.6 individuals to this would increase the mortality rate by 0.12%. increases in mortality of less than 1% are considered undetectable against background variations and therefore this indicates that this level of mortality would be undetectable against natural variation (Parker *et al.* 2022).

12.9.10.5 The collision risk for Arctic terns during the breeding season would occur throughout the lifetime of the Proposed Development with a high probability but would result in an undetectable effect on the population when considered against background variations. Therefore, the magnitude is considered to be Low.

SENSITIVITY OF ARCTIC TERN

12.9.10.6 With respect to collision risk with WTG during breeding season, overall Arctic terns are considered to be of Medium sensitivity. This is due to a combination of a medium tolerance and adaptability to offshore windfarms, high recoverability following cessation of the effect and medium conservation value.

SIGNIFICANCE OF THE EFFECT DURING THE BREEDING SEASON

12.9.10.7 Overall, for collision risk with WTG during breeding season, the magnitude has been assessed as **Low** and the sensitivity of Arctic terns is considered to be **Medium**. The effect will, therefore, **Slight adverse**, which is **not significant** in EIA terms.

12.9.10.8 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above.

AUTUMN MIGRATION

MAGNITUDE OF IMPACT DURING THE AUTUMN MIGRATION

12.9.10.9 An estimate of 0.1 Arctic terns were predicted to be at collision risk in the autumn migration. The BDMPS reference population for the autumn migration period is 69,867 (Table 12.11).

12.9.10.10 At the average baseline mortality rate for Arctic tern of 0.163 (Table 12.12), the number of individuals expected to be at risk of mortality in the autumn migration is 11,388 (69,867 x 0.163). The addition of 0.1 individuals to this would increase the mortality rate by 0.001%. Increases in mortality of less than 1% are considered undetectable against background variations and therefore this indicates that this level of mortality would be undetectable against natural variation (Parker *et al.* 2022).

12.9.10.11 The collision risk for Arctic terns during the autumn migration period season would occur throughout the lifetime of the Proposed Development with a high probability but would result in an undetectable effect on the population when considered against background variations. Therefore, the magnitude is considered to be Negligible.

SENSITIVITY OF ARCTIC TERN

12.9.10.12 With respect to collision risk with WTG during autumn migration, overall Arctic terns are considered to be of Medium sensitivity. This is due to a combination of a low tolerance and adaptability to offshore windfarms, high recoverability following cessation of the effect and medium conservation.

SIGNIFICANCE OF THE EFFECT DURING THE AUTUMN MIGRATION

12.9.10.13 Overall, for collision risk with WTG during autumn migration the magnitude has been assessed as **Negligible** and the sensitivity of Arctic terns is considered to be **Medium**. The effect will, therefore, be **Not Significant** in EIA terms.

12.9.10.14 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above.

SPRING MIGRATION

MAGNITUDE OF IMPACT DURING THE SPRING MIGRATION

12.9.10.15 An estimate of 0.6 Arctic terns were predicted to be at collision risk in the spring migration. The BDMPS reference population for the autumn migration period is 69,867(Table 12.11).

12.9.10.16 At the average baseline mortality rate for Arctic tern of 0.163 (Table 12.12), the number of individuals expected to be at risk of mortality in the spring migration is 11,388 (69,867 x 0.163). The addition of 0.6 individuals to this would increase the mortality rate by 0.005%. Increases in mortality of less than 1% are considered undetectable against background variations and therefore this indicates that this level of mortality would be undetectable against natural variation (Parker *et al.* 2022).

12.9.10.17 The collision risk for Arctic terns during the spring migration period season would occur throughout the lifetime of the Proposed Development with a high probability but would result in an undetectable effect on the population when considered against background variations. Therefore, the magnitude is considered to be Negligible.

SENSITIVITY OF ARCTIC TERNS

12.9.10.18 With respect to collision risk with WTG during spring migration, overall Arctic terns are considered to be of Medium sensitivity. This is due to a combination of a low tolerance and adaptability to offshore windfarms, high recoverability following cessation of the effect and medium conservation.

SIGNIFICANCE OF THE EFFECT DURING THE SPRING MIGRATION

12.9.10.19 Overall, for collision risk with WTG during spring migration the magnitude has been assessed as **Negligible** and the sensitivity of Arctic terns is considered to be **Medium**. The effect will, therefore, be **Not Significant** in EIA terms.

12.9.10.20 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above.

ALL SEASONS

MAGNITUDE OF IMPACT DURING ALL SEASONS

12.9.10.21 An estimate of 5.3 arctic terns were predicted to be at collision risk across all seasons. At the average baseline mortality rate for Arctic terns of 0.163 (Table 12.13), the number of individuals from the largest BDMPS population expected to be at risk of mortality across all seasons is 11,388 (69,867 x 0.163). The addition of 5.3 to this increases the mortality rate by 0.05%. The biogeographic population for arctic terns is 628,000 (Furness, 2015). The number of individuals from the biogeographic population expected to be at risk of mortality across all seasons is 102,364 (628,000 x 0.163). The addition of 5.3 to this increases the mortality rate by 0.005%. Thus, the increase in background mortality is between 0.005% and 0.05%. This magnitude of increase in mortality would not materially alter the background mortality of the population and would be undetectable.

12.9.10.22 The collision risk for Arctic terns during all seasons would occur throughout the lifetime of the Proposed Development with a high probability but would result in an undetectable effect on the population when considered against background variations. Therefore, the magnitude is considered to be Negligible.

SENSITIVITY OF ARCTIC TERNS

12.9.10.23 With respect to collision risk with WTG during all seasons, overall Arctic terns are considered to be of Medium sensitivity. This is due to a combination of a low tolerance and adaptability to offshore windfarms, high recoverability following cessation of the effect and medium conservation.

SIGNIFICANCE OF THE EFFECT DURING ALL SEASONS

12.9.10.24 Overall, for collision risk with WTG throughout the year the magnitude has been assessed as **Negligible** and the sensitivity of Arctic terns is considered to be **Medium**. The effect will, therefore, be **Not Significant** in EIA terms.

12.9.10.25 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above.

Black-headed gull

BREEDING SEASON

12.9.10.26 Almost no black-headed gull collisions were predicted in the breeding season (0.1) therefore this level of impact does not require further assessment and is considered to be **Not Significant** in EIA terms.

12.9.10.27 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above.

NONBREEDING SEASON

MAGNITUDE OF IMPACT DURING THE NONBREEDING SEASON

12.9.10.28 The biogeographic reference population for the nonbreeding season is 4,250,000 (Table 12.12). An estimate of 23.6 black-headed gulls were predicted to be at collision risk in the nonbreeding season.

12.9.10.29 At the average baseline mortality rate for black-headed gulls of 0.175 (Table 12.13), the number of individuals from the biogeographic population expected to be at risk of mortality during the nonbreeding season is 743,750 (4,250,000 x 0.175). The addition of 23.6 to this increases the mortality rate by 0.002%. This magnitude of increase in mortality would not materially alter the background mortality of the population and would be undetectable.

12.9.10.30 Thus, while the proportion of the biogeographic population which is present in the Irish Sea during the winter is not known with certainty, even if only a small percentage (e.g. <5%) of the total wintering population is present, the effect would remain undetectable.

12.9.10.31 The collision risk for black-headed gulls during the nonbreeding season would occur throughout the lifetime of the Proposed Development with a high probability but would result in an undetectable effect on the population when considered against background variations. Therefore, the magnitude is considered to be Negligible.

SENSITIVITY OF BLACK-HEADED GULL

12.9.10.32 With respect to collision risk with WTG during nonbreeding season, overall black-headed gulls are considered to be of Low sensitivity. This is due to a combination of a medium tolerance and adaptability to offshore windfarms, high recoverability following cessation of the effect and low conservation value.

SIGNIFICANCE OF THE EFFECT DURING THE NONBREEDING SEASON

12.9.10.33 Overall, for collision risk with WTG during nonbreeding season the magnitude has been assessed as **Negligible** and the sensitivity of black-headed gulls is considered to be **Low**. The effect will, therefore, be **Not Significant** in EIA terms.

12.9.10.34 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above.

Common gull

BREEDING SEASON

12.9.10.35 An estimate of 1.5 common gulls were predicted to be at collision risk in the breeding season. The biogeographic reference population for common gull is 1,725,000 (Table 12.12). At the average baseline mortality rate for common tern of 0.258 (Table 12.13), the number of individuals expected to be at risk of mortality in the breeding season is 445,050 (1,725,000 x 0.258). The addition of 6.3 individuals to this would increase the mortality rate by <0.001%. increases in mortality of less than 1% are considered undetectable against background variations and therefore this indicates that this level of mortality would be undetectable against natural variation (Parker *et al.* 2022).

12.9.10.36 The collision risk for common gulls during the nonbreeding season would occur throughout the lifetime of the Proposed Development with a high probability. However, since the Irish Sea wintering population is not known with certainty, the magnitude is considered to be Negligible to Low.

SENSITIVITY OF COMMON GULL

12.9.10.37 With respect to collision risk with WTG during nonbreeding season, overall common gulls are considered to be of Low sensitivity. This is due to a combination of a high tolerance and adaptability to offshore windfarms, high recoverability following cessation of the effect and medium conservation value.

SIGNIFICANCE OF THE EFFECT DURING THE BREEDING SEASON

12.9.10.38 Overall, for collision risk with WTG during nonbreeding season the magnitude has been assessed as **Negligible** to **Low** and the sensitivity of common gulls is considered to be **Low**. The effect will, therefore, be **Not Significant** in EIA terms.

12.9.10.39 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above.

NONBREEDING SEASON

MAGNITUDE OF IMPACT DURING THE NONBREEDING SEASON

12.9.10.40 An estimate of 120.4 common gulls were predicted to be at collision risk in the nonbreeding season. The biogeographic reference population for common gull is 1,725,000 (Table 12.12). Common gulls are present throughout the Irish Sea during the nonbreeding period. Jessopp *et al.*, (2018) presented a combined common gull and herring gull estimate (due to the difficulty of separating these species by eye during surveys) of up to 35,000 along the Irish Sea east coast. Large numbers of common gulls migrate from Scandinavia and northern continental Europe to Britain and Ireland during the winter, leading Wright *et al.*, (2012) to estimate the total wintering population (of Britain and Ireland) as 700,000. Although no regional breakdown was provided, this indicates that the population in the Irish Sea in winter is likely to be large, and probably considerably higher than that estimated by Jessopp *et al.*, (2018). If the Irish Sea hosts only 10% or more of the wintering population estimate (i.e. 10% of 700,000 = 70,000), which is very likely to be a precautionary value, then the predicted background mortality of the wintering population would be at least 18,410 at an average mortality rate of 0.258 (Table 12.13). The addition of 120.4 individuals would increase the mortality by less than 1%, which would be considered undetectable (Parker *et al.* 2022).

12.9.10.41 The collision risk for common gulls during the nonbreeding season would occur throughout the lifetime of the Proposed Development with a high However, since the Irish Sea wintering population is not known with certainty, the magnitude is considered to be Negligible to Low.

SENSITIVITY OF COMMON GULL

12.9.10.42 With respect to collision risk with WTG during nonbreeding season, overall common gulls are considered to be of Low sensitivity. This is due to a combination of a high tolerance and adaptability to offshore windfarms, high recoverability following cessation of the effect and medium conservation value.

SIGNIFICANCE OF THE EFFECT DURING THE NONBREEDING SEASON

12.9.10.43 Overall, for collision risk with WTG during nonbreeding season the magnitude has been assessed as **Negligible to Low** and the sensitivity of common gulls is considered to be **Low**. The effect will, therefore, be of **Negligible** to **Slight adverse** significance, which is **not significant** in EIA terms.

12.9.10.44 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above.

Common tern

BREEDING SEASON

MAGNITUDE OF IMPACT DURING THE BREEDING SEASON

12.9.10.45 An estimate of 6.5 common terns were predicted to be at collision risk in the breeding season. The BDMPS reference population for the breeding season is 30,254 (Table 12.11). At the average baseline mortality rate for common tern of 0.263 (Table 12.13), the number of individuals expected to be at risk of mortality in the breeding season is 7,957 (30,254 x 0.263). The addition of 6.5 individuals to this would increase the mortality rate by 0.08%. increases in mortality of less than 1% are considered undetectable against background variations and therefore this indicates that this level of mortality would be undetectable against natural variation (Parker *et al.* 2022).

12.9.10.46 The collision risk for common terns for the breeding season would occur throughout the lifetime of the Proposed Development with a high probability but would result in an undetectable effect on the population when considered against background variations. Therefore, the magnitude is considered to be Negligible.

SENSITIVITY OF COMMON TERN

12.9.10.47 With respect to collision risk with WTG during the breeding season, overall common terns are considered to be of Medium sensitivity. This is due to a combination of a medium tolerance and adaptability to offshore windfarms, high recoverability following cessation of the effect and medium conservation value.

SIGNIFICANCE OF THE EFFECT DURING THE BREEDING SEASON

12.9.10.48 Overall, for collision risk with WTG during breeding season the magnitude has been assessed as **Negligible** and the sensitivity of common terns is considered to be **Medium**. The effect will, therefore, be **Not Significant** in EIA terms.

12.9.10.49 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above.

AUTUMN MIGRATION

MAGNITUDE OF IMPACT DURING THE AUTUMN MIGRATION

12.9.10.50 An estimate of 0.8 common terns were predicted to be at collision risk in the autumn migration. The BDMPS reference population for the autumn migration period is 71,030 (Table 12.11). At the average baseline mortality rate for common tern of 0.263 (Table 12.12), the number of individuals expected to be at risk of mortality in the autumn migration is 18,681 (71,030 x 0.263). The addition of 0.8 individuals to this would increase the mortality rate by 0.004%. Increases in mortality of less than 1% are considered undetectable against background variations and therefore this indicates that this level of mortality would be undetectable against natural variation.

12.9.10.51 The collision risk for common terns during the autumn migration period would occur throughout the lifetime of the Proposed Development with a high probability but would result in an undetectable effect on the population when considered against background variations. Therefore, the magnitude is considered to be Negligible.

SENSITIVITY OF COMMON TERN

12.9.10.52 With respect to collision risk with WTG during autumn migration, overall common terns are considered to be of Medium sensitivity. This is due to a combination of a medium tolerance and adaptability to offshore windfarms, high recoverability following cessation of the effect and medium conservation value.

SIGNIFICANCE OF THE EFFECT DURING THE AUTUMN MIGRATION

12.9.10.53 Overall, for collision risk with WTG during autumn migration the magnitude has been assessed as **Negligible** and the sensitivity of common terns is considered to be **Medium**. The effect will, therefore, be **Not Significant** in EIA terms.

12.9.10.54 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above.

SPRING MIGRATION

MAGNITUDE OF IMPACT DURING THE SPRING MIGRATION

12.9.10.55 An estimate of 0.5 common terns were predicted to be at collision risk in the spring migration. The BDMPS reference population for the autumn migration period is 71,030 (Table 12.11). At the average baseline mortality rate for common tern of 0.263 (Table 12.12), the number of individuals expected to be at risk of mortality in the spring migration is 18,681 (71,030 0.263). The addition of 0.5 individuals to this would increase the mortality rate by 0.003%. Increases in mortality of less than 1% are considered undetectable against background variations and therefore this indicates that this level of mortality would be undetectable against natural variation (Parker *et al.* 2022).

12.9.10.56 The collision risk for common terns during the spring migration period would occur throughout the lifetime of the Proposed Development with a high probability but would result in an undetectable effect on the population when considered against background variations. Therefore, the magnitude is considered to be Negligible.

SENSITIVITY OF COMMON TERNS

12.9.10.57 With respect to collision risk with WTG during spring migration, overall common terns are considered to be of Medium sensitivity. This is due to a combination of a medium tolerance and adaptability to offshore windfarms, high recoverability following cessation of the effect and medium conservation value.

SIGNIFICANCE OF THE EFFECT DURING THE SPRING MIGRATION

12.9.10.58 Overall, for collision risk with WTG during spring migration the magnitude has been assessed as **Negligible** and the sensitivity of common terns is considered to be **Medium**. The effect will, therefore, be **Not Significant** in EIA terms.

12.9.10.59 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above.

ALL SEASONS

MAGNITUDE OF IMPACT DURING ALL SEASONS

12.9.10.60 An estimate of 7.8 common terns were predicted to be at collision risk across all seasons. At the average baseline mortality rate for common terns of 0.263 (Table 12.13), the number of individuals from the largest BDMPS population expected to be at risk of mortality across all seasons is 18,681 (71,030 x 0.263). The addition of 7.8 to this would increase the mortality rate by 0.04%. The biogeographic population for common terns is 480,000 (Furness, 2015). The number of individuals from the biogeographic population expected to be at risk of mortality across all seasons is 126,240 (480,000 x 0.263). The addition of 7.8 to this would increase the mortality rate by 0.006%. Thus, the increase in background mortality is between 0.006% and 0.04%. This magnitude of increase in mortality would not materially alter the background mortality of the population and would be undetectable.

12.9.10.61 The collision risk for common terns during all seasons would occur throughout the lifetime of the Proposed Development with a high probability but would result in an undetectable effect on the population when considered against background variations. Therefore, the magnitude is considered to be Negligible.

SENSITIVITY OF COMMON TERNS

12.9.10.62 With respect to collision risk with WTG during all seasons, overall common terns are considered to be of Medium sensitivity. This is due to a combination of a medium tolerance and adaptability to offshore windfarms, high recoverability following cessation of the effect and medium conservation value.

SIGNIFICANCE OF THE EFFECT DURING ALL SEASONS

12.9.10.63 Overall, for collision risk with WTG throughout the year the magnitude has been assessed as **Negligible** and the sensitivity of common terns is considered to be **Medium**. The effect will, therefore, be **Not Significant** in EIA terms.

12.9.10.64 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above.

Gannet

BREEDING SEASON

MAGNITUDE OF IMPACT DURING THE BREEDING SEASON

12.9.10.65 An estimate of 1.8 gannets were predicted to be at collision risk in the breeding season. The breeding gannet population was estimated to be between 420,257 and 517,233 (Table 12.11). At the average baseline mortality rate for gannets of 0.191 (Table 12.13) the natural mortality for this population is between 80,269 and 98,792. The addition of 1.8 to this would increase the mortality rate by 0.002% which would be undetectable.

12.9.10.66 The impact of collision risk with WTG on gannets during the breeding season, would occur throughout the lifetime of the Proposed Development with a high probability. However, the increase in mortality associated with this impact is considered to have an undetectable effect on the population, therefore the consequence will be very small. Overall therefore, the magnitude is considered to be Negligible.

SENSITIVITY OF THE GANNET

12.9.10.67 With respect to collision risk with WTG during breeding season, overall gannets are considered to be of Medium sensitivity. This is due to a combination of a low tolerance of offshore windfarms but high adaptability due to their large foraging ranges and varied prey, medium recoverability following cessation of the effect and high conservation value since a proportion of the gannets present may be connected to SPA populations.

SIGNIFICANCE OF THE EFFECT DURING THE BREEDING SEASON

12.9.10.68 Overall, for collision risk with WTG during breeding season the magnitude has been assessed as **Negligible** and the sensitivity of gannets is considered to be **Medium**. The effect will, therefore, **be Not Significant** in EIA terms.

12.9.10.69 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above.

AUTUMN MIGRATION

MAGNITUDE OF IMPACT DURING THE AUTUMN MIGRATION

12.9.10.70 An estimate of 0.7 gannets were predicted to be at collision risk in the autumn period. Very large numbers of gannets pass through the Irish Sea on migration and the autumn population was estimated to be 644,745 (Table 12.11). At the average baseline mortality rate for gannets of 0.191 (Table 12.13) the natural mortality for this population is 123,146. The addition of 0.7 to this would increase the mortality rate by <0.001% which would be undetectable.

12.9.10.71 The impact of collision risk with WTG on gannets during the autumn, would occur throughout the lifetime of the Proposed Development with a high probability. However, the increase in mortality associated with this impact is considered to have an undetectable effect on the population, therefore the consequence will be very small. Overall therefore, the magnitude is considered to be Negligible.

SENSITIVITY OF THE RECEPTOR

12.9.10.72 With respect to collision risk with WTG during the autumn, overall gannets are considered to be of Medium sensitivity. This is due to a combination of a low tolerance of offshore windfarms but high adaptability due to their large foraging ranges and varied prey, medium recoverability following cessation of the effect and high conservation value since, as noted above, a proportion of the gannets present may be connected to SPA populations.

SIGNIFICANCE OF THE EFFECT DURING THE AUTUMN MIGRATION

12.9.10.73 Overall, for collision risk with WTG during nonbreeding season the magnitude has been assessed as **Negligible** and the sensitivity of gannets is considered to be **Medium**. The effect will, therefore, be **Not Significant** in EIA terms.

12.9.10.74 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above.

SPRING MIGRATION

MAGNITUDE OF IMPACT DURING THE SPRING MIGRATION

12.9.10.75 An estimate of 0.3 gannets were predicted to be at collision risk in the autumn period. Very large numbers of gannets pass through the Irish Sea on migration and the autumn population was estimated to be 536,011 (Table 12.11). At the average baseline mortality rate for gannets of 0.191 (Table 12.13) the natural mortality for this population is 102,378. The addition of 0.3 to this would increase the mortality rate by <0.001% which would be undetectable.

12.9.10.76 The impact of collision risk with WTG on gannets during the autumn, would occur throughout the lifetime of the Proposed Development with a high probability. However, the increase in mortality associated with this impact is considered to have an undetectable effect on the population, therefore the consequence will be very small. Overall therefore, the magnitude is considered to be Negligible.

SENSITIVITY OF THE RECEPTOR

12.9.10.77 With respect to collision risk with WTG during the spring, overall gannets are considered to be of Medium sensitivity. This is due to a combination of a low tolerance of offshore windfarms but high adaptability due to their large foraging ranges and varied prey, medium recoverability following cessation of the effect and high conservation value since, as noted above, a proportion of the gannets present may be connected to SPA populations.

SIGNIFICANCE OF THE EFFECT DURING THE SPRING MIGRATION

12.9.10.78 Overall, for collision risk with WTG during nonbreeding season the magnitude has been assessed as **Negligible** and the sensitivity of gannets is considered to be **Medium**. The effect will, therefore, be **Not Significant** in EIA terms.

12.9.10.79 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above.

ALL SEASONS

MAGNITUDE OF IMPACT DURING ALL SEASONS

12.9.10.80 An estimate of 2.8 gannets were predicted to be at collision risk across all seasons combined. At the average baseline mortality rate for gannets of 0.191 (Table 12.13), the number of individuals from the larger BDMPS population expected to be at risk of mortality across all seasons is 123,145 (644,745,233 x 0.191). The addition of a maximum of one to this would increase the mortality rate by 0.002%. The biogeographic population for gannets is 1,180,000 (Furness, 2015). The number of individuals from the biogeographic population expected to be at risk of mortality across all seasons is 225,380 (1,180,000 x 0.191). The addition of 2.8 to this increases the mortality rate 0.001%.

12.9.10.81 The impact of collision risk with WTG on gannets during all seasons combined would occur throughout the lifetime of the Proposed Development with a high probability. However, the increase in mortality associated with this impact is considered to have an undetectable effect on the population, therefore the consequence will be very small. Overall therefore, the magnitude is considered to be Negligible.

SENSITIVITY OF THE RECEPTOR

12.9.10.82 With respect to collision risk with WTG during the autumn, overall gannets are considered to be of Medium sensitivity. This is due to a combination of a low tolerance of offshore windfarms but high adaptability due to their large foraging ranges and varied prey, medium recoverability following cessation of the effect and high conservation value since, as noted above, a proportion of the gannets present may be connected to SPA populations.

SIGNIFICANCE OF THE EFFECT DURING ALL SEASONS

12.9.10.83 Overall, for collision risk with WTG during nonbreeding season the magnitude has been assessed as **Negligible** and the sensitivity of gannets is considered to be **Medium**. The effect will, therefore, be **Not Significant** in EIA terms.

12.9.10.84 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above.

Kittiwake

BREEDING SEASON

MAGNITUDE OF IMPACT DURING THE BREEDING SEASON

12.9.10.85 An estimate of 17.9 kittiwakes were predicted to be at collision risk in the breeding season. The BDMPS reference population for the breeding season is between 134,247 and 405,701 (Table 12.11). At the average baseline mortality rate for kittiwake of 0.156 (Table 12.13), the number of individuals expected to be at risk of mortality in the breeding season is between 20,630 and 63,289. The addition of 17.9 individuals to this would increase the mortality rate by between 0.03% to 0.09%. Increases in mortality of less than 1% are considered to be undetectable against background variations (Parker *et al.* 2022).

12.9.10.86 The collision risk for kittiwakes during the breeding season would occur throughout the lifetime of the Proposed Development with a high probability but would result in an undetectable effect on the population when considered against background variations. Therefore, the magnitude is considered to be Negligible.

SENSITIVITY OF KITTIWAKE

12.9.10.87 With respect to collision risk with WTG during breeding season, overall kittiwakes are considered to be of Medium to High sensitivity. This is due to a combination of a low tolerance and adaptability to offshore windfarms, medium recoverability following cessation of the effect and high conservation value since a proportion of the kittiwakes present may be connected to SPA populations.

SIGNIFICANCE OF THE EFFECT DURING THE BREEDING SEASON

12.9.10.88 Overall, for collision risk with WTG during breeding season the magnitude has been assessed as **Negligible** and the sensitivity of kittiwakes is considered to be **Medium** to **High**. The effect will therefore be **Not Significant** in EIA terms.

12.9.10.89 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above.

AUTUMN MIGRATION

MAGNITUDE OF IMPACT DURING THE AUTUMN MIGRATION

12.9.10.90 An estimate of 44.6 kittiwakes were predicted to be at collision risk in the autumn migration. The BDMPS for the autumn migration is 708,156 (Table 12.11).

12.9.10.91 At the average baseline mortality rate for kittiwake of 0.156 (Table 12.12), the number of individuals expected to be at risk of mortality in the autumn migration is 110,472. The addition of 44.6 individuals to this would increase the mortality rate by 0.04%. Increases in mortality of less than 1% are considered undetectable against background variations and therefore this indicates that this level of mortality would be undetectable against natural variation.

12.9.10.92 The collision risk for kittiwakes during the autumn migration period would occur throughout the lifetime of the Proposed Development with a high probability but would result in an undetectable effect on the population when considered against background variations. Therefore, the magnitude is considered to be Negligible.

SENSITIVITY OF KITTIWAKE

12.9.10.93 With respect to collision risk with WTG during autumn migration, overall kittiwakes are considered to be of Medium sensitivity. This is due to a combination of a low tolerance and adaptability to offshore windfarms, medium recoverability following cessation of the effect and high conservation value since a proportion of the kittiwakes present may be connected to SPA populations.

SIGNIFICANCE OF THE EFFECT DURING THE AUTUMN MIGRATION

12.9.10.94 Overall, for collision risk with WTG during autumn migration the magnitude has been assessed as **Negligible** and the sensitivity of kittiwakes is considered to be **Medium**. The effect will, therefore, be **Not Significant** in EIA terms.

12.9.10.95 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above.

SPRING MIGRATION

MAGNITUDE OF IMPACT DURING THE SPRING MIGRATION

12.9.10.96 An estimate of 139.1 kittiwakes were predicted to be at collision risk in the spring migration. The BDMPS for the spring migration is 928,207 (Table 12.11).

12.9.10.97 At the average baseline mortality rate for kittiwake of 0.156 (Table 12.12), the number of individuals expected to be at risk of mortality in the spring migration is 144,800 (928,207 x 0.056). The addition of 139.1 individuals to this would increase the mortality rate by 0.1%. Increases in mortality of less than 1% are considered undetectable against background variations and therefore this indicates that this level of mortality would be undetectable against natural variation (Parker *et al.* 2022).

12.9.10.98 The collision risk for kittiwakes during the spring migration period would occur throughout the lifetime of the Proposed Development with a high probability but would result in an undetectable effect on the population when considered against background variations. Therefore, the magnitude is considered to be Negligible.

SENSITIVITY OF KITTIWAKE

12.9.10.99 With respect to collision risk with WTG during spring migration, overall kittiwakes are considered to be of Medium sensitivity. This is due to a combination of a low tolerance and adaptability to offshore windfarms, medium recoverability following cessation of the effect and high conservation value since a proportion of the kittiwakes present may be connected to SPA populations.

SIGNIFICANCE OF THE EFFECT DURING THE SPRING MIGRATION

12.9.10.100 Overall, for collision risk with WTG during spring migration the magnitude has been assessed as **Negligible** and the sensitivity of kittiwakes is considered to be **Low**. The effect will, therefore, be **Not Significant** in EIA terms.

12.9.10.101 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above.

ALL SEASONS

MAGNITUDE OF IMPACT DURING ALL SEASONS

12.9.10.102 An estimate of 201.6 kittiwakes were predicted to be at collision risk across all seasons. At the average baseline mortality rate for kittiwake of 0.156 (Table 12.13), the number of individuals from the largest BDMPS population expected to be at risk of mortality across all seasons is 144,800 (928,207 x 0.156). The addition of 201.6 to this increases the mortality rate by 0.14%. The biogeographic population for kittiwakes is 5,100,000 (Furness, 2015). The number of individuals from the biogeographic population expected to be at risk of mortality across all seasons is 795,600 (5,100,000 x 0.174). The addition of 201.6 to this increases the mortality rate by 0.03%. Thus, the increase in background mortality is between 0.03% and 0.14%. This magnitude of increase in mortality would not materially alter the background mortality of the population and would be undetectable.

12.9.10.103 The collision risk for kittiwakes during all seasons would occur throughout the lifetime of the Proposed Development with a high probability but would result in an undetectable effect on the population when considered against background variations. Therefore, the magnitude is considered to be Negligible to Low.

SENSITIVITY OF KITTIWAKE

12.9.10.104 With respect to collision risk with WTG across the whole year, overall kittiwakes are considered to be of Medium sensitivity. This is due to a combination of a low tolerance and adaptability to offshore windfarms, medium recoverability following cessation of the effect and high conservation value since a proportion of the kittiwakes present may be connected to SPA populations.

SIGNIFICANCE OF THE EFFECT DURING ALL SEASONS

12.9.10.105 Overall, for collision risk with WTG throughout the year the magnitude has been assessed as **Negligible to Low** and the sensitivity of kittiwakes is considered to be **Medium**. The effect will, therefore, be **Not Significant** to **Slight** which is **not significant** in EIA terms.

12.9.10.106 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above.

Little gull

BREEDING SEASON

12.9.10.107 No little gull collisions were predicted in the breeding season therefore no assessment is required.

NONBREEDING SEASON

MAGNITUDE OF IMPACT DURING THE NONBREEDING SEASON

12.9.10.108 An estimate of 38.7 little gulls were predicted to be at collision risk in the nonbreeding season. The biogeographic reference population for the breeding season is 75,000 (Table 12.12). At the average baseline mortality rate for little gulls of 0.2 (Table 12.13), the number of individuals from the biogeographic population expected to be at risk of mortality during the nonbreeding season is 15,000 (75,000 x 0.2). The addition of 38.7 to this increases the mortality rate by 0.3%. This magnitude of increase in mortality would not materially alter the background mortality of the population and would be undetectable.

12.9.10.109 The collision risk for little gulls during the nonbreeding season would occur throughout the lifetime of the Proposed Development with a high probability. .However, since the Irish Sea wintering population is not known with certainty, the magnitude is considered to be Low.

SENSITIVITY OF LITTLE GULL

12.9.10.110 With respect to collision risk with WTG during nonbreeding season, overall little gulls are considered to be of low sensitivity. This is due to a combination of a high tolerance and adaptability of offshore windfarms, high recoverability following cessation of the effect and low conservation value, since SPA connectivity is expected to be Low.

SIGNIFICANCE OF THE EFFECT DURING THE NONBREEDING SEASON

12.9.10.111 Overall, for collision risk with WTG during nonbreeding season the magnitude has been assessed as **Low** and the sensitivity of little gulls is considered to be **Low**. The effect will, therefore, be **Slight adverse** significance, which is **Not Significant** in EIA terms.

12.9.10.112 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above.

12.9.11 Impact 4 – Project Design Option 1a Barrier effects

Operational and maintenance phase

12.9.11.1 The presence of the wind turbines in the Array Area could potentially create a barrier for seabirds. Birds could be prevented from accessing foraging grounds and the journey to or from foraging grounds could be made more energetically expensive, particularly during the breeding season. As a consequence, the Proposed Development has the potential to result in long-term changes to bird movements.

12.9.11.2 It has been shown that some species (such as divers and scoters) avoid windfarms by making detours around wind turbine arrays which potentially increases their energy expenditure (Petersen *et al*., 2006; Petersen and Fox, 2007; Masden *et al*., 2010, 2012), which under some circumstances could potentially decrease survival chances. Such effects may have a greater impact on birds that regularly commute around a windfarm (e.g. birds heading to/from foraging grounds and roosting/nesting sites) than on migrants that would only have to negotiate around a windfarm once per migratory period, or twice per annum, if flying the same return route (Speakman *et al*., 2009; Masden *et al*., 2012).

MAGNITUDE OF IMPACT

12.9.11.3 During the spring and autumn migration periods, the route taken by migrating individuals may change due to a barrier effect created by the presence of wind turbines within the Array Area of 63.4 km^2. Although migrating birds may have to increase their energy expenditure to circumvent the Array Area at a time when their energy budgets are typically restricted, this effect is likely to be small for one-off avoidances. Masden *et al*., (2010, 2012) and Speakman *et al*., (2009) calculated that the costs of one-off avoidances during migration were small, accounting for less than 2% of available fat reserves. Therefore, the magnitude of the impact on birds that only migrate (including seabirds, waders and waterbirds on passage) through the Array Area can be considered Negligible and these species have been scoped out of further assessment.

12.9.11.4 Outside of passage movement, several bird species could be susceptible to a barrier effect if the presence of wind turbines prevented access to foraging grounds or made the journey to or from foraging grounds more energetically expensive, particularly during the breeding season. Some seabird species recorded within the Array Area including guillemot, razorbill, gannet and kittiwake breed at designated SPA sites (e.g. Wicklow Head, Howth Head Coast, Ireland's Eye, Lambay

Island and Saltee Islands) that are within foraging range of the Array Area and therefore could be susceptible to a barrier effect.

12.9.11.5 Although guillemots are considered to have a high sensitivity to barrier effects (Maclean *et al.*, 2009), they have a medium score (3) for habitat flexibility (Furness and Wade, 2012). Habitat flexibility scores have been used to classify a range of seabird species from 1 (use a wide range of habitats over a large area, and usually with a relatively wide range of foods) to 5 (specialise in using a very limited and predominantly inshore habitat, and generally with a narrow focus on a particular food). A medium score, such as that allocated to guillemots, means that this species has some flexibility in the choice of foraging locations and is not likely to be restricted to foraging only on the shallow Arklow Bank. Due to some flexibility in foraging habitat, the magnitude for guillemots is considered to be Negligible or Low.

12.9.11.6 Gannets and kittiwakes are considered to have a low vulnerability to barrier effects (Maclean *et al.*, 2009), as well as a low habitat flexibility score (1 to 2) so although these species breed within foraging range of the Array Area, they are unlikely to be affected by a windfarm barrier and are likely to forage in a wide range of habitats over a large area. The magnitude for gannets and kittiwakes is therefore, considered to be Negligible.

12.9.11.7 In general, the impact of a windfarm barrier is predicted to be of local spatial extent, long term duration, continuous and high reversibility. It is predicted that the impact will affect seabirds directly. Overall therefore, the magnitude is considered to be Negligible or Low.

SENSITIVITY OF SEABIRDS

12.9.11.8 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). For example, assessment of barrier effects of offshore windfarms in the Forth and Tay area for gannets breeding in the Forth Islands SPA concluded that even in a situation where windfarms were planned in close proximity to the Bass Rock gannet colony, the barrier effect for that population would be negligible (Searle *et al.*, 2014; Searle *et al.*, 2017). Other species such as divers and auks are considered to have a high 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).

12.9.11.9 Due to the proximity of the Array Area to land, some breeding seabird species (i.e. guillemot, gannet and kittiwake) are considered to have a high conservation value (Table 12.10) due to their connectivity with Irish SPA sites designated for breeding birds that are within foraging range of the Array Area (e.g. Wicklow Head, Howth Head Coast, Ireland's Eye, Lambay Island and Saltee Islands). Red-throated divers are also considered to have a high conservation value as they may pass through the Array Area during migration on their way to and from nonbreeding designated sites at Murrough SPA, the Raven SPA and Northern Cardigan Bay SPA.

12.9.11.10 In general, seabirds are deemed to be of low to high vulnerability, medium to high recoverability and medium to high value. The sensitivity of the receptor is therefore, considered to be Low to High.

SIGNIFICANCE OF THE EFFECT

12.9.11.11 Overall, the magnitude of the impact has been assessed as **Negligible** or **Low** and the sensitivity of seabird species is considered to range between **Low** to **High**. The effect will, therefore, be at most **Moderate adverse**. Given the range of species involved, and their varied sensitivities, together with the Project's orientation (parallel to the coast) it is considered that the risk of significant adverse barrier effects is very low and therefore this is **not significant** in EIA terms.

12.9.11.12 No mitigation is proposed for this potential impact, therefore the residual effect remains as stated above.

12.9.12 Impact 4 – Project Design Option 1 (WTG model 1b) Barrier effects

12.9.12.1 All impacts for Impact 4 – Barrier for Project Design Option 1b are identical with those for Project Design Option 1a as the Array Area is not affected by the different Project Design Options, as detailed in section 12.9.11.

12.9.13 Impact 4 – Project Design Option 2 Barrier effects

12.9.13.1 All impacts for Impact 4 – Barrier for Project Design Option 2 are identical with those for Project Design Option 1a as the Array Area is not affected by the different Project Design Options, as detailed in section 12.9.11.

12.10 Cumulative impacts assessment methodology

12.10.1 Methodology

12.10.1.1 The Cumulative Impact Assessment (CIA) takes into account the impacts associated with the Proposed Development together with other proposed and reasonably foreseeable projects, plans and existing and permitted projects. The projects and plans selected as relevant to the CIA presented within this Chapter are based upon the results of a screening exercise (see Volume III, Appendix 3.2: CIA Screening). Each project and plan has been considered on a case by case basis for screening in or out of this chapter's assessment based upon effect-receptor pathways and the spatial/temporal scales involved. This includes consideration of biologically defined minimum population scales (BDMPS, Furness 2015) for nonbreeding periods, and species specific foraging ranges (and tracking studies where available) in the breeding season.

12.10.1.2 This tiered approach is adopted to provide an assessment of the Proposed Development as a whole. The tiering methodology is provided in Volume III, Appendix 3.2: CIA Screening.

12.10.1.3 All marine renewable projects have been screened out as there are none within 75km of the Proposed Development, all are very small in scale and there are no pathways for cumulative effects. All cable projects, dredging operations and coastal developments have been screened out due to their short term, localised effects and absence of cumulative pathways with the Proposed Development.

12.10.1.4 Due to the commitments made by the Developer in respect of the Foreshore Licence FS007339 and Foreshore Licence Application FS007555 (Table 12.20), FS007339 and FS007555 have been screened out of the cumulative impact assessment.

Table 12.50: List of other projects and plans considered within the cumulative impact assessment

Project/Plan	Status	Distance from Array Area (km)	Distance from offshore export cable routes (km)	Description of Project/Plan	Dates of construction (if applicable)	Dates of operation (if applicable)	Overlap with the Proposed Development
Offshore Windfarms							
Tier 1							
ABWP1	Operational	0	0.5	ABWP1, consisting of seven wind turbines at a capacity of 25.2 Megawatt (MW).	2003 to 2004	2004 to ongoing	Screened in due to ongoing impact. Located within the Array Area.
Rhyl Flats	Operational	156.3	155.5	Operational windfarm comprising 25 turbines	N/A	2009 – ongoing	Screened in due to ongoing impact. Located within Irish Sea with potential to contribute to impacts on regional seabird populations
Barrow Offshore Windfarm	Operational	208.6	207.6	Operational windfarm comprising 30 turbines	N/A	2006 to ongoing	Screened in due to ongoing impact. Located within Irish Sea with potential to contribute to impacts on regional seabird populations
Gwynt y Mor Offshore Windfarm	Operational	159	158.1	Operational windfarm comprising 160 turbines	N/A	2015 – ongoing	Screened in due to ongoing impact. Located within Irish Sea with potential to contribute to impacts on regional seabird populations

Project/Plan	Status	Distance from Array Area (km)	Distance from offshore export cable routes (km)	Description of Project/Plan	Dates of construction (if applicable)	Dates of operation (if applicable)	Overlap with the Proposed Development
North Hoyle	Operational	170.9	170.1	Operational windfarm comprising 30 turbines	N/A	2003 – ongoing	Screened in due to ongoing impact. Located within Irish Sea with potential to contribute to impacts on regional seabird populations
Walney Extension	Operational	187.1	186.1	Operational windfarm comprising 47 turbines	N/A	2018 – ongoing	Screened in due to ongoing impact. Located within Irish Sea with potential to contribute to impacts on regional seabird populations
Burbo Bank	Operational	189.9	189.0	Operational windfarm comprising 25 turbines	N/A	2007 – ongoing	Screened in due to ongoing impact. Located within Irish Sea with potential to contribute to impacts on regional seabird populations
Burbo Bank Extension	Operational	180.6	179.8	Operational windfarm comprising 32 turbines	N/A	2017-ongoing	Screened in due to ongoing impact. Located within Irish Sea with potential to contribute to impacts on regional seabird populations

Project/Plan	Status	Distance from Array Area (km)	Distance from offshore export cable routes (km)	Description of Project/Plan	Dates of construction (if applicable)	Dates of operation (if applicable)	Overlap with the Proposed Development
Robin Rigg Offshore Windfarm	Operational	247.3	246.3	Operational windfarm comprising 58 turbines	N/A	2010 – ongoing	Screened in due to ongoing impact. Located within Irish Sea with potential to contribute to impacts on regional seabird populations
West of Duddon Sands Offshore Windfarm	Operational	196.9	195.9	Operational windfarm comprising 108 turbines	N/A	2014 – ongoing	Screened in due to ongoing impact. Located within Irish Sea with potential to contribute to impacts on regional seabird populations
Walney Offshore Windfarm	Operational	199.1	198.1	Operational windfarm comprising 102 turbines	N/A	2010 – ongoing	Screened in due to ongoing impact. Located within Irish Sea with potential to contribute to impacts on regional seabird populations
Ormonde	Operational	207.4	206.4	Operational windfarm comprising 30 turbines	N/A	2012 – ongoing	Screened in due to ongoing impact. Located within Irish Sea with potential to contribute to impacts on regional seabird populations
Tier 2							

Project/Plan	Status	Distance from Array Area (km)	Distance from offshore export cable routes (km)	Description of Project/Plan	Dates of construction (if applicable)	Dates of operation (if applicable)	Overlap with the Proposed Development
Erebus Offshore Windfarm	Consented	133.3	132.7	Consented for up to 7 turbines	2025-2027	From 2028	Potential for overlap with Proposed Development construction and operational and maintenance phases
Awel y Mor Offshore Windfarm	Consented	148.5	147.6	Consented for up to 50 turbines	2026-2030	From 2031	Potential for overlap with Proposed Development construction and operational and maintenance phases
Twin Hub Offshore Windfarm	Consented	256.2	255.6	Floating test site with 4 turbines	2026	2027	Potential for overlap with Proposed Development construction and operational and maintenance phases.
Tier 3							
ABWP1	Decommissioning	0	0.5	ABWP1, consisting of seven wind turbines at a capacity of 25.2 MW.	2026	NA	Screened in due to potential for overlap between decommissioning of ABWP1 and construction of ABWP2.
Mona Offshore Windfarm	Proposed	146.7	145.7	English Round 4 project with up to 107 turbines	2026-2027	From 2028	Potential for overlap with Proposed Development

Project/Plan	Status	Distance from Array Area (km)	Distance from offshore export cable routes (km)	Description of Project/Plan	Dates of construction (if applicable)	Dates of operation (if applicable)	Overlap with the Proposed Development
							construction and operational and maintenance phases
Morgan Offshore Windfarm	Proposed	165.3	164.3	English Round 4 project with up to 96 turbines	2028-2029	From 2030	Potential for overlap with Proposed Development construction and operational and maintenance phases
Morecambe Offshore Windfarm	Proposed	174.2	173.3	English Round 4 project with up to 40 turbines	2026-2029	From 2030	Potential for overlap with Proposed Development construction and operational and maintenance phases
Valorous Offshore Windfarm	Proposed	141.9	141.3	Early stage planning	2029	From 2030	Potential overlap of operational and maintenance phases.
Phase 1 Projects							
Codling Wind Park (formerly known as Codling I and Codling II)	Proposed	18.2	17.3	'Relevant Project'. Application expected to be made under the Maritime Area Planning (MAP) Act 2021. 60 to 70 WTGs and up to three OSPs.	2026-2028	From 2029	Potential for overlap with Proposed Development construction and operational and maintenance phases.

Project/Plan	Status	Distance from Array Area (km)	Distance from offshore export cable routes (km)	Description of Project/Plan	Dates of construction (if applicable)	Dates of operation (if applicable)	Overlap with the Proposed Development
Dublin Array (formerly known as Bray and Kish Offshore Windfarms)	Proposed	25.8	24.9	‘Relevant Project’. Application expected to be made under the MAP Act 2021.	2028-2032	From 2033	Potential for overlap with Proposed Development construction and operational and maintenance phases.
North Irish Sea Array	Proposed	65.1	64.1	‘Relevant Project’. Application expected to be made under the MAP Act 2021.	2027-2029	From 2030	Potential for overlap with Proposed Development construction and operational and maintenance phases.
Oriel Wind Park	Proposed	108.1	107.2	‘Relevant Project’. Application expected to be made under the MAP Act 2021.	2026-2028	From 2029	Potential for overlap with Proposed Development construction and operational and maintenance phases.

12.10.1.5 Table 12.51 presents the potential impacts, development phase, and the list of projects / plans with which the two Project Design Options have been cumulatively assessed.

Table 12.51: Cumulative assessment impacts, phases, scenarios, and projects to be considered cumulatively

<table>
<tr><th rowspan="2">Potential cumulative impact</th><th colspan="3">Phase</th><th rowspan="2">Cumulative impact scenario</th><th rowspan="2">Justification</th></tr>
<tr><th>C</th><th>O</th><th>D</th></tr>
<tr><td>Disturbance and displacement</td><td>✓</td><td>✓</td><td>✓</td><td>Both Project Design Options were assessed as identical for this impact and are assessed cumulatively with the following windfarms:
Construction/decommissioning phase
Phase 1 Projects
• Codling;
• Dublin Array;
• North Irish Sea Array; and
• Oriel
Operational and maintenance phase
Tier 1
• ABWP1;
• Barrow;
• Burbo Bank;
• Burbo Bank Extension;
• Gwynt y Mor;
• North Hoyle;
• Ormonde;
• Rhyl Flats;
• Robin Rigg;
• Walney;
• Walney Extension; and
• West of Duddon Sands.
Operational and maintenance phase
Tier 2:
• Awel y Mor;
• Erebus; and
• Twin Hub.
Operational and maintenance phase
Tier 3:
• ABWP1 (decommissioning);
• Mona;
• Morecambe;
• Morgan; and
• Valorous.
Operational and maintenance phase
Phase 1 Projects
• Codling;
• Dublin Array;
• North Irish Sea Array; and</td><td>Outcome of the CIA will be greatest when the greatest number of other windfarms are considered</td></tr>
</table>

Potential cumulative impact	Phase C	O	D	Cumulative impact scenario	Justification
				• Oriel.	
Indirect disturbance and displacement resulting from changes to prey and habitats	✓	✓	✓	Both Design Options were assessed as identical for this impact and are assessed cumulatively with the following windfarms: **Construction/decommissioning phase Phase 1 Projects** • Codling; • Dublin Array; • North Irish Sea Array; and • Oriel **Operational and maintenance phase Tier 1** • ABWP1; • Barrow; • Burbo Bank; • Burbo Bank Extension; • Gwynt y Mor; • North Hoyle; • Ormonde; • Rhyl Flats; • Robin Rigg; • Walney; • Walney Extension; and • West of Duddon Sands. **Operational and maintenance phase Tier 2:** • Awel y Mor; • Erebus; and • Twin Hub. **Operational and maintenance phase Tier 3:** • ABWP1 (decommissioning); • Mona; • Morecambe; • Morgan; and • Valorous. **Operational and maintenance phase Phase 1 Projects** • Codling; • Dublin Array; • North Irish Sea Array; and • Oriel.	Outcome of the CIA will be greatest when the greatest number of other windfarms are considered
Collision risk	×	✓	×	**Operational and maintenance phase Tier 1** • ABWP1;	Outcome of the CIA will be greatest when the greatest number

Potential cumulative impact	Phase C O D	Cumulative impact scenario	Justification
		• Barrow; • Burbo Bank; • Burbo Bank Extension; • Gwynt y Mor; • North Hoyle; • Ormonde; • Rhyl Flats; • Robin Rigg; • Walney; • Walney Extension; and • West of Duddon Sands. **Operational and maintenance phase Tier 2:** • Awel y Mor; • Erebus; and • Twin Hub. **Operational and maintenance phase Tier 3:** • Mona; • Morecambe; • Morgan; and • Valorous. **Operational and maintenance phase Phase 1 Projects** • Codling; • Dublin Array; • North Irish Sea Array; and • Oriel.	of other windfarms are considered

12.10.1.6 Both Project Design Options (1 and 2) and associated parameters identified in Table 12.14 and Table 12.15 have been assessed for the potential to result in cumulative effects on identified receptors or receptor groups.

12.10.1.7 Barrier effects have not been included in the cumulative assessment since potential impacts for migration movements were scoped out (section 12.9.11.3) and the location of the Proposed Development, when considered alongside the other proposed Irish Sea windfarms and the location of seabird breeding colonies, would not be expected to combine with other projects to produce a cumulative barrier effect during the breeding or nonbreeding seasons.

12.11 Cumulative impact assessment

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

12.11.1.2 It is understood that applications for the Codling, Dublin Array, North Irish Sea Array and Oriel projects (collectively referred to here as the other Phase 1 projects) are being prepared. While the application materials for these were not available when this EIAR was prepared, data has been shared between the projects to permit cumulative assessment. Assessment has been conducted on the basis of the information provided. Furthermore, it has been agreed between the projects that it would not be appropriate to present impact estimates for each other's proposed developments in advance of applications being submitted. Therefore for each species and impact assessed, a combined total representing the impact for the other Phase 1 projects has been presented in this cumulative assessment to be added to those for the Proposed Development.

12.11.2 Impact 5 – Cumulative disturbance and displacement

Construction phase

TIER 1

12.11.2.1 Tier 1 projects are operational and therefore there is no cumulative construction effect with the Proposed Development.

TIER 2

12.11.2.2 Vessel and helicopter movements associated with construction of the Proposed Development, together with vessel and helicopter movements associated with the construction of other consented offshore windfarms in the Irish Sea, may contribute to cumulative disturbance and displacement if the periods of construction of different projects overlap. Other Tier 2 projects screened into the assessment within the Cumulative Offshore Ornithology Study Area include Erebus, Awel y Mor and Twin Hub (Table 12.50).

TIER 3

12.11.2.3 Vessel and helicopter movements associated with construction of the Proposed Development, together with vessel and helicopter movements associated with the construction of other offshore windfarms in the Irish Sea, may contribute to cumulative disturbance and displacement if the periods of construction of different projects overlap. Tier 2 projects (above) and additional Tier 3 projects screened into the assessment within the Cumulative Offshore Ornithology Study Area include ABWP1 (decommissioning), Mona, Morgan, Morecambe and Valorous (Table 12.50).

PHASE 1 PROJECTS

12.11.2.4 Vessel and helicopter movements associated with construction of the Proposed Development, together with vessel and helicopter movements associated with the construction of other offshore windfarms in the Irish Sea, may contribute to cumulative disturbance and displacement if the periods of construction of different projects overlap. Tier 2 and 3 projects (above and additional Phase 1 projects screened into the assessment within the Cumulative Offshore Ornithology Study Area include Codling Wind Park, Dublin Array, North Irish Sea Array and Oriel (Table 12.50).

12.11.2.5 The species assessed for project-alone construction displacement impacts in section 12.9.2 were red-throated diver, guillemot and razorbill; these species have been assessed for cumulative effects.

12.11.2.6 Since this impact is highly dependent on the extent of temporal overlap across projects, in the absence of construction timelines it is not possible to undertake a detailed quantitative assessment. Details of export cable routes are also not available for the other projects therefore only the Array Area have been considered. A highly precautionary approach would be to assume complete overlap in construction for all projects, while the best case 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 proposed developments.

12.11.2.7 The Project-alone assessment of construction disturbance and displacement from the Array Area was conducted on the basis that the source of impact will be the centre(s) of construction activity within the windfarm (i.e. locations where turbine foundations and towers will be installed). The estimates for use in this assessment were derived from the density of birds recorded within the windfarm array. These densities are not available for the other windfarms, thus it is not possible to conduct quantitative cumulative assessment using the same approach.

MAGNITUDE OF IMPACT

12.11.2.8 The Proposed Development alone was predicted to have a Not Significant impact based on both Project Design Options due to construction disturbance and displacement (sections 12.9.2, 12.9.3 and 12.9.4). Given the local spatial extent and short term duration of the impact the magnitude is considered to be Negligible to Low for both Project Design Options.

12.11.2.9 Assessed cumulatively with the projects set out in Table 12.51, the impact is predicted to be of regional spatial extent, short term duration, occurring during only comparatively short periods at each windfarm, including decommissioning of ABWP1. Any consequent increase in mortality associated with this cumulative impact is considered to have undetectable effects on the populations, therefore the consequence will be very small. The magnitude is therefore, considered to be Negligible to Low for both Project Design Options, depending on the degree of overlap across projects (from none to complete), and given the nature of the impacts it is considered that there is a very low risk of a cumulative effect for red-throated divers, guillemot and razorbill.

SENSITIVITY OF RED-THROATED DIVER, GUILLEMOT AND RAZORBILL

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

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

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

SIGNIFICANCE OF THE EFFECT

12.11.2.13 Overall, the cumulative magnitude of the impact for both Project Design Options is deemed to be **Negligible** to **Low** and the sensitivity of red-throated diver, guillemot and razorbill is considered to be **High**. The effect will, therefore, be **Negligible** to **Moderate adverse** significance, depending on the degree of overlap in construction across projects. However, overall it is considered that the likelihood that the construction phases for each of these projects will completely overlap is sufficiently small that there will not be a significant effect in EIA terms.

Operational and maintenance phase

TIER 1

12.11.2.14 The presence of operating wind turbines and maintenance activities (including vessel and helicopter movements) associated with the Proposed Development, together with that associated with other offshore windfarms in the Irish Sea, may contribute to cumulative disturbance and displacement if the operational phases of different projects overlap. Other Tier 1 projects screened into the assessment within the Cumulative Offshore Ornithology Study Area include operational projects in English and Welsh jurisdictions of the Irish Sea: Barrow, Burbo Bank, Burbo Bank Extension, Gwynt Y Mor, North Hoyle, Ormonde, Rhyl Flats, Robin Rigg, Walney, Walney Extension and West of Duddon Sands (Table 12.50).

TIER 2

12.11.2.15 The presence of operating wind turbines and maintenance activities (including vessel and helicopter movements) associated with the Proposed Development, together with that associated with other offshore windfarms in the Irish Sea, may contribute to cumulative disturbance and displacement if the operational phases of different projects overlap. In addition to Tier 1 projects (above), other Tier 2 projects screened into the assessment within the Cumulative Offshore Ornithology Study Area include operational projects in English and Welsh jurisdictions of the Irish Sea in addition to Arklow Bank Wind Park 2, Awel y Mor, Erebus and Twin Hub (Table 12.50).

TIER 3

12.11.2.16 The presence of operating wind turbines and maintenance activities (including vessel and helicopter movements) associated with the Proposed Development, together with that associated with other offshore windfarms in the Irish Sea, may contribute to cumulative disturbance and displacement if the operational phases of different projects overlap. In addition to Tier 1 and 2 projects (above), other Tier 3 projects screened into the assessment within the Cumulative Offshore Ornithology Study Area include operational projects in English and Welsh jurisdictions of the Irish Sea in addition to Arklow Bank Wind Park 2, ABWP1 (decommissioning), Mona, Morgan, Morecambe and Valorous (Table 12.50).

PHASE 1 PROJECTS

12.11.2.17 The presence of operating wind turbines and maintenance activities (including vessel and helicopter movements) associated with the Proposed Development, together with that associated with other offshore windfarms in the Irish Sea, may contribute to cumulative disturbance and displacement if the operational phases of different projects overlap. In addition to Tier 1, 2 and 3 projects (above), Phase 1 projects screened into the assessment within the Cumulative Offshore Ornithology Study Area include operational projects in English and Welsh jurisdictions of the Irish Sea in addition to Arklow Bank Wind Park 2, Codling Wind Park, Dublin Array, North Irish Sea Array and Oriel (Table 12.50).

12.11.2.18 The species assessed for project alone operational displacement impacts were red-throated diver, gannet, guillemot and razorbill; these species have been assessed for cumulative effects.

12.11.2.19 The level of data available and the practicality of combining disturbance and displacement impacts across windfarms is quite variable, reflecting the availability of relevant data for older projects and changes in the approach to assessment. Wherever possible the cumulative assessment is quantitative (i.e. where data in an appropriate format have been obtained). Where this has not been possible (e.g. for older projects), or proposed projects for which no data are currently available, a qualitative assessment has been undertaken. Through consultation between the Irish Phase One developers, it has been agreed to share ornithological data in order to enable each project to undertake a quantitative cumulative assessment. However, until these projects submit their final applications there is the potential that design changes may result in changes to their estimated impacts. Therefore the cumulative assessment presented here should be considered on the basis that it has used the correct values available at the time it was written, but that the figures used may have subsequently changed.

RED-THROATED DIVER

MAGNITUDE OF IMPACT

12.11.2.20 The Proposed Development alone was predicted to have a Not Significant impact based on both Project Design Options due to displacement during operation. The magnitude is considered to be Negligible to Low for both Project Design Options.

12.11.2.21 The estimates of the total numbers of red-throated divers at risk of displacement from other offshore windfarms in the Irish Sea are included in Table 12.52 where red-throated divers have been reported. The totals omit windfarms for which no data were available, but they are also likely to over-estimate the numbers present due to the precautionary use of seasonal peak numbers at each site rather than average numbers, which is likely to lead to double counting as birds move through the Irish waters. For UK windfarms no seasonal figures could be found in the relevant reports, therefore only annual figures are presented.

Table 12.52: Cumulative numbers of Red-throated divers at risk of displacement from offshore windfarms in the Irish sea

Tier	Windfarm	Breeding season	Autumn migration	Nonbreeding season	Spring migration	Annual
1	ABWP1	-	-	-	-	-
1	Gwynt y Mor	-	-	-	-	35
1	Rhyl Flats	-	-	-	-	24
1	Burbo Bank	-	-	-	-	11
1	Burbo Bank Extension	-	-	-	-	30
1	North Hoyle	-	-	-	-	-
1	Walney Extension	-	-	-	-	53
1	West of Duddon Sands	-	-	-	-	-
1	Walney	-	-	-	-	-
1	Ormonde	-	-	-	-	-
1	Barrow	-	-	-	-	-
1	Robin Rigg	-	-	-	-	-
2	Awel-y-Mor	-	-	-	-	47*
2	Erebus	-	-	-	-	-
3	Morgan	-	-	-	-	-

Tier	Windfarm	Breeding season	Autumn migration	Nonbreeding season	Spring migration	Annual
3	Morecambe	-	-	-	-	3
3	Mona	-	-	-	-	-
	Total UK	**-**	**-**	**-**	**-**	**203**
	Other Phase 1 Projects	14	63	207	184	468
	ABWP2 (Design Options 1 and 2)	35	45	165	130	375
	Total Ireland	**49**	**108**	**372**	**316**	**843**
	Total (Ireland + UK)	**49**	**108**	**372**	**316**	**1046**

** 47 red-throated diver reported within the array plus 8 km buffer*

12.11.2.22 The estimated annual cumulative total of red-throated divers at risk of displacement from the Proposed Development is 375 individuals, which rises to 1,046 individuals when including the Irish and UK Projects (Table 12.52).

12.11.2.23 Considering a range of displacement of 90 to 100%, and mortality of displaced individuals from 1 to 10%, the estimated number of red-throated divers subject to mortality from displacement throughout the year is between nine and 105 (Table 12.53).

Table 12.53: Cumulative Annual Displacement Matrix for Red-throated divers

Mortality (%)	Displacement (%)									
	10	20	30	40	50	60	70	80	90	100
1	1	2	3	4	5	6	7	8	9	10
2	2	4	6	8	10	13	15	17	19	21
3	3	6	9	13	16	19	22	25	28	31
4	4	8	13	17	21	25	29	33	38	42
5	5	10	16	21	26	31	37	42	47	52
6	6	13	19	25	31	38	44	50	56	63
7	7	15	22	29	37	44	51	59	66	73
8	8	17	25	33	42	50	59	67	75	84
9	9	19	28	38	47	56	66	75	85	94
10	10	21	31	42	52	63	73	84	94	105
20	21	42	63	84	105	126	146	167	188	209
30	31	63	94	126	157	188	220	251	282	314
50	52	105	157	209	262	314	366	418	471	523
75	78	157	235	314	392	471	549	628	706	785
100	105	209	314	418	523	628	732	837	941	1046

12.11.2.24 At the average baseline mortality rate for red-throated divers of 0.228 (Table 12.13), the number of individuals from the larger BDMPS population expected to be at risk of mortality across all seasons is 2,899 (12,717 x 0.228). The addition of a maximum of 105 to this would increase the mortality rate by 3.6%, while the evidence-based estimate of nine would be for an increase in mortality of 0.3%. The biogeographic population for red-throated divers is 27,000 (Furness, 2015). The number of individuals from the biogeographic population expected to be at risk of mortality across all seasons is 6,156 (27,000 x 0.228). The addition of 105 to this increases the mortality rate by 1.7%, while the evidence-based estimate would be for an increase on mortality of 0.15%. If displacement mortality is no more than 6% this would result in an undetectable increase.

12.11.2.25 For both reference populations the maximum predicted increase in mortality rate is greater than the 1% threshold of detectability. However, at a more realistic, but still precautionary mortality rate of 3% the additional mortality for the BDMPS would be within the 1% threshold, and the equivalent maximum displacement mortality rate for the biogeographic population would be 6%.

12.11.2.26 Therefore, given that the 1% threshold is only exceeded through a combination of highly precautionary assumptions about displacement (100% displacement and 10% mortality), it is considered that cumulative operational displacement of red-throated diver summed across the entire nonbreeding period would have an undetectable effect on the population.

12.11.2.27 A significant proportion of the Irish Sea population of red-throated divers will be expected to be at risk of displacement effects due to the presence of offshore windfarms (882 / 10573 = 8%). The effect will last for the lifetime of the projects (assuming no habituation occurs) and on the basis of current best evidence about this species the effect is considered highly likely to occur. If mortality of displaced birds is as high as 10% then this could have a detectable effect on the population, however while several studies have found evidence for high levels of displacement, there is no evidence that affected birds experience elevated mortality as a consequence. Indeed, recent work indicates individuals of this species have a reasonable degree of flexibility to accommodate disturbance and even in mid-winter are not needing to forage at the likely limit of their capacity in order to meet their energy requirements (Thompson *et al.* 2023). Thus, the population consequences of displacement on the population are expected to be much lower than the mortality at 10% suggests.

12.11.2.28 Therefore, when assessed cumulatively with the projects set out in Table 12.51 and assuming a lower displacement mortality rate (e.g. no more than 3%) the magnitude of cumulative impact is considered to be no more than Low for both Project Design Options.

SENSITIVITY OF RED-THROATED DIVERS

12.11.2.29 With respect to operational disturbance and displacement including all seasons, overall red-throated divers are considered to be of Medium sensitivity (see section 12.9.2.150). This is due to a combination of low adaptability and tolerance to disturbance, medium recoverability following cessation of the effect and medium conservation value since, as noted above, a proportion of the red-throated divers present may be connected to SPA populations.

SIGNIFICANCE OF THE EFFECT

12.11.2.30 Overall, for the cumulative operational disturbance and displacement across all seasons the cumulative magnitude has been assessed as **Low** for both Project Design Options and the sensitivity of red-throated divers is considered to be **Medium**. The effect will, therefore, be **Slight adverse**, which is **not significant** in EIA terms.

GANNET

MAGNITUDE OF IMPACT

12.11.2.31 The Proposed Development alone was predicted to have a Not Significant impact based on both Project Design Options due to displacement during operation. The magnitude is considered to be Negligible for both Project Design Options.

12.11.2.32 The estimates of the total numbers of gannets at risk of displacement from other offshore windfarms in the Irish Sea are included in Table 12.54. These totals omit windfarms for which no data are available (as indicated in the table), but they are also likely to over-estimate the numbers present due to the precautionary use of seasonal peak numbers at each site rather than average numbers, which is likely to lead to double counting as birds move through the Irish Sea. For UK windfarms no seasonal figures could be found in the relevant reports, therefore only annual figures are presented.

Table 12.54: Cumulative numbers of Gannets at risk of displacement from offshore windfarms in the Irish sea

Tier	Windfarm	Breeding season	Autumn migration	Spring migration	Annual
1	ABWP1	-	-	-	-
1	Gwynt y Mor	-	-	-	-
1	Rhyl Flats	-	-	-	-
1	Burbo Bank Extension	-	-	-	429
1	North Hoyle	-	-	-	-
1	Walney Extension	-	-	-	1348
1	West of Duddon Sands	-	-	-	-
1	Walney	-	-	-	-
1	Burbo Bank	-	-	-	-
1	Ormonde	-	-	-	-
1	Barrow	-	-	-	-
1	Robin Rigg	-	-	-	-
2	Awel-y-Mor	-	-	-	528
2	Twin Hub	-	-	-	-

Tier	Windfarm	Breeding season	Autumn migration	Spring migration	Annual
2	Erebus	-	-	-	658
3	Morgan	-	-	-	454
3	Morecambe	-	-	-	912
3	Mona	-	-	-	693
	Total UK	**-**	**-**	**-**	**5022**
	Other Phase 1 Projects	1207	874	193	2274
	Proposed Development	90	40	30	160
	Total Ireland	**1297**	**914**	**223**	**2434**
	Total (Ireland + UK)	**1297**	**914**	**223**	**7456**

12.11.2.33 The estimated annual cumulative total of gannets at risk of displacement from the Proposed Development is 160 individuals, which rises to 7,456 individuals when including the Irish and UK Projects (Table 12.54).

12.11.2.34 Considering a range of displacement of 60 to 80%, and mortality of displaced individuals of 1%, the estimated number of gannets subject to mortality from displacement throughout the year is predicted to be between 45 and 60 (Table 12.55).

Table 12.55: Cumulative Annual Displacement Matrix for Gannets

Mortality (%)	Displacement (%)									
	10	20	30	40	50	60	70	80	90	100
1	7	15	22	30	37	45	52	60	67	75
2	15	30	45	60	75	89	104	119	134	149
3	22	45	67	89	112	134	157	179	201	224
4	30	60	89	119	149	179	209	239	268	298
5	37	75	112	149	186	224	261	298	336	373
6	45	89	134	179	224	268	313	358	403	447
7	52	104	157	209	261	313	365	418	470	522
8	60	119	179	239	298	358	418	477	537	596
9	67	134	201	268	336	403	470	537	604	671
10	75	149	224	298	373	447	522	596	671	746
20	149	298	447	596	746	895	1044	1193	1342	1491
30	224	447	671	895	1118	1342	1566	1789	2013	2237
50	373	746	1118	1491	1864	2237	2610	2982	3355	3728
75	559	1118	1678	2237	2796	3355	3914	4474	5033	5592

Mortality (%)	Displacement (%)									
	10	20	30	40	50	60	70	80	90	100
100	746	1491	2237	2982	3728	4474	5219	5965	6710	7456

12.11.2.35 At the average baseline mortality rate for gannets of 0.191 (Table 12.13), the number of individuals from the larger BDMPS population expected to be at risk of mortality across all seasons is 123,146 (644,745 x 0.191). The addition of a maximum of 60 to this would increase the mortality rate by 0.05%. The biogeographic population for gannets is 1,180,000 (Furness, 2015). The number of individuals from the biogeographic population expected to be at risk of mortality across all seasons is 225,380 (1,180,000 x 0.191). The addition of 60 to this increases the mortality rate 0.03%. Both of these increases in mortality are below the 1% threshold of detectability (Parker *et al.* 2022).

12.11.2.36 It is evident that loss of up to 60 gannets from these populations would not materially alter the background mortality of the population and would be undetectable. The cumulative impact of displacement and disturbance from offshore infrastructure on gannets is predicted to last for the lifetime of the projects (assuming no habituation occurs) and on the basis of current best evidence about this species the effect is considered highly likely to occur. It is predicted that the impact will affect the receptor directly. In contrast to the observed levels of displacement, there is no strong evidence that affected birds experience elevated mortality as a consequence.

12.11.2.37 Therefore, when assessed cumulatively with the projects set out in Table 12.51 the magnitude of cumulative impact is considered to be Low for both Project Design Options.

SENSITIVITY OF GANNETS

12.11.2.38 The cumulative effect on gannets is expected to last the duration of the projects, and most of the individuals affected are likely to be drawn from SPA populations and therefore gannets are of high conservation value. Gannets are also considered to have a low tolerance of offshore windfarms but high adaptability due to their large foraging ranges and varied prey. Population recovery will be expected to occur in the medium term following cessation of the effect. Therefore, overall, with respect to cumulative operational disturbance and displacement throughout the year, gannet is considered to be of Medium sensitivity.

SIGNIFICANCE OF THE EFFECT

12.11.2.39 Overall, for the cumulative operational disturbance and displacement across all seasons the magnitude has been assessed as **Low** for both design options and the sensitivity of gannet is considered to be **Medium**. The effect will, therefore, be **Slight adverse** which is **not significant** in EIA terms.

GUILLEMOT

MAGNITUDE OF IMPACT

12.11.2.40 The Proposed Development alone was predicted to have a Not Significant impact based on both Project Design Options due to displacement during operation. The magnitude is considered to be Negligible for both Project Design Options.

12.11.2.41 The estimates of the total numbers of guillemots at risk of displacement from offshore windfarms in the Irish Sea are included in Table 12.56. These totals omit windfarms for which no data are available (as indicated in the table), but they are also likely to over-estimate the numbers present due to the precautionary use of seasonal peak numbers at each site rather than average numbers, which is likely to lead to double counting as birds move through the Irish Sea. For UK windfarms no seasonal figures could be found in the relevant reports, therefore only annual figures are presented.

Table 12.56: Cumulative numbers of Guillemots at risk of displacement from offshore windfarms in the Irish sea

Tier	Windfarm	Breeding season	Nonbreeding season	Annual
1	ABWP1	-	-	-
1	Gwynt y Mor	-	-	
1	Rhyl Flats	-	-	
1	Burbo Bank Extension	-	-	3448
1	North Hoyle	-	-	
1	Walney Extension	-	-	6093
1	West of Duddon Sands	-	-	833
1	Walney	-	-	-
1	Burbo Bank	-	-	-
1	Ormonde	-	-	238
1	Barrow	-	-	-
1	Robin Rigg	-	-	28
2	Awel-y-Mor	-	-	4488
2	Twin Hub	-	-	-
2	Erebus	-	-	35339
3	Morgan	-	-	8994
3	Morecambe	-	-	11697
3	Mona	-	-	11912
	Total UK	**-**	**-**	**83070**
	Phase 1 Projects	**36834**	**47776**	**84610**

Tier	Windfarm	Breeding season	Nonbreeding season	Annual
	Proposed Development	3117	5768	8885
	Total Ireland	**39951**	**53544**	**93495**
	Total (Ireland + UK)	**39951**	**53544**	**176565**

12.11.2.42 The estimated annual cumulative total of guillemot at risk of displacement from the Proposed Development is 8,885 individuals, which rises to 176,565 individuals when including the Irish and UK Projects (Table 12.56).

12.11.2.43 Considering a range of displacement of 30 to 70%, and mortality of displaced individuals from 1 to 10%, the estimated number of guillemots subject to mortality from displacement throughout the year is between 530 and 12,360, with an evidence based estimate (50% displaced. 1% mortality) of 883 (Table 12.57).

Table 12.57: Cumulative Annual Displacement Matrix for Guillemots

Mortality (%)	Displacement (%)									
	10	20	30	40	50	60	70	80	90	100
1	177	353	530	706	883	1059	1236	1413	1589	1766
2	353	706	1059	1413	1766	2119	2472	2825	3178	3531
3	530	1059	1589	2119	2648	3178	3708	4238	4767	5297
4	706	1413	2119	2825	3531	4238	4944	5650	6356	7063
5	883	1766	2648	3531	4414	5297	6180	7063	7945	8828
6	1059	2119	3178	4238	5297	6356	7416	8475	9535	10594
7	1236	2472	3708	4944	6180	7416	8652	9888	11124	12360
8	1413	2825	4238	5650	7063	8475	9888	11300	12713	14125
9	1589	3178	4767	6356	7945	9535	11124	12713	14302	15891
10	1766	3531	5297	7063	8828	10594	12360	14125	15891	17657
20	3531	7063	10594	14125	17657	21188	24719	28250	31782	35313
30	5297	10594	15891	21188	26485	31782	37079	42376	47673	52970
50	8828	17657	26485	35313	44141	52970	61798	70626	79454	88283
75	13242	26485	39727	52970	66212	79454	92697	105939	119181	132424
100	17657	35313	52970	70626	88283	105939	123596	141252	158909	176565

12.11.2.44 At the average baseline mortality rate of 0.140 (Table 12.13) the number of individuals expected to die from the nonbreeding population in a year is 219,445 (1,567,463 x 0.140). The addition of between 530 and 12,360 to this would increase the mortality rate by 0.2% to 5.6%, while using the more realistic, but still precautionary estimate of 883 individuals the background mortality rate would increase by 0.4%. Based on the annual biogeographic population with connectivity to UK waters of 4,125,000 (Furness 2015), 577,500 individuals would be expected to die; the addition of between 530 and 12,360 to this would increase the mortality rate by 0.09%

to 2.1%, while using the more realistic, but still precautionary estimate of 883 the background mortality rate would increase by 0.15%.

12.11.2.45 A detailed review of the potential effects of displacement from offshore windfarms on auks (Norfolk Vanguard Ltd 2019) acknowledged that the impact of displacement of razorbills and guillemots by offshore windfarms is uncertain. However, the review also found that on the basis of existing information, annual mortality of adults (including impacts of existing human activities) is very low (10% and 6% per annum respectively), and that displacement of razorbills and guillemots by offshore windfarms is likely to be incomplete, may reduce with habituation, and that offshore windfarms may in the long-term increase food availability to guillemots and razorbills through providing enhanced habitat for fish populations. This suggests that impacts of displacement from offshore windfarms are unlikely to represent levels of mortality anywhere near to the 6% or 10% total annual mortality that occurs due to the combination of many natural factors plus existing human activities. Consequently, this evidence-based review recommended a precautionary maximum displacement rate of 50% for auks within an offshore windfarm and 30% within a 1km buffer, and what was considered a highly precautionary maximum mortality rate of 1%. Therefore, on the basis of these robust but highly precautionary displacement and mortality rates, this would result in an increase in background mortality of less than 1% in the Irish Sea population.

12.11.2.46 The cumulative operational disturbance and displacement effect will last for the lifetime of the projects (assuming no habituation occurs) and on the basis of current best evidence about this species the effect is considered highly likely to occur. The best available evidence indicates that additional mortality will be less than 1% (see above). Thus, the population consequences of displacement on the population are expected to be undetectable.

12.11.2.47 Therefore, when assessed cumulatively with the projects set out in Table 12.51 the magnitude of cumulative impact is considered to be Low to Medium for both Project Design Options.

SENSITIVITY OF GUILLEMOTS

12.11.2.48 The effect on guillemots is expected to last the duration of the projects, and the individuals affected are likely to be drawn from both SPA and non-SPA populations and therefore guillemots are of medium conservation value. Recent monitoring studies have indicated guillemots are quite tolerant of wind turbines (MacArthur Green 2023) and this can also be seen in the distribution of guillemots around the existing ABWP1 turbines (Volume III, Appendix 12.8 Technical Report – Seabird Spatial Distribution Maps). Population recovery will be expected to occur in the medium term following cessation of the effect. Therefore, overall, with respect to cumulative operational disturbance and displacement throughout the year, guillemot is considered to be of Medium sensitivity.

SIGNIFICANCE OF THE EFFECT

12.11.2.49 Overall, for the cumulative operational disturbance and displacement across all seasons the magnitude has been assessed as **Low** to **Medium** for both Project Design Options and the sensitivity of guillemot is considered to be **Medium**. The cumulative effect will, therefore, be of **Slight** to **Moderate adverse** significance, which is **not significant** in EIA terms.

RAZORBILL

MAGNITUDE OF IMPACT

12.11.2.50 The Proposed Development alone was predicted to have a Not Significant impact based on both Project Design Options due to displacement during operation. The magnitude is considered to be Negligible for both Project Design Options.

12.11.2.51 The estimates of the total numbers of razorbills at risk of displacement from other offshore windfarms in the Irish Sea are included in Table 12.58. These totals omit windfarms for which no data are available (as indicated in the table), but they are also likely to over-estimate the numbers present due to the precautionary use of seasonal peak numbers at each site rather than average numbers, which is likely to lead to double counting as birds move through the Irish Sea. For UK windfarms no seasonal figures could be found in the relevant reports, therefore only annual figures are presented.

Table 12.58: Cumulative numbers of Razorbills at risk of displacement from offshore windfarms in the Irish sea

Tier	Windfarm	Breeding season	Autumn migration	Nonbreeding season	Spring migration	Annual
1	ABWP1	-	-	-	-	-
1	Gwynt y Mor	-	-	-	-	455
1	Rhyl Flats	-	-	-	-	-
1	Burbo Bank Extension	-	-	-	-	93
1	North Hoyle	-	-	-	-	2354
1	Walney Extension	-	-	-	-	9933
1	West of Duddon Sands	-	-	-	-	-
1	Walney	-	-	-	-	-
1	Burbo Bank	-	-	-	-	360
1	Ormonde	-	-	-	-	-
1	Barrow	-	-	-	-	-
1	Robin Rigg	-	-	-	-	7
2	Awel-y-Mor	-	-	-	-	692
2	Twin Hub	-	-	-	-	-
2	Erebus	-	-	-	-	3867

Tier	Windfarm	Breeding season	Autumn migration	Nonbreeding season	Spring migration	Annual
3	Morgan	-	-	-	-	622
3	Morecambe	-	-	-	-	1881
3	Mona	-	-	-	-	2883
	Total UK	**-**	**-**	**-**	**-**	**23147**
	Phase 1 Projects	**2264**	**10763**	**3512**	**2229**	**18768**
	Proposed Development	217	2382	2201	4207	9007
	Total Ireland	**2481**	**13145**	**5713**	**6436**	**27775**
	Total (Ireland + UK)	**2481**	**13145**	**5713**	**6436**	**50922**

12.11.2.52 The estimated annual cumulative total of razorbills at risk of displacement from the Proposed Development is 9,007 individuals, which rises to 50,922 individuals when including the Irish and UK Projects (Table 12.58).

12.11.2.53 Considering a range of displacement of 30 to 70%, and mortality of displaced individuals from 1 to 10%, the estimated number of razorbills subject to mortality from displacement throughout the year is between 153 and 3,565, with the evidence based estimate (50% displaced. 1% mortality) of 255 (Table 12.59).

Table 12.59: Cumulative Annual Displacement Matrix for Razorbills

Mortality (%)	Displacement (%)									
	10	20	30	40	50	60	70	80	90	100
1	51	102	153	204	255	306	356	407	458	509
2	102	204	306	407	509	611	713	815	917	1018
3	153	306	458	611	764	917	1069	1222	1375	1528
4	204	407	611	815	1018	1222	1426	1630	1833	2037
5	255	509	764	1018	1273	1528	1782	2037	2291	2546
6	306	611	917	1222	1528	1833	2139	2444	2750	3055
7	356	713	1069	1426	1782	2139	2495	2852	3208	3565
8	407	815	1222	1630	2037	2444	2852	3259	3666	4074
9	458	917	1375	1833	2291	2750	3208	3666	4125	4583
10	509	1018	1528	2037	2546	3055	3565	4074	4583	5092
20	1018	2037	3055	4074	5092	6111	7129	8148	9166	10184
30	1528	3055	4583	6111	7638	9166	10694	12221	13749	15277
50	2546	5092	7638	10184	12731	15277	17823	20369	22915	25461

Mortality (%)	Displacement (%)									
	10	20	30	40	50	60	70	80	90	100
75	3819	7638	11457	15277	19096	22915	26734	30553	34372	38192
100	5092	10184	15277	20369	25461	30553	35645	40738	45830	50922

12.11.2.54 At the average baseline mortality rate of 0.174 (Table 12.13) the number of individuals expected to die annually from the largest of the BDMPS populations is 111,826 (642,676 x 0.174). The addition of between 153 and 3,565 to this would increase the mortality rate by 0.1% to 3.2%, while using the more realistic, but still precautionary estimate of 255 individuals the background mortality rate would increase by 0.2%. Based on the annual biogeographic population with connectivity to UK waters of 1,707,000 (Furness 2015), 297,018 individuals would be expected to die; the addition of between 153 and 3,565 to this would increase the mortality rate by <0.1% to 1.2%, while using the more realistic, but still precautionary estimate of 255 the background mortality rate would increase by 0.08%.

12.11.2.55 A detailed review of the potential effects of displacement from offshore windfarms on auks (Norfolk Vanguard Ltd 2019) acknowledged that the impact of displacement of razorbills and guillemots by offshore windfarms is uncertain. However, the review found that on the basis of existing information, annual mortality of adults (including impacts of existing human activities) is very low (10% and 6% per annum respectively), and that displacement of razorbills and guillemots by offshore windfarms is likely to be incomplete, may reduce with habituation, and that offshore windfarms may in the long-term increase food availability to guillemots and razorbills through providing enhanced habitat for fish populations. This suggests that impacts of displacement from offshore windfarms are unlikely to represent levels of mortality anywhere near to the 6% or 10% total annual mortality that occurs due to the combination of many natural factors plus existing human activities. Consequently, this evidence-based review recommended a precautionary maximum displacement rate of 50% for auks within an offshore windfarm and 30% within a 1km buffer, and what was considered a highly precautionary maximum mortality rate of 1%. Therefore, on the basis of these robust but highly precautionary displacement and mortality rates, this would result in an increase in background mortality of less than 1% in the Irish Sea population.

12.11.2.56 The cumulative operational disturbance and displacement effect will last for the lifetime of the projects (assuming no habituation occurs) and on the basis of current best evidence about this species the effect is considered highly likely to occur. The best available evidence indicates that additional mortality will be less than 1% (see above). Thus, the population consequences of displacement on the population are expected to be undetectable.

12.11.2.57 Therefore, when assessed cumulatively with the projects set out in Table 12.51 the magnitude of cumulative impact is considered to be Low to Medium for both Project Design Options.

SENSITIVITY OF RAZORBILLS

12.11.2.58 The effect on razorbills is expected to last the duration of the projects, and the individuals affected are likely to be drawn from both SPA and non SPA populations and therefore razorbills are of medium conservation value. Recent monitoring studies have indicated razorbills are quite tolerant of wind turbines (MacArthur Green 2023) and this can also be seen in the distribution of razorbills around the existing ABWP 1 turbines (Tech Annex 12.08). Population recovery will be expected to occur in the medium term following cessation of the effect. Therefore, overall, with respect to cumulative operational disturbance and displacement throughout the year, razorbill is considered to be of Medium sensitivity.

SIGNIFICANCE OF THE EFFECT

12.11.2.59 Overall, for the cumulative operational disturbance and displacement across all seasons the magnitude has been assessed as **Low** to **Medium** for both Project Design Options and the sensitivity of razorbills are considered to be **Medium**. The cumulative effect will, therefore, be of **Slight** to **Moderate adverse** significance, which is **not significant** in EIA terms.

Decommissioning phase

12.11.2.60 The Rehabilitation Schedule sets out the process for decommissioning. This proposes decommissioning which is largely a reversal of construction and will take place over a period of up to two years. It is assumed the same would apply to other windfarms considered in this cumulative assessment.

12.11.2.61 During the decommissioning phase, direct disturbance and displacement of red-throated divers, gannet, guillemots and razorbills is likely to occur due to the presence of working vessels and crews and the movement and noise associated with these within the Array Area.

MAGNITUDE OF IMPACT

12.11.2.62 Any effects generated from the cumulative impact of disturbance and displacement from increased vessel activity during the decommissioning phase are expected to be similar, or of reduced magnitude, to those generated during the construction phase, as certain activities such as piling would not be required. This is because it would largely involve a reverse of the construction phase through the removal of structures and materials installed. It is anticipated that all structures above the seabed level will be completely removed, with cables and any scour/cable protection to be left in situ. The decommissioning sequence will generally be the reverse of the construction sequence and involve similar types and numbers of vessels and equipment.

12.11.2.63 Such activities have already been assessed in the cumulative construction section above and have been found to be of Low or Negligible magnitude.

12.11.2.64 As for the construction phase, the cumulative impact of displacement and disturbance is predicted to be of local spatial extent, short term duration, continuous and high reversibility. It is predicted that the impact will affect seabirds directly. The magnitude is therefore, considered to be Negligible.

SENSITIVITY OF SEABIRDS

12.11.2.65 As for the construction phase, gannets, razorbills, guillemots and red-throated divers are deemed to be of medium to high vulnerability, medium to high recoverability and high value. The sensitivity of the receptors is therefore, considered to be Medium to High.

SIGNIFICANCE OF THE EFFECT

12.11.2.66 The magnitude of the cumulative impact has been assessed as **Negligible** and the sensitivity of seabird species is considered to range between **Medium** to **High**. The effect will, therefore, be **Not Significant** in EIA terms.

12.11.3 Impact 6 – Cumulative Indirect disturbance and displacement resulting from changes to prey species and habitats

Construction phase

ALL TIERS

12.11.3.1 The potential cumulative effects on benthic invertebrates and fish have been assessed in Chapter 10: Benthic Subtidal and Intertidal Ecology and Chapter 10: Fish, Shellfish and Sea Turtle

Ecology. The main fish prey species considered in this EIAR to be important to seabirds include herring, sprat and sandeel (refer to Chapter 10: Fish, Shellfish and Sea Turtle Ecology).

12.11.3.2 The conclusions of the cumulative assessments in Chapter 9: Benthic Subtidal and Intertidal Ecology and Chapter 10: Fish, Shellfish and Sea Turtle Ecology inform this assessment of indirect cumulative effects on ornithological receptors.

MAGNITUDE OF IMPACT

12.11.3.3 The Proposed Development alone was predicted to have a Not Significant impact based on both Project Design Options due to indirect disturbance and displacement resulting from changes to prey species and habitats. The magnitude is considered to be Negligible for both Project Design Options.

12.11.3.4 Construction activities associated with the Proposed Development, together with that associated with other offshore windfarms in the Irish Sea, may contribute to cumulative indirect disturbance and displacement resulting from changes to prey species and habitats, in the event construction phases of different projects overlap, including decommissioning of ABWP1. Other projects screened into the assessment within the Cumulative Offshore Ornithology Study Area include Codling Wind Park, Dublin Array, North Irish Sea Array and Oriel.

12.11.3.5 The potential for a cumulative effect on these species during construction would only occur if projects within the Cumulative Offshore Ornithology Study Area assessed overlap in their construction activity.

12.11.3.6 As a worst case, it is assumed that the construction schedule of the Proposed Development will overlap with that for other windfarms within the Cumulative Offshore Ornithology Study Area. However, since the likelihood of a significant effect for the Proposed Development alone was determined to be very small, it is assumed that this conclusion also applies cumulatively.

12.11.3.7 The cumulative impact indirect effects of displacement and disturbance caused by construction activities and associated vessel traffic on seabirds is predicted to be of local spatial extent, short term duration, occurring only once but with a high probability. However, the increase in mortality associated with this impact is considered to have an undetectable effect on the population, therefore the consequence will be very small.

12.11.3.8 Therefore, when assessed cumulatively with the projects set out in Table 12.51, the magnitude of cumulative impact is considered to be Negligible for both Project Design Options.

SENSITIVITY OF SEABIRDS

12.11.3.9 With respect to indirect construction disturbance, overall seabirds are considered to be of Low to High sensitivity. This is due to combinations of low to high adaptability and low to high tolerance, predicted rapid recoverability following cessation of the effect and medium to high conservation value since.

SIGNIFICANCE OF THE EFFECT

12.11.3.10 Overall, for the cumulative indirect construction disturbance the magnitude of the impact has been assessed as **Negligible** for both Project Design Options and the sensitivity of seabird species is considered to range between **Low** to **High**. The effect will, therefore, be **Not Significant** in EIA terms.

Operational and maintenance phase

ALL TIERS

12.11.3.11 Birds may be indirectly disturbed and displaced during the operational and maintenance phase if there are direct impacts on prey species and the habitats of prey species.

12.11.3.12 During operation, the production of underwater noise (e.g. through the turning of the wind turbines), loss of habitat, EMF and the generation of suspended sediments (e.g. due to scour or maintenance activities) that may alter the behaviour or availability of bird prey species. Underwater noise and EMF may cause fish and mobile invertebrates to avoid the operational area and also affect their physiology and behaviour. Suspended sediments may cause fish and mobile invertebrates to avoid the operational area and may smother and hide immobile benthic prey. These mechanisms could result in less prey being available within the operational area to foraging seabirds. Changes in fish and invertebrate communities due to the presence of hard substrate (resulting in colonisation by epifauna and provision of novel habitat providing shelter for fish and invertebrates) may also occur, and changes in fishing activity could influence the communities present.

12.11.3.13 Such potential cumulative effects on benthic habitats and fish have been assessed in Chapter 9: Benthic Subtidal and Intertidal Ecology and Chapter 10: Fish, Shellfish and Sea Turtle Ecology. The main fish prey species considered in this EIAR to be important to seabirds include herring, sprat and sandeel (refer to Chapter 10: Fish, Shellfish and Sea Turtle Ecology).

12.11.3.14 The conclusions of the cumulative assessments in Chapter 9: Benthic Subtidal and Intertidal Ecology and Chapter 10: Fish, Shellfish and Sea Turtle Ecology inform this assessment of indirect effects on ornithological receptors.

MAGNITUDE OF IMPACT

12.11.3.15 The Proposed Development alone was predicted to have a Not Significant impact based on both Project Design Options due to indirect disturbance and displacement resulting from changes to prey species and habitats. The magnitude is considered to be Negligible for both Project Design Options.

12.11.3.16 The presence and maintenance of the Proposed Development, together with the presence and maintenance of other offshore windfarms in the Irish Sea, may contribute to cumulative indirect disturbance and displacement resulting from changes to prey species and habitats, in the event the operational phases of different projects overlap. Other projects screened into the assessment within the Cumulative Offshore Ornithology Study Area include operational projects in English and Welsh jurisdictions of the Irish Sea in addition to ABWP1, Codling Wind Park, Dublin Array, North Irish Sea Array and Oriel (Table 12.46). It is understood that applications for the Codling, Dublin Array, North Irish Sea Array and Oriel projects are being prepared, although the application material is not available at this time. As such, it has not been possible to undertake a fully quantitative CIA for these projects.

12.11.3.17 The conclusion on the potential for indirect effects for the Proposed Development alone was that this would be imperceptible or slight adverse. This conclusion was based on factors such as the highly localised nature of EMF and the absence of evidence from operational windfarms for indirect effects on seabirds due to prey changes. This is considered to be equally applicable cumulatively.

12.11.3.18 Therefore, when assessed cumulatively with the projects set out in Table 12.51 the magnitude of cumulative impact is considered to be Negligible for both Project Design Options.

SENSITIVITY OF SEABIRDS

12.11.3.19 As for during construction, seabirds are deemed to be of low to high vulnerability, medium to high recoverability and medium to high value. The sensitivity of the receptor is therefore, considered to be Low to High.

SIGNIFICANCE OF THE EFFECT

12.11.3.20 Overall, for the cumulative indirect operational disturbance the magnitude of the impact has been assessed as **Negligible** for both Project Design Options and the sensitivity of seabird species is considered to range between **Low** to **High**. The effect will, therefore be **Not Significant** in EIA terms.

Decommissioning phase

12.11.3.21 The Rehabilitation Schedule sets out the process for decommissioning. This makes it clear that decommissioning is largely a reversal of construction and will take place over a period of up to two years. It is assumed the same would apply to other windfarms considered in this cumulative assessment.

12.11.3.22 During the decommissioning phase, indirect effects at the Proposed Development alone, such as displacement of seabird prey species, may occur as structures are removed from the Array Area.

12.11.3.23 As a worst case, it is assumed that the decommissioning schedule of the Proposed Development will overlap with that for other windfarms within the Cumulative Offshore Ornithology Study Area. However, since the likelihood of a significant effect for the Proposed Development alone was determined to be very small, it is assumed that this conclusion also applies cumulatively.

MAGNITUDE OF IMPACT

12.11.3.24 As for the construction phase, the cumulative impact of displacement and disturbance is predicted to be of local spatial extent, short term duration, continuous and high reversibility. It is predicted that the impact will affect seabirds indirectly. The magnitude is therefore, considered to be Negligible.

SENSITIVITY OF SEABIRDS

12.11.3.25 As for the construction phase, seabirds are deemed to be of low to high vulnerability, medium to high recoverability and medium to high value. The sensitivity of the receptor is therefore, considered to be Low to High.

SIGNIFICANCE OF THE EFFECT

12.11.3.26 The magnitude of the cumulative impact has been assessed as **Negligible** and the sensitivity of seabird species is considered to range between **Low** to **High**. The effect will, therefore, be **Not Significant** in EIA terms.

12.11.4 Impact 7 – Cumulative collision risk

Operational and Maintenance Phase

TIER 1

12.11.4.1 The Proposed Development, together with other offshore windfarms in the Irish Sea, may contribute to cumulative collision risk, in the event the operational phases of different projects overlap. Seabirds are highly mobile, therefore they can encounter offshore windfarms, and be at risk of collisions, across large areas. Other Tier 1 projects screened into the assessment within the Cumulative Offshore Ornithology Study Area include operational projects in English and Welsh jurisdictions of the Irish Sea in addition to ABWP1, Barrow, Burbo Bank, Burbo Bank Extension, Gwynt y Mor, North Hoyle, Ormonde, Rhyl Flats, Robin Rigg, Walney, Walney Extension and West of Duddon Sands (Table 12.50).

TIER 2

12.11.4.2 The Proposed Development, together with other offshore windfarms in the Irish Sea, may contribute to cumulative collision risk, in the event the operational phases of different projects overlap. Seabirds are highly mobile, therefore they can encounter offshore windfarms, and be at risk of collisions, across large areas. In addition to Tier 1 projects (above) other Tier 2 projects screened into the assessment within the Cumulative Offshore Ornithology Study Area include consented projects in English and Welsh jurisdictions of the Irish Sea Awel y Mor, Erebus and Twin Hub (Table 12.50).

TIER 3

12.11.4.3 The Proposed Development, together with other offshore windfarms in the Irish Sea, may contribute to cumulative collision risk, in the event the operational phases of different projects overlap. Seabirds are highly mobile, therefore they can encounter offshore windfarms, and be at risk of collisions, across large areas. Other projects screened into the assessment within the Cumulative Offshore Ornithology Study Area in addition to Tiers 1 and 2 include proposed projects in English and Welsh jurisdictions of the Irish Sea Mona, Morgan, Morecambe and Valorous (Table 12.50).

PHASE 1 PROJECTS

12.11.4.4 The Proposed Development, together with other offshore windfarms in the Irish Sea, may contribute to cumulative collision risk, in the event the operational phases of different projects overlap. Seabirds are highly mobile, therefore they can encounter offshore windfarms, and be at risk of collisions, across large areas. Other projects screened into the assessment within the Cumulative Offshore Ornithology Study Area in addition to Tiers 1, 2 and 3 include proposed projects in the Irish Sea Codling, Dublin Array, North Irish Sea Array and Oriel(Table 12.50).

12.11.4.5 Collision risks at the Proposed Development alone were assessed for Arctic tern, black-headed gull, common gull, common tern, gannet, great black-backed gull, kittiwake and little gull. Other seabird species were either recorded in very low numbers, or have flight characteristics (e.g. fly below rotor height) which put them at very low risk, and therefore were predicted to be at negligible or zero risk of collisions.

12.11.4.6 Collision estimates are only available for some of the above species for some of the English and Welsh windfarms. These are collated in Table 12.47. No collision estimates could be obtained for the Barrow, Burbo Bank, Gwynt-y-Mor, North Hoyle, Rhyl Flats, Walney and West of Duddon Sands windfarms. Only annual total estimates were presented for most other windfarms, therefore the annual totals have been assessed below. Consequently assessment has only been possible for common gull, common tern, gannet and kittiwake.

12.11.4.7 The use of Band models is selected on a project-by-project basis. As advocated by SNCBs in the UK, results from Band option 2 (which uses generic flight height data from Johnston *et al.* 2014a) is presented for all projects.

12.11.4.8 It is considered that all of the windfarms identified for inclusion in the cumulative assessment in Table 12.50 (overview) have the potential to contribute to a cumulative effect.

COMMON GULL

MAGNITUDE OF IMPACT

12.11.4.9 The Proposed Development alone was predicted to have a Not Significant impact based on both Project Design Options due to collision risks. The impact magnitude is considered to be Negligible to Low for both Project Design Options.

12.11.4.10 The estimated annual cumulative total of common gull at risk of collisions from the Proposed Development are 117. 2 (design option 1a), 137.0 (Project Design Option 1b) and 119.2 (Project Design Option 2) , which rise to 179.3 to 199.1 individuals when including the Irish and UK Projects (Table 12.60).

Table 12.60 Cumulative annual collision risk for common gull using the highest collision predictions for all Project Design Options

Tier	Windfarm	Breeding season	Nonbreeding	Annual
1	ABWP1	-	-	-
1	Gwynt y Mor	-	-	-
1	Rhyl Flats	-	-	-
1	Burbo Bank Extension	-	-	-
1	North Hoyle	-	-	-
1	Walney Extension	-	-	36
1	West of Duddon Sands	-	-	-
1	Walney	-	-	-
1	Burbo Bank	-	-	-
1	Ormonde	-	-	-
1	Barrow	-	-	-
1	Robin Rigg	-	-	-
2	Awel-y-Mor	-	-	0.1
2	Twin Hub	-	-	-
2	Erebus	-	-	-
3	Morgan	-	-	-
3	Morecambe	-	-	3.4
3	Mona	-	-	-
	Total UK	**0**	**0**	**39.5**

Tier	Windfarm	Breeding season	Nonbreeding	Annual
	Phase 1 Projects			22.6
	Proposed Development – Project Design Option 1a	1.9	115.3	117.2
	Proposed Development – Project Design Option 1b	2.2	134.8	137.0
	Proposed Development – Project Design Option 2	2.0	117.2	119.2
	Total Ireland	**1.9-2.2**	**115.3-134.8**	**139.8-159.6**
	Total Ireland and UK	**1.9-2.2**	**115.3-134.8**	**179.3-199.1**

12.11.4.11 The biogeographic reference population for common gull is 1,725,000 (Table 12.12). An estimate of 202.7 common gulls were predicted to be at collision risk throughout the year, primarily due to impacts in the nonbreeding season. Common gulls are present throughout the Irish Sea during the nonbreeding period. Jessopp *et al.*, (2018) presented a combined common gull and herring gull estimate (due to the difficulty of separating these species by eye during surveys) of up to 35,000 along the Irish Sea east coast (Jessopp *et al.*, 2018). Large numbers of common gulls migrate from Scandinavia and northern continental Europe to Britain and Ireland during the winter, leading Wright *et al.*, (2012) to estimate the total wintering population (of Britain and Ireland) as 700,000. Although no regional breakdown was provided, this indicates that the population in the Irish Sea in winter is likely to be large, and probably considerably higher than indicated by the number estimated by Jessopp *et al.*, (2018). If the Irish Sea hosts only 15% or more of the wintering population estimate (i.e. 15% of 700,000 = 105,000), which is very likely to be a precautionary value, then the predicted background mortality of the wintering population would be at least 27,090 at an average mortality rate of 0.258 (Table 12.13). The addition of 202.7 individuals would increase the mortality by less than 1%, which would be considered undetectable.

12.11.4.12 The collision risk for common gulls during the nonbreeding season would occur throughout the lifetime of the Proposed Development with a high However, since the Irish Sea wintering population is not known with certainty, the magnitude is considered to be Negligible to Low.

12.11.4.13 Therefore, the increase in mortality is not predicted to materially alter the background mortality of the population and would be undetectable. The cumulative impact of collisions is predicted to be of international spatial extent, long term duration, continuous and high reversibility. Overall therefore, when assessed cumulatively with the projects set out in Table 12.51 the magnitude is considered to be Negligible to Low for all Project Design Options.

SENSITIVITY OF THE COMMON GULL

12.11.4.14 With respect to collision risk with WTG during nonbreeding season, overall common gulls are considered to be of Low sensitivity. This is due to a combination of a high tolerance and adaptability of offshore windfarms, high recoverability following cessation of the effect and medium conservation value.

SIGNIFICANCE OF THE EFFECT

12.11.4.15 Overall, for the cumulative collision risk across all seasons the magnitude has been assessed as **Negligible** to **Low** for all Project Design Options and the sensitivity of common gulls is considered to be **Low**. The effect will, therefore, be **Slight adverse** which is **not significant** in EIA terms.

COMMON TERN

MAGNITUDE OF IMPACT

12.11.4.16 The Proposed Development alone was predicted to have a Not Significant impact based on both Project Design Options due to collision risks. The impact magnitude is considered to be Negligible to Low for both Project Design Options.

12.11.4.17 The estimated annual cumulative total of common terns at risk of collisions from the Proposed Development are 7. 2 (Project Design Option 1a), 8.6 (Project Design Option 1b) and 7.6 (Project Design Option 2) , which rise to 22.3 to 23.7 individuals when including the Irish and UK projects (Table 12.61).

Table 12.61: Cumulative annual collision risk for common terns using the highest collision predictions for all Project Design Options

Tier	Windfarm	Breeding season	Autumn migration	Winter migration	Spring migration	Annual
1	ABWP1	-	-	-	-	-
1	Gwynt y Mor	-	-	-	-	-
1	Rhyl Flats	-	-	-	-	-
1	Burbo Bank Extension	-	-	-	-	9.00
1	North Hoyle	-	-	-	-	-
1	Walney Extension	-	-	-	-	-
1	West of Duddon Sands	-	-	-	-	-
1	Walney	-	-	-	-	-
1	Burbo Bank	-	-	-	-	-
1	Ormonde	-	-	-	-	-
1	Barrow	-	-	-	-	-
1	Robin Rigg	-	-	-	-	-
2	Awel-y-Mor	-	-	-	-	0.20
2	Twin Hub	-	-	-	-	-
2	Erebus	-	-	-	-	-

Tier	Windfarm	Breeding season	Autumn migration	Winter migration	Spring migration	Annual
3	Morgan	-	-	-	-	-
3	Morecambe	-	-	-	-	0.17
3	Mona	-	-	-	-	-
	Total UK	**0**	**0**	**0**	**0**	**9.4**
	Phase 1 Projects	2.7	2.9	0	0.17	5.7
	Proposed Development – Project Design Option 1a	6.0	0.7		0.5	7.2
	Proposed Development – Project Design Option 1b	7.2	0.9		0.6	8.6
	Proposed Development – Project Design Option 2	6.3	0.8		0.5	7.6
	Total Ireland	**8.7-9.9**	**3.6-3.8**		**0.67-0.77**	**12.9-14.3**
	Total Ireland and UK					**22.3-23.7**

12.11.4.18 At the average baseline mortality rate for common terns of 0.263 (Table 12.13), the number of individuals from the largest BDMPS population expected to be at risk of mortality across all seasons is 18,681 (71,030 x 0.263). The addition of 23.7 to this increases the mortality rate by 0.13%. The biogeographic population for common terns is 628,000 (Furness, 2015). The number of individuals from the biogeographic population expected to be at risk of mortality across all seasons is 165,164 (628,000 x 0.263). The addition of 23.7 to this increases the mortality rate by 0.01%. Thus, the increase in background mortality is between 0.01% and 0.13%. This magnitude of increase in mortality would not materially alter the background mortality of the population and would be undetectable.

12.11.4.19 The cumulative collision risk for common terns during all seasons would occur throughout the lifetime of the Proposed Development with a high probability but would result in an undetectable effect on the population when considered against background variations. Overall therefore, when assessed cumulatively with the projects set out in Table 12.51 the magnitude is considered to be Negligible for all Project Design Options.

SENSITIVITY OF COMMON TERNS

12.11.4.20 With respect to collision risk with WTG during all seasons, overall common terns are considered to be of Medium sensitivity. This is due to a combination of a medium tolerance and adaptability of offshore windfarms, high recoverability following cessation of the effect and medium conservation value.

SIGNIFICANCE OF THE EFFECT DURING THE ALL SEASONS

12.11.4.21 Overall, for cumulative collision risk with WTG throughout the year the magnitude has been assessed as **Negligible** for all Project Design Options and the sensitivity of common terns is considered to be **Medium**. The effect will, therefore, be **Not Significant** in EIA terms.

GANNET

MAGNITUDE OF IMPACT

12.11.4.22 The Proposed Development alone was predicted to have a Not Significant impact based on both Project Design Options due to collision risks. The impact magnitude is considered to be Negligible for both Project Design Options.

12.11.4.23 The estimated annual cumulative total of gannets at risk of collisions from the Proposed Development are 0.9 (Project Design Option 1a), 1.0 (Project Design Option 1b) and 0.9 (Project Design Option 2) , which rise to 152.3 to 152.3 individuals when including the Irish and UK projects (Table 12.62).

Table 12.62: Cumulative annual collision risk for gannets using the highest collision predictions for all Project Design Options

Tier	Windfarm	Breeding season	Autumn migration	Spring migration	Annual
1	ABWP1	-	-	-	-
1	Gwynt y Mor	-	-	-	-
1	Rhyl Flats	-	-	-	-
1	Burbo Bank Extension	-	-	-	3.6
1	North Hoyle	-	-	-	-
1	Walney Extension	-	-	-	37.4
1	West of Duddon Sands	-	-	-	-
1	Walney	-	-	-	-
1	Burbo Bank	-	-	-	-
1	Ormonde	-	-	-	2.0
1	Barrow	-	-	-	-
1	Robin Rigg	-	-	-	-
2	Awel-y-Mor	-	-	-	20.5
2	Twin Hub	-	-	-	12.0
2	Erebus	-	-	-	7.0
3	Morgan	-	-	-	2.1

Tier	Windfarm	Breeding season	Autumn migration	Spring migration	Annual
3	Morecambe	-	-	-	1.8
3	Mona	-	-	-	2.5
	Total UK	**0**	**0**	**0**	**89.9**
	Phase 1 Projects	37.3	19.9	5.2	62.4
	Proposed Development – Project Design Option 1a	0.6	0.3	0	0.9
	Proposed Development – Project Design Option 1b	0.6	0.3	0	1.0
	Proposed Development – Project Design Option 2	0.6	0.2	0	0.9
	Total Ireland	**37.9-37.9**	**20.1-20.2**	**5.2-5.2**	**63.3-63.4**
	Total Ireland + UK	**37.9-37.9**	**20.1-20.2**	**5.2-5.2**	**153.2-153.3**

12.11.4.24 An estimate of 155.4 gannets were predicted to be at cumulative collision risk across all seasons combined. At the average baseline mortality rate for gannets of 0.191 (Table 12.13), the number of individuals from the larger BDMPS population expected to be at risk of mortality across all seasons is 123,145 (644,745,233 x 0.191). The addition of a maximum of 155.4 to this would increase the mortality rate by 0.1%. The biogeographic population for gannets is 1,180,000 (Furness, 2015). The number of individuals from the biogeographic population expected to be at risk of mortality across all seasons is 225,380 (1,180,000 x 0.191). The addition of 155.4 to this increases the mortality rate by 0.07%.

12.11.4.25 The impact of collision risk with WTG on gannets during all seasons combined would occur throughout the lifetime of the Proposed Development with a high probability. However, the increase in mortality associated with this impact is considered to have an undetectable effect on the population, therefore the consequence will be very small. Overall therefore, when assessed cumulatively with the projects set out in Table 12.51 the magnitude is considered to be Negligible to Low.

SENSITIVITY OF GANNETS

12.11.4.26 Most of the individuals affected are likely to be drawn from SPA populations (as most gannet breed at SPA colonies) and therefore gannets are of high conservation value. Gannets are also considered to have a low tolerance of offshore windfarms but high adaptability due to their large foraging ranges and varied prey. Population recovery will be expected to occur in the medium term following cessation of the effect. Therefore, overall, with respect to cumulative collision risk throughout the year, gannet is considered to be of Medium sensitivity.

SIGNIFICANCE OF THE EFFECT

12.11.4.27 Overall, for the cumulative collision risk across all seasons the magnitude has been assessed as **Negligible** to **Low** for all Project Design Options and the sensitivity of gannets is considered to be **Medium**. The effect will, therefore, be **Slight** at worst which is **not significant** in EIA terms.

KITTIWAKE

MAGNITUDE OF IMPACT

12.11.4.28 The Proposed Development alone was predicted to have a Not Significant impact based on both Project Design Options due to collision risks. The impact magnitude is considered to be Negligible to Low for both Project Design Options.

12.11.4.29 The estimated annual cumulative total of kittiwakes at risk of collisions from the Proposed Development are 186.8 (design option 1a), 209. (design option 1b) and 188.8 (design option 2) , which rise to 820.7 to 843.0 individuals when including the Irish and UK projects (Table 12.63).

12.11.4.30 Large numbers of kittiwakes are present within the Irish Sea all year round. The nonbreeding populations were estimated to be 708,156 in spring and 928,219 in autumn, and the breeding season BDMPS is estimated to be 405,701 (Table 12.11).

Table 12.63: Cumulative annual collision risk for kittiwake using the highest collision predictions for all Project Design Options

Tier	Windfarm	Breeding season	Autumn migration	Spring migration	Annual
1	ABWP1	-	-	-	
1	Gwynt y Mor	-	-	-	
1	Rhyl Flats	-	-	-	
1	Burbo Bank Extension	-	-	-	22.3
1	North Hoyle	-	-	-	
1	Walney Extension	-	-	-	187.6
1	West of Duddon Sands	-	-	-	
1	Walney	-	-	-	
1	Burbo Bank	-	-	-	
1	Ormonde	-	-	-	2.2
1	Barrow	-	-	-	
1	Robin Rigg	-	-	-	
2	Awel-y-Mor	-	-	-	53.9
2	Twin Hub	-	-	-	10.8
2	Erebus	-	-	-	58.0
3	Morgan	-	-	-	39.8

Tier	Windfarm	Breeding season	Autumn migration	Spring migration	Annual
3	Morecambe	-	-	-	32.0
3	Mona	-	-	-	37.1
	Total UK	**0**	**0**	**0**	**443.6**
	Phase 1 Projects	56.1	77.9	56.2	190.3
	Proposed Development – Project Design Option 1a	16.7	42.8	127.3	186.8
	Proposed Development – Project Design Option 1b	18.8	47.3	142.9	209.1
	Proposed Development – Project Design Option 2	16.8	43.2	128.7	188.8
	Total Ireland	**72.8-74.9**	**120.7-125.2**	**183.5-199.1**	**377.1-399.4**
	Total Ireland and UK	**72.8-74.9**	**120.7-125.2**	**183.5-199.1**	**820.7-843.0**

12.11.4.31 An estimate of 858 kittiwakes were predicted to be at cumulative collision risk across all seasons combined. At the average baseline mortality rate for kittiwake of 0.156 (Table 12.13), the number of individuals from the larger BDMPS population expected to be at risk of mortality across all seasons is 144,802 (928,219 x 0.156). The addition of a maximum of 858 to this would increase the mortality rate by 0.6%. The biogeographic population for kittiwakes is 5,100,000 (Furness, 2015). The number of individuals from the biogeographic population expected to be at risk of mortality across all seasons is 795,600 (5,100,000 x 0.191). The addition of 858 to this increases the mortality rate 0.1%.

12.11.4.32 The impact of cumulative collision risk with WTG on kittiwakes during all seasons combined would occur throughout the lifetime of the Proposed Development with a high probability. However, the increase in mortality associated with this impact is considered to have an undetectable effect on the population, therefore the consequence will be very small. Overall therefore, when assessed cumulatively with the projects set out in Table 12.51 the magnitude is considered to be Negligible to Low.

SENSITIVITY OF THE KITTIWAKE

12.11.4.33 Al large proportion of the individuals affected are likely to be drawn from SPA populations (as most kittiwake breed at SPA colonies) and therefore kittiwakes are of medium conservation value. Kittiwakes are considered to have a high tolerance and adaptability of offshore windfarms. Population recovery will be expected to occur in the medium term following cessation of the effect. Therefore, overall, with respect to cumulative collision risk throughout the year, kittwake is considered to be of Medium sensitivity.

SIGNIFICANCE OF THE EFFECT

12.11.4.34 Overall, for the cumulative collision risk across all seasons the magnitude has been assessed as **Negligible** to **Low** for all Project Design Options and the sensitivity of kittiwakes is considered to be **Medium**. The effect will, therefore, be **Slight adverse** at worst which is **not significant** in EIA terms.

12.12 Transboundary effects

12.12.1.1 A screening of transboundary impacts has been carried out and has identified that there was no potential for significant transboundary effects with regard to offshore ornithology receptors from the Proposed Development upon the interests of other states.

12.12.1.2 The potential transboundary impacts assessed within section 12.8 are summarised below:

- Disturbance and displacement (including impacts on species which may have connectivity to UK SPAs) during the construction, operational and maintenance and decommissioning phases. Overall, the effects will be of negligible to moderate adverse significance, which were considered to be not significant in EIA terms (for example due to very low numbers of impacted individuals and highly precautionary assumptions; see relevant sections for details);
- 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, operational and maintenance and decommissioning phases. Overall, the effect will be negligible, which are not significant in EIA terms;
- Collision risk (including impacts on species which may have connectivity to UK SPAs) during the construction, operational and maintenance and decommissioning phases. Overall, the effect will be of negligible to slight adverse significance, which are not significant in EIA terms; and
- Barrier effect (including impacts on species which may have connectivity to UK SPAs) during the construction, operational and maintenance and decommissioning phases. Overall, the effect will be of moderate adverse significance at worst, which were considered to be not significant in EIA terms (for example due to very low numbers of impacted individuals and highly precautionary assumptions; see relevant sections for details).

12.13 Summary of effects

12.13.1.1 Information on offshore ornithology within the Offshore Ornithology Study Area was collected through review of available literature, other offshore windfarm assessments, UK statutory guidance, detailed analysis of the data collected during the site-specific aerial surveys and intertidal surveys, and consultation with relevant stakeholders.

12.13.1.2 Table 12.64 and Table 12.65 present a summary of the potential impacts for both Project Design Options, mitigation measures and residual effects in respect to offshore ornithology. The impacts assessed include: disturbance and displacement, indirect disturbance and displacement resulting from changes to prey species and habitats, collision risk, and barrier effect. Overall, it is concluded that there will be no significant effects arising from the Proposed Development during the construction, operational and maintenance or decommissioning phases.

Table 12.64: Summary of potential environmental impacts, mitigation and monitoring for Project Design Option 1 (1a and 1b)

Description of impact	Phase C	Phase O	Phase D	Factored-in measures	Magnitude of impact	Sensitivity of Receptors	Significance of effect	Additional measures	Residual effect	Proposed monitoring
Impact 1 – (WTG model 1a/1b) Direct disturbance and displacement	✓	✓	✓	Environmental Vessel Management Plan (see Table 12.20 for details)	C: Negligible to Low O: Negligible to Medium D: Negligible to Low	C: Medium to High O: Medium to High D: Medium to High	C: Not significant to Moderate adverse (not significant in EIA terms) O: Slight to Moderate adverse (not significant in EIA terms) D: Not significant to Moderate adverse (not significant in EIA terms)	None	C: Not significant to Moderate adverse (not significant in EIA terms) O: Slight to Moderate adverse (not significant in EIA terms) D: Not significant to Moderate adverse (not significant in EIA terms)	Monitoring during the construction phase and for a period of five years post-construction. Collection of distribution data via digital aerial surveys before/after construction.
Impact 2 – (WTG model 1a/1b) Indirect disturbance and displacement resulting from changes to prey species and habitats	✓	✓	✓	Best practice vessel and marine machinery operation (see Table 12.20 for details)	C: Negligible O: Negligible D: Negligible	C: Low to High O: Low to High D: Low to High	C: Not significant O: Not significant D: Not significant	None	C: Not significant O: Not significant D: Not significant	N/A
Impact 3 – (WTG model 1a) Collision risk	×	✓	×	Lower blade tip height of 37m from lowest astronomical tide	O: Negligible to Low	O: Low to Medium	O: Slight to Moderate adverse (not significant in EIA terms)	None	O: Slight to Moderate adverse (not significant in EIA terms)	Collection of data to reduce uncertainties in collision

Description of impact	Phase C O D	Factored-in measures	Magnitude of impact	Sensitivity of Receptors	Significance of effect	Additional measures	Residual effect	Proposed monitoring
								risk parameters.
Impact 3 – (WTG model 1b) Collision Risk	× ✓ ×	Lower blade tip height of 37m from lowest astronomical tide	O: Negligible to Low	O: Low to Medium	O: Slight to Moderate adverse (not significant in EIA terms)	None	O: Slight to Moderate adverse (not significant in EIA terms)	Note also that the Proposed Development is committed to participating in the 'East Coast Monitoring Group' (ECMG), to discuss and agree potential strategic monitoring initiatives in relation to offshore ornithology. The need for strategic monitoring and the level of participation by individual projects, will be determined by the conclusions

Description of impact	Phase C	Phase O	Phase D	Factored-in measures	Magnitude of impact	Sensitivity of Receptors	Significance of effect	Additional measures	Residual effect	Proposed monitoring
										of the EIAR process, in consultation with statutory and technical stakeholders , and with a focus on validation and evidence gathering.
Impact 4 – (WTG model 1a/1b) Barrier Effect	×	✓	×	N/A	O: Negligible to Low	O: Low to High	O: Slight to Moderate adverse (not significant in EIA terms)	None	O: Slight to Moderate adverse (not significant in EIA terms)	N/A
Impact 5 – (WTG model 1a/1b) Cumulative direct disturbance and displacement	✓	✓	✓	Note project alone contribution minimised as per Impact 1	C: Negligible to Low O: Low to Medium D: Negligible	C: High O: Medium D: Medium to High	C: Negligible to Moderate adverse (not significant in EIA terms) O: Slight to Moderate adverse (not significant in EIA terms) D: Not significant	None	Negligible to Moderate adverse (not significant in EIA terms) O: Slight to Moderate adverse (not significant in EIA terms) D: Not significant	N/A

Description of impact	Phase C	Phase O	Phase D	Factored-in measures	Magnitude of impact	Sensitivity of Receptors	Significance of effect	Additional measures	Residual effect	Proposed monitoring
Impact 6 – (WTG model 1a/1b) Cumulative indirect disturbance and displacement	✓	✓	✓	Note project alone contribution minimised as per Impact 2	C: Negligible O: Negligible D: Negligible	C: Low to High O: Low to High D: Low to High	C: Not significant O: Not significant D: Not significant	None	C: Not significant O: Not significant D: Not significant	N/A
Impact 7 – (WTG model 1b) Cumulative collision risk	×	✓	×	Lower blade tip height of 37m from lowest astronomical tide (for the Proposed Development)	O: Negligible to Low	O: Low to Medium	O: Not significant to Slight adverse (not significant in EIA terms)	None	O: Not significant to Slight adverse (not significant in EIA terms)	N/A

Table 12.65: Summary of potential environmental impacts, mitigation and monitoring for Project Design Option 2

Description of impact	Phase C	Phase O	Phase D	Factored-in measures	Magnitude of impact	Sensitivity of Receptors	Significance of effect	Additional measures	Residual effect	Proposed monitoring
Impact 1 – WTG Model 2 Direct disturbance and displacement	✓	✓	✓	Environmental Vessel Management Plan (see Table 12.20 for details)	C: Negligible to Low O: Negligible to Medium D: Negligible to Low	C: Medium to High O: Medium to High D: Medium to High	C: Not significant to Moderate adverse (not significant in EIA terms) O: Slight to Moderate adverse (not significant in EIA terms) D: Not significant to Moderate adverse (not significant in EIA terms)	None	C: Not significant to Moderate adverse (not significant in EIA terms) O: Slight to Moderate adverse (not significant in EIA terms) D: Not significant to Moderate adverse (not significant in EIA terms)	Monitoring during the construction phase and for a period of five years post-construction. Collection of distribution data via digital aerial surveys before/after construction.
Impact 2 – WTG Model 2 Indirect disturbance and displacement resulting from changes to prey species and habitats	✓	✓	✓	Best practice vessel and marine machinery operation (see Table 12.20 for details)	C: Negligible O: Negligible D: Negligible	C: Low to High O: Low to High D: Low to High	C: Not significant O: Not significant D: Not significant	None	C: Not significant O: Not significant D: Not significant	N/A
Impact 3 – WTG Model 2 Collision risk	×	✓	×	Lower blade tip height of 37m from lowest astronomical tide	O: Negligible to Low	O: Low to Medium	O: Slight to Moderate adverse (not significant in EIA terms)	None	O: Slight to Moderate adverse (not significant in EIA terms)	Collection of data to reduce uncertainties in collision

Description of impact	Phase C O D	Factored-in measures	Magnitude of impact	Sensitivity of Receptors	Significance of effect	Additional measures	Residual effect	Proposed monitoring
								risk parameters. Note also that the Proposed Development is committed to participating in the ECMG, to discuss and agree potential strategic monitoring initiatives in relation to offshore ornithology. The need for strategic monitoring and the level of participation by individual projects, will be determined by the conclusions of the EIAR process, in consultation

Description of impact	Phase C	Phase O	Phase D	Factored-in measures	Magnitude of impact	Sensitivity of Receptors	Significance of effect	Additional measures	Residual effect	Proposed monitoring
										with statutory and technical stakeholders , and with a focus on validation and evidence gathering.
Impact 4 – WTG Model 2 Barrier Effect	×	✓	×	N/A	O: Negligible to Low	O: Low to High	O: Slight to Moderate adverse (not significant in EIA terms)	None	O: Slight to Moderate adverse (not significant in EIA terms)	N/A
Impact 5 – WTG Model 2 Cumulative direct disturbance and displacement	✓	✓	✓	Note project alone contribution minimised as per Impact 1	C: Negligible to Low O: Low to Medium D: Negligible	C: High O: Medium D: Medium to High	C: Negligible to Moderate adverse (not significant in EIA terms) O: Slight to Moderate adverse (not significant in EIA terms) D: Not significant	None	Negligible to Moderate adverse (not significant in EIA terms) O: Slight to Moderate adverse (not significant in EIA terms) D: Not significant	N/A
Impact 6 – WTG Model 2 Cumulative indirect disturbance and displacement	✓	✓	✓	Note project alone contribution minimised as per Impact 2	C: Negligible O: Negligible D: Negligible	C: Low to High O: Low to High	C: Not significant O: Not significant	None	C: Not significant O: Not significant	N/A

Description of impact	Phase C	Phase O	Phase D	Factored-in measures	Magnitude of impact	Sensitivity of Receptors	Significance of effect	Additional measures	Residual effect	Proposed monitoring
						D: Low to High	D: Not significant		D: Not significant	
Impact 7 – WTG Model 2 Cumulative collision risk	×	✓	×	Lower blade tip height of 37m from lowest astronomical tide (for the Proposed Development)	O: Negligible to Low	O: Low to Medium	O: Not significant to Slight adverse (not significant in EIA terms)	None	O: Not significant to Slight adverse (not significant in EIA terms)	N/A

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