Dublin Array
Generation for generations

EIAR Volume 3: Offshore Infrastructure Assessment Chapters
Chapter 6: Offshore and Intertidal Ornithology

Kish Offshore Wind Ltd.

RWE SLR GoBe APEM Group

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Dublin Array Offshore Wind Farm

Environmental Impact Assessment Report

Volume 3, Chapter 6: Offshore and Intertidal Ornithology

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Acronyms

Term	Definition
AA	Appropriate Assessment
ADO	Alternative design option
BDMPS	Biologically Defined Minimum Population Size
BoCCI4	Fourth review of Birds of Conservation Concern in Ireland
CD / mCD	Chart Datum/ meters relative to Chart Datum
CEA	Cumulative Effects Assessment
CIEEM	Chartered Institute of Ecology and Environmental Management
COWRIE	Collaborative Offshore Wind Research Into the Environment
CRM	Collision Risk Modelling
cSPA	Candidate Special Protection Area
DAHG/DCHG	Department for Culture, Heritage and the Gaeltacht
DCCAE	Department of Communications, Climate Action and Environment
Dublin Array	Dublin Array Offshore Wind Farm
Offshore ECC	Offshore Export Cable Corridor
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
EIS	Environmental Impact Statement
EPA	Environment Protection Agency
EU	European Union
GCP	Grid Connection Point at existing Carrickmines 220kV substation
GIS	Geographical Information System
GW	Gigawatt
HDD	Horizontal Directional Drilling
HPAI	Highly Pathogenic Avian Influenza
ICES	International Council for the Exploration of the Sea
INFOMAR	Integrated Mapping for the Sustainable Development of Ireland's Marine Resource
km	Kilometres

Term	Definition
LAT/ mLAT	Lowest Astronomical Tide/ meters relative to Lowest Astronomical Tide
MAC	Maritime Area Consent
MAPA	Maritime Area Planning Act 2021
MARA	Maritime Area Regulatory Authority
MDO	Maximum Design Option
MHWS	Mean High Water Springs
MLWS	Mean Low Water Springs
MPA	Marine Protection Area
MPDM	Marine Planning and Development Bill
MSL	Mean Sea Level
MW	Megawatt
NAF	Nocturnal Activity Factors
NE	Natural England
NEPVA tool	Natural England Population Viability Analysis tool
NIS	Natura Impact Statement
NPWS	National Parks Wildlife Service
O&M	Operations and Maintenance
ORE	Offshore Renewable Energy
OREDP	Offshore Renewable Energy Development Plan
OSS	Onshore Substation
OSP	Offshore Substation Platform
OWF	Offshore Wind Farm
PRH	Proportion (of birds at) Rotor Height
PVA	Population Viability Analysis
R&D	Research and Development
RoI	Republic of Ireland
RSL	Relative Sea Level
RWE	RWE Renewables Ireland Ltd (a wholly owned subsidiary of RWE AG)
SAC	Special Area of Conservation

Term	Definition
sCRM	Stochastic Collision Risk Modelling
SEA	Strategic Environmental Assessment
SI	Statutory Instrument
SNCB	Statutory Nature Conservation Bodies
SPA	Special Protection Area
SSC	Suspended Sediment Concentration
UK	United Kingdom
WTG	Wind turbine generator
UXO	Unexploded Ordnance
ZoI	Zone of Influence

Glossary

Term	Definition
Array Area	The area within which the WTGs and OSP will be located.
Biologically Defined Minimum Population Size	An estimate of the numbers of a seabird species occurring within defined UK waters.
Benthic	Relating to or occurring on the seabed.
COWRIE	COWRIE is an independent body set up by the Crown Estate who carry out research into the impacts associated with offshore wind farm development on the environment and fauna.
Intertidal	The area of the shoreline which is covered at high tide and uncovered at low tide.
Stochastic	Derived from or related to a random process or probability distribution.
Offshore Export Cable Corridor	Corridor for an export transmission cable from the array to landfall.
Ornithology	The study of birds
Population Viability Analysis	A species - specific method of risk assessment that determines the probability that a species will go extinct within a defined period

6 Offshore and Intertidal Ornithology

6.1 Introduction

6.1.1 This chapter presents the result of the assessment for the potential impacts of the construction, operation and maintenance (O&M), and decommissioning phases associated with the array area and offshore Export Cable Corridor (the latter referred to as the Offshore ECC) on offshore and intertidal ornithology receptors throughout all life stages. This chapter has been prepared on behalf of the Applicant by Cork Ecology with input from MacArthur Green (MG).

6.1.2 This EIAR chapter should be read in conjunction with the following documents included within the EIAR, due to interactions between the technical aspects:

- Volume 3, Chapter 1: Physical Processes (hereafter referred to as the Physical Processes chapter): to be referenced for an overview on the suspended sediment concentrations expected during construction, operation and decommissioning phases, which can have direct impacts on foraging seabirds (e.g. impairment of visibility and therefore foraging ability which might be expected to reduce foraging success), as well as indirect impacts on their prey;
- Volume 3, Chapter 3: Benthic Ecology (hereafter referred to as the Benthic Ecology chapter): to be referenced for an overview of the potential impacts to benthic species, which could indirectly impact seabirds;
- Volume 3, Chapter 4: Fish and Shellfish Ecology (hereafter referred to as the Fish and Shellfish Ecology chapter): to be referenced for an overview of the potential impacts to fish species, which could indirectly impact seabirds;
- Volume 4, Appendix 4.3.6-1 of the EIAR (hereafter referred to as the Offshore and Intertidal Ornithology Technical Baseline). The baseline provides a detailed characterisation of the receiving offshore and intertidal ornithology environment incorporating the site-specific survey data. Information from the baseline report has been summarised within this chapter;
- Volume 4, Appendix 4.3.6-2: Method Statement: Offshore Ornithology Assessment for East Coast Phase 1 projects.
- Volume 4, Appendix 4.3.6-3: Review of Method Statement, Offshore Wind Ornithology Assessment for East Coast Phase 1 Projects, ABPmer.
- Volume 4, Appendix 4.3.6-4: Seabird Collision Risk Modelling (CRM) Technical Report (hereafter referred to as the Seabird CRM Technical Report): *to be referenced for a description of the approach and results;*

- Volume 4, Appendix 4.3.6-5: Offshore Ornithology Migration Collision Risk Modelling (mCRM) Technical Report (hereafter referred to as the mCRM Technical Report): to be referenced for a description of the approach and methods undertaken for the migration collision risk assessment, and mCRM outputs;
- Volume 4, Appendix 4.3.6-6: Seabird Displacement Analysis Technical Report (hereafter referred to as the Seabird Displacement Technical Report): to be referenced for a description of the approach and predicted displacement and mortality outputs;
- Volume 4, Appendix 4.3.6-7: Population Viability Analysis (PVA) Technical Report (hereafter referred to as the PVA Technical Report): to be referenced for a description of the approach undertaken for PVA and predicted PVA outputs.

6.2 Regulatory Background

6.2.1 The legislation, policy and guidance relevant to the whole planning application is set out in Volume 2, Chapter 2: Consents, Legislation, Policy & Guidance (hereafter referred to as the Policy Chapter). The principal legislation, policy and guidance relevant to this chapter is set out in Annex A.

6.2.1 In particular, the assessment of potential impacts upon offshore ornithology has been made with specific reference to the following:

- International Conventions:
  - Bonn Convention;
  - Bern Convention; and
  - OSPAR Convention to Protect the Marine Environment of the North East Atlantic.
- European Legislation:
  - • EU Directive 2009/147/EC on the conservation of wild birds as amended (Birds Directive)
- National legislation:
  - The Wildlife Act 1976 and subsequent amendment acts (2000, 2010, 2012); and
  - • The European Communities (Birds and Natural Habitats) Regulations 2011 as amended.

6.2.2 Consideration of designated European sites is required under The European Communities (Birds and Natural Habitats Regulations 2011 (S.I. No. 477 of 2011)), as amended, which transpose the EU Habitat and Birds Directives and having regard to the provisions of the updated Renewable Energy Directive (RED III). An assessment of the impact of the Dublin Array offshore infrastructure on European sites and their supporting species and habitat qualifying interests is presented in the NIS (Part 4: Habitats Directive Assessments, Volume 4: NIS).

6.2.3 Where specific Irish guidance is not available given the infancy of offshore wind in Ireland, a number of other guidance documents specific to the consideration of ornithology are available from jurisdictions/countries with established offshore renewable energy sectors where comprehensive guidance has been developed. The assessment has followed all relevant guidance identified by NPWS during consultation undertaken to support the assessment. The principal guidance and regulatory documents for this assessment are:

- Policy, guidance and guidelines:
  - Using a collision risk model to assess bird collision risks for offshore wind farms (Band 2012);
  - Attributing seabirds at sea to appropriate breeding colonies and populations (Butler *et al.,* 2020);
  - JNCC Review of data used to calculate avoidance rates for collision risk modelling of seabirds (Ozsanlav-Harris *et al.,* 2023);
  - Guidance on ornithological cumulative impact assessment for offshore wind developers (King *et al.,* 2009);
  - Assessment methodologies for offshore wind farms (Maclean *et al.,* 2009);
  - A stochastic collision risk model for seabirds in flight. Marine Scotland commissioned report (McGregor *et al.,* 2018);
  - Natural England nepva tools (Mobbs *et al.,* 2020);
  - Natural England 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 (Parker *et al.,* 2022b);
  - Natural England 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 (Parker *et al.,* 2022c);
  - Interim Guidance on Apportioning Impacts from Marine Renewable Developments to Breeding Seabird Populations in Special Protection Areas (NatureScot, 2018);
  - NatureScot Seasonal Periods for Birds in the Scottish Marine Environment (NatureScot, 2020);
  - NatureScot Guidance to support Offshore Wind Applications: Guidance Notes 1 – 11 (NatureScot, 2023);
  - Joint Statutory Nature Conservation Bodies (SNCB) Interim Displacement Advice Note (SNCB, 2022a); and

- Joint SNCB Interim Advice on the Treatment of Displacement for Red-throated Diver (SNCB, 2022b).

6.2.4 In addition to the published guidance, the Applicants have collaborated with other Phase 1 projects – Arklow Bank Wind Park, Codling Wind Park, Oriel Wind Farm and North Irish Sea Array (NISA) to produce a methodology note seeking agreement with NPWS to align approaches and input parameters for ornithological assessments. Reference is made to this document as relevant throughout:

- Method Statement Offshore Wind Ornithology Assessment for East Coast Phase 1 Project (GoBe, 2022) included as Appendix 4.3.6-2.

6.2.5 The NPWS response to the Phase 1 Method Statement was circulated in November 2023 and is also referenced in this document as relevant throughout:

- Review of Method Statement Offshore Wind Ornithology Assessment for East Coast Phase 1 Projects (ABPmer, 2023) included as Appendix 4.2.6-3.

6.2.6 The Applicants response to the review with cross referencing where additional detail on how the approach has been followed is provided in Annex B of this chapter.

6.3 Consultation

6.3.1 In preparation for the EIAR for Dublin Array, non-statutory consultation has been undertaken with various statutory and non-statutory bodies. A Scoping report (RWE, 2020) was made publicly available and issued to statutory consultees on 9th October 2020. Table 1 provides a summary of the consultation undertaken for offshore ornithology to date for Dublin Array.

6.3.2 In accordance with recommendations outlined in the DCCAE guidance[1] the Applicant sought to consult during the scoping stage with the National Parks and Wildlife Service (NPWS) and Birdwatch Ireland (BWI).

[1] Guidance on Environmental Impact Statement (EIS) and Natura Impact Statement (NIS) Preparation for Offshore Renewable Energy Projects (Environmental Working Group of the Offshore Renewable Energy Steering Group and the DCCAE, 2017)

Table 1 Summary of consultation relating to offshore and intertidal ornithology

Date	Consultation type	Consultation and key issues raised	Section where provision is addressed
9th May 2019	Meeting with NPWS	▪ Baseline, rationale for boat based survey ▪ E Coast projects should share data ▪ Additional data sources identified by NPWS ▪ Migratory passerines & geese and passage, post-breeding dispersal including nocturnal activity	▪ Survey methods are outlined in the Offshore and Intertidal Ornithology Technical Baseline. ▪ East coast project data is presented in the Cumulative Effects Assessment. ▪ Summary of data sources used provided in Table 2. ▪ Details of treatment of migratory wildfowl and waders presented in the Migratory CRM Technical Annex.
15th November 2019	Meeting with BWI	▪ Outline of consenting process and proposed MPDM bill. ▪ BWI offshore sensitivity tool ▪ Potential for co-ordination of surveys/studies & sharing data. ▪ Overview of project ▪ Ornithology baseline ▪ Concerns about NPWS resource	▪ Offshore sensitivity tool was considered as part of the Scoping process. ▪ Shared data is presented in the Cumulative Effects Assessment.
10th November 2020	Meeting with NPWS	Summary of site specific data & other baseline data	Summary of site specific data and published baseline data sources provided in Table 2.
		Approach to CRM, displacement & apportioning & PVA	The approach and methods for CRM, displacement, apportioning and PVA are provided in the following technical appendices, with a short summary provided in this chapter: Seabird CRM Technical Report Seabird Displacement Technical Report PVA Technical Report Apportioning Technical Report (Habitats Directive Assessment, Part 5: NIS Appendices)
		Will effects of change to prey availability be considered?	Potential changes in prey availability are presented in the Fish and Shellfish Ecology chapter and under Impacts 4, 5 and 13 in this chapter

Date	Consultation type	Consultation and key issues raised	Section where provision is addressed
		Approach to assessment of non-seabirds	The approach to assessment of non-seabirds is presented in the mCRM Technical Report, with outputs summarised under Impact 9 in this chapter
		New marine SPAs in the eastern Irish sea are likely to come forward. A number of Marine Protection Areas (MPAs) are also planned which would be of relevance to the EIAR but which may not be brought forward in time for inclusion.	The North West Irish Sea candidate SPA (cSPA) and the seaward boundary extension to The Murrough SPA are considered in detail within Part 4: Habitats Directive Assessment: Part 4: SISAA
		NPWS asked for confirmation that all available seabird colony count data has been identified by the project.	The Seabirds Count database covering surveys between 2015 and 2021 was used as the basis for seabird colony count data in this chapter. Full details of the colonies included are presented in the Apportioning Technical Report
		NPWS asked whether the baseline characterisation would draw on the ObSERVE data and asked whether divers and seaducks would be included in assessment of displacement effects. Divers and seaducks may not be present in significant numbers on any particular day but may pass through the area frequently and if so numbers could be significant taken over a period of time.	Relevant information from the ObSERVE 1 study (Jessopp *et al.,* 2018) is presented in the Offshore and Intertidal Ornithology Technical Baseline. Potential displacement effects on divers and seaduck are considered under Impacts 1, 2, 3 and 6.
30th November 2020	Scoping, Marine Institute (MI)	There is a large reliance on existing data, while they acknowledge that this is normal, they would like clarification on the subject areas where there are specific data gaps and if there is an explicit commitment to carry out field surveys to fill those gaps	Summary of site specific data and published baseline data sources provided in section 6.4 of this chapter. Summary of relevant published data and methods and results from site-specific ornithological baseline surveys are presented in the Offshore and Intertidal Ornithology Technical Baseline
		Establishing a baseline is critical to this assessment and will assist in monitoring for future activities and identifying likely impacts.	Summary of survey methods and baseline results from site-specific ornithological baseline surveys are presented in the Offshore and Intertidal Ornithology Technical Baseline

Date	Consultation type	Consultation and key issues raised	Section where provision is addressed
		The scale of effects should be considered beyond the footprint of the turbines and the licenced area	In the breeding season, potential impacts are considered for SPA and non-SPA colonies within mean maximum foraging range (+1S.D) of the array area. In the non-breeding season, potential impacts are considered over a wider region
		We refer the developers to the ongoing monitoring studies on offshore wind parks being carried out in Belgium. These comprehensive studies (ongoing since 2005) will provide much information on the likely interactions with a range of marine features including mammals and birds and should guide the selection of useful and relevant metrics.	Relevant information from published studies including the Belgian study and others from operational wind farms has been incorporated in the Impacts Assessment section of this chapter and in the Seabird Displacement Technical Report
		The MI does not agree that ESAS survey methods are the most appropriate particularly with respect to the potential effects of the developed wind farm on seabirds. Vessel based surveys have a number of sources of uncertainty related to sensitivity of species to vessel. For instance, it is unlikely that vessel surveys will even detect common scoter but there are many thousands of them to be found in the Irish sea. Aerial digital surveys are the method of choice. These have been standard now in the UK and elsewhere for a number of years. At least aerial surveys should be used to benchmark the vessel based surveys. The spatial extent of the seabird surveys would ideally extend well beyond the project area. Effectively to take into account the cumulative effects and considering the foraging distances and other proposed ORE developments or other plans or projects it could be necessary to include all of the north west Irish sea in the analysis and to generate data throughout that area to support the analysis.	Given the project already had existing boat-based data, it was considered to be most appropriate to continue with boat-based surveys and combine the data with the most recent boat based survey data and those from third party datasets available, including the ObSERVE aerial surveys in the western Irish Sea conducted in 2016 by UCC (Jessopp *et al.,*2018).

Date	Consultation type	Consultation and key issues raised	Section where provision is addressed
		It should be noted that iWeBs data is for high tide (roosting) sites only. Given that pipelines traverse intertidal areas there is a need for some low tide intertidal bird surveys to predict any potential disturbance effect.	Intertidal bird surveys were undertaken in the vicinity of the landfall location out to 1 km offshore. Details of the survey methods and results are presented in the Intertidal Ornithology Technical Report
3rd October 2023	Meeting with NPWS	Review of Phase 1 Ornithology Methods Statement	This review document was circulated in November 2023 (ABPmer, 2023), approach referenced in Section 6.4 and included in Appendix 4.3.6-3
		NPWS asked if tracking studies were being used to identify birds from SPA colonies that may have a greater reliance on the Dublin Array site than may be apparent from the proposed apportioning method	Tracking studies were considered however, the apportioning approach was considered a more robust tool, given the low availability of tracking data and the age of that data. Full details on the apportioning approach are presented in the Apportioning Technical Report.
		Discussion of adaptation of CRM Migration tool for an Irish context, including the addition of contextualised data	Full details of the approach undertaken and the results are presented in the mCRM Technical Report.
		Discussion on assessing new North West Irish Sea cSPA – NPWS to share unpublished data supporting the designation of the cSPA	Potential impacts on the North West Irish Sea cSPA are considered under Impacts 8 and 18.
		Discussion of seabird colony at Wicklow Head SPA. NPWS highlighted recent paper in Irish Birds on kittiwake numbers.	Recent counts of kittiwake numbers at Wicklow Head are presented in the Offshore and Intertidal Ornithology Baseline Technical Report and the Apportioning Technical Report.
		Discussion of breeding status of roseate tern at Dalkey Islands SPA.	The breeding status of roseate tern at Dalkey Islands SPA is presented in the Offshore and Intertidal Ornithology Baseline Technical Report.
		Discussion of status of breeding herring gulls at Skerries Islands SPA. NPWS confirmed that monitoring of this site was a priority for 2024.	Counts of herring gulls at Skerries Islands SPA are presented in the Apportioning Technical Report.

Date	Consultation type	Consultation and key issues raised	Section where provision is addressed
		Discussion of shag displacement – NPWS noted that shag was low to no displacement risk, but would be useful to include in the assessment of displacement effects	An assessment of shag displacement is presented under Impact 10 and in the Seabird Displacement Technical Report.
		Discussion of cumulative effects approach. NPWS approved of the use of the ICES Ecoregion approach.	Cumulative impacts on offshore and intertidal ornithology are assessed under Impacts 16, 17 and 18.
8th December 2023	Review of the Phase One Methodology Statement	The Irish East Coast Phase One projects (Dublin Array, Codling Wind Park, Arklow Bank Wind Park, North Irish Sea Array (NISA) and Oriel Wind Farm) submitted a joint methodology statement to NPWS outlining the approach to the ornithology assessments (GoBe, 2022). This included the approach to collision risk modelling (CRM), displacement, barrier effects, apportioning, population viability analysis (PVA) and migratory bird assessments. NPWS consulted ABPmer, UK Centre for Ecology & Hydrology (UKCEH) and BioSOSS to provide a written response to the proposed methodology. It is noted that this review is the viewpoint of the relevant contracted consultees, and not specifically that of NPWS (ABPmer, 2023).	The NPWS response (ABPmer, 2023) has been considered through the ornithology assessment methodology (see Appendix 4.3.6-3)

6.4 Methodology

Study Areas

6.4.1 For a description of the methodology as to how this EIAR was prepared, see Volume 2 Chapter 3: EIA Methodology (hereafter referred to as the EIA Methodology Chapter). The methodology that follows below is specific to this chapter.

6.4.2 The guidance (DCCAE, 2017[2]) recommends that the Zone of Influence (ZoI) and study area are established at the scoping stage. It is acknowledged that these ZoI may differ depending upon the pressure or ecosystem component under consideration. Data and identification of features of interest within the zones that might be impacted by an ORE project are required so that a source - pathway - receptor risk assessment can be carried out and the subsequent evaluation of effects can be undertaken for key features.

6.4.3 For the purposes of the EIA, the ZoI has not been defined in strict distance terms but rather on a species-specific basis, taking into account seabird movement patterns. For the breeding season assessments, the ZoI was based on the mean maximum foraging range of gannet, as outlined below. For the non-breeding season assessments, a wider geographical area including the Irish Sea and waters west of Scotland were considered, depending on the species involved.

6.4.4 The three study areas that were used for the offshore and intertidal ornithology assessment are defined below.

Offshore Ornithology Regional Study Area

6.4.5 The Offshore Ornithology regional study area (hereafter the regional study area) was determined by the area within which potential impacts to breeding seabirds could occur and was based on the foraging ranges of breeding seabirds. Many seabirds have large foraging ranges which in some cases extend several hundred kilometres from their breeding colonies. Birds may therefore overlap (i.e. have connectivity with) the array area, even when the colonies they originate from are a significant distance away. The regional study area therefore also encompasses the SPA and non-SPA breeding colonies with potential connectivity to the array area during the breeding season.

[2]Guidance on Environmental Impact Statement (EIS) and Natura Impact Statement (NIS) Preparation for Offshore Renewable Energy Projects (Environmental Working Group of the Offshore Renewable Energy Steering Group and the DCCAE, 2017);

6.4.6 Published mean-maximum foraging ranges (plus one standard deviation (+1 S.D.)) in Woodward *et al.,* (2019) were used to define the regional study area. Gannet has the largest foraging range (315.2 km ± 194.2 km) of the key species considered in the ornithology assessment, apart from fulmar and Manx shearwater, both of which have very extensive foraging ranges (Table 13). The regional study area therefore extends 509.4 km from the array area. SPA breeding colonies for other key species in the assessment will fall within the mean-maximum foraging range of gannet. Therefore, this approach is appropriate to define the maximum extent of the regional study area. This approach is considered to be more precautionary than including all colonies within the larger foraging ranges of Manx shearwater and fulmar, as the breeding season reference population will be smaller for these species based on a study area of 509.4 km. This approach has been used for these species in recent EIAR chapters for Scottish Offshore Wind Farm (OWF) projects such as Berwick Bank (SSE Renewables, 2023).

Offshore Ornithology Study Area

6.4.7 The Offshore Ornithology study area (hereafter offshore study area) is defined as the array area[3] and a surrounding 4 km buffer[4] (Figure 1). The guidance (DCCAE, 2018) suggests that for sites larger than 10 km^2, a buffer of 4 km around the site is adequate for surveys. A buffer of 4 km around a potential offshore wind farm site was also recommended in a review of assessment methodologies for offshore wind farms for COWRIE in the UK[5] (MacLean *et al.,* 2009). The 4 km buffer used for the baseline surveys is in line with the DCCAE guidance (2017) for survey methodologies and is therefore considered sufficient for the purposes of baseline characterisation.

Intertidal Ornithology Study Area

6.4.8 The study area for the assessment of effects on birds in the intertidal zone encompasses the intertidal area between Mean High Water Spring (MHWS) tides extending out to 1 km seaward from MHWS, encompassing the whole of the intertidal area (Figure 2). Further details are presented in the Intertidal Ornithology Technical Report. In addition, the proposed route of the Offshore Export Cable Corridor (Offshore ECC) from the offshore study area to the proposed landfall location is also included in the intertidal study area.

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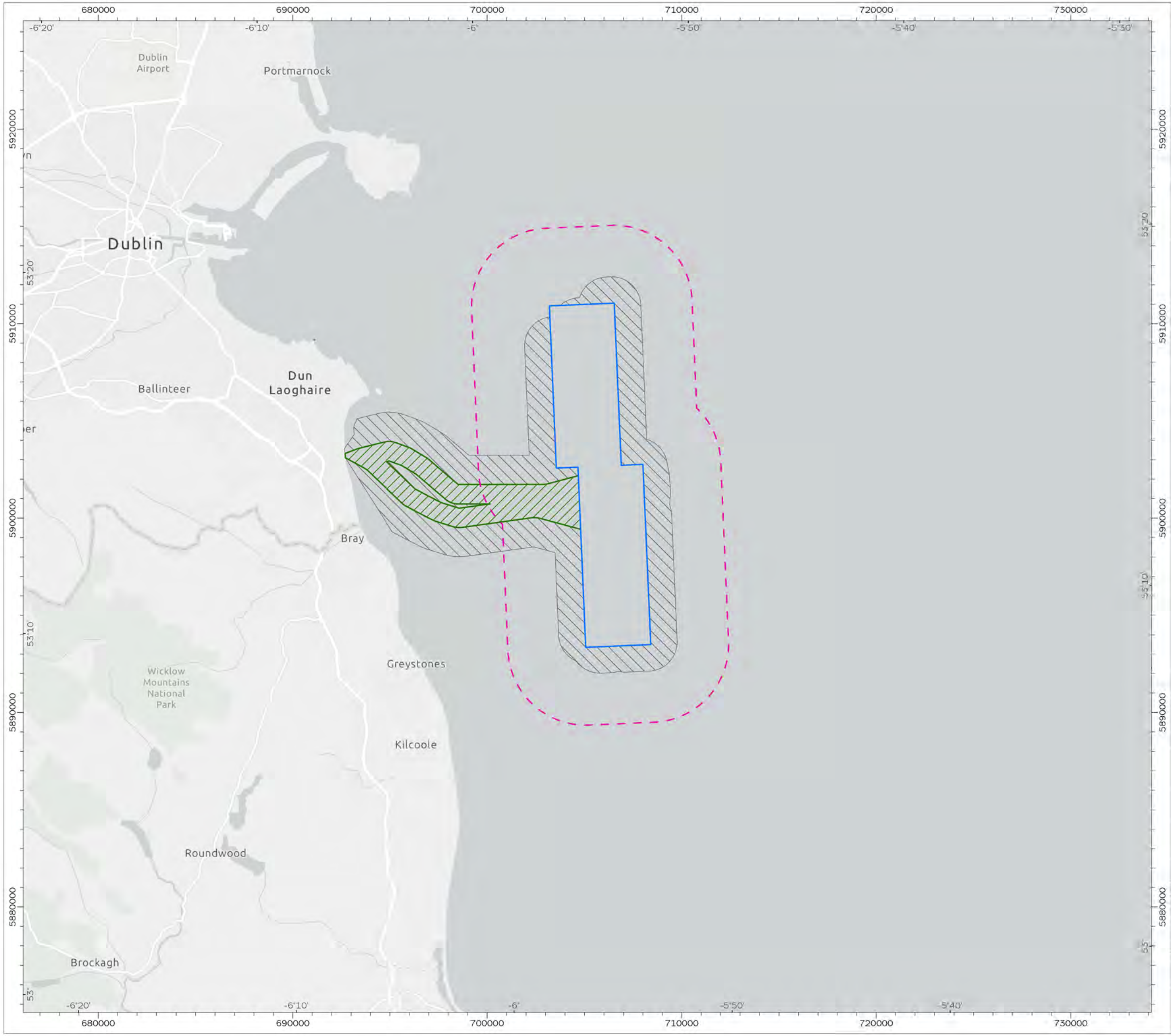
[3] Activities undertaken within the temporary occupation area, namely the use of jack-up vessels and anchors during the construction, O&M, and decommissioning phases have been screened out within the physical processes chapter for suspended sediment and deposition with their use not resulting in notable changes in SSC and associated sediment deposition, however the use of a buffer ensures a precautionary approach is taken.

[4] All distances are taken from the outer boundary of all offshore works incorporating the offshore infrastructure, the buffer also incorporates the temporary occupation area and as such are inherently precautionary

[5] https://www.researchgate.net/publication/256461323_A_Review_of_Assessment_Methodologies_for_Offshore_Wind_Farm



Array Area
Temporary Occupation Area
Export Cable Corridor
Offshore Ornithology Study Area

DRAWING STATUS
FINAL

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PROJECT TITLE
Dublin Array

DRAWING TITLE
Offshore Ornithology Study Area

DRAWING NUMBER: 1
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0 1 2 3 4 nm
N

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PRJ	WGS 1984 UTM Zone 29N		

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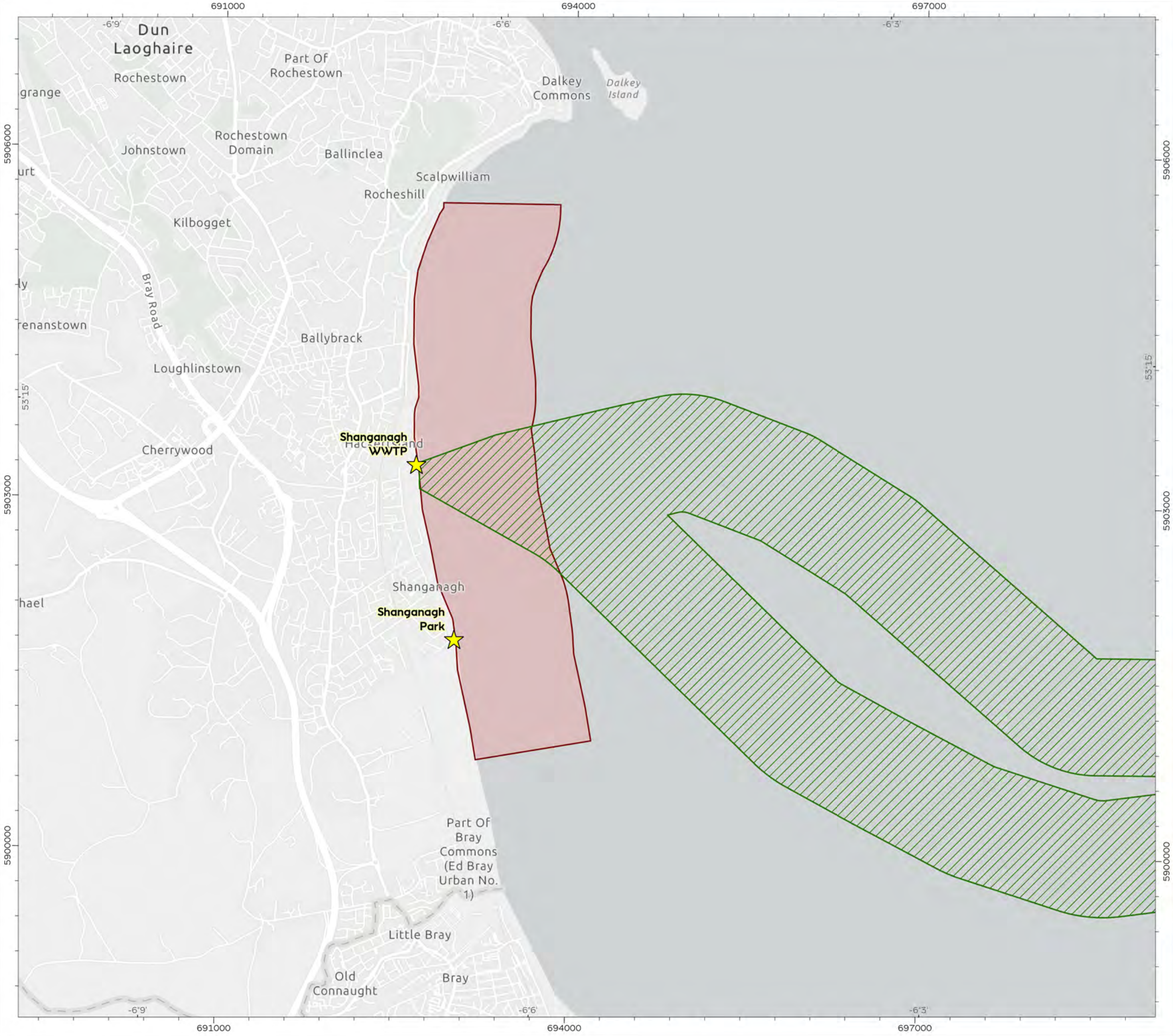

Export Cable Corridor

Intertidal Study Area

Vantage Points

DRAWING STATUS

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0 0.1 0.3 0.4 0.6 nm

N

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DATUM IRENET95 VERTICAL REF LAT

PRJ IRENET95 Irish Transverse Mercator

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Dublin Array Generation for generations

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Baseline Data

6.4.9 Data to inform the characterisation of the receiving environment has been collated by combining information from a series of site-specific surveys supplemented with a thorough desk-based study of published data. Data was drawn from previous site surveys, contemporary studies commissioned by the Applicant and existing published datasets. Full details of the data sources considered in the development of the Ornithology baseline are presented in Table 2.

Table 2 Data sources considered in the development of the offshore and intertidal ornithology baseline

Data Source	Type of Data	Temporal and Spatial Coverage
Site specific survey data		
2001/02 Survey Report (Percival *et al.,* 2002)	Summary report of project-specific boat-based surveys	14 surveys conducted between September 2001 and September 2002. Used to provide context for the more recent survey data.
2010/11 Survey Report (Newton & Trewby, 2011)	Summary report of project-specific boat-based surveys	15 surveys conducted between June 2010 and June 2011. Used to provide context for the more recent survey data.
2016/17 Survey data & Report (Newton & Kavanagh, 2018)	Summary report and project-specific boat-based survey data	11 surveys conducted between September 2016 and September 2017. Used in the EIAR Assessment.
2019/21 Survey data (Appendix 4.3.6-8)(SLR, 2021 a, b)	Project-specific boat-based survey data	24 surveys conducted between June 2019 and April 2021. Used in the EIAR Assessment.
Winter 2019/20, Autumn 2020 and Winter 2023/2024 survey data(Appendix 4.3.6-9) (SLR, 2021c, SLR, 2024)	Intertidal surveys at Offshore Export Cable landfall location	Intertidal surveys conducted between November 2019 and March 2020, September and October 2020 and September 2023 to March 2024. Used to inform EIAR Assessment
Published at-sea survey data from the wider region		
JNCC Report No. 267 (Pollock *et al.,* 1997)	Published report	ESAS survey data collected between 1980 and 1997 in Irish waters, including a period of intensive surveys between 1994 and 1997, which targeted areas around Ireland with poor survey coverage. Used to provide historic context for the wider Irish Sea.
ObSERVE 2016 aerial surveys (Jessopp *et al.,* 2018)	Published report	Fine-scale aerial surveys conducted in summer, autumn and winter 2016 to assess the occurrence and distribution of seabird species in the western Irish Sea. Used to provide recent context for the wider Irish Sea.

Data Source	Type of Data	Temporal and Spatial Coverage
Seabird colony data from the wider region		
Burnell *et al.,* 2023	Seabirds Count national colony census data	Published data from a census of breeding seabirds in Britain and Ireland between 2015 and 2021. Used to provide SPA reference populations for the EIAR.
Seabird Monitoring Programme	Online colony counts	Online database of seabird colony counts in Ireland and UK – most recent data from Seabirds Count national census 2015-2021. Used to provide SPA reference populations for the EIAR.
Cummins *et al.*, 2019	NPWS published report	The Status of Ireland's Breeding Seabirds: Birds Directive Article 12 Reporting 2013 – 2018. Used to provide SPA reference populations for the EIAR.
ALCnature 2021	National Urban Gull Survey 2021	Report outlining first ever national survey for urban nesting gulls undertaken in Ireland.
Newton *et al.*, 2016	Breeding Birds Survey and Visitor Activity and Impact Study	Report to summarise breeding bird surveys conducted over seven days during summer 2016 (May, June and July) and observations of visitor presence, activity and instances of disturbance of breeding seabirds

Summary of survey methods

6.4.10 The site-specific surveys provide a robust and current dataset utilised to characterise the offshore ornithological environment. A detailed baseline description of offshore and intertidal ornithology, the data sources and survey methods used are presented within the Ornithology Technical Baseline. A list of the supporting data sources used to inform the baseline is presented in Table 2.

6.4.11 Site-specific boat-based surveys were undertaken in the offshore study area on a monthly basis between June 2019 and April 2021, with the exception of February and March 2020 (unsuitable weather conditions) and April 2020 (Covid-19 restrictions). Additional surveys were undertaken in May 2020, March 2021 and April 2021. Further details are provided in the Ornithology Technical Baseline.

6.4.12 Data were collected along 13 transects spaced 2 km apart and aligned east-west across the study area. Two surveys were conducted in both August and September 2019 to provide additional coverage of post breeding seabird activity and distribution. In addition, two surveys were conducted in May 2020, and also in March and April 2021.

6.4.13 As recommended in the DCCAE 2017 Guidance Appendix II, the methods used to conduct the baseline seabird surveys followed standard COWRIE approved survey methodology (Camphuysen *et al.,* 2004). The suitability of boat-based surveys in comparison to aerial surveys to inform assessments for OWFs was assessed in the COWRIE method review, where it was concluded that the methods provide similar data as far as seabird counts are concerned. Census techniques are similar, but the level of detail for individual bird behaviour is less during aerial surveys. Aerial surveys are quicker, so enabling coverage of larger areas per unit time, whereas boat-based surveys are more time-consuming (Camphuysen *et al.,*2004).

6.4.14 On each survey, birds were counted ahead of, and out to one side, of the survey vessel in a 90° arc, with a 300 m transect width, using two surveyors, as per Camphuysen *et al.,* (2004). Three ESAS accredited surveyors were on board for surveys between June 2019 and January 2020. Due to Covid-19 restrictions, there was only space for two ESAS accredited surveyors on surveys between May 2021 and September 2021. At any one time, one surveyor was acting as the primary observer, with a second acting as scribe and secondary observer, while the third surveyor (if present) was on a break.

6.4.15 Binoculars were used to confirm identifications as well as to scan ahead for species such as red-throated divers, which are easily disturbed and take flight at some distance from the approaching vessel. Birds on the water were assigned to distance bands (A = <50 m, B = 51-100 m, C = 101-200 m, D = 201–300 m, E =>300 m), according to their perpendicular distance from the ship's track.

6.4.16 A snapshot method was used for flying birds, which considers the ship's speed and prevents overestimation of flying seabird densities. In addition, the estimated height of flying birds was also recorded in five height bands above sea level; 0-5 m, 5-10 m, 10-20 m, 20-30 m, >30 m.

6.4.17 The count interval for surveys was one-minute intervals, and synchronised GPS recorders were used to record the vessel position every minute. Environmental conditions such as wind direction and force, sea state, swell height and visibility were recorded every 15 minutes throughout survey days. Surveys were carried out in good weather where possible, to maximise detection rates of birds on the water. Surveys were generally halted if the sea state exceeded sea state 4, as recommended in Camphuysen *et al.,* (2004). Further details of the site-specific ornithology surveys including information on survey design and methods, as well as the analysis techniques implemented to characterise the baseline are presented in the Offshore and Intertidal Ornithology Technical Baseline.

6.4.18 Surveys of the intertidal study area covered the nearshore to high water mean spring (HWMS) to include the landfall location for the offshore ECC at Shanganagh to the south of the Uisce Eireann Shanganagh Wastewater Treatment Plant area. The survey programme involved monthly intertidal and nearshore coastal bird surveys during the winter period 2019/2020 (November 2019 to March 2020) and autumn period 2020 (September and October 2020). Surveys were conducted from two vantage points chosen to maximise visibility of birds within the intertidal zone up to 750 m to the north and to the south of the potential cable landfall location i.e. a total shoreline distance of 1.5 km and looking east out to 1 km offshore. Additional surveys were conducted between September 2023 and March 2024 (SLR, 2024).

6.4.19 The scope of the intertidal ornithology surveys at Shanganagh was to provide robust baseline ornithological survey data of non-breeding waterbird species density, abundance, distribution and patterns of behaviour within the intertidal study area during the winter period 2019/20 and autumn period 2020.

6.4.20 Survey periods lasted three hours and began either four hours before or one hour after high tide or four hours before or one hour after low tide. The survey aimed to record bird species assemblages and numbers on a range of rising and ebbing tides from each vantage point each month. Further details of the methods used to undertake these surveys and the intertidal study area are presented in the Intertidal Ornithology Technical Baseline.

Assessment Methodology

6.4.21 As described above the baseline was established through the compilation of best available evidence from desk-based studies and site-specific surveys. The characterisation of the baseline from these sources is considered adequate for the purposes of this assessment.

6.4.22 The assessment of potential impacts on offshore and intertidal birds has considered the magnitude and duration of the impact, the reversibility of the impact and the timing and frequency of the activity. The sensitivity and conservation importance of different species has also been considered as part of the impact assessment.

Approach to modelling

6.4.23 The approaches and models used to support the assessments for collision risk modelling and displacement are detailed in the sections below (Displacement effects and Collision Ris) and presented in full in the Seabird CRM Technical Report; mCRM Technical Report and the Seabird Displacement Technical Report and Seabird Displacement Technical Report. The methods and approaches used are in line with the Phase 1 methodology note as detailed in Annex B.

Displacement effects

6.4.24 Displacement has been defined as 'a reduced number of birds occurring within or immediately adjacent to an offshore wind farm' (Furness et al., 2013). Activities during all phases of the construction, operation and maintenance and decommissioning of the offshore infrastructure have the potential to disturb/displace bird species in this context. This could result in displacement from the immediate area, therefore potentially driving temporary habitat loss and potentially reducing the area available to birds for foraging, loafing and moulting.

6.4.25 As discussed in the Phase 1 Method Statement (Appendix 4.3.6-2), the Phase 1 Projects undertook a review of available Irish Guidance and best practice along with wider offshore renewable industry best-practice. There was alignment on their methodologies to be appropriate for the assessment of potential impacts on marine ornithology receptors in the western Irish Sea. It is noted that there is currently no descriptive guidance detailing an approach for assessing displacement effects on birds in an Irish context. Being the closest established industry, the methodologies reported here largely draw on UK (Natural England and Nature Scot) guidance, which is heavily supported by substantive and robust research and evidence. Moreover, based on the geographic location of the proposed project, it is assumed that the ornithological species present in the western Irish Sea will have similar biological traits to the same species in England and Wales, due to proximity. Therefore, joint guidance produced by SNCBs in the UK has been used as the basis for this assessment (SNCB, 2022). on the basis of it being applied to assess displacement effects on seabirds for several recent offshore wind farm projects. Consideration is also given to NatureScot guidance (NatureScot, 2023).

6.4.26 The initial SNCB (UK) displacement guidance was published in 2017 (SNCBs, 2017) and was revised, primarily for the assessment of red-throated divers in 2022 (SNCBs, 2022). In the assessment presented herein, displacement and barrier effects have been considered together following the recommended SNCBs (UK) approach (SNCBs, 2017). As defined in the UK guidance, both flying birds and birds on the water are considered in this displacement assessment (Volume 4, Appendix 4.3.6-6).

6.4.27 The SNCB (UK) guidance recommends assessing the impacts of displacement based on the overall mean seasonal peak numbers of birds (averaged over the years of baseline characterisation survey) in the development footprint and an appropriate buffer (SNCBs, 2022). For the assessment herein, where possible, numbers of birds in the array area and a buffer area are estimated for each month, and then divided by the number of surveys undertaken for that month over the two survey periods (2016-2017 and 2019-2021) to give the mean estimated number of birds per month (see section 2.5). The mean peak number per season was then used for the displacement assessment (Volume 4, Appendix 4.3.6-6).

6.4.28 Sensitivity to displacement differs considerably between seabird species. The SNCB (UK) guidance contains a table of species ranked according to their sensitivity to disturbance and also the degree of habitat specialisation, from previous reviews e.g. Furness et al., (2013) and Bradbury et al., (2014). The guidance recommends that as a general guide, any species scoring three or more under either category, and which is present in the offshore wind farm site or buffer should be taken forward for assessment, unless there is strong empirical evidence to the contrary. A review of count data gathered during site-specific surveys and associated expert ornithological judgement (e.g., Bradbury et al., 2014; Dierschke et al., 2016) was used to identify species that are likely to be sensitive to displacement. The species identified were guillemot, razorbill, cormorant, shag, common scoter, great northern diver and red-throated diver. Although scores for gannet are less than three for both categories, the SNCB (UK) guidance (2022) states that gannet should be included in the assessment, as there are empirical studies demonstrating they are sensitive to displacement (e.g. Krijgsveld et al., 2011, Vanermen et al., 2013). Furthermore, kittiwake and Manx shearwater are also included in the displacement assessment on a precautionary basis following the NPWS response (ABPmer, 2023) to the Phase 1 East Coast Developers Methodology document (GoBe Consultants Ltd., 2022).

6.4.29 For the majority of seabird species, SNCB (UK) guidance advises that a 2 km buffer around the array area is appropriate, however for more sensitive species such as great northern diver and common scoter, a 4 km buffer is recommended, while for very sensitive species such as red-throated diver, a 10 km buffer is recommended (SNCBs, 2022).

6.4.30 The mortality rates that inform the displacement are presented in Section 6.5.

Collision risk modelling

6.4.31 Collision Risk Modelling (CRM) is widely used to estimate the potential number of birds which may collide with Wind Turbine Generators (WTGs) in each calendar month, so as to inform impact assessments. CRM has been conducted using the stochastic implementation of the Band (2012) model provided as scripts in the R programming environment (package: stochLAB v.1.1.2; Caneco et al. 2022). Detailed methods and results are presented in the Seabird CRM Technical Report. CRM has been run with multiple design options to aid in preventing and avoiding impacts, particularly the requirement for minimum blade clearance heights above MHWM to ensure the lowest risk. This approach allows for careful consideration of alternatives, design detail and bespoke mitigation measures and has therefore been integral to informing project design decisions.

6.4.32 CRM follows an evidence led approach taking into account site-specific ornithological data collected from within the array area along with the up-to-date literature on seabirds and their behaviour in relation to OWFs (Volume 4, Appendix 4.3.6-4). Due to the large number of existing OWF developments in the UK and Europe, a robust evidence base is available and has been used to provide data on the impacts of OWFs to seabird species that are found in Irish waters.

6.4.33 There is currently no Irish specific guidance on the use of site-specific or generic data for flight height estimates to be used in the CRM within Ireland. As noted above, being the closest established industry, the methodologies reported here largely draw on UK (Natural England and Nature Scot) guidance, which is heavily supported by substantive and robust research and evidence. Moreover, based on the geographic location of the proposed project, it is assumed that the ornithological species present in the western Irish Sea will have similar biological traits to the same species in England and Wales, due to proximity. UK guidance on minimum data requirements for using site-specific data recommends that species with more than 100 flight height estimates should be assessed using band option 1[6] and less frequently observed birds, band option 2[7]. The number of flight height observations for each species and corresponding proportion of birds at rotor height are presented in Volume 4, Appendix 4.3.6-1. The site-specific data shows that for common and roseate tern, zero individuals were recorded at rotor height, this was based on 360 observations for common tern and 119 for roseate tern. Nevertheless, Band Option 2 has been modelled on a precautionary basis. The impacts discussed within the assessment are therefore likely to be overestimated, with potential impacts lower than those identified through CRM. Several other different species-specific behavioural aspects of assessed birds, including their ability to avoid moving or static structures and how active they are diurnally and nocturnally, are accounted for by the CRM. Details of these considerations are also provided in the Seabird CRM Technical Report.

[6] A basic model, assuming a uniform distribution of flight heights between the lowest and highest levels of the rotors and using the proportion of birds at highest risk as derived from site survey.
[7] A basic model, using the proportion of birds at risk height as derived from a generic flight height distribution.

6.4.34 Table 2 describes the WTG options considered within this assessment (see Volume 2, Chapter 6: Project Description [hereafter referred to as the Project Description Chapter] for more details). In all cases, turbine model option A resulted in the Maximum Design Option (MDO), based on CRM outputs. Further details are presented in the Seabird CRM Technical Report.

Table 3 Turbine options considered within the CRM assessment for Dublin Array.

Turbine model option	Average RPM	Rotor radius (m)	Hub height (m. above MSL)	Predicted operation time (%)	Max. blade width (m)	Average blade pitch (°)	No. of turbines	Latitude (°)
A	5	118	147.5	99	8.5	2.4	50	53.23
B	4.7	125	154.5	99	9.0	2.4	45	53.23
C	4.2	139	168.5	99	10.0	2.3	39	53.23

Precautionary Nature of CRM

6.4.35 CRM has been undertaken for this assessment using the species parameters as outlined in the CRM Report and as agreed across other east coast Phase 1 projects. The Offshore Renewables Joint Industry Programme[8] (ORJIP) conducted a study around Thanet OWF that found only six birds (all gull species) out of 12,000 recorded bird movements collided with WTGs during the two-year period from 2014 to 2016 (Skov et al., 2018). NatureScot (2023a) and Natural England (2022) avoidance rates have been used throughout the CRM assessment. However, these values are precautionary, the literature has suggested higher avoidance rates for gannet and kittiwake (99.5% and 99.0%, respectively; Bowgen and Cook, 2018).

6.4.36 APEM Ltd (2014) found that all gannets during the migration period avoided WTGs in the study area which indicates a potential 100% avoidance rate for gannet. The study suggested an avoidance rate of 99.5% during the autumn migration would be suitably precautionary. However, an avoidance rate of 99.2% has been suggested in the NatureScot (2023a) guidance. This lower suggested avoidance rate therefore overemphasizes collision risk for this species.

6.4.37 In addition, a report from Aberdeen Offshore Windfarm Limited (AOWFL, 2023) at the European Offshore Wind Development Centre (EOWDC) recorded zero collisions or narrow escapes in 10,000 videos of bird flight in relation to OWFs. This indicates that bird collision rates are lower in reality than the predicted rates and highlights the precautionary nature of the current methodology.

[8] ORJIP is a UK-wide programme aimed to address environmental and consenting risks and issues within the offshore wind and marine energy industry. ORJIP fosters collaboration between industry professionals, regulators, SNCBs, and academics.

6.4.38 Furthermore, flight speeds from the current methodology have also been shown to be precautionary. Royal HaskoningDHV (2020b) undertook a review of the published literature on kittiwake flight speeds for Norfolk Boreas Offshore windfarm. This study found that a flight speed of 10.8m/s is a more realistic estimation of flight speed for kittiwake compared to the current recommended flight speed for kittiwake (13.1m/s). Other studies have even suggested flight speeds of 8.7m/s for kittiwake and lower flight speeds for gannet and large gulls compared to the current advice (Skov et al., 2018). The flight speed parameter used within the CRM assessment directly impacts the predicted potential mortality for seabirds due to collision risk. Therefore, the predicted potential mortalities could be lowered using more appropriate precautionary rates compared to the current advice.

6.4.39 The CRM model used within this assessment assumes uniform seabird flight heights. This use of uniform seabird flight height distributions also adds another level of precaution given most individuals of seabird species fly close to the sea surface, with the proportion of individuals present in higher height bands decreasing with increasing altitude.

6.4.40 Overall, a review of the current studies surrounding CRM parameters for seabirds suggest that the parameters used in this assessment incorporate a high degree of precaution. Therefore, the CRM results will be a precautionary indication of collision risk. The impacts discussed within this assessment are likely to be overestimated, with potential impacts lower than those identified through CRM.

Combined Displacement and Collision Impacts.

6.4.41 During operation and maintenance, gannet and kittiwake have been assessed for impacts by both displacement and collision risk. Throughout the assessment for gannet, macro-avoidance rates have been used to account for overestimation of combined impacts of collision and displacement. To avoid this overestimation, the macro-avoidance rate of 70% was applied which reduced the density of gannet in flight going into the CRM by 70%, as per the Natural England interim advice on updated CRM parameters (Natural England, July, 2022). The avoidance rates used have been detailed in the Seabird CRM Technical Report. The subsequent potential collision mortalities were then summed with the potential displacement mortalities.

6.4.42 No macro-avoidance rate has been used for kittiwake, therefore an additive approach has been undertaken. The potential combined mortalities are therefore likely to be overestimates

6.5 Assessment Criteria

6.5.1 This assessment for ornithology is consistent with the EIA methodology presented in the EIA Methodology (hereafter referred to EIA Methodology chapter), with some adaptations to make it applicable to ornithology receptors. The criteria for determining the sensitivity of the receiving environment and the magnitude of impacts for the offshore and intertidal ornithology assessment are defined in Table 3 and Table 4 respectively.

6.5.2 The process for determining the significance of effects is a two-stage process that involves defining the sensitivity of the receptors and the magnitude of the potential impacts. A matrix was used for the determination of significance in EIA terms (see Table 5). The combination of the magnitude of the impact with the sensitivity of the receptor determines the assessment of significance of effect.

Sensitivity of Receptor Criteria

6.5.3 The sensitivities of offshore and intertidal ornithology receptors are defined by both their potential vulnerability to an impact from the proposed development, their recoverability, and the value or importance of the receptor. This needs to be taken on a species by species basis, as a species with a high conservation value may not be sensitive to a specific effect, while a species with a low conservation value might be very sensitive to the effect. For example, kittiwake is a species listed as a qualifying feature for some SPAs and has a conservation concern listing of 'Red' Species in Ireland in the most recent Birds of Conservation Concern in Ireland (BOCCI) rankings (2020-2026), because of recent population declines (Gilbert *et al.*, 2021). However, kittiwakes are not considered to be particularly sensitive to human disturbance as there are several examples of individuals nesting on buildings or structures or bridges. In contrast, red-throated diver is also a species listed as a qualifying feature for some SPAs, and is currently 'Amber-listed' in the BOCCI rankings (Gilbert *et al.*, 2021). However, this species is considerably more sensitive to human-related disturbance than kittiwake.

6.5.4 Taking account of such differences between species is an important part of the overall process of determining the potential significance of an impact and this has been applied where appropriate as a method to assess the sensitivity of an effect assigned to a specific receptor.

6.5.5 Integral to this assessment is the conservation status of identified species and the protection required to be afforded to wild birds in accordance with the Birds Directive. First, an assessment is made of the populations from which individuals are predicted to originate. Second the degree of connectivity of receptor species to SPAs in the region is considered. Third, consideration is given to additional national and local designations including the current Birds of Conservation Concern in Ireland (BoCCI national conservation status for particular species, where appropriate (Gilbert *et al.,* 2021). Together, these analyses inform the conservation status of the identified species, which is shown in Table 8 and considered throughout the assessments.

6.5.6 The criteria for defining the sensitivity of offshore and intertidal birds in this chapter are outlined in Table 4.

Table 4 Sensitivity of offshore and intertidal ornithology

Receptor Sensitivity	Definition
High	**Adaptability:** No ability to adapt behaviour so that individual survival and reproduction rates are affected. **Tolerance:** No tolerance – Effect will cause a change in both individual reproduction and survival rates. **Recoverability:** No ability for individuals to recover from any impact on vital rates (reproduction and survival rates). **Importance:** The receptor is of international importance and/or there is clear connectivity to a particular SPA.
Medium	**Adaptability:** Limited ability to adapt behaviour so that individual survival and reproduction rates may be affected. **Tolerance:** Limited tolerance – Effect may cause a change in both individual reproduction and survival of individuals. **Recoverability:** Limited ability for individuals to recover from any impact on vital rates (reproduction and survival rates). **Importance:** The receptor is of national or international importance and/or individuals at risk are probably drawn from a particular SPA, although other colonies (inc. non-SPAs) may also contribute to the population at risk.
Low	**Adaptability:** Some ability to adapt behaviour so that individual reproduction rates may be affected but survival rates not likely to be affected. **Tolerance:** Some tolerance – Effect unlikely to cause a change in both individual reproduction and survival rates. **Recoverability:** Some ability for individuals to recover from any impact on vital rates (reproduction and survival rates) **Importance:** The receptor is of national importance and/or it is not possible to determine connectivity to any SPAs with any certainty, or no SPAs designated for this species.
Negligible	**Adaptability:** Receptor is able to adapt behaviour so that individual survival and reproduction rates are not affected. **Tolerance:** Receptor is able to tolerate the effect without any impact on individual reproduction and survival rates. **Recoverability:** Receptor is able to return to previous behavioural states/activities once the impact has ceased. **Importance:** The receptor is of local importance and/or no SPAs are designated for this species.

6.5.7 Previous published reviews have ranked individual seabird species for their sensitivity to potential impacts such as collision, disturbance and displacement (e.g. Furness and Wade, 2012, Furness *et al.,* 2013, Bradbury *et al.,* 2014, Dierschke *et al.,* 2016). Conclusions from these reviews have been used to inform definitions of sensitivity for bird species in the individual species assessments, in addition to the definitions given in Table 4.

6.5.8 The criteria used to define the importance of a species are outlined in Table 5.

Table 5 Defining criteria of conservation value

Importance	Defining Criteria
International	Internationally designated sites within mean maximum foraging range +1 S.D. of the array area in the breeding season. Regularly occurring species protected under international law (i.e., Annex I species listed as qualifying interests of SPAs within mean maximum foraging range +1 S.D. of the array area for breeding species, or nearby non-breeding season SPA).
National	Nationally designated sites within mean maximum foraging range +1 S.D. of the array area. Species protected under national law. Regularly occurring Annex I or Birds Directive Migratory species which are not listed as qualifying interests of SPAs within mean maximum foraging range +1 S.D. of the array area. BoCCI 'Red' list (Gilbert *et al.,* 2021) species that have nationally important populations within the offshore study area.
Local	The species is common throughout Irish waters but forms a key component of the bird assemblages in the offshore study area. BoCCI 'Red' list (Gilbert *et al.,* 2021) species with populations within the offshore study area that are not nationally important (i.e., are locally widespread and/or abundant).

Magnitude of Impact Criteria

6.5.9 The criteria for defining magnitude levels for ornithology receptors in this chapter are outlined in Table 6. The magnitude of potential impacts is defined by a number of factors including the spatial extent of any interaction, the likelihood, duration, frequency and reversibility of a potential impact.

6.5.10 This set of criteria has been determined on the basis of predicted changes to the regional bird population of each species. As a guide, it has been based on summing predicted adult mortality in the breeding season and mortality of all age classes (adults and immature birds) in the non-breeding season and presenting this figure as an overall percentage increase in the baseline mortality in terms of the regional population for each key species. For comparison, mortality has also been calculated based on summing predicted mortality (all ages) in the breeding and non-breeding seasons and presenting this figure as an overall percentage increase in the baseline mortality in terms of the regional population for each key species.

6.5.11 A guide percentage has been included for each of the categories of impact magnitude in Table 6, based on the predicted change to baseline mortality rate. These guide percentages were agreed between the East Coast Phase 1 developers to ensure a consistent approach in the assessment. Where the baseline mortality rate was predicted to increase by more than 1% , the predicted magnitude has also been sense-checked against relevant Population Viability Analysis (PVA) outputs for the species under consideration, to help inform the magnitude rating, depending on the PVA predictions.

6.5.12 PVA is used as an assessment tool that can forecast potential future population sizes/trends under different scenarios e.g. with and without the potential OWF impacts. The predicted baseline (continuation of the population change without the addition of potential OWF impacts) is compared with the potential 'impact scenarios' described within this EIA Report. The outcomes of this assessment were then used to inform the potential for significant effects on the key species considered for each impact.

6.5.13 Guidance from Natural England (Parker *et al.,* 2022c) recommends that where predicted impacts are greater than 1% of the baseline mortality of the relevant population (e.g. colony or regional population), then the significance of this increase in baseline mortality should be considered further by the use of PVA. Where impacts are predicted to be 1% or less of the baseline mortality rate for a population then this level of impact can be considered non-significant (Parker *et al.,* 2022c).

6.5.14 As outlined in the East Coast Phase 1 Projects Method Statement (GoBe, 2022), this approach was agreed between the East Coast developers. It was agreed that PVA would be undertaken using the Natural England Seabird PVA Tool (Mobbs *et al.,* 2020) when the impact from a single OWF or cumulative/in-combination impact to a population, SPA or colony was estimated to exceed 1% of baseline annual mortality.

Table 6 Defining magnitude of impact criteria

Magnitude	Definition
High	**Extent:** High proportion of the population is affected. **Duration:** The impact is anticipated to be permanent (i.e., over 60 years). **Frequency:** The effect is expected to occur constantly throughout a relevant project phase. **Probability:** The effect is reasonably expected to occur. **Consequence (Adverse):** The impact would affect the behaviour and distribution of sufficient numbers of individuals, with sufficient severity, to affect the favourable conservation status and/or the long-term viability of the population at a generational scale. Guide: Predicted increase to baseline mortality rate is above 5%. **Consequence (Beneficial):** Long-term, large-scale increase in the population trajectory at a generational scale. Guide: Predicted increase to baseline population growth rate is above 5%.
Medium	**Extent:** Medium proportion of the population is affected. **Duration:** Medium-term effects (lasting seven to 15 years) to long-term effects (15 – 60 years). **Frequency:** The effect is expected to occur constantly throughout a relevant project phase. **Probability:** The effect is reasonably expected to occur. **Consequence (Adverse):** Temporary changes in behaviour and/or distribution of individuals at a scale that would result in potential reductions to lifetime reproductive success to some individuals although not enough to affect the population trajectory over a generational scale. Permanent effects on individuals that may influence individual survival but not at a level that would alter population trajectory over a generational scale. Guide: Predicted increase to baseline mortality rate is between 2% and 5%. **Consequence (Beneficial):** Benefit to the habitat influencing foraging efficiency resulting in increased reproductive potential and increased population health and

Magnitude	Definition
	size. Guide: Predicted increase to baseline population growth rate is between 2% and 5%.
Low	**Extent:** Small proportion of the population is affected. **Duration:** The impact is anticipated to be temporary (i.e., lasting less than one year) to short-term (i.e., one to seven years). **Frequency:** The effect is expected to occur frequently throughout a relevant project phase. **Probability:** The effect is unlikely to occur. **Consequence (Adverse):** Short-term and/or intermittent and temporary behavioural effects in a small proportion of the population. Reproductive rates of individuals may be impacted in the short term (over a limited number of breeding cycles). Survival and reproductive rates very unlikely to be impacted to the extent that the population trajectory would be altered. Guide: Predicted increase to baseline mortality rate is between 1% and 2%. **Consequence (Beneficial):** Short term (over a limited number of breeding cycles) benefit to the habitat influencing foraging efficiency resulting in increased reproductive potential. Guide: Predicted increase to baseline population growth rate is between 1% and 2%.
Negligible	**Extent:** Very small proportion of the population is affected. **Duration:** The impact is anticipated to be momentary (seconds to minutes) to brief (lasting less than one day). **Frequency:** The effect is expected to occur once or infrequently throughout a relevant project phase. **Probability:** The effect is unlikely to occur. **Consequence (Adverse):** Very short term, recoverable effect on the behaviour and/or distribution in a very small proportion of the population. No potential for the any changes in the individual reproductive success or survival therefore no changes to the population size or trajectory. Guide: Predicted increase to baseline mortality rate is less than 1%. **Consequence (Beneficial):** Very minor benefit to the habitat influencing foraging efficiency of a limited number of individuals. Guide: Predicted increase to baseline population growth rate is less than 1%.

Defining the significance of effect

6.5.15 Assessment of the significance of the potential effect upon Offshore and Intertidal Ornithology is determined by correlating the magnitude of the impact and the sensitivity of the receptor in a matrix presented in Table 7.

6.5.16 Moderate levels of effect have the potential, subject to the assessor's professional judgement, to be 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. For clarity, it is confirmed that the assessment of significance in EIA terms within this chapter encompasses an assessment of effects on the conservation status of the receptor species, including potential impacts of displacement/ disturbance on breeding and rearing.

6.5.17 Effects that are ranked significant or above are therefore considered important in the decision-making process, whilst effects of moderate significance or less warrant little, if any, weight in the decision-making process. However, it should be noted that while impacts of moderate significance are not significant in their own right, it is important to distinguish these from other non-significant impacts as they may contribute to significant impacts cumulatively or through interactions.

Table 7 Significance of potential effects

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

6.6 Receiving Environment

Offshore Ornithology

6.6.1 A technical report has been prepared to provide a detailed characterisation of the receiving environment across the offshore ornithology study area (see Offshore and Intertidal Ornithology Technical Baseline). Data to inform this characterisation of the receiving environment has been collated from a series of site-specific surveys of the array area and a 4 km buffer area, supplemented by a thorough desk-based study of published data. Data was drawn from contemporary studies commissioned by Dublin Array, previous site surveys, and existing published datasets

6.6.2 This section is intended to be a summary of the key findings presented in the Offshore and Intertidal Ornithology Technical Baseline. Detail has not been repeated within this chapter in order to present a clear and concise impact assessment.

6.6.3 Between June 2019 and April 2021, 28 seabird species were regularly recorded (more than 10 birds) on boat-based baseline surveys in the offshore study area. This compares to 25 species between September 2016 and September 2017). A summary of these species and their conservation status is presented in Table 8. The links between conservation status and species sensitivity are discussed in Paragraph 6.5.3 onwards.

Table 8 Summary of baseline results for regularly recorded seabird species in the offshore study area

Species	Conservation status[9]	Summary of baseline results
Red-throated Diver *Gavia stellata*	BoCCI[1] Amber listed Birds Directive Migratory Species Birds Directive Annex 1	Recorded in low numbers in the non-breeding season, with only two sightings between May and September. A total of 12 birds were recorded on 2016-2017 baseline surveys between October and May. On 2019-2020 surveys, 51 red-throated divers were recorded between September and April, with a peak of nine birds in January 2020. Overall combined average abundance (birds/km) was low, with a peak of with 0.12 birds/km recorded.
Great Northern Diver *Gavia immer*	BoCCI Amber-listed Birds Directive Migratory Species Birds Directive Annex 1	A single great northern diver was recorded on 2016-2017 baseline surveys, in March 2017. On the 2019-2021 surveys, 20 great northern divers were recorded between November and May, with a peak of three birds in both December 2019 and December 2020. Combined average abundance (birds/km) over the two survey periods was highest in December, with 0.03 birds/km recorded.
Fulmar *Fulmarus glacialis*	BoCCI Amber listed Birds Directive Migratory Species	A total of 19 fulmars were recorded on 2016-2017 baseline surveys, with a peak of seven birds in September 2016. On the 2019-2021 surveys, 96 fulmars were recorded on all surveys, with a peak of 13 birds in early September 2019. Average abundance (birds/km) over the two survey periods was highest in May and September, with 0.09 birds/km recorded in both months.
Manx Shearwater *Puffinus puffinus*	BoCCI Amber listed Birds Directive Migratory Species	Manx shearwaters were regularly recorded in the offshore study area between March and September. Highest estimated numbers of Manx shearwaters were recorded in April with a peak mean of 3,785 birds in April.
European Storm Petrel *Hydrobates pelagicus*	BoCCI Amber listed Birds Directive Migratory Species Birds Directive Annex 1	Five storm petrels were recorded on 2016-2017 surveys, in August 2017. On 2019-2021 surveys, 11 storm petrels were recorded between May and August, with a peak of seven birds in late May 2020. Average abundance (birds/km) over the two survey periods was low, with a peak of 0.04 birds/km recorded in May and August.
Gannet *Morus bassanus*	BoCCI Amber listed Birds Directive Migratory Species	Gannets were recorded in the offshore study area in all months. Overall, estimated numbers of gannets were highest in the breeding season, with a peak mean of 1,167 birds in May. Estimated numbers for the non-breeding season were considerably lower, with peaks of 47 birds in October and 73 birds in December.
Cormorant *Phalacrocorax carbo*	BoCCI Amber listed	Cormorants were recorded in the offshore study area in all months. A total of 226 cormorants were recorded on 2016-2017 baseline surveys, with peaks of 31 birds in September 2016 and 27 birds in

[9] Although not classified as Annex 1 or migratory species, all wildbirds are protected under Article 1 and 5 of the Birds Directive

Species	Conservation status[9]	Summary of baseline results
	Birds Directive Migratory Species	November 2016. On 2019-2021 surveys, 393 cormorants were recorded, with a peak of 135 birds in July 2020. Across both survey periods, numbers were lowest between December and February. Average abundance over the two survey periods was highest in July, with 0.88 birds/km recorded.
Shag *Gulosus aristotelis*	BoCCI Amber listed Birds Directive	Shags were recorded in the offshore study area in all months. Overall, estimated numbers of shags on baseline surveys were highest in the non-breeding season, with a peak mean of 1,103 birds in November. In the breeding season, estimated peak numbers were highest in July (573 birds) and August (587 birds).
Common Scoter *Melanitta nigra*	BoCCI Red listed Birds Directive Migratory Species	Baseline surveys recorded highest numbers of common scoter in autumn. A total of nine common scoter were recorded on 2016-2017 baseline surveys, with eight birds in October 2016 and one bird in February 2017. On 2019-2021 surveys, 124 common scoter were recorded, with a peak count of 55 birds in late April 2021. Average abundance over the two survey periods was highest in April, with 0.27 birds/km recorded, and October, with 0.18 birds/km recorded.
Arctic Skua *Stercorarius parasiticus*	BoCCI Green listed Birds Directive Migratory Species	Low numbers of Arctic skuas were recorded on baseline surveys between June and November. Four Arctic skuas were recorded on 2016-2017 surveys, with two birds in June 2017 and single birds in September 2016 and 2017. On 2019-2021 surveys, 21 Arctic skuas were recorded, with a peak count of 13 birds in early September 2019. Average abundance over the two survey periods was very low, with a peak of 0.06 birds/km recorded in September.
Great Skua *Stercorarius skua*	BoCCI Amber listed Birds Directive Migratory Species	On 2016-2017 surveys, two great skuas were recorded in September 2016. On 2019-2021 surveys, one great skua was recorded in April, with 12 recorded between August and December. Peak counts involved three birds in late September 2019 and three birds in October 2020. Average abundance (birds/km) over the two survey periods was very low, with a peak of 0.02 birds/km recorded in September and October
Mediterranean Gull *Ichthyaetus melanocephalus*	BoCCI Amber listed Birds Directive Migratory Species Birds Directive Annex 1	Mediterranean gulls were recorded in low numbers on 2019-2021 baseline surveys between August and March, with a peak of 20 birds in November. The species was not recorded on 2016-2017 baseline surveys.
Little Gull *Hydrocoloeus minutus*	BoCCI Amber listed Birds Directive Annex 1 Migratory Species	Highest numbers of little gulls on baseline surveys were recorded in the winter months. On 2016-2017 surveys, 15 little gulls were recorded, with a peak of 10 birds in February 2017. On 2019-2021 surveys, 157 little gulls were recorded between July and January, with peak counts of 90 birds in January 2020

Species	Conservation status[9]	Summary of baseline results
		and 30 birds in December 2020. Average abundance over the two survey periods was generally low, with a peak of 0.64 birds/km recorded in January 2020.
Black-headed Gull *Chroicocephalus ridibundus*	BoCCI Amber listed Birds Directive Migratory Species	Highest numbers of black-headed gulls on baseline surveys were recorded in the non-breeding season. On 2016-2017 surveys, 141 black-headed gulls were recorded between October and February, with a peak of 109 birds in December 2016. On 2019-2021 surveys, 355 black-headed gulls were recorded between September and May. Peak counts were 96 birds in November 2019, 145 birds in December 2019, and 68 birds in December 2020. Average abundance over the two survey periods was very low in the breeding season, and higher in the non-breeding season, with a peak average abundance of 1.82 birds/km in December.
Common Gull *Larus canus*	BoCCI Amber listed Birds Directive Migratory Species	Common gulls were mainly recorded on baseline surveys in the non-breeding season. The 2016-2017 baseline surveys recorded 33 common gulls in the non-breeding season only, with peak counts of 11 birds in November 2016 and 17 birds in December 2016. On 2019-2021 baseline surveys, a total of 547 common gulls were recorded, predominantly in the non-breeding season. Peak counts were 246 birds in December 2019 and 94 birds in January 2021. Average abundance over the two survey periods was low in the breeding season, and higher in the winter months, with a peak average abundance of 1.48 birds/km in December.
Lesser black-backed Gull *Larus fuscus*	BoCCI Amber listed Birds Directive Migratory Species	Baseline surveys recorded lesser black-backed gulls predominantly in the breeding season. The 2016-2017 surveys recorded nine lesser black-backed gulls over the survey period, with a peak of four birds in September 2016. On the 2019-2021 baseline surveys, a total of 332 lesser black-backed gulls were recorded, with a peak count of 194 birds in early August 2019. Average abundance over the two survey periods was very low in the winter months, and slightly higher in the breeding season, with a peak of 0.88 birds/km in August.
Herring Gull *Larus argentatus*	BoCCI Amber listed Birds Directive Migratory Species	Herring gulls were recorded on baseline surveys in all months. Overall, estimated numbers were highest in the breeding season, with peak means of 1,058 birds in May and 1,855 birds in August. In the non-breeding season, estimated numbers were highest in February, with a peak of 475 birds.
Great black-backed Gull *Larus marinus*	BoCCI Green listed Birds Directive Migratory Species	Great black-backed gulls were recorded on baseline surveys in all months. Overall, estimated numbers were higher in the breeding season, with a peak mean of 186 birds in March, and 137 birds in May. In the non-breeding season, the peak mean was 97 birds in December.
Kittiwake *Rissa tridactyla*	BoCCI Red listed Birds Directive Migratory Species	Kittiwakes were recorded on baseline surveys in all months. Overall, estimated numbers were slightly higher in the breeding season, with a peak mean of 1,497 birds in April. In the non-breeding season, the peak mean was 1,279 birds in December.

Species	Conservation status[9]	Summary of baseline results
Sandwich Tern *Thalasseus sandvicensis*	BoCC Amber listed Birds Directive Migratory Species Birds Directive Annex 1	Sandwich terns were not recorded on 2016-2017 baseline surveys. On 2019-2021 surveys, 13 Sandwich terns were recorded, with seven birds in early August 2019, three birds in late August 2019 and three birds in May 2020.
Roseate Tern *Sterna dougallii*	BoCCI Amber listed Birds Directive Migratory Species Birds Directive Annex 1	Baseline surveys recorded roseate terns between May and September. The 2016-2017 surveys recorded 56 roseate terns, with peak counts of 19 birds in September 2016, and 20 birds in September 2017. On 2019-2021 surveys, 63 roseate terns were recorded, with peak counts of 16 birds in late May 2020, and 10 birds in early August 2019. Average abundance over the two survey periods was low, with peaks of 0.12 birds/km in May, 0.13 birds/km in August and 0.19 birds/km in September.
Common Tern *Sterna hirundo*	BoCCI Amber listed Birds Directive Migratory Species Birds Directive Annex 1	Common terns were recorded on baseline surveys between April and October. The 2016-2017 baseline surveys recorded 462 common terns between May and October, with peak counts of 97 birds in September 2016 and 279 birds in September 2017. On 2019-2021 baseline surveys, 957 common terns were recorded between April and September, with peak counts of 123 birds in July 2019, 106 birds in early August 2019 and 279 birds in August 2020. Average abundance between April and October was moderate, with a peak of 2.00 birds/km in September.
Arctic Tern *Sterna paradisaea*	BoCCI Amber listed Birds Directive Migratory Species Birds Directive Annex 1	Arctic terns were recorded on baseline surveys between May and September. The 2016-2017 baseline surveys recorded 26 Arctic terns, with a peak count of 13 birds in September 2016. On 2019-2021 surveys, 174 Arctic terns were recorded, with peak counts of 39 birds in July 2020, and 49 birds in August 2020. Average abundance between May and September was low, with peaks of 0.31 birds/km in July and 0.27 birds/km in August.
Unidentified common/Arctic terns	See species specific conservation status above for common/arctic tern	A further 99 unidentified common/Arctic terns were also recorded on the 2016-2017 surveys, with 56 birds recorded in September 2016, and 42 recorded in September 2017. On 2019-2021 surveys, an additional 261 unidentified common/Arctic terns were recorded between July and September, with peak counts of 93 birds in July 2020, and 94 birds in late August 2019. Average abundance was similar between July and September, with a peak of 0.54 birds/km in July and 0.51 birds/km in September.
Little Tern *Sternula albifrons*	BoCCI Amber listed Birds Directive Migratory Species Birds Directive Annex 1	Little terns were not recorded on 2016-2017 baseline surveys. On 2019-2021 surveys, 14 little terns were recorded between June and August, with two seen in June 2019, eight in July 2019, one in early August 2019, two in June 2020 and one in July 2020. Average abundance (birds/km) between June and August was very low, with a peak of 0.06 birds/km in July.

Species	Conservation status[9]	Summary of baseline results
Guillemot *Uria aalge*	BoCCI Amber listed Birds Directive Migratory Species	Guillemots were recorded in all months and were the most numerous seabird species recorded on baseline surveys. Overall, estimated numbers of guillemots were highest in the breeding season, with peak means of 43,913 birds in April and 14,318 birds in May. Estimated numbers in the post-breeding moult period were lower, with peak means of 4,790 birds in August and 4,496 birds in September. In the non-breeding season, the peak mean estimates were 3,117 birds in November and 3,119 birds in December.
Razorbill *Alca torda*	BoCCI Red listed Birds Directive Migratory Species	Razorbills were recorded on baseline surveys in all months. Overall, estimated numbers of razorbills were highest in the post-breeding period, with a peak mean of 5,784 birds in September. Estimated numbers in the breeding season peaked in July, with a peak mean of 2,346 birds. In the non-breeding season, estimated numbers peaked in March, with a peak mean of 1,289 birds.
Unidentified guillemot/razorbill	See species specific conservation status for guillemot and razorbill above	It was not always possible to fully identify guillemots and razorbills to species on baseline surveys, particularly at greater distances from the survey vessel, and when numbers of birds were high. Overall, estimated numbers of unidentified guillemots/razorbills were highest in the breeding season, with a peak mean of 4,583 birds in April. Estimated numbers in the post-breeding period were lower, with a peak mean of 935 birds in August. Numbers of unidentified guillemots/razorbills were low in the non-breeding season.
Black Guillemot *Cepphus grille*	BoCCI Amber listed Birds Directive Migratory Species	Five black guillemots were recorded on 2016-2017 baseline surveys, with four birds seen in November 2016 and one in February 2017. On 2019-2021 baseline surveys, 125 black guillemots were recorded, with birds seen in most months. Peak counts were 17 birds in late September 2019, 37 in October 2019 and 22 in December 2019. Average abundance over the two survey periods was low, with a peak of 0.22 birds/km in October.
Puffin *Fratercula arctica*	BoCCI Red listed Birds Directive Migratory Species	Two puffins were recorded on 2016-2017 baseline surveys, in May 2017. On 2019-2021 surveys, 56 puffins were recorded between April and November, with peak counts of seven birds in mid-April 2021, 12 birds in June 2019, and eight birds in both July 2019 and July 2020. Average abundance over the two survey periods was low, with a peak of 0.07 birds/km recorded in August.

1 Gilbert *et al.*, 2021

6.6.4 There were a further eight species that were only recorded rarely (less than eight birds) on baseline surveys. Of these eight species, only two (black-throated diver and eider) have SPAs in Ireland, and neither of these are within mean maximum foraging distance of Dublin Array. The remaining six species are typically passage migrants through Irish waters that do not occur off the east coast of Ireland in significant numbers, as shown by the baseline survey results. These eight species were therefore not considered further in this assessment. Numbers of these rarely occurring species are presented and discussed in more detail within the Offshore and Intertidal Ornithology Technical Baseline.

6.6.5 In addition, there were a further 10 unidentified species groups where it was not possible to identify the birds to species level recorded on baseline surveys. For key species such as guillemot and razorbill, unidentified individuals were divided out based on the ratios of identified guillemots and razorbills each month. Further details are presented in the Seabird Displacement Technical Report.

Intertidal Ornithology

6.6.6 The landfall location for the offshore ECC will be at Shanganagh to the south of the Uisce Eireann Shanganagh Wastewater Treatment Plant. The following is a summary of the key results from the Ornithology Technical Report.

6.6.7 The landfall location at Shanganagh lies outside any EU site designated for nature conservation. The nearest SPA is Dalkey Islands SPA (Site Code: 4172), which is situated approximately 3 km north of the northern boundary of the intertidal study area. The next closest SPA is the South Dublin Bay and River Tolka Estuary SPA (Site Code: 4024), which is located approximately 7 km to the north of the northern boundary of the intertidal study area.

6.6.8 Overall, the majority of waterbird taxa such as gulls, wildfowl, divers, cormorants and shags were recorded on or over the water offshore out to 1.0 km. Of the two vantage points (VP) covered, VP2 is the most relevant to this assessment as it is close to the proposed landfall location, while VP1 is approximately 1.5 km to the south. A summary of the numbers of birds recorded at VP2 between November 2019 and October 2020 is presented in Table 8. A summary of the numbers of birds recorded at VP2 between September 2023 and March 2024 is presented in Table 10.

6.6.9 Between November 2019 and October 2020, there were at least 30 species of waterbird recorded from VP2 (Table 9). Waders such as oystercatchers (*Haematopus ostralegus*), ringed plover (*Charadrius hiaticula*) and greenshank (*Tringa nebularia*) tended to be observed foraging along the water's edge. The shoreline was less utilised by waterbirds owing to its narrow foreshore and absence of a strand, with the exception of the mouth of the Shanganagh River, which enters the sea approximately 200 m to the north of VP2. Small to medium sized flocks of gulls and waders were regularly recorded foraging in this area throughout the survey season.

Table 9 Peak counts of waterbird species recorded on each survey date between November 2019 and October 2020[10]

Species	No of counts with species present	Proportional frequency of observations	28/11/19	11/12/19	12/12/19	22/01/20	23/01/20	12/02/20	19/03/20	16/9/20	21/10/20
Common Scoter	1	2%	-	14	-	-	-	-	-	-	-
Red-breasted Merganser	12	22%	-	-	-	-	-	2	2	2	2
Red-throated Diver	18	33%	-	2	-	4	-	2	2	-	2
Great Northern Diver	4	7%	-	1	-	-	-	-	1	-	2
Great Crested Grebe	11	20%	-	-	-	-	-	2	-	7	2
Fulmar	3	6%	-	-	-	-	-	-	1	1	-
Gannet	1	2%	-	-	-	-	-	-	-	-	2
Shag	44	81%	4	9	2	7	1	3	3	4	5
Cormorant	18	33%	-	-	-	-	1	1	2	1	2
Grey Heron	3	6%	-	-	1	-	-	2	-	1	-
Oystercatcher	21	39%	10	7	13	11	19	5	11	12	3
Ringed Plover	6	11%	-	-	60	30	6	12	-	-	-
Knot	3	6%	-	22	-	-	-	-	-	-	-
Redshank	1	2%	-	-	-	-	-	-	-	3	-
Greenshank	4	7%	-	-	-	-	-	-	2	2	2
Bar-tailed Godwit	1	2%	-	-	-	-	-	-	-	-	7
Turnstone	14	26%	9	9	-	-	14	10	7	11	-
Little Gull	2	4%	-	2	-	-	-	-	-	-	-
Mediterranean Gull	8	15%	3	1	-	-	-	1	-	2	-

[10] the number of half-hourly counts in which each species was observed and the proportional frequency of those observations (i.e. the proportion of half-hourly counts on which they were recorded – n=54)

Species	No of counts with species present	Proportional frequency of observations	28/11/19	11/12/19	12/12/19	22/01/20	23/01/20	12/02/20	19/03/20	16/9/20	21/10/20
Black-headed Gull	42	78%	120	100	30	25	42	27	3	19	31
Common Gull	7	13%	-	-	-	-	6	3	2	2	2
Kittiwake	2	4%	-	11	-	-	-	-	-	-	-
Lesser black-backed Gull	15	28%	2	5	12	12	7	-	-	-	-
Herring Gull	38	70%	10	18	-	16	27	12	4	26	18
Great black-backed Gull	26	48%	5	4	8	8	11	2	1	3	2
Unidentified gull species	4	7%	-	-	10	17	-	-	-	-	-
Sandwich Tern	3	6%	-	-	-	-	-	-	-	6	-
Common/Arctic Tern	1	2%	-	-	-	-	-	-	-	3	-
Guillemot	8	15%	-	2	-	2	-	-	4	6	1
Razorbill	4	7%	-	-	-	-	-	-	-	3	-
Unidentified auk	1	2%	-	-	-	-	-	-	-	-	6
Black guillemot	13	24%	2	2	-	-	-	2	2	2	2

6.6.10 In general, black-headed gull and shag were the most frequently recorded species in the intertidal study area. Oystercatcher was the most regularly recorded species of wader recorded on intertidal surveys.

6.6.11 Black-headed gull was recorded on 78% of counts throughout the season, making it the second most regularly recorded species. Birds were recorded in all survey months, with a peak of 120 birds in November 2019 and 100 birds in December 2019. Lower numbers were recorded in other months.

6.6.12 Shag was the most regularly recorded species, present in 81% of counts. The peak count of shags was nine birds in December 2019. Two further species were recorded on more than 50% of overall counts; herring gull (recorded on 70% of counts) and great black-backed gull (recorded on 48% of counts). The peak counts of herring gull were 27 birds in January 2020 and 26 birds in September 2020. The peak counts of great black-backed gull were 11 birds in January 2020 and eight birds in December 2019.

6.6.13 Oystercatchers were the most regularly recorded species of wader, with small numbers recorded each month and a peak of 19 birds in January 2020. Ringed plovers were recorded between December 2019 and February 2020, with a peak count of 60 birds in December 2019, while turnstone (*Arenaria interpres*) were regularly recorded in low numbers over the period, with a peak of 14 birds in January 2020. Other wader species such as knot (*Calidris canutus*), redshank (*Tringa totanus*) and greenshank were also recorded occasionally over the survey period in lower numbers.

6.6.14 Species that are known to be susceptible to disturbance such as divers and common scoter were only recorded in the intertidal study area in very low numbers over the study period. A peak of four red-throated divers were recorded in January 2020, with two birds seen in December 2019, February 2020, March 2020 and October 2020. Single great northern divers were recorded in December 2019 and March 2020, with two birds recorded in October 2020. Common scoter were only recorded in December 2019 when 14 birds were seen.

6.6.15 Overall, no species were recorded in numbers exceeding 1% of the national population, which would be considered significant.

Table 10 Peak counts of waterbird species recorded on each survey date between September 2023 and March 2024[11]

Species	No. of Counts in Which Species Observed	Proportional Frequency of Observations	September	October	November	December	January	February	March
Bar-tailed godwit	1	<1%	-	-	-	2	-	-	-
Black guillemot	6	4%	-	-	-	-	-	14	-
Black-headed gull	113	69%	25	8	12	29	20	25	23
Brent goose	3	2%	-	-	-	-	50	-	200
Guillemot	16	10%	-	1	2	1	-	-	2
Common gull	5	3%	-	2	5	1	-	1	-
Ringed plover	28	17%	40	35	25	40	4	14	-
Common tern	1	<1%	2	-	-	-	-	-	-
Curlew	1	<1%	-	-	-	-	-	-	3
Oystercatcher	39	24%	14	25	26	20	30	23	20
Herring gull	150	91%	47	106	27	46	22	71	27
Shag	71	43%	1	2	3	15	4	4	2
Great black-backed gull	109	66%	6	3	3	4	4	3	2
Cormorant	87	53%	4	3	4	6	1	6	1
Grey heron	2	1%	-	1	-	-	-	-	-

[11] the number of half-hourly counts in which each species was observed and the proportional frequency of those observations (i.e. the proportion of half-hourly counts on which they were recorded – n=164)

Species	No. of Counts in Which Species Observed	Proportional Frequency of Observations	September	October	November	December	January	February	March
Lesser black-backed gull	2	1%	-	-	1	-	-	-	2
Mediterranean gull	36	22%	19	45	2	2	4	28	5
Gannet	5	3%	1	1	-	-	-	-	-
Razorbill	8	5%	1	-	-	3	-	2	-
Red-throated diver	10	6%	-	1	-	3	-	1	-
Turnstone	26	16%	20	5	5	2	1	2	-
Sandwich tern	1	<1%	1	-	-	-	-	-	-

6.6.16 Between September 2023 and March 2023, at least 22 waterbird species were recorded from VP2 (Table 10). Gull species and shags and cormorants were the most frequently occurring species groups recorded in the study area. Herring gull was recorded during 91% of counts from VP2 throughout the season, with a peak count of 106 birds in October 2023. In addition, black-headed gulls were recorded on 69% of counts, with a peak count of 29 birds in December 2023, great black-backed gull were recorded on 66% of counts, with a peak count of six birds in September 2023, and cormorants were recorded on 53% of counts, with a peak count of six birds in December 2023 and February 2024.

6.6.17 Excluding gulls, the highest peak count for any species was for light-bellied brent goose (n = 220). This species was only recorded on surveys in January 2024 (n = 50 and n = 12) and one count in March 2024 (n = 220). These data show that although some peak counts of light-bellied brent goose were relatively high, the frequency of their occurrence within the study area was low. This species was only recorded flying through the study area with no indication that the geese were using the survey area other than flying through it.

6.6.18 Overall, as with the 2019-2020 surveys, no species were recorded in numbers exceeding 1% of the national population, which would be considered significant. Further information on the intertidal surveys is presented in the Intertidal Survey Reports (SLR, 2021 and SLR, 2024).

6.6.19 The low numbers recorded on surveys indicates that the intertidal study area does not support significant numbers of these species.

6.7 Designated Sites

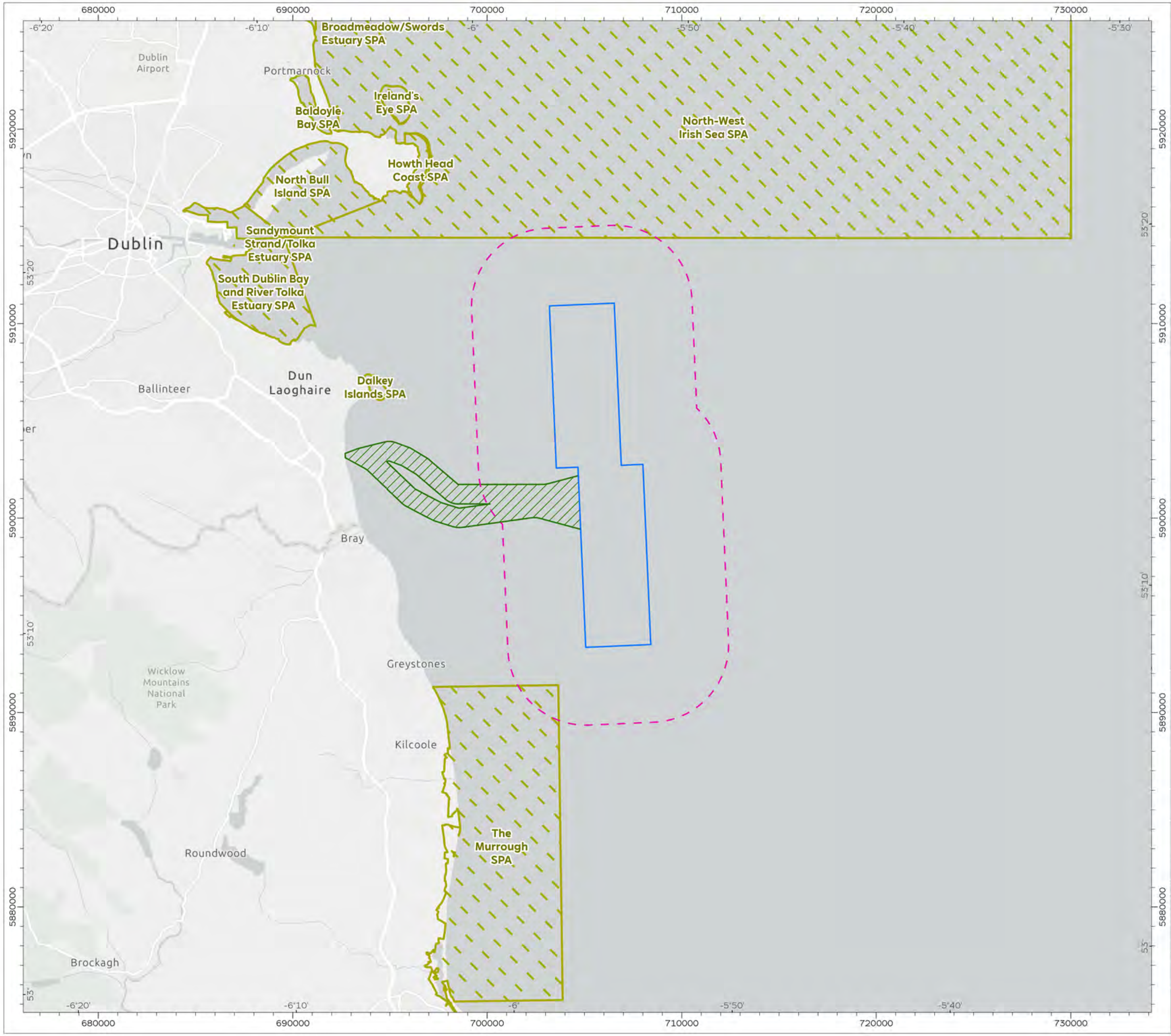
6.7.1 By way of further information in respect of the receiving environment, Table 11 below identifies the key designated sites relevant to offshore and intertidal ornithology in closest proximity to Dublin Array that support important populations of breeding seabirds, or foraging areas for seabirds in the non-breeding season. The full list of sites designated under the Birds Directive including more distant conservation sites considered for ornithological connectivity with Dublin Array are considered in the SISAA with assessment undertaken in the NIS where the potential for likely significant effect has been identified (Part 4, Habitats Directive Assessments, Volume 3: SISAA and Volume 4: NIS).

6.7.2 Distances provided are straight line sourced using GIS and therefore present the shortest distance between the SPA and offshore infrastructure[12].

[12] All distances are taken from the outer boundary of all offshore works incorporating the offshore infrastructure and temporary occupation area and as such are inherently precautionary

Table 11 Key designated conservation sites and relevant species of qualifying interest for offshore and intertidal ornithology

Designated site	Relevant qualifying interest features	Distance from Offshore ECC (km)	Distance from Array Area (km)
Dalkey Islands SPA Site Code: 4172	Roseate tern, common tern, Arctic tern	2.2	8.6
South Dublin Bay and River Tolka Estuary SPA Site Code: 4024	Light-bellied brent goose (*Branta bernicla hrota*), oystercatcher, ringed plover, grey plover (*Pluvialis squatarola*), knot, sanderling (*Calidris alba*), dunlin (*Calidris alpina*), bar-tailed godwit (*Limosa lapponica*), redshank, black-headed gull, roseate tern, common tern, Arctic tern	5.9	12.1
North Bull Island SPA Site Code: 4006	Light-bellied brent goose, shelduck (*Tadorna tadorna*), teal (*Anas crecca*), pintail (*Anas acuta*), shoveler (*Anas clypeata),* oystercatcher, golden plover (*Pluvialis apricaria*), grey plover, knot, sanderling, dunlin, black-tailed godwit (*Limosa limosa*), bar-tailed godwit, curlew (*Numenius arquata*), redshank, turnstone, black-headed gull	11.1	10.2
Howth Head Coast SPA Site Code: 4113	Kittiwake	12.3	8.5
North-West Irish Sea cSPA Site Code: 4236	Red-throated diver, great northern diver, fulmar, Manx shearwater, cormorant, shag, common scoter, little gull, black-headed gull, common gull, lesser black-backed gull, herring gull, great black-backed gull, kittiwake, roseate tern, common tern, Arctic tern, little tern, guillemot, razorbill, puffin	10.5	3.4
Ireland's Eye SPA Site Code: 4117	Cormorant, herring gull, kittiwake, guillemot, razorbill	16.3	12
Lambay Island SPA Site Code: 4069	Fulmar, cormorant, shag, greylag goose (*Anser anser*), lesser black-backed gull, herring gull, kittiwake, guillemot, razorbill, puffin	25.8	19.3
Skerries Islands SPA Site Code: 4122	Cormorant, shag, light-bellied brent goose, purple sandpiper (*Calidris maritima*), turnstone, herring gull	35.6	30.2
Rockabill SPA Site Code: 4014	Purple sandpiper, roseate tern, common tern, Arctic tern	25.6	19.8
The Murrough SPA Site Code: 4186	Red-throated diver, greylag goose, light-bellied brent goose, wigeon, teal, black-headed gull, herring gull, little tern	8.11	2.39
Wicklow Head SPA Site Code: 4127	Kittiwake	25.6	19.8



Array Area
Export Cable Corridor
Offshore Ornithology Study Area
Special Protection Area (SPA)

DRAWING STATUS

FINAL

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PROJECT TITLE

Dublin Array

DRAWING TITLE

Key Designated SPAs in Relation to Dublin Array

DRAWING NUMBER: 3

PAGE NUMBER: 1 of 1

VER	DATE	REMARKS	DRAW	CHEK	APRD
01	2024-05-14	For Issue	GB	BB	SS

0 2 4 6 8 km
0 1 2 3 4 nm

N

SCALE	1:200,000	PLOT SIZE	A3
DATUM	WGS 1984	VERTICAL REF	LAT
PRJ	WGS 1984 UTM Zone 29N		

Kish Offshore Wind Limited - Bray Offshore Wind Limited

6.8 Future Receiving Environment

6.8.1 EIAR guidelines from the EPA (2022), states that the environment will change over time, even without the introduction of the proposed project. Therefore, the EIAR must include a description of the likely evolution of the environmental factor in the absence of the project. This predicted changing baseline may be referred to as the likely future receiving environment. These changes to the baseline may be natural changes (due to ecological and climate trends, for example) or may be caused by other actions (nearby projects, for example).

6.8.2 The future receiving environment in the absence of the Dublin Array project is expected to be similar to the current baseline, in the immediate area of the proposed project. Regarding ornithology, if Dublin Array did not proceed, then it is considered likely that breeding seabird populations within foraging range of the project footprint would continue to use the sea area in the breeding season as recorded on baseline surveys. Similarly, numbers and species of birds passing through the area in the non-breeding season or on spring or autumn migration would be similar to what was recorded on baseline surveys. In time, numbers of each species would be likely to change, with some species increasing in numbers and others decreasing in numbers, depending on how these species are impacted by environmental changes caused by climate change.

6.8.3 For sensitive species such as kittiwake, where climate change is predicted to lead to a rise in sea temperature, which is likely to impact on the distribution and availability of prey species such as sandeels (RSPB, 2018), numbers breeding at colonies within foraging range would be predicted to decrease. In addition, if fishing activity were to increase in the area in the future, then this could have further impacts on prey availability, resulting in additional pressures on the breeding populations of such species. Naturally occurring diseases such as Highly Pathogenic Avian Influenza (HPAI) could affect breeding birds at coastal seabird colonies, which could impact breeding populations of sensitive species.

6.9 Do-nothing environment

6.9.1 Should Dublin Array not be constructed then it is considered likely that breeding seabird populations within foraging range of the project footprint would continue to use the sea area in the breeding season as recorded on baseline surveys. Similarly, numbers and species of birds passing through the area in the non-breeding season or on spring or autumn migration would be similar to those recorded on baseline surveys. Both breeding and passage birds would be subject to potential impacts of collision, displacement and barrier effects arising from other offshore wind farm projects in the vicinity, assuming that they become operational.

6.9.2 However, if Dublin Array did not proceed, then there would be no associated reductions in greenhouse gases and no benefit to reducing the effects of climate change. Current downward pressures on the breeding populations of sensitive seabird species such as kittiwakes, which are considered at risk of the effects of climate change on their prey distribution (RSPB, 2018), would be predicted to continue.

6.10 Defining the sensitivity of the baseline

6.10.1 Seabird species assessed for impacts are those which were regularly recorded during baseline surveys and which are considered to be at potential risk either due to their abundance, potential sensitivity to wind farm impacts and biological characteristics (e.g., commonly fly at rotor heights) which make them potentially sensitive. The conservation status of these species is included in Table 8.

6.10.2 Impacts have been assessed in relation to relevant biological seasons, as defined by Furness (2015), and a summary of these seasons for seabird species is presented in Table 12.

Table 12 Definitions of breeding and non-breeding season used in this assessment (Furness, 2015)

Species	Breeding Season	Migration periods	Non-breeding Season
Red-throated Diver	March to August	September to November February to April	December to January
Great Northern Diver	June to August	-	September to May
Fulmar	January to August	September to October December to March	September to December
Manx Shearwater	April to August	August to early October Late March to May	Not present in Irish waters in significant numbers
Storm Petrel[3]	Mid-May to October	-	Not present in Irish waters in significant numbers
Gannet	March to September	September to November December to March	October to February
Cormorant	April to August	-	September to March
Shag	February to August	-	September to January
Common Scoter[1]	May to August	-	September to April
Arctic Skua	May to July	August to October April to May	Not present in Irish waters in significant numbers
Great Skua	May to August	August to October March to April	November to February
Mediterranean Gull[2]	May to July	-	August to April
Little Gull[2]	May to July	-	August to April
Black-headed Gull[3]	March to August	-	September to February
Common Gull[3]	March to August	-	September to February
Lesser black-backed Gull	April to August	August to October March to April	November to February
Herring Gull	March to August	-	September to February
Great black-backed Gull	Late March to August	-	September to March
Kittiwake	March to August	August to December	September to February

Species	Breeding Season	Migration periods	Non-breeding Season
	(Migration free – May to July)	January to April	
Sandwich Tern	April to August	July to September March to May	Not present in Irish waters in significant numbers
Roseate Tern	May to August	August to September April to May	Not present in Irish waters in significant numbers
Common Tern	May to August	Late July to early September April to May	Not present in Irish waters in significant numbers
Arctic Tern	May to early August	July to early September Late April to May	Not present in Irish waters in significant numbers
Little Tern	May to early August	July to early September Mid-April to May	Not present in Irish waters in significant numbers
Guillemot	March to July	-	August to February
Razorbill	April to July	August to October January to March	November to December
Black Guillemot	April to August	-	September to March
Puffin	April to early August	-	Mid-August to March

1 Based on information presented in Heffernan & Hunt, (2022)
2 Snow & Perrins, (1998) as species not included in Furness (2015)
3 Based on NatureScot (2020) season definition as species not included in Furness (2015)

6.10.3 Furness (2015) presents the breeding season as both "full" (including some of the pre-breeding and post-breeding migration period), and as "migration-free", where the pre- and post-breeding migration periods are excluded. For this assessment, impacts have been presented for the full breeding season for all species except kittiwake and common tern. For kittiwake, the migration-free breeding season (May to July) has been used. This is because there is evidence from Irish east coast colonies that the kittiwake breeding season is over by the end of July, with adults and fledged chicks predominantly having left the colonies by the end of July (C. Barton pers. obs.). For common tern, the migration free breeding season (June to mid-July) has been used rather than the full breeding season (May to August). This is because the autumn migration period runs from late July to September, and it is considered that the increased numbers of common terns recorded on baseline surveys in August were most likely post-breeding birds migrating through the Offshore Ornithology Study Area. As a precautionary measure, all July sightings were included in the migration-free breeding season, with sightings in August and September considered as the autumn migration period.

6.10.4 For the breeding season, the regional reference populations for seabird species were calculated by summing the most recent counts for breeding colonies within mean-maximum foraging range (+1 S.D.) where available, as defined in Woodward *et al.,* (2019) (Table 13).

Table 13 Mean-maximum foraging distance + 1S.D. for seabird species

Species	Mean maximum foraging distance + 1 S.D.
Red-throated Diver	9 km
Great Northern Diver	N/A
Fulmar[1]	542.3 ± 657.9 km
Manx Shearwater[1]	1,346.8 ± 1,018.7 km[2]
Storm Petrel	336.0 km
Gannet	315.2 ± 194.2 km
Cormorant	25.6 ± 8.3 km
Shag	13.2 ± 10.5 km
Common Scoter	N/A
Arctic Skua	2.5 km
Great Skua[1]	443.3 ± 487.9 km
Mediterranean Gull	20 km
Little Gull	N/A
Black-headed Gull	18.5 km
Common Gull	50 km
Lesser black-backed Gull	127 ± 109 km
Herring Gull	58.8 ± 26.8 km
Great black-backed Gull	73 km
Kittiwake	156.1 ± 144.5 km
Sandwich Tern	34.3 ± 23.2 km
Roseate Tern	12.6 ± 10.6 km
Common Tern	18.0 ± 8.9 km
Arctic Tern	25.7 ± 14.8 km
Little Tern	5 km
Guillemot	73.2 ± 80.5 km
Razorbill	88.7 ± 75.9 km
Black Guillemot[3]	0.5-7.0 km[2]
Puffin	137.1 ± 128.3 km

1 The mean maximum foraging range + 1 SD for gannet (509.4 km) has been used for this species in this assessment
2 For comparison, the mean foraging range for Manx shearwater is 136.1±88.7 km (Woodward *et al.*, 2019)
3 Based on Birdlife International, (2023)

Regional Reference Populations

6.10.5 In EIA-level assessments, impacts are assessed against relevant regional populations, including birds from Ireland and birds from overseas populations that migrate through or winter in Irish waters. The precedent for reference populations for EIA-level assessments in the UK is the Biologically Defined Minimum Population Size (BDMPS) (Furness, 2015). The Furness (2015) BDMPS population sizes do not include all birds from Irish colonies, and those that do may only include a low proportion of them. Therefore the BDMPS population sizes have been adapted to include Irish populations to be used within this assessment (See paragraph 0 onwards).

6.10.6 Guidance from Natural England defines the BDMPS for the breeding season as the breeding population within foraging range from the project, plus non-breeding and immature birds (Parker *et al.*, 2022c). This is because it is considered that the population in the region is likely to originate from a much wider range of colonies (not just SPA colonies) and may include young immature birds spending the summer in their wintering area as well as immature birds loosely associated with local colonies (Furness, 2015).

6.10.7 However, based on recent EIARs submitted to Marine Scotland (e.g. West of Orkney (Xodus, 2023) and Berwick Bank (SSE Renewables, 2023), for the breeding season, the regional reference population has only included adults from breeding colonies within mean maximum foraging range (plus 1 S.D.), with predicted adult mortality from the impact being assessed being compared to this reference population. In this assessment, both approaches have been presented, to allow a comparison to be made.

6.10.8 For the breeding season, most recent population counts for the key seabird species and breeding colonies of relevance to this assessment within mean maximum foraging range (plus 1 S.D.) have been taken from Burnell *et al.*, (2023), Cummins *et al.*, (2019) or the Seabirds Monitoring Programme (SMP) online database. All sources are referenced in the text. Further details of colony counts for individual species are presented in the Offshore and Intertidal Ornithology Technical Baseline.

6.10.9 The number of non-breeding or immature birds for the breeding season BDMPS reference population was estimated by multiplying the number of breeding adults within mean max plus 1 S.D. foraging range by the ratio of immature to adult birds, based on Horswill and Robinson, (2015). Further details of this approach are presented in the Offshore and Intertidal Ornithology Technical Baseline. Regional reference breeding populations are shown in Table 14.

Table 14 Regional reference populations for the breeding season

Species	Breeding Season Regional Reference Population (breeding adults)	Immature to adult ratio (number of immatures per adult)	Breeding Season Regional Reference Population (adults and immature birds)
Red-throated Diver	Species does not breed within mean maximum foraging range		
Great Northern Diver	Species does not breed in Ireland or UK		
Fulmar[1]	68,284 adults	1.083	142,236 birds
Manx Shearwater[1]	1,814,000 adults	1.132	3,867,448 birds
Storm Petrel	7,260 adults	-	-
Gannet	238,718 adults	0.761	420,382 birds
Cormorant	1,361,412 adults	1.451	3,461 birds
Shag	274 adults	0.792	491 adults
Common Scoter	Species does not breed within mean maximum foraging range		
Arctic Skua	Species does not breed in Ireland		
Great Skua	Not recorded during breeding season		
Mediterranean Gull	Species does not breed within mean maximum foraging range		
Little Gull	Species does not breed in Ireland or UK		
Black-headed Gull	Species does not breed within mean maximum foraging range		
Common Gull	56 adults	0.452	81 birds
Lesser black-backed Gull	39,684 adults	0.876	74,447 birds
Herring Gull	8,264 adults	1.370	16,529 birds
Great black-backed Gull	940 adults	1.538	2,386 birds
Kittiwake	70,260 adults	0.898	133,353 birds
Sandwich Tern	Species does not breed within mean maximum foraging range		
Roseate Tern[2]	Species does not breed within mean maximum foraging range		
Common Tern	1,034 adults	0.701	1,759 birds
Arctic Tern	332 adults	0.511	502 birds
Little Tern	Species does not breed within mean maximum foraging range		
Guillemot	119,058 adults	0.916	228,115 birds
Razorbill	26,338 adults	0.876	49,410 birds
Black Guillemot	Species does not breed within mean maximum foraging range		
Puffin	66,626	0.842	122,725 birds

1 The mean maximum foraging range + 1 SD for gannet (509.4 km) has been used for this species in for this assessment
2 No proven evidence of definite breeding at Dalkey Island during recent surveys for Seabirds Count (Burnell *et al.,* 2023).

6.10.10 For the non-breeding season, the BDMPS approach devised by Furness, (2015) was used as a basis to estimate suitable regional reference populations for use in the EIA. However, the BDMPS regions defined by Furness, (2015) excluded part of the Irish Sea, therefore revisions to the Furness, (2015) approach were required to take account of this.

6.10.11 For each species, BDMPS (Furness, 2015) regional populations incorporate a proportion of the estimated Irish breeding population. This approach has been discussed and aligned with the Irish East Coast Phase One OWFs. This component was removed from the BDMPS population and replaced with the breeding population as estimated in Burnell *et al.*, (2023), for east coast and south counties between County Louth and Mizen Head in County Cork. These population estimates were corrected to include non-adult birds using age group proportions from Horswill and Robinson (2015). This figure was then added to the estimated number of breeding adults to calculate the regional reference population of adults and immatures in the breeding season. Further details and refinements for individual species are presented in the Offshore and Intertidal Ornithology Technical Baseline. Regional reference populations for the non-breeding season are shown in Table 15.

Table 15 Regional reference populations for the non-breeding seasons

Species	Non-breeding Season Regional Reference Population (adults and immature birds)		
	Autumn Migration	Winter	Spring Migration
Red-throated Diver	12,718	4,149	12,718
Great Northern Diver	1,664 in non-breeding season		
Fulmar	843,783	571,956	843,783
Manx Shearwater	1,576,784	N/A	1,576,784
Storm Petrel	Not present in Irish waters in significant numbers		
Gannet	535,183		643,917
Cormorant	19,418 in non-breeding season		
Shag	17,111 in non-breeding season		
Arctic Skua	5,287		5,111
Great Skua	16,336	1,398	25,090
Common Scoter[1]	8,616	3,089	8,616
Little Gull[1]	0	1,539	0
Black-headed Gull[2]	28,049 in non-breeding season		
Common Gull[2]	10,242 in non-breeding season		
Lesser black-backed Gull	172,234	172,234	172,234
Herring Gull	187,094 in non-breeding season		
Great black-backed Gull	53,406 in non-breeding season		
Kittiwake	933,197	933,197	933,197
Sandwich Tern	14,535	14,535	14,535
Roseate Tern	6,358	6,358	6,358
Common Tern	74,000	74,000	74,000
Arctic Tern	72,231	72,231	72,231
Little Tern	1,712	1,712	1,712
Guillemot	1,332,623 in non-breeding season		
Razorbill	632,453	632,453	632,453
Puffin	297,774 in non-breeding season		

1 Based on estimate for Western Irish Sea from Jessopp *et al.,* (2018)
2 Based on estimate from Lewis, *et al.,* (2019)

6.10.12 The impact of additional mortality on seabirds due to effects such as displacement or collision, has been assessed in terms of the change in the baseline mortality rate which could result. Species-specific baseline mortality rates were based on age-specific demographic and survival rates and age class proportions from Horswill and Robinson (2015), as presented in Table 4 of the Offshore and Intertidal Ornithology Technical Baseline.

6.10.13 For the breeding season assessment based on adult birds only, the increase in baseline mortality was calculated using the estimated adult baseline survival rate from Horswill and Robinson (2015). For example, for gannet the estimated adult baseline survival rate is 0.919, therefore the corresponding rate for adult mortality is 0.081 (Table 16).

6.10.14 For the breeding season assessment based on adult and immature birds, and for the non-breeding season assessments, 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 survival rates for each age class and their relative proportions in the population from Horswill and Robinson (2015). Baseline mortality rates used in this assessment are summarised in Table 16 (after Horswill and Robinson, 2015). Further details are presented in the Offshore and Intertidal Ornithology Technical Baseline.

Table 16 Adult survival, adult mortality, age ratio of immature to adult birds and average mortality rates used in this assessment

Species	Adult survival	Adult mortality	Percentage age ratio of adults (%)	Average mortality for all age classes
Red-throated diver	0.840	0.16	65.2	0.224
Manx shearwater	0.870	0.13	46.9	0.13
Gannet	0.919	0.081	56.8	0.181
Shag	0.858	0.142	55.8	0.262
Lesser black-backed gull	0.885	0.115	53.3	0.123
Herring gull	0.834	0.166	42.2	0.172
Great black-backed gull	0.930	0.07	39.4	0.095
Kittiwake	0.854	0.146	52.7	0.156
Common tern	0.883	0.117	58.8	0.191
Guillemot	0.939	0.061	52.2	0.136
Razorbill	0.895	0.105	53.3	0.129
Puffin	0.906	0.094	54.3	0.177

6.10.15 The potential magnitude of impact was estimated by calculating the increase in baseline mortality within each season (Table 16) with respect to the relevant regional population (Table 15). The estimated value was then used as a guide in determining the magnitude of impact (Table 6), in combination with other factors such as conservation importance.

6.11 Uncertainties and technical difficulties encountered

6.11.1 The data sources used in this chapter are detailed in Table 2, with additional relevant information from the Offshore and Intertidal Ornithology Technical Baseline. The desktop data used are the most up to date publicly available information which can be obtained from the applicable data sources as cited, and are considered suitable to adequately inform this assessment.

6.11.2 There is a high degree of variability in the marine environment, both spatially and temporally. However, as the baseline site characterisation for this Offshore EIAR has been based on several years of boat-based survey data and relevant published data for the wider area, it is considered to be a robust representative of the array area and surrounding buffer area for the purpose of impact assessment.

6.11.3 It was not always possible to complete boat-based surveys every month, due to poor weather conditions in some months (February and March 2020), and Covid-19 restrictions (April 2020). Additional surveys were undertaken in May 2020, March 2021 and April 2021 to supplement these missed surveys. Further details of the number of surveys achieved in each month in the 2016-2017 and 2019-2021 datasets is presented in the Offshore and Intertidal Ornithology Technical Baseline. Overall, it is considered that the boat-based survey data are representative of the array area and surrounding buffer area for the purpose of impact assessment, as at least two surveys were completed in each month over the period, apart from February, when only one survey was completed.

6.11.4 Given the limited scale of works required for the Offshore ECC (i.e. a relatively small number of vessel movements over a relatively small area for a short period of time), no specific surveys were commissioned for the area between the offshore study area and the Intertidal Ornithology study area (i.e. within 1.0 km from MHWS, covered by shore-based surveys). Instead, the assessment for this section of the export cable corridor makes use of published data on the presence of birds from the desk study, presented in the Offshore and Intertidal Ornithology Technical Baseline. This approach was considered adequate to inform the impact assessment for the Offshore ECC.

6.12 Scope of the assessment

6.12.1 Table 17 presents the impacts that will be assessed in the offshore and intertidal ornithology assessment. Any effects on species that are qualifying interests for SPAs are assessed in the NIS (Part 4: Habitats Directive Assessments, Volume 4: NIS).

Table 17 Potential impacts considered within the ornithology ecological assessment

Potential impact / change	Impact
Construction	
Disturbance and displacement on key bird species as a result of increased vessel activity and other construction activity within the array area	Impact 1
Disturbance and displacement on key bird species as a result of increased vessel activity and other construction activity within the Offshore ECC	Impact 2
Disturbance and displacement on key bird species as a result of construction activity for the export cable landfall within the Intertidal study area	Impact 3
Indirect effects as a result of habitat loss/displacement of prey species due to increased noise and disturbance to seabed during construction in array area and Offshore ECC	Impact 4
Operation and Maintenance (O&M)	
Disturbance and displacement on key bird species as a result of O&M vessel activity within the array area	Impact 5
Indirect effects as a result of habitat loss/displacement of prey species due to increased noise and disturbance to seabed during operation and maintenance	Impact 6
Disturbance from aviation and navigation lighting	Impact 7
Displacement and barrier effects on key bird species within the array area and appropriate buffer as a result of offshore infrastructure	Impact 8
Mortality of key bird species as a result of collision with offshore wind turbines	Impact 9
Decommissioning	
Disturbance and displacement on key bird species as a result of increased vessel activity and other decommissioning activity within the array area	Impact 10
Disturbance and displacement on key bird species as a result of increased vessel activity and other decommissioning activity within the Offshore ECC	Impact 11
Disturbance and displacement on key bird species as a result of decommissioning activity for the export cable landfall within the Intertidal study area	Impact 12
Indirect effects as a result of habitat loss/displacement of prey species due to increased noise and disturbance to seabed during decommissioning	Impact 13

6.13 Impacts scoped out of the assessment

6.13.1 A number of impacts have been scoped out of the assessment for offshore and intertidal ornithology as they are considered to have no potential for significant effect. These impacts are outlined below, together with the justification for scoping them out:

- Disturbance from underwater noise (construction, operation and decommissioning); and
- Accidental pollution and contamination (construction, operation and decommissioning).

Disturbance from underwater noise

6.13.2 During all project phases the presence of noise has the potential to interact with ornithological receptors, although given the low sensitivity of birds to noise disturbance at sea and the temporary nature of the impact it is considered that there is no potential for significant effects.

6.13.3 Seabirds are highly mobile with large foraging ranges (Woodward *et al.,* 2019), providing them with a significant amount of alternative foraging habitat outside of a comparatively tiny disturbance range. If seabirds are foraging in noisy areas, then species that feed by shallow diving, dipping, shallow diving or surface feeding are of limited sensitivity to underwater noise, due to the brevity of exposure time and sensitivity to disturbance (Furness *et al.,* 2013, Fleissbach *et al.,* 2019). For deeper diving birds (e.g., auk species), there is some evidence (e.g., Mooney, 2020) to suggest potential impacts from underwater noise, although any effects would be limited temporally and spatially. Available evidence suggests birds do not hear well underwater and are unlikely to be impacted while diving. Anatomical studies of ear structures in diving birds (e.g., Dooling and Therrien, 2012), suggest that there are adaptations for protection against the large pressure changes that occur while diving which may protect the ear from damage due to acoustic over-exposure.

6.13.4 Furthermore, effects will be spatially and temporally limited, with construction impacts between 18-30 months and only present within the construction area (array area, ECC and intertidal zone). The impacts of avoidance are covered within the disturbance and displacement assessment above. The effects are also reversable in nature, with birds returning to the area following the end of any noisy activities during construction and decommissioning. Consequently, birds are considered to be highly adaptive to this impact (owing to their mobile nature), with any indirect impacts already suitably assessed as part of the disturbance and displacement assessment and prey species assessment. The impacts on seabirds from underwater noise as a standalone impact during the construction and decommissioning phases have, therefore, no potential to result in significant effects.

Accidental pollution and contamination

6.13.5 The impact of pollution including accidental spills and contaminant releases associated with the construction of infrastructure and use of supply/service vessels has the potential to lead to direct mortality of offshore and intertidal ornithology receptors or a reduction in prey availability, either of which may affect species' survival rates. With the implementation of an appropriate Project Environment Management Plan (PEMP), it is considered that any mortality is very unlikely to occur, and a major incident that may impact on any species at a population level is also considered very unlikely. Therefore, this impact has been scoped out of the assessment.

6.14 Key parameters for assessment

6.14.1 As set out in the Application for Opinion under Section 287B of the Planning and Development Act 2000, flexibility is being sought where details or groups of details may not be confirmed at the time of the planning application. In summary, and as subsequently set out in the ABP Opinion on Flexibility (detailed within the EIA Methodology Chapter) the flexibility being sought relates to those details or groups of details associated with the following components (in summary - see further detail in see the Project Description Chapter):

- WTG (model – dimensions and number);
- OSP (dimensions);

- Array layout;
- Foundation type (WTG and OSP; types and dimensions and scour protection techniques); and
- Offshore cables (IAC and ECC; length and layout).

6.14.2 To ensure a robust, coherent, and transparent assessment of the proposed Dublin Array project for which development consent is being sought under section 291 of the Planning Act, the Applicant has identified and defined a Maximum Design Option (MDO) and Alternative Design Option(s) (ADO) for each environmental topic/receptor. The MDO and ADO have been assessed in the EIAR to determine the full range and magnitude of effects, providing certainty that any option within the specified parameters will not give rise to environmental effects more significant than that which could occur from those associated with the MDO. The extent of significant effects is therefore defined and certain, notwithstanding that not all details of the proposed development are confirmed in the application.

6.14.3 The range of parameters relating to the infrastructure and technology design allow for a range of options in terms of construction methods and practices, which are fully assessed in the EIAR. These options are described in the project description and are detailed in the MDO and ADO tables within each offshore chapter of the EIAR. This ensures that all aspects of the proposed Dublin Array project are appropriately identified, described and comprehensively environmentally assessed.

6.14.4 In addition to the details or groups of details associated with the components listed above (where flexibility is being sought), the confirmed design details and the range of normal construction practises are also assessed within the EIAR (see the Project Description Chapter). Whilst flexibility is not being sought for these elements (for which plans and particulars are not required under the Planning Regulations), the relevant parameters are also incorporated into the MDO and alternative option(s) table (Table 6, with details provided in Appendix B) to ensure that all elements of the project details are fully considered and assessed.

6.14.5 With respect to project design features where flexibility is not being sought, such as trenchless cable installation techniques at the landfall, the MDO and alternative design option(s) are the same (as there is no alternative). With respect to the range of normal construction practises that are intrinsic to installation of the development, such as the nature and extent of protection for offshore cables and the design of cable crossings, but which cannot be finally determined until after consent has been secured and detailed design is completed, the parameters relevant to the receptor being assessed are quantified, assigned and assessed as a maximum and alternative, as informed by the potential for impact upon that receptor. In the event of a favourable decision on the Planning Application they will be agreed prior to the commencement of the relevant part of the development by way of compliance with a standard 'matters of detail' planning condition (see the Policy Chapter). Throughout, an explanation and justification is provided for the MDO and alternative(s) within the relevant tables, as it relates the details or groups of details where statutory design flexibility is being sought, and wider construction practises where flexibility is provided by way of planning compliance condition.

Table 18 Maximum and Alternative Design Options assessed

Maximum design option	Alternative design options	Justification
Construction		
Impact 1: Disturbance and displacement from increased vessel activity and other construction activity within the array area and temporary occupation area		
Construction period: Maximum of **30 months**.	**Construction period:** Minimum of **18 months.**	The spatial area where disturbance and displacement could arise is consistent for all scenarios with activity ongoing across the array area, and temporary occupation area. Temporal extent: The longest construction period will lead to the greatest period of disturbance and therefore the maximum design option results in the greatest displacement. Applying the alternative design option would result in impacts that are the same or less than impacts associated with the maximum design option.
Full build out of the array area. Option A: 50 WTGs, and one OSP	All design option layouts represent similar spatial use of the array area. Option B: 45 WTGs and one OSP; or Option C: 39 WTGs and one OSP.	
Buoyed construction area around array area.	All design scenario layouts may entail similar buoyed construction areas given similar build out scenarios.	
Jack up and anchoring operations: - Option A: 50 WTGs - WTG/OSP installation jack up vessel (JUV) footprint - 6 jack-up operations required per turbine - WTG/OSP installation of foundation vessel anchor footprints	**Jack up and anchoring operations:** No alternative options have been considered for this operation, as the methodology described as the maximum design option is considered the most appropriate option. However, lower number of WTGs will reduce the number of operations and reduce the level of seabed disturbance.	
Construction vessels will comprise of installation vessels and smaller support vessels. Installation vessels include those for foundation, WTG and OSP installation and cable lay vessels. The foundation, WTG and OSP installation vessels will include cranes, which when fully extended will be **220 m** in height. Up to three large installation vessels and associated support craft operating simultaneously with a total of **66** vessels on site at any time. Up to **813** round trips to port from construction vessels and an additional **1,825** round trips from small vessels such as CTVs during construction period (CTVs likely to be to/from Dún Laoghaire). Use of helicopter for crew transfer to 3 installation vessels, with 2 flights occurring to each vessel every two weeks	Construction vessels will comprise of installation vessels and smaller support vessels. Installation vessels include those for foundation, WTG and OSP installation and cable lay vessels. The foundation, WTG and OSP installation vessels will include cranes, which when fully extended will be **220 m** in height. Up to three large installation vessels and associated support craft operating simultaneously with a total of **51** vessels on site at any time; and Up to **774** round trips to port from construction vessels and an additional **538** round trips from small vessels such as CTVs during construction period (CTVs likely to be to/from Dún Laoghaire). All crew transfers undertaken by vessel.	
Impact 2: Disturbance and displacement on key bird species as a result of increased vessel activity and other construction activity within the Offshore ECC and temporary occupation area		
Export cable seabed preparation: - 40 m (maximum width of seabed disturbance) - 18.35 km (maximum length of one cable; cable route B) x 2 cables - 70% subject to seabed preparation)	**Export cable seabed preparation** Alternative options for cable installation involve the potential for varying percentages of total cable lengths requiring seabed preparation than the MDO resulting in lower area of seabed disturbance.	Temporal extent: The longest construction period will lead to the greatest period of disturbance and therefore the maximum design option results in the greatest displacement. Applying the alternative design option would result in impacts that are the same or less than impacts associated with the maximum design option.
Export Pre-Lay Grapnel Run: - 50 m (maximum width seabed disturbance) - 18.35 km (maximum length of one cable; cable route B) x 2 cables	As for the MDO	

Maximum design option	Alternative design options	Justification
Impact 3: Disturbance and displacement on key bird species as a result of construction activity for the export cable landfall within the Intertidal study area		
Landfall methodology: Trenchless installation (via HDD or direct pipe) beneath the beach, cliffs and intertidal area to be undertaken at Shanganagh. Excavation pits to be excavated and reinstated using back hoe dredge. Material will be stored to minimise loss of sediment as far as is reasonably practicable.	**Landfall methodology:** No alternative options have been considered for this operation, as trenchless techniques are considered the most appropriate option.	Temporal extent: The longest construction period will lead to the greatest period of disturbance and therefore the maximum design option results in the greatest displacement. Applying the alternative design option would result in impacts that are the same or less than impacts associated with the maximum design option.
Landfall methodology: Trenchless techniques will be used beneath the beach, cliffs and intertidal area to be undertaken at Shanganagh. - Drilling punch-out location: Subtidal; - Up to one per cable; - Excavation pits: Up to one per cable; - Maximum excavation pit dimensions: 25 m (long) x 5 m (wide)	**Landfall methodology:** No alternative options have been considered for this operation, as trenchless techniques are considered the most appropriate option.	
Use of drilling fluid (landfall): Trenchless installation The drilling fluid is anticipated to be a low concentration bentonite/water mixture. Drill exit head to will stop short of punch out, flush bentonite, and complete the final 10 m in order to mitigate bentonite release on punch out. For the purposes of the assessment this is assumed to be an instantaneous release as this is the most conservative assumption for the purposes of the study/assessment model.	**Landfall methodology:** No alternative options have been considered for this operation, as trenchless techniques are considered the most appropriate option.	
Impact 4: Indirect effects on foraging seabirds as a result of habitat loss/displacement of prey species due to increased noise and disturbance to seabed during construction in array area and Offshore ECC		
Assessment is based on the MDO and alternative design options presented in Volume 3, Chapter 5: Fish and Shellfish Ecology.		Assessment is based on the MDO and alternative design options presented in Volume 3, Chapter 5: Fish and Shellfish Ecology and is in line with modelled sediment plume and noise outputs that represent the maximum spatial and temporal footprint of the effect with the longest duration to return to background levels.
Operation and Maintenance		
Impact 5: Disturbance and displacement on key bird species as a result of vessel activity associated with O&M		
Lifetime of the proposed development: 35 years (operating life) Three daily CTV trips with the addition of up to **100** vessels trips to support scheduled routine and non-routine maintenance per year.	**Lifetime of the proposed development:** 35 years (operating life) Two daily CTV trips with the addition of up to **75** vessels trips to support scheduled routine and non-routine maintenance.	The maximum numbers of vessels and associated vessel movements represents the maximum potential for disturbance and collision risk.
Impact 6: Indirect effects as a result of habitat loss/displacement of prey species due to increased noise and disturbance to seabed in array area and Offshore ECC		
Assessment is based on the MDO and alternative design options presented in Volume 3, Chapter 5: Fish and Shellfish Ecology.		

Maximum design option	Alternative design options	Justification
Impact 9: Disturbance from aviation and navigation lighting		
Option C: Lighting of 39 WTGs at a height of 309.6 m LAT. Lighting will comprise aviation warning lights on all peripheral WTGs in the array area and navigational lights at platform level on significant peripheral structures, the latter no greater than 3nm apart.	Option B: Lighting of 45 WTGs with a blade tip height of 281.6 m LAT or Option A: 50 WTGs with a blade tip height of 267.6 m LAT . Lighting will comprise aviation warning lights on all peripheral WTGs in the array area and navigational lights at platform level on significant peripheral structures, the latter no greater than 3nm apart.	Despite the smaller number of larger WTGs, they occupy a similar extent as the larger number of smaller WTGs and therefore a similar number of peripheral WTGs will be used, albeit set at slightly higher hub heights.
Impact 8: Displacement and barrier effects on key bird species within the array area and appropriate buffer as a result of offshore infrastructure		
Full build out of the array area. Option A: 50 WTGs, and one OSP, comprising **51** structures. For displacement, the assessment is based on displacement occurring over the array area and out to 2 km, for most seabird species. For common scoter and great northern diver, a combined array area plus surrounding 4 km buffer was applied while for red-throated diver, a combined array area plus surrounding 10 km buffer was applied.	All design option layouts represent similar spatial use of the array area. Option B: 45 WTGs or Option C: 39 WTGs and one OSP, comprising **46** or **40** structures The alternative design options will have the same scale of effects as the MDO, as displacement assessment considers the whole of the array area and surrounding buffers.	Evidence from existing offshore wind farms indicates that if there is displacement that it will be limited to within 2 km of the wind farm boundary for the majority of species of concern for the development. For red-throated diver, UK SNCB advice is to consider potential displacement effects out to 10 km from the array area, while for great northern diver and common scoter, advice is to consider displacement effects out to 4 km and this has been applied here (SNCBs, 2022a&b).
Impact 9: Mortality of key bird species as a result of collision with offshore wind turbines		
Option A: **50** turbines Rotor diameter: **236 m**	Option B: **45** turbines Rotor diameter: **250 m** Option C: **39** turbines Rotor diameter: **278 m**	CRM shows that Option A: 50 WTGs with 236 rotor diameter have largest theoretical collision impact risk for all species considered (Seabird CRM Technical Report)
Decommissioning		
Impact 10: Disturbance and displacement on key bird species as a result of increased vessel activity and other decommissioning activity within the array area		
Removal of structures is expected to be undertaken as an approximate reverse of the installation process; - It is anticipated that piled foundations will be cut at a level just below the seabed; - Buried cables to be cut and left in situ (but to be determined in consultation with key stakeholders as part of the decommissioning plan and following best practice at the time of decommissioning); - Scour and cable protection left in situ; and - Decommissioning activities lasting approximately three years for both onshore and offshore works. **Removal of foundations:** - Option A: 50 WTGs; and - One OSP.	Decommissioning activities are expected to be the same for all design options. Alternative design options are represented by varying numbers of total structures within the array area (represented by different WTG options), as shown below. **Removal of foundations:** - Option C: 39 WTGs and Option B: 45 WTGs; and - One OSP.	The MDO is the option with the greatest number of WTGs (Option A: 50 WTGs). All alternatives have lower potential for damage to assets and infrastructure during decommissioning.

Maximum design option	Alternative design options	Justification
- Landfall infrastructure will be left in situ where considered appropriate.	As for the MDO Landfall infrastructure will be left in situ where considered appropriate.	
Impact 13: Disturbance and displacement on key bird species as a result of increased vessel activity and other decommissioning activity within the offshore ECC		
As above. See Impact 10: Disturbance and displacement on key bird species as a result of increased vessel activity and other decommissioning activity within the array area		
Impact 14: Disturbance and displacement on key bird species as a result of decommissioning activity for the export cable landfall within the Intertidal study area		
As above. See Impact 10: Disturbance and displacement on key bird species as a result of increased vessel activity and other decommissioning activity within the array area		
Impact 13: Indirect effects on foraging seabirds as a result of habitat loss/displacement of prey species due to increased noise and disturbance to seabed during decommissioning in array area and Offshore ECC		
As above. See Impact 10: Disturbance and displacement on key bird species as a result of increased vessel activity and other decommissioning activity within the array area		

6.15 Project Design Features and Avoidance and Preventative Measures

6.15.1 As outlined within the EIA Methodology Chapter and in accordance with the EPA Guidelines (2022), this EIAR describes the following:

- Project Design Features: These are features of the Dublin Array project that were selected as part of the iterative design process, which are demonstrated to avoid and prevent significant adverse effects on the environment in relation to ornithology. The relevant project design feature has been presented within Table 19.

- Other Avoidance and Preventative Measures: These are measures that were identified throughout the early development phase of the Dublin Array project, also to avoid and prevent likely significant effects, which go beyond design features. These measures were incorporated in as constituent elements of the project, they are referenced in the project description chapter of this EIAR and they form part of the project for which development consent is being sought. These measures are distinct from design features and are found within our suite of management plans. There are no avoidance and preventative measures relevant to this EIAR chapter.

- Additional Mitigation: These are measures that were introduced to the Dublin Array project after a likely significant effect was identified during the EIA assessment process. These measures either mitigate against the identified significant adverse effect or reduce the significance of the residual effect on the environment. The assessment of impacts is presented in Sections 6.16 to 6.18 of this EIAR chapter.

6.15.2 All measures are secured within Volume 8, Chapter 2: Schedule of Commitments.

6.15.3 Where additional mitigation is identified as being required to reduce the significance of any residual effect in EIA terms, this is presented in Sections 6.16 to 6.18.

6.15.4 In this respect, the necessary and appropriate mitigation measures to avoid incidental killing, and to prevent significant disturbance, of birds insofar as is possible is already provided for within the proposed development. Additionally, the Applicant is committed to participating in the 'East Coast Monitoring Group' (ECMG) (see Section 6.22), 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 with statutory and technical stakeholders, and with a focus on validation and evidence gathering.

Table 19 Project design features relating to offshore and intertidal ornithology

Project Design Features	Where secured
Minimum WTG blade clearance of 28m above MHWS, (31.6 LAT) (exceeds minimum of 22m, above MHWS).	Outlined within the Project Description Chapter

6.16 Environmental Assessment: Construction phase

6.16.1 The effects of the construction of the offshore infrastructure for Dublin Array have been assessed on offshore and intertidal ornithology as defined in Section 6.5. The environment impacts arising from construction are listed in Table 18, along with the MDO and alternative design options against which each construction phase impact has been assessed.

Impact 1: Disturbance and displacement from increased vessel activity and other construction activity within the array area and temporary occupation area

6.16.2 Direct temporary disturbance or displacement of birds within the array area and temporary occupation area during the construction phase may occur as a result of a range of activities including use of jack-up vessels during foundation installation/maintenance, installation of inter-array and offshore export cables (including seabed clearance operations prior to cable installation) and anchor placements associated with these activities. Disturbance arising from these activities has the potential to affect identified key species directly (e.g. disturbance of individuals) and indirectly (e.g. disturbance to prey distribution or availability, which subsequently affects foraging seabirds). The design scenarios outlined in Table 18, describe the elements of Dublin Array considered within this assessment.

6.16.3 Some seabird species are more sensitive to disturbance than others. There is evidence from studies that demonstrate that species such as divers and scoters may avoid shipping by several kilometres (e.g. Garthe and Hüppop, 2004; Schwemmer *et al.,* 2011), while gulls are not considered sensitive to disturbance, as they are often associated with fishing boats (e.g. Camphuysen, 1995; Hüppop and Wurm, 2000).

6.16.4 It is noted that displacement effects for breeding seabirds are more likely to be observed as changes in productivity as opposed to survival rates (Humphreys et al., 2015). Seabirds experiencing challenging conditions are more likely to abandon the current breeding attempt before compromising their own survival (Furness et al., 2013), although there is the potential that stressed birds could go into the wintering period in poor body condition and hence may be more susceptible to higher mortality effects as a result. However, there are currently no studies surrounding the link between offshore wind farm displacement and potential reduction in body condition, and therefore increased mortality.

6.16.5 There is also the potential for displacement effects to have direct consequences for wintering birds if they are displaced from high quality habitat by the presence of an offshore wind farm. In this scenario, birds may have to redistribute to poorer quality habitat, which may result in poorer body condition leading to lower over-winter survival rates or potentially reduced breeding success in the subsequent year. However, it is considered that this scenario is unlikely to occur as outside the breeding season as seabirds do not have to regularly return to a colony and so are able to move to greater distances to suitable foraging areas, thus avoiding displacement effects. As stated above, there are currently no studies surrounding the link between offshore wind farm displacement and potential reduction in body condition, and therefore increased mortality. This assessment is therefore based on hypothetical mortality rates from birds being displaced from the offshore wind farm.

6.16.6 In order to focus the assessment, an exercise was undertaken to identify those species likely to be sensitive to disturbance and displacement as a result of increased vessel activity associated with construction. This was based on previous sensitivity reviews such as Garthe and Hüppop (2004), who developed a scoring system for such disturbance factors, which is used widely in offshore wind farm EIAs. Similarly, Furness and Wade (2012) developed disturbance ratings for particular species based on Garthe and Hüppop (2004), alongside scores for habitat flexibility and conservation importance in a Scottish context. This approach was further developed by Furness *et al.,* (2013) in a review of seabird vulnerability to offshore wind farms, which included rankings for disturbance by ship and helicopter traffic. A similar vulnerability index for ship traffic disturbance was prepared by Fleissbach *et al.,* (2019).

6.16.7 Rankings for disturbance from wind farm structures, ship and helicopter traffic from Furness *et al.,* (2013) have been applied here, where species that show limited escape behaviour and a very short flight distance when approached scored "one" (very low sensitivity), and species that show strong escape behaviour at a large response distance scored "five" (very high sensitivity).

6.16.8 For this assessment, species with very low or low sensitivity to disturbance or displacement or species that were only recorded occasionally in very small numbers within the offshore study area were screened out of further assessment for Impact 1 (Table 20).

Table 20 Sensitivity of species to disturbance and displacement from increased vessel activity in array area and temporary occupation area during construction

Species	Sensitivity to disturbance and displacement from vessels during construction	Screening Result (In/Out)
Red-throated Diver	Very High	**Screened in** due to numbers recorded and very high sensitivity to disturbance and displacement.
Great Northern Diver	Very High	**Screened out** as the species was only recorded in the array area in very low numbers on baseline surveys and therefore any disturbance/ displacement will be negligible.
Fulmar	Very Low	**Screened out** as the species has a very low sensitivity to disturbance and is not known to avoid vessels.

Species	Sensitivity to disturbance and displacement from vessels during construction	Screening Result (In/Out)
Manx Shearwater	Very Low	**Screened out** as the species has a very low sensitivity to disturbance and is not known to avoid vessels.
Storm Petrel	Very Low	**Screened out** as the species has a very low sensitivity to disturbance and is not known to avoid vessels.
Gannet	Low	**Screened out** as the species has a low sensitivity to disturbance and is not known to avoid vessels.
Cormorant	High	**Screened in** due to numbers recorded and high sensitivity to disturbance and displacement.
Shag	Medium	**Screened in** due to numbers recorded and medium sensitivity to disturbance and displacement.
Common Scoter	Very High	**Screened out** as the species was recorded flying through the array area in very low numbers on baseline surveys and therefore additional disturbance/displacement would be negligible.
Arctic Skua	Very Low	**Screened out** as the species has a very low sensitivity to disturbance and is not known to avoid vessels.
Great Skua	Very Low	**Screened out** as the species has a very low sensitivity to disturbance and is not known to avoid vessels.
Mediterranean Gull[1]	Very Low	**Screened out** as the species has a very low sensitivity to disturbance and is not known to avoid vessels.
Little Gull[1]	Very Low	**Screened out** as the species has a very low sensitivity to disturbance and is not known to avoid vessels.
Black-headed Gull	Low	**Screened out** as the species has a low sensitivity to disturbance and is not known to avoid vessels.
Common Gull	Low	**Screened out** as the species has a low sensitivity to disturbance and is not known to avoid vessels.
Lesser black-backed Gull	Low	**Screened out** as the species has a low sensitivity to disturbance and is not known to avoid vessels.
Herring Gull	Low	**Screened out** as the species has a low sensitivity to disturbance and is not known to avoid vessels.
Great black-backed Gull	Low	**Screened out** as the species has a low sensitivity to disturbance and is not known to avoid vessels.
Kittiwake	Low	**Screened out** as the species has a low sensitivity to disturbance and is not known to avoid vessels.
Sandwich Tern	Low	**Screened out** as the species has a low sensitivity to disturbance and is not known to avoid vessels.
Roseate Tern	Low	**Screened out** as the species has a low sensitivity to disturbance and is not known to avoid vessels.
Common Tern	Low	**Screened out** as the species has a low sensitivity to disturbance and is not known to avoid vessels.
Arctic Tern	Low	**Screened out** as the species has a low sensitivity to disturbance and is not known to avoid vessels.
Little Tern	Low	**Screened out** as the species has a low sensitivity to disturbance and is not known to avoid vessels.

Species	Sensitivity to disturbance and displacement from vessels during construction	Screening Result (In/Out)
Guillemot	Medium	**Screened in** due to numbers recorded and medium sensitivity to disturbance and displacement.
Razorbill	Medium	**Screened in** due to numbers recorded and medium sensitivity to disturbance and displacement.
Black Guillemot	Medium	**Screened out** as the species was only recorded in the array area in very low numbers on baseline surveys and therefore any disturbance/ displacement will be negligible.
Puffin	Low	**Screened out** as the species has a low sensitivity to disturbance and is not known to avoid vessels.

1 Displacement sensitivity taken from Bradbury *et al.,* 2014, as this species not included in Furness *et al.,* 2013

6.16.9 Based on Table 20, five species; red-throated diver, cormorant, shag, guillemot and razorbill were identified as being potentially sensitive to disturbance and displacement from increased vessel activity within the array area and temporary occupation area during the construction phase. For each of these species, the magnitude of impact and overall sensitivity to Impact 1 were considered.

6.16.10 For red-throated diver, published evidence from reviews indicates that this species has a very high sensitivity to disturbance from vessels (Bradbury *et al*, 2014). In addition, the species is listed on Annex I of the Birds Directive, and so would be considered to be of international importance (Table 4). As the Murrough SPA is within 10 km of the array area, there is the potential for birds from this SPA to occur within the array area, although it is considered that not all birds in the array area may spend time within the SPA. Impacts on red-throated divers from The Murrough SPA are presented in the NIS (Part 4: Habitats Directive Assessments, Volume 4: NIS).

6.16.11 Baseline surveys show that red-throated divers occur in the vicinity of the array area between September and April, i.e. in the non-breeding season, with no birds recorded between May and August (Offshore and Intertidal Ornithology Technical Baseline). Any disturbance from vessels will therefore be limited to the non-breeding season, when birds are in the vicinity of the array area and temporary occupation area, and there will be no disturbance to red-throated divers in the breeding season, therefore reproductive rates will not be affected. The overall sensitivity of red-throated diver to Impact 1 is therefore considered to be **Medium**.

6.16.12 For cormorant, published evidence from reviews indicates that this species has a high sensitivity to disturbance from vessels (Table 20). The species is not listed on Annex I of the Birds Directive, however there are designated SPAs for breeding cormorant within mean maximum foraging range of the array area, which would be considered to be of international importance (Table 4). Other non-SPA colonies may also contribute to the population at risk. The overall sensitivity of cormorant to Impact 1 is therefore considered to be **Medium**.

6.16.13 For shag, guillemot and razorbill, published evidence from reviews indicates that these species have a medium sensitivity to disturbance from vessels (Table 20). These species are not listed on Annex I of the Birds Directive, however there are designated SPAs for breeding shags, guillemots and razorbills within mean maximum foraging range of the array area, which would be considered to be of international importance (Table 4). The degree of connectivity between these SPAs and birds recorded in the array area is not known, and other non-SPA colonies may also contribute to the population at risk. The overall sensitivity of these species to Impact 1 is therefore considered to be **Medium**.

6.16.14 Activities resulting in the disturbance or displacement of birds within the array area and temporary occupation area from increased vessel activity and construction activity will occur intermittently throughout the construction period. The offshore construction works, which includes activities resulting in temporary disturbance or displacement of birds from increased vessel activity, will occur over a period of up to 30 months excluding preparation works, between 2029 and 2032. This is the maximum construction period identified within Table 18 .

6.16.15 The impact is predicted to affect a small proportion of the regional population, and will be, intermittent, and of temporary to short-term duration. The EPA (2022) Guidelines define temporary duration as lasting less than one year, while "short-term" duration is defined as between one and seven years duration. However, it is considered that only a small proportion of the total array area will be affected by construction activities at any one time, and that individual construction activities will typically be completed within a few months. Consequently, only birds in the vicinity of these individual activities will be affected directly (Table 21).

Table 21 Determination of magnitude for Impact 1

	Assessment of maximum design option	Assessment of alternative design options
Extent	Small proportion of the population will be affected	Small proportion of the population will be affected
Duration	The impact will be restricted to the construction phase of the project and will therefore be short-term (up to a maximum of 30 months), although works in any given discrete location within the project boundary will be temporary (less than one year), as defined by EPA (2022).	The impact will be restricted to the construction phase of the project and will therefore be short-term (minimum of 18 months), although works in any given discrete location within the project boundary will be temporary (less than one year), as defined by EPA (2022).
Frequency	The effect is anticipated to occur intermittently within the construction area during the proposed construction activities, with only a small proportion of the total construction area being affected at any one time.	The effect is anticipated to occur intermittently within the construction area during the proposed construction activities, with only a small proportion of the total construction area being affected at any one time.
Probability	Temporary disturbance effects are considered likely in the vicinity of the construction activities	Temporary disturbance effects are considered likely in the vicinity of the construction activities

	Assessment of maximum design option	Assessment of alternative design options
Consequence	As disturbance will be temporary, the degree of change relative to the baseline level is considered to be low and reversible.	As disturbance will be temporary, the degree of change relative to the baseline level is considered to be low and reversible. As for the maximum design option, however the impact will occur less frequently with fewer vessels on site.
Overall magnitude	The potential magnitude is rated as Low.	The potential magnitude is rated as Low.

6.16.16 On this basis, it is considered that any disturbance to red-throated diver will be temporary (non-breeding season only), and that the magnitude of any effect will therefore be **Low**. Similarly for cormorant, shag, guillemot and razorbill, the duration of any disturbance will be temporary and the magnitude of any effect will therefore be **Low.**

6.16.17 For red-throated diver, cormorant, shag, guillemot and razorbill, the magnitude of the impact is deemed to be **Low** and the overall sensitivity of these species is considered to be **Medium**. The effect will therefore be of **Slight Adverse** significance, which is **Not Significant** in EIA terms (Table 7).

6.16.18 The alternative design options (any other option within the range of parameters set out in the project description) will not give rise to an effect which is more significant than the maximum design option.

Residual Effect

The impacts associated with disturbance and displacement from increased vessel activity and other construction activity within the array area as a result of the Dublin Array development have been assessed as 'not significant' in EIA terms. Therefore, no further mitigation (in addition to that already identified in Table 19) is considered necessary. No ecologically significant adverse residual effects on offshore ornithology have therefore been predicted.

Impact 2: Disturbance and displacement on key bird species as a result of increased vessel activity and other construction activity within the Offshore ECC

6.16.19 Direct temporary disturbance or displacement of birds within the Offshore ECC may occur during construction as a result of installation of the offshore export cables (including seabed clearance operations prior to cable installation) and anchor placements associated with these activities. Disturbance arising from these activities has the potential to affect identified species directly, for example as disturbance of individual seabirds by cable-laying vessels. The MDO outlined in Table 18 describes the elements of the proposed project considered within this assessment.

6.16.20 Activities resulting in the disturbance or displacement of birds within the Offshore ECC as a result of increased vessel activity and cable-laying activities may occur intermittently throughout the construction period. Installation of the offshore export cables (including seabed clearance operations prior to cable installation) will occur over a period of up to 13 weeks per circuit.

6.16.21 The Offshore ECC does not pass through any areas designated as SPAs (Figure 3).

6.16.22 Direct disturbance impacts on seabirds are predicted to affect a small proportion of the regional population, and will be intermittent, and of temporary duration, as the cable-laying operations are predicted to last approximately five months, (although only a small proportion of the total area will be affected at any one time, with individual activities having much shorter durations) and will only affect any birds in the vicinity of these activities directly.

6.16.23 The species scoped in as being sensitive to disturbance and displacement in Table 20 will also potentially be affected for Impact 2. Thus, five species; red-throated diver, cormorant, shag, guillemot and razorbill were identified as being potentially sensitive to disturbance and displacement from increased vessel activity within the Offshore ECC during the construction phase. For each of these species, the magnitude of impact for Impact 2 was considered to be the same as for Impact 1 (Table 21).

6.16.24 On this basis, it is considered that any disturbance to red-throated diver will be temporary (both in terms of duration and as birds are only present in the non-breeding season), and that the magnitude of any effect will therefore be Low. Similarly for cormorant, shag, guillemot and razorbill, the duration of any disturbance will be temporary and the magnitude of any effect will therefore be **Low**.

6.16.25 For red-throated diver, cormorant, shag, guillemot and razorbill, the magnitude of the impact is deemed to be **Low** and the overall sensitivity of these species to Impact 2 is considered to be **Medium**. The effect will therefore be of **Slight Adverse** significance, which is **Not Significant** in EIA terms (Table 7).

6.16.26 The alternative design options (any other option within the range of parameters set out in the project description) will not give rise to an effect which is more significant than the maximum design option.

Residual Effect

The impacts associated with disturbance and displacement from increased vessel activity and other construction activity within the Offshore ECC as a result of the Dublin Array development have been assessed as 'not significant' in EIA terms. Therefore, no further mitigation (in addition to that already identified in Table 19) is considered necessary. No ecologically significant adverse residual effects on offshore ornithology have therefore been predicted.

Impact 3: Disturbance and displacement on key bird species as a result of construction activity for the export cable landfall within the intertidal study area

6.16.27 Direct temporary disturbance or displacement of intertidal bird species within the vicinity of the landfall may occur during installation of the Offshore ECC. Disturbance arising from these activities has the potential to affect identified species directly, for example as disturbance of individual intertidal birds by presence of vessels, and also by indirect effects caused by localised disturbance or reduction in availability of prey species. The maximum design scenario outlined in Table 18 describes the elements of the proposed project considered within this assessment.

6.16.28 The habitat at the Shanganagh cliffs (i.e., the cliff faces) is considered suitable for nesting sand martin however nesting sand martin were not recorded during the various surveys (see Volume 6, Appendix 6.5.2-1, Biodiversity Technical Baseline Report). Trenchless technology will be employed to ensure no damage is caused to the cliffs and therefore sand martin are not considered further here.

6.16.29 Overall, baseline surveys recorded low numbers of birds in the Intertidal study area. Details on the numbers and species recorded are summarised in Table 8 and in the Offshore and Intertidal Technical Baseline. Species that are known to be susceptible to disturbance such as divers and common scoter were only recorded in the Intertidal study area in very low numbers over the study period. Between November 2019 and October 2020, a peak of four red-throated divers were recorded on intertidal surveys at the export cable landfall in January 2020, with two birds seen in December 2019, February 2020, March 2020 and October 2020. Single great northern divers were recorded in December 2019 and March 2020, with two recorded in October 2020. Common scoter were only recorded in December 2019 when 14 birds were seen (SLR, 2021c). Between September 2023 and March 2024, the peak count of red-throated divers was three birds in December 2023. Great northern diver and common scoter were not recorded during the latter survey period (SLR, 2024). Overall, the low numbers recorded on intertidal surveys indicates that the Intertidal study area does not support significant numbers of these species.

6.16.30 Based on the survey results, these three species; red-throated diver, great northern diver and common scoter were considered to be potentially affected by Impact 3. For each of these species, the magnitude of impact and overall sensitivity to Impact 3 were considered to be the same as for Impact 1 and 2 (Table 19 and Table 21), due to the similarities of the potential impacts.

6.16.31 It is considered that any disturbance to red-throated diver, great northern diver and common scoter will be temporary (non-breeding season only), and that the magnitude of any effect will therefore be **Low**.

6.16.32 For red-throated diver, great northern diver and common scoter, the magnitude of the impact is deemed to be **Low** and the overall sensitivity of these species is considered to be **Medium**. The effect will therefore be of **Slight Adverse** significance, which is **Not significant** in EIA terms (Table 7).

6.16.33 The alternative design options (any other option within the range of parameters set out in the project description) will not give rise to an effect which is more significant than the maximum design option.

Residual Effect

The impacts associated with disturbance and displacement from construction activity associated with the Export cable landfall within the Inter-tidal study area as a result of the Dublin Array development have been assessed as 'not significant' in EIA terms. Therefore, no further mitigation (in addition to that already identified in Table 19) is considered necessary. No ecologically significant adverse residual effects on offshore ornithology have therefore been predicted.

Impact 4: Indirect effects on foraging seabirds as a result of habitat loss/displacement of prey species due to increased noise and disturbance to seabed during construction in array area and Offshore ECC

6.16.34 Indirect effects on foraging seabirds caused by disturbance or displacement to prey species may occur during construction. Indirect effects may arise from the generation of suspended sediments (e.g. during cable-laying) or underwater noise associated with certain construction activities. Such activities may change the behaviour or distribution of prey species for foraging seabirds in the vicinity, resulting in lower prey availability for these individuals. An increase in suspended sediment concentration (SSC) may cause fish and mobile invertebrates to avoid the construction area and may hide immobile benthic prey. Suspended sediments may also make it harder for foraging seabirds to see their prey. These outcomes may lead to a reduction in prey being available within the construction area for foraging seabirds. Such potential effects on benthic invertebrates and fish have been assessed in the Benthic Ecology chapter and Fish and Shellfish Ecology chapter. The conclusions of those assessments inform this assessment of indirect effects on foraging seabirds in the array area and the Offshore ECC.

6.16.35 Construction activities may change the behaviour or availability of prey species for seabirds, resulting in the availability of such prey species being temporarily reduced. However, the majority of seabird species have a variety of target prey species and have large foraging ranges, meaning that they can forage for alternative prey species or move to other foraging areas if prey becomes temporarily unavailable due to construction activities. The sensitivity of seabirds to indirect effects as a result of habitat loss or displacement of prey species due to increased noise and disturbance during construction is therefore considered to be **Low**.

6.16.36 Within the array area, the area of seabed predicted to be disturbed during construction is predicted to be small in comparison to the total array area. Construction of Dublin Array will occur between 2029 to 2032, with offshore construction currently being scheduled to last up to a maximum of 30 months, excluding preparation works. It is considered that habitat disturbance to prey species and increases in suspended sediment will be temporary, short-term and small in extent. It is considered that these impacts together with the limited habitat lost as a result of cable protection within the array area will not cause a significant reduction in the extent, distribution or quality of habitats that support the prey of foraging seabirds.

6.16.37 It is concluded that habitat disturbance to prey species and increases in suspended sediment within the Offshore ECC during construction, as well as the very small area of seabed habitat lost within the Offshore ECC as a result of cable protection will not cause a significant reduction in the extent, distribution or quality of habitats that support the prey of foraging seabirds. The trenching of cables will cause a localised and temporary impact on the habitats within the vicinity.

6.16.38 The assessment of effects on benthic ecology (Benthic Ecology chapter) determined the impact to biotopes identified within the region as low, with the maximum sensitivity of the receptors (including Annex I habitats) assessed as high (range: low to high). Therefore, the maximum significance of effect from SSC and deposition occurring as a result of construction activities in the array area is moderate adverse (but lower for a number of the biotopes recorded – range: slight to moderate adverse), which is not significant in EIA terms.

6.16.39 The magnitude of the impact on fish and shellfish receptors from increases in SSC and deposition occurring as a result of construction activities has been assessed as low, with the maximum sensitivity of these receptors being medium. Therefore, the significance of effect of temporary increases in SSC and deposition on fish and shellfish receptors is slight adverse, which is not significant in EIA terms (See Fish and Shellfish Ecology chapter).

6.16.40 Based on the assessment presented in the Fish and Shellfish Ecology chapter, the potential sensitivity of fish and shellfish receptors to underwater noise from piling and unexploded ordnance (UXO) clearance is rated as low. The potential sensitivity of fish and shellfish receptors to underwater noise from other activities is also rated as low.

6.16.41 The maximum magnitude of the impact of underwater noise from piling and unexploded ordnance (UXO) clearance on fish and shellfish species has been assessed as low, with the maximum sensitivity of these receptors being low. Therefore, the significance of effect of additional underwater noise and vibration on fish and shellfish receptors is a slight adverse effect, which is not significant in EIA terms.

6.16.42 As no significant effects on potential prey species (benthic organisms, fish or shellfish) or on the habitats that support them have been identified, then there is no potential for any indirect effects of an adverse significance to occur on foraging seabirds in the vicinity.

6.16.43 The maximum magnitude of any indirect impact on foraging seabirds is predicted to be the same as for Impact 1 (Table 21), and has therefore been assessed as **Low**. The maximum sensitivity of these receptors has also been assessed as **Low**. Therefore, the significance of any indirect effect on foraging seabirds as a result of habitat loss/displacement of prey species due to increased noise and disturbance to seabed during construction activities in the array area and Offshore ECC is a **Slight Adverse** effect, which is **Not significant** in EIA terms (Table 7).

6.16.44 The alternative design options (any other option within the range of parameters set out in the project description) will not give rise to an effect which is more significant than the maximum design option.

Residual Effect

The indirect impacts associated with habitat loss/displacement of prey species due to increased noise and disturbance to seabed during construction on key bird species have been assessed as 'not significant' in EIA terms. Therefore, no further mitigation (in addition to that already identified in Table 19) is considered necessary. No ecologically significant adverse residual effects on offshore ornithology have therefore been predicted.

6.17 Environmental Assessment: Operation and Maintenance phase

Impact 5: Disturbance and displacement on key bird species as a result of vessel activity associated with O&M

6.17.1 Direct temporary disturbance or displacement of birds within the array area during the O&M phase may occur as a result of vessel activities. Disturbance arising from these vessel activities has the potential to affect identified key species directly (e.g. disturbance of individuals). The MDO outlined in Table 18, describes the elements of Dublin Array considered within this assessment.

6.17.2 Some seabird species are more sensitive to disturbance than others. There is evidence from studies that demonstrate that species such as divers and scoters may avoid shipping by several kilometres (e.g. Garthe and Hüppop, 2004; Schwemmer *et al.,* 2011), while gulls are not considered sensitive to disturbance, as they are often associated with fishing boats (e.g. Camphuysen, 1995; Hüppop and Wurm, 2000).

6.17.3 Based on the exercise undertaken for Impact 1 (Table 20), five species (red-throated diver, cormorant, shag, guillemot and razorbill) were identified as being potentially sensitive to disturbance and displacement from vessel activity during the O&M phase. For all five species, the overall sensitivity to disturbance or displacement from vessels was considered to be **Medium.**

6.17.4 Vessel activity resulting in the disturbance or displacement of birds will occur intermittently throughout the O&M period, with activity predicted to be lower than during the construction phase (Table 18). Any disturbance impact is predicted to only affect a very small proportion of the regional population, and will be intermittent, and of temporary duration. Consequently, only birds in the immediate vicinity of these vessels will be affected directly (Table 20). The magnitude of any disturbance or displacement effects is therefore considered to be **Negligible** (Table 22).

Table 22 Determination of magnitude for Impact 5

	Assessment of maximum design option	Assessment of alternative design options
Extent	Very small proportion of the population will be affected.	Very small proportion of the population will be affected.
Duration	The impact will be restricted to the operation phase of the project and will therefore be long-term, although any one instance of disturbance from maintenance vessels within the project boundary will be brief (less than one day), as defined by EPA (2022).	The impact will be restricted to the operation phase of the project and will therefore be long-term, although any one instance of disturbance from maintenance vessels within the project boundary will be brief (less than one day), as defined by EPA (2022).
Frequency	The effect is anticipated to occur intermittently within the array area during the operation phase, with only a very small proportion of the total array area being affected at any one time.	The effect is anticipated to occur intermittently within the array area during the operation phase, with only a very small proportion of the total array area being affected at any one time.
Probability	Temporary disturbance effects are considered likely in the immediate vicinity of the maintenance activities	Temporary disturbance effects are considered likely in the immediate vicinity of the maintenance activities
Consequence	As disturbance will be temporary, the degree of change relative to the baseline level is considered to be low and reversible.	As disturbance will be temporary, the degree of change relative to the baseline level is considered to be low and reversible. As for the MDO, however the impact will occur less frequently with fewer vessels on site.
Overall magnitude	The potential magnitude is rated as Negligible.	The potential magnitude is rated as Negligible.

6.17.5 Similarly, any O&M activities in relation to the cables within the offshore ECC may have temporary and localised disturbance and displacement impacts on seabirds, but these effects are unlikely to result in detectable effects at either local or regional bird population levels and are therefore considered to be of **Negligible** magnitude.

6.17.6 The magnitude of the effect is deemed to be **Negligible** and the sensitivity of potentially affected seabird species is considered to be **Medium**. The effect will therefore be **Not Significant**, which is **Not significant** in EIA terms (Table 7).

6.17.7 The alternative design options (any other option within the range of parameters set out in the project description) will not give rise to an effect which is more significant than the maximum design option.

Residual Effect

The impacts associated with disturbance or displacement from vessel activities in the O&M phase have been assessed as 'not significant' in EIA terms. Therefore, no further mitigation (in addition to that already identified in Table 19) is considered necessary. No ecologically significant adverse residual effects on offshore ornithology have therefore been predicted.

Impact 6: Indirect effects as a result of habitat loss/displacement of prey species due to increased noise and disturbance to seabed in array area and Offshore ECC

6.17.8 Long term subtidal habitat loss impacts will occur during the construction phase and will be continuous throughout the anticipated 35-year operation and maintenance phase. Long term habitat loss will occur directly under all turbine and OSP foundation structures, and at any associated scour protection and cable protection. The seabed habitats removed by the installation of infrastructure will reduce the amount of suitable habitat and available food resource for fish and shellfish species and benthic communities associated with the baseline substrates/sediments, which could in turn, reduce the availability of these prey species for foraging seabirds in the vicinity.

6.17.9 However, the majority of fish species would be able to avoid habitat loss effects due to their greater mobility and would recover into the areas affected following completion of construction. Sandeels (and other less mobile prey species) would be affected by long term subtidal habitat loss, although recovery of this species is expected to occur quickly as the sediments recover following installation of infrastructure and adults recolonise and also via larval recolonisation of any sandy sediments in the vicinity.

6.17.10 The placement of infrastructure will lead to an alteration of the structure and dynamics of benthic communities where infrastructure exists, with increased structural complexity often leading to greater species diversity, abundance or productivity of benthic assemblages (e.g., Smith et al., 2014). This increase in diversity and productivity as a result of the colonisation of seabed structures may have an impact on fish and shellfish receptors, resulting in either attraction or displacement. There is the potential for knock on effects for ornithological receptors, for example with an increase in abundance of prey leading to an increased abundance of birds within the array area.

6.17.11 The increase in hard substrate and structural complexity due to the placement of subsea infrastructure was assessed within the Fish and Shellfish Chapter, Impact 9. The maximum magnitude of the impact was assessed as Low adverse for both the MDO and alternative design option, with the maximum sensitivity of the receptors being Medium. Therefore, the significance of effects on fish and shellfish associated with the introduction of hard substrate and structural complexity was Slight adverse, which is not significant in EIA terms. Based on these conclusions, there will not be any significant changes to fish species within the array area (both positive or negative), therefore, there is not expected to be subsequent changes to bird densities within the array area.

6.17.12 It should be noted that turbine foundations may act as "artificial reefs" for fish species (Dannheim *et al*., 2020), and there is also evidence that top predators such as seabirds may target OWFs for food and/or refuge and benefit from the ecological changes that take place following their installation (Degraer *et al*., 2020).

6.17.13 The assessment of effects on fish receptors (Chapter 4) has been assessed as being negligible, with the maximum sensitivity of the receptors being low. Therefore, the significance of effect of long-term loss of habitat on fish receptors is considered a neutral effect, which is not significant in EIA terms.

6.17.14 Based on the predicted neutral effect on fish that are prey species for seabirds, the impact on seabirds is predicted to affect a small proportion of the population over medium-term duration, as prey species distribution is considered likely to recover over time. The magnitude is therefore considered to be **Low** (Table 23).

Table 23 Determination of magnitude for Impact 6

	Assessment of maximum design option	Assessment of alternative design options
Extent	Small proportion of the population will be affected.	Small proportion of the population will be affected.
Duration	The impact will be restricted to the operation phase of the project and will therefore be long-term, although prey species distribution is considered likely to recover over time therefore duration could be considered to be medium-term	The impact will be restricted to the operation phase of the project and will therefore be long-term, although prey species distribution is considered likely to recover over time therefore duration could be considered to be medium-term
Frequency	The effect is anticipated to occur within the array area during the operation phase, although only a very small proportion of the total array area will be affected.	The effect is anticipated to occur within the array area during the operation phase, although only a very small proportion of the total array area will be affected.
Probability	Effects are considered likely in the immediate vicinity of the turbine locations.	Effects are considered likely in the immediate vicinity of the turbine locations.
Consequence	As prey species distribution is considered likely to recover, the degree of change relative to the baseline level is considered to be low and reversible.	As prey species distribution is considered likely to recover, the degree of change relative to the baseline level is considered to be low and reversible.
Overall magnitude	The potential magnitude is rated as Low.	The potential magnitude is rated as Low.

6.17.15 The maximum magnitude of any indirect impact on foraging seabirds has therefore been assessed as **Low**, with the maximum sensitivity of these receptors being considered **Low**, as only a small proportion of the population is considered to be affected, and the duration of any indirect effect will be temporary, as any affected birds will be able to move elsewhere to forage. In addition, the distribution of affected prey species is considered likely to recover over time.

6.17.16 Therefore, the significance of any indirect effect on foraging seabirds as a result of habitat loss/displacement of prey species due to increased noise and disturbance to seabed during the operation and maintenance phase in the array area and Offshore ECC is a **Slight Adverse** effect, which is **Not significant** in EIA terms (Table 7).

6.17.17 The alternative design options (any other option within the range of parameters set out in the project description) will not give rise to an effect which is more significant than the maximum design option.

Residual Effect

The indirect impacts on foraging seabirds associated with habitat loss/displacement of prey species due to increased noise and disturbance to seabed during the operation and maintenance phase have been assessed as 'not significant' in EIA terms. Therefore, no further mitigation (in addition to that already identified in Table 19) is considered necessary. No ecologically significant adverse residual effects on offshore ornithology have therefore been predicted.

Impact 7: Disturbance from aviation and navigation lighting

6.17.18 The current Irish guidance for the lighting of offshore WTGs is currently under review with the prospect that it may become more closely aligned with neighbouring jurisdictions. On this basis it is necessary to consider the presence of both white and red aviation lighting. The current guidance also includes the requirement to have the white lights on 24 hours, this requirement may or may not remain in any updated guidance. Specific requirements for aviation and navigational lighting will be agreed with the relevant stakeholders post-consent and prior to construction.

6.17.19 There is the potential that aviation and navigation lighting on wind turbines could attract or repel birds moving through the array area at night. There is some evidence that nocturnal lighting may cause changes in bird behaviour and habitat selection (Drewitt and Langston, 2008). However much of this evidence is based on oil and gas platforms, and as offshore wind farms are typically less intensively lit than these installations, any impacts are likely to be less extreme. A review of evidence of potential lighting attraction reported examples of species such as Manx shearwaters, and storm petrels being attracted to artificial light sources such as lighthouses (Deakin *et al.,* 2022), however it should be noted that such sources would be considerably brighter than lighting associated with offshore turbines.

6.17.20 It is currently planned that only significant peripheral turbines will be illuminated (with white aviation and yellow navigation lighting). All other turbines will only host search and rescue (SAR) lighting which are low intensity and will not be switched on during normal operation hours and only during SAR operations. The MDO outlined in Table 18 describes the elements of the proposed project considered within this assessment.

6.17.21 Based on available evidence, it is considered that red lighting (for example, aviation warning lights) may have minimal effects on seabirds, with yellow lighting (for example, navigational lighting) also having low impacts (Syposz *et al,* 2021). Any impacts are considered to be restricted to the operation and maintenance phase.

6.17.22 A significant impact could potentially occur if large numbers of migrant birds fly through the array area in a single event, leading to mass disorientation or collisions. However, there is no evidence from existing offshore wind farm to suggest mass collision events occur as a result of aviation and navigation lighting that is typically used for offshore wind farms. Evidence from Kerlinger *et al.,* (2010) and Welcker *et al.,* (2017) found that nocturnal migrants do not have a higher risk of collision with wind farms than species that migrate during daylight, while mortality rates are not higher at offshore wind farms with lighting compared to those without. Furthermore, studies have shown that nocturnal flight is altered to counteract the risk of collision at offshore wind farms (Dirksen *et al.,* 1998 and Desholm and Kahlert, 2005).

6.17.23 The seabird species that are considered most at risk of collisions with turbines (gannet and kittiwake), are unlikely to be active at night, as they either return to their colonies or roost on the sea surface during darkness (Wade *et al.,* 2016). A tracking study by Furness *et al.,* (2018) reported that gannet flight and diving activity was minimal during darkness. Kotzerka *et al.,* (2010) reported that kittiwake foraging trips mainly occurred during daylight hours and that birds were largely inactive during darkness and therefore at lower risk of interactions with turbines.

6.17.24 Gulls are known to have low to moderate levels of nocturnal activity but are sometimes attracted to lit fishing vessels and well-lit oil and gas platforms that attract fish to the surface waters (Burke *et al.,* 2012). However, it is considered that as offshore wind farms are typically considerably less intensively lit than these installations, the degree of nocturnal attraction for large gull species is likely to be lower.

6.17.25 While species such as Manx shearwater and storm petrel could be considered at potential risk of attraction to turbine lighting at night, the potential for impacts is still considered low. Although there is some evidence of foraging occurring at night in Scotland (Kane, 2020), Manx shearwater foraging occurs almost exclusively during daylight hours. The majority of nocturnal behaviour would typically be associated with birds rafting close to colonies in the evening and then returning to their burrows after dusk. As there are no Manx shearwater colonies in the immediate vicinity of Dublin Array, and as foraging activity is likely to be low during nocturnal hours, potential impacts from attraction to turbine lighting in terms of impacts on breeding success is considered to be of negligible magnitude.

6.17.26 With respect to day time lighting, the influence is expected to be limited owing to the relative brightness of the sky and resultant lower intensity, compared to the influence of red or white lights at night, therefore moderating effect on ornithological receptors during daytime.

6.17.27 Overall, based on available evidence from published studies, it is considered likely that seabird species in the marine environment would exhibit no more than a **Medium** sensitivity to lighting associated with Dublin Array.

6.17.28 The magnitude of any effect from aviation and navigation lighting on key bird species has also been assessed as **Low** (Table 24).

Table 24 Determination of magnitude for Impact 7

	Assessment of maximum design option	Assessment of alternative design options
Extent	It is considered that a small proportion of the population will be affected	As aviation warning lights will be located on peripheral WTGs only, the alternative layouts comprising 45 or 50 WTGs will not have a greater number of lights and in line with the MDO, considered only a small proportion of the population will be affected.
Duration	The impact will be present for the duration of the operation and maintenance phase. This is considered to be long-term but intermittent (noting the anticipated moderated effect during daylight hours), as defined by EPA (2022).	The impact will be present for the duration of the operation and maintenance phase. This is considered to be long-term but intermittent (noting the anticipated moderated effect during daylight hours), as defined by EPA (2022).
Frequency	The effect is anticipated to occur intermittently (noting the anticipated moderated effect during daylight hours) within the array area during the operation and maintenance phase.	The effect is anticipated to occur intermittently (noting the anticipated moderated effect during daylight hours) within the array area during the operation and maintenance phase.
Probability	The effect is considered unlikely to occur, based on the low levels of flight activity shown by seabirds in darkness, and low intensity of turbine lighting.	The effect is considered unlikely to occur, based on the low levels of flight activity shown by seabirds in darkness, and low intensity of turbine lighting.
Consequence	Survival and reproductive rates of key bird species are very unlikely to be impacted to the extent that the population trajectory would be altered.	Survival and reproductive rates of key bird species are very unlikely to be impacted to the extent that the population trajectory would be altered.
Overall magnitude	The maximum potential magnitude is rated as Low.	The maximum potential magnitude is rated as Low.

6.17.29 The maximum magnitude of any effect on key bird species from aviation and navigation lighting associated with Dublin Array has therefore been assessed as **Low**, with the maximum sensitivity of species being considered as **Medium**. Therefore, the significance of any effect on birds from aviation and navigation lighting is a **Slight Adverse** effect, which is **Not significant** in EIA terms (Table 7).

6.17.30 The alternative design options (any other option within the range of parameters set out in the project description) will not give rise to an effect which is more significant than the maximum design option.

Residual Effect

The effect on key bird species from aviation and navigation lighting associated with Dublin Array have been assessed as 'not significant' in EIA terms. Therefore, no further mitigation (in addition to that already identified in Table 19) is considered necessary. No ecologically significant adverse residual effects on offshore ornithology have therefore been predicted.

Impact 8: Displacement and barrier effects on key bird species within the array area and appropriate buffer as a result of offshore infrastructure

6.17.31 Displacement has been defined as 'a reduced number of birds occurring within or immediately adjacent to an offshore wind farm' (Furness *et al.*, 2013). Displacement and/or barrier effects on birds within an offshore wind farm and the immediate surrounding area during the operation and maintenance phase may occur as a result of the presence of the operational turbines. Displacement and/or barrier effects have the potential to affect individuals of sensitive bird species directly. In effect, this represents indirect habitat loss, which would potentially reduce the area available to forage, rest and/or moult for sensitive seabirds that currently occur within and around the array area. In addition, there may be additional energy costs for individuals if they choose to fly around an OWF rather than through it. Displacement and/or barrier effects may therefore contribute to the overall fitness of individual birds, which could also reduce individual breeding success or at an extreme level, cause mortality of individuals.

6.17.32 The MDO outlined in Table 18 describes the elements of the proposed project considered within this assessment.

6.17.33 There is no descriptive guidance detailing an approach for assessing displacement or barrier effects on birds in an Irish context. Therefore, joint guidance produced by the SNCBs in the UK has been used as the basis for this assessment, as it is considered the industry standard approach. This approach has been applied to assess displacement and barrier effects on seabirds for several recent offshore wind farm projects, and was agreed between the east coast Phase 1 developers (GoBe, 2022). The NPWS review of the Phase 1 Methods Statement stated, "Where data are lacking, particularly in relation to bird distribution around breeding colonies or in the over-winter period, simple methods such as the Displacement Matrix approach are likely warranted." (APBmer, 2023). On this basis, the use of the SNCB guidance is considered appropriate given the lack of detailed up-to date productivity and adult survival data for Irish east coast seabird colonies.

6.17.34 The initial SNCB displacement guidance was published in 2017 (SNCBs, 2017) and was revised, primarily for the assessment of red-throated divers in 2022 (SNCBs, 2022a&b). In this assessment, displacement and barrier effects have been considered together following the recommended SNCBs approach (SNCBs, 2022a&b). As defined in the guidance, both flying birds and birds on the water are considered in this displacement assessment.

6.17.35 The SNCB guidance recommends that displacement effects are assessed for a development site as well as an appropriate buffer area around the site (SCNBs, 2017). The guidance also recommends assessing the impacts of displacement based on the overall mean seasonal peak numbers of birds (averaged over the years of survey) in the development footprint and an appropriate buffer (SNCBs, 2022a). For this assessment, where possible, numbers of birds in the array area and a buffer area were estimated for each month, and then divided by the number of surveys undertaken for that month over the two survey periods (2016-2017 and 2019-2021) to give the mean estimated number of birds per month (See Section 2.5). The mean peak number per season was then used for the displacement assessment.

6.17.36 Sensitivity to displacement differs considerably between seabird species. The SNCB guidance contains a table of species ranked according to their sensitivity to disturbance and also the degree of habitat specialization, from previous reviews e.g. Furness *et al.,* (2013) and Bradbury *et al.,* (2014). The guidance recommends that as a general guide, any species scoring three or more under either category, and which is present in the offshore wind farm site or buffer should be progressed to the matrix stage unless there is strong empirical evidence to the contrary. Although scores for gannet are less than three for both categories, SNCB guidance states that gannet should be included in the assessment, as there are empirical studies demonstrating they are sensitive to displacement and barrier effects (e.g. Krijgsveld *et al.,* 2011, Vanermen *et al.,* 2013).

6.17.37 Using this approach, it was determined that 14 species should be considered for the displacement assessment: common scoter, red-throated diver, great northern diver, cormorant, shag, black guillemot, guillemot, razorbill, puffin, little tern, Sandwich tern, roseate tern, common tern and Arctic tern. Further details on this process are presented in the Seabird Displacement Matrices Technical Report.

6.17.38 In addition, based on the NPWS response (ABP, 2023) to the Phase 1 East Coast Developers Methodology document submitted in December 2022 (GoBe, 2022), it was decided to include kittiwake and Manx shearwater in the displacement assessment. Although neither species have high rankings for disturbance susceptibility or habitat specialisation as defined in the SNCB guidance (SNCBs, 2022a), both species were assessed for potential displacement effects following the precautionary principle, as recommended in the NPWS response.

6.17.39 Sufficient numbers to conduct a Distance analysis were only recorded on baseline surveys for six species; Manx shearwater, gannet, shag, kittiwake, guillemot and razorbill. This means that it was only possible to assess displacement impacts using the SNCB approach on these six species, as the remaining species were not recorded in high enough numbers on baseline surveys to estimate monthly numbers in the study area. For the remaining species, displacement impacts were assessed using a qualitative approach, based on the numbers and distribution recorded on baseline surveys, other published survey data and available published evidence on displacement from other offshore wind farm projects.

6.17.40 For the majority of seabird species, it is considered that a 2 km buffer around the array area is appropriate, however for more sensitive species such as great northern diver and common scoter, a 4 km buffer is recommended, while for very sensitive species such as red-throated diver, a 10 km buffer is recommended (SNCBs, 2022b). For the six species assessed here using the SNCB approach, a 2 km buffer was used, as recommended in the guidance.

6.17.41 The SNCB guidance recommends that the full range of potential displacement (from 0% to 100% of the mean seasonal peak bird numbers observed pre-construction) is presented within a 'Matrix Approach', using 10% intervals. These tables should be presented as array area only and array area plus 2 km buffer.

6.17.42 The SNCB approach considers that when birds are displaced, some individuals may suffer mortality as a result of being unable to find sufficient food after being displaced from their preferred foraging areas. Potential mortality of displaced birds is therefore also presented in the matrix approach, with the presentation of 0-100% mortality of displaced birds, again presented in 10% increments. It is also considered appropriate to have a finer gradation of percentage mortality impacts at the lower range of this scale e.g. 1% intervals between 0% and 10%. Potential reduction in productivity of breeding birds was not considered in this assessment, as recommended in the SNCB guidance, due to the lack of empirical evidence on the consequences of displacement on breeding seabirds.

6.17.43 The full range of potential displacement and mortality by season for each of the six species assessed using the 'Matrix Approach' is presented in the Seabird Displacement Matrices Technical Report. The definition of the breeding and non-breeding seasons for each of these species was based on definitions published by Furness (2015). Where appropriate, the non-breeding season was further broken down into autumn and spring migration periods as defined in Furness (2015).

6.17.44 The impact of additional mortality due to displacement effects has been assessed in terms of the change in the baseline mortality rate which could result. Estimated baseline mortality rates were based on age-specific demographic and survival rates and age class proportions from Horswill and Robinson (2015), as presented in the Offshore and Intertidal Ornithology Technical Baseline and summarised in Table 16. The potential magnitude of impact was estimated by calculating the increase in baseline mortality within each season with respect to the relevant regional populations.

6.17.45 For the breeding season assessment based on all ages (adult and immature birds), and for the non-breeding season assessments, 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 survival rates for each age class and their relative proportions in the population (Table 16).

Manx shearwater displacement

6.17.46 For Manx shearwater, a displacement rate of 30% and a mortality rate of 1% was applied to each season based on an evaluation of the published literature. Further information is presented in the Seabird Displacement Matrices Technical Report.

6.17.47 There were sufficient sightings of Manx shearwaters on the water to run a Distance analysis on both the 2016-2017 and 2019-2021 datasets, therefore the Manx shearwater displacement assessment is based on the Distance analysis of the 2016-2017 and 2019-2021 data for birds on the water and flying birds.

6.17.48 During baseline surveys, Manx shearwaters were most abundant in the array area plus 2 km buffer in the breeding season. The highest mean peak number was recorded in April (2,198 birds). Estimated numbers were lower in the non-breeding season, with a mean peak of 176 Manx shearwaters in September, which corresponds to the autumn migration period of the non-breeding season (Furness, 2015), and four birds in March, which corresponds to the spring migration period of the non-breeding season (Furness, 2015). The complete range of displacement matrices for the array area and the array area and 2 km buffer as well as for the different seasons are presented in the Seabird Displacement Matrices Technical Report.

6.17.49 Annual estimated Manx shearwater mortality from displacement in the array area and 2 km buffer based on a 30% displacement rate and a 1% mortality rate is presented in Table 25.

Table 25 Displacement and mortality estimates for Manx shearwater (all ages) in the array area plus 2 km buffer

Season	Mean peak number	Estimated seasonal displacement	Estimated seasonal mortality
Breeding (Apr-Aug)	2,198	659	7 (3 adults)
Autumn migration (Sep-Early Oct)	176	53	1
Spring migration (Late Mar)	4	1	0
Total	2,378	713	8

6.17.50 During the breeding season, the mean peak number of Manx shearwaters was 2,198 individuals within the array area and 2 km buffer. Based on a displacement rate of 30% in the array area and 2 km buffer, this would affect an estimated 659 birds. However, this estimate includes non-breeding adults and immature birds, as well as breeding adults.

6.17.51 Studies have shown that for several seabird species, in addition to breeding birds, colonies are also attended by many immature individuals and a smaller number of non-breeding adults (e.g. Wanless *et al.,* 1998). There is little information on the breakdown of immature and non-breeding adults present at a colony, however, this has been estimated using proportions from Horswill and Robinson (2015) (Offshore and Intertidal Ornithology Technical Baseline). Based on the proportion of immature Manx shearwaters from the population age ratio (0.532), 53.2% of the population present are immature birds, with a corresponding 46.8% of the population being adult birds. This means that an estimated 308 Manx shearwaters displaced from the array area and 2 km buffer during the breeding season would be adult birds, with 351 immature birds also displaced.

6.17.52 Applying a mortality rate of 1%, it was calculated that the additional mortality due to displacement effects was seven Manx shearwaters (three adults and four immature birds) in the breeding season. However, a proportion of adult birds present at colonies in the breeding season will opt not to breed in a particular breeding season. It is not known how many adult Manx shearwaters present at a colony may be non-breeding "sabbatical" birds in any particular breeding season (Baker *et al.*, 2022). Therefore, for this assessment, it was assumed that all adults were breeding birds, which is a precautionary approach. For this assessment Manx shearwater displacement mortality was considered to be three adults and four immature birds.

6.17.53 The total Manx shearwater regional breeding population is estimated to be 1,814,000 adult birds (Table 14). For the breeding season assessment based on adult birds only, the increase in baseline mortality was calculated based on an estimated adult Manx shearwater baseline survival rate of 0.870, therefore the corresponding rate for adult Manx shearwater mortality is 0.13 (Table 16). Applying this mortality rate, the estimated regional baseline mortality of Manx shearwaters is 235,820 adult birds per breeding season (1,814,000 x 0.13). The additional predicted mortality of three breeding adult Manx shearwaters in the breeding season would increase the baseline mortality rate by 0.0013% (Table 26).

Table 26 Increase in estimated baseline mortality for adult Manx shearwaters in the array area plus 2 km buffer as a result of displacement

Season	Regional baseline population	Annual Regional Baseline Mortality	Increase in baseline mortality (%) (adults)
Breeding (Apr-Aug)	1,814,000	235,820	0.0013
Autumn migration (Sep-Early Oct)	1,576,784	204,982	0.0005
Spring migration (Late Mar)	1,576,784	204,982	0
Total	-	-	0.0018

6.17.54 For the autumn migration period of the non-breeding season, estimated seasonal Manx shearwater displacement mortality was one bird (all ages) (Table 25). The total Manx shearwater regional population in the autumn migration period is estimated to be 1,576,784 birds (Table 15). The increase in baseline mortality was calculated based on an estimated average mortality rate of 0.13. Applying this mortality rate, the estimated regional baseline mortality of Manx shearwater is 204,982 birds in the non-breeding season (1,576,784 x 0.13). The additional predicted mortality of one Manx shearwater in the autumn migration period of the non-breeding season would increase the baseline mortality rate by 0.0005% (Table 26). For the spring migration period of the non-breeding season, estimated seasonal Manx shearwater displacement mortality was zero birds (Table 26).

6.17.55 Predicted annual Manx shearwater mortality due to displacement effects for adults in the breeding season and all ages in the non-breeding season was four birds, which corresponds to an increase in the annual baseline mortality rate of 0.0018% (Table 26). However, this does not take account of any non-breeding, adult "sabbatical" birds that might be present at colonies but not breeding, therefore this is considered to be a precautionary estimate.

6.17.56 A comparison of estimated Manx shearwater mortality against a regional population consisting of adult and immature birds is shown in Table 27. Applying a mortality rate of 1%, the additional mortality due to displacement effects was seven birds (all ages) in the breeding season. The total Manx shearwater regional breeding population is estimated to be 1,814,000 birds (Table 14). The average mortality for all age classes is 0.13 (Table 16). Applying this mortality rate, the estimated regional baseline mortality of Manx shearwater is 235,820 birds per breeding season (all ages) (1,814,000 x 0.13). The additional predicted mortality of seven Manx shearwaters in the breeding season would increase the baseline mortality rate by 0.003% (Table 27).

Table 27 Increase in estimated baseline mortality for Manx shearwaters (all ages) in the array area plus 2 km buffer as a result of displacement

Season	Regional baseline population	Annual Regional Baseline Mortality	Increase in baseline mortality (%) (adults)
Breeding (Apr-Aug)	1,814,000	235,820	0.003
Autumn migration (Sep-Early Oct)	1,576,784	204,982	0.0005
Spring migration (Late Mar)	1,576,784	204,982	0
Total	-	-	0.0035

6.17.57 For the autumn migration period of the non-breeding season, estimated seasonal Manx shearwater displacement mortality was one bird (all ages) (Table 25). The additional predicted mortality of one Manx shearwater in the autumn migration period of the non-breeding season would increase the baseline mortality rate by 0.0005% (Table 26). Predicted annual Manx shearwater mortality due to displacement effects for all ages in the breeding season and non-breeding season was eight birds, which corresponds to an increase in the annual baseline mortality rate of 0.0035% (Table 27).

6.17.58 As highlighted by Natural England guidance, where predicted impacts equate to 1% or below of baseline mortality for a population (e.g. colony population) then this level of impact could be considered non-significant (Parker *et al.,* 2022c). As the predicted increases in annual baseline mortality for Manx shearwater were below 1%, PVA was not carried out on the regional Manx shearwater population, as agreed in the East Coast Phase 1 Method Statement (GoBe, 2022).

6.17.59 Based on the results of the displacement assessment, the magnitude of impact from displacement on the regional Manx shearwater population was considered to be **Negligible**, (Table 28).

Table 28 Determination of magnitude for Manx shearwater displacement

	MDO	Alternative Design Option
Extent	Very small proportion of the population is predicted to be affected	Very small proportion of the population is predicted to be affected
Duration	The impact is likely to occur throughout the operation phase of the project and will therefore be long-term, as defined by EPA (2022).	The impact is likely to occur throughout the operation phase of the project and will therefore be long-term, as defined by EPA (2022).
Frequency	The effect is anticipated to occur for Manx shearwater in the breeding season, between April and August.	The effect is anticipated to occur for Manx shearwater in the breeding season, between April and August.
Probability	Displacement effects are considered possible in the vicinity of the array area and surrounding 2 km buffer.	Displacement effects are considered possible in the vicinity of the array area and surrounding 2 km buffer.
Consequence	Although displacement of Manx shearwaters in the breeding season is possible, at the population level, associated mortality is predicted to be very low, which would equate to Negligible magnitude.	Although displacement of Manx shearwaters in the breeding season is possible, at the population level, associated mortality is predicted to be very low, which would equate to Negligible magnitude.
Overall magnitude	The potential magnitude is rated as Negligible.	The potential magnitude is rated as Negligible.

6.17.60 For this assessment, receptor sensitivity has been based on three reviews of evidence from post-construction studies at offshore wind farms. A review of post-construction studies of seabirds at offshore wind farms in European waters concluded that Manx shearwater was one of the species which weakly avoided offshore wind farms, although evidence for this species was limited (Dierschke *et al.,* 2016). However, other factors such as flexibility of habitat use and extensive foraging range also should be considered. A review of vulnerability of Scottish seabirds to offshore wind turbines in the context of disturbance and displacement ranked Manx shearwater as the 34th most sensitive out of 38 species (Furness *et al.,* 2013). Bradbury *et al.,* (2014), classified the Manx shearwater population vulnerability to displacement from offshore wind farms as very low.

6.17.61 Evidence from reviews presented above and from post-construction studies summarised in the Displacement Matrices Technical Report, indicates that Manx shearwater sensitivity to displacement from operational offshore wind farms is likely to be **Low**.

6.17.62 Estimated numbers of Manx shearwaters recorded within the array area would qualify as internationally important in the breeding season (Offshore and Intertidal Ornithology Technical Baseline), with individuals potentially originating from a number of SPAs in the region, as well as non-SPA colonies. On this basis the conservation importance for Manx shearwater was considered to be medium.

6.17.63 Overall, based on available evidence from published studies, and the origin of birds from SPA and non-SPA colonies in the region, it is considered that Manx shearwater sensitivity to displacement associated with Dublin Array is likely to be **Low** (Table 4).

6.17.1 For Manx shearwater, the magnitude of the impact is deemed to be **Negligible**, and the overall sensitivity of this species is considered to be Low, with individuals potentially originating from a number of SPAs in the region, as well as non-SPA colonies. The significance of any effect on Manx shearwaters from displacement and barrier effects associated with Dublin Array is a **Not Significant effect**, which is **Not significant** in EIA terms.

Gannet displacement

6.17.2 For gannet, a displacement rate of 70% and a mortality rate of 1% was applied to each season based on recent NatureScot guidance (NatureScot, 2023) and an evaluation of the published literature. These rates are in line with values discussed and agreed between the east coast Phase 1 developers, and circulated to NPWS in December 2022 (Volume 4, Appendix 4.3.6-2). Further information is presented in the Seabird Displacement Matrices Technical Report.

6.17.3 There were insufficient sightings of gannets on the water in the 2016-2017 dataset to run a Distance analysis, therefore the gannet displacement assessment is based only on the Distance analysis of the 2019-2021 data for birds on the water, and 2016-2017 and 2019-2021 datasets for flying birds.

6.17.4 During baseline surveys, gannets were most abundant in the array area plus 2 km buffer in the breeding season. The highest mean peak number was recorded in May (700 birds). Estimated numbers were lower in the non-breeding season, with a mean peak of 21 gannets in October, which corresponds to the autumn migration period of the non-breeding season (Furness, 2015), and 27 birds in December, which corresponds to the spring migration period of the non-breeding season (Furness, 2015). The complete range of displacement matrices for the array area and the array area and 2 km buffer as well as for the different seasons are presented in the Seabird Displacement Matrices Technical Report.

6.17.5 Annual estimated gannet mortality from displacement in the array area and 2 km buffer based on a 70% displacement rate and a 1% mortality rate is presented in Table 29.

Table 29 Displacement and mortality estimates for gannet (all ages) in the array area plus 2 km buffer

Season	Mean peak number	Estimated seasonal displacement	Estimated seasonal mortality
Breeding (Mar-Sep)	700	490	5 (4 adults)
Autumn migration (Oct-Nov)	21	15	0
Spring migration (Dec-Feb)	27	19	0
Total	748	524	5

6.17.6 During the breeding season, the mean peak number of gannets was 700 individuals within the array area and 2 km buffer. Based on a displacement rate of 70% in the array area and 2 km buffer, this would affect an estimated 490 birds. However, this estimate includes non-breeding adults and immature birds, as well as breeding adults.

6.17.7 In the breeding season (March to September) age was recorded for 1,362 gannets on baseline surveys, with 219 immature (non-breeding) birds (16.1%) and 1,143 adults (83.9%) recorded. Further details are presented in the Offshore and Intertidal Ornithology Technical Baseline.

6.17.8 Based on the proportion of immature gannets recorded on baseline surveys in the breeding season, it was assumed that 16.1% of the population present are immature birds. This would mean that an estimated 79 gannets displaced from the array area and 2 km buffer during the breeding season would be immature, with 411 adult birds also displaced.

6.17.9 Applying a mortality rate of 1%, it was calculated that the additional mortality due to displacement effects was five gannets (four adults and one immature bird) in the breeding season. However, a proportion of adult birds present at colonies in the breeding season will opt not to breed in a particular breeding season. It has been estimated that 10% of adult gannets may be "sabbatical" birds in any particular breeding season (Xodus, 2023), and this has been applied for this assessment. On this basis, 0.4 displaced adult gannets were considered not to be breeding, however, for this assessment numbers have been rounded to the nearest whole bird for clarity, therefore gannet mortality was considered to be four adults and one immature bird.

6.17.10 The total gannet regional breeding population is estimated to be 238,718 adult birds (Table 14). For the breeding season assessment based on adult birds only, the increase in baseline mortality was calculated based on an estimated adult gannet baseline survival rate of 0.919, therefore the corresponding rate for adult gannet mortality is 0.081 (Table 30). Applying this mortality rate, the estimated regional baseline mortality of gannets is 19,336 adult birds per breeding season (238,718 x 0.081). The additional predicted mortality of four breeding adult gannets in the breeding season would increase the baseline mortality rate by 0.02% (Table 30).

Table 30 Increase in estimated baseline mortality for adult gannet in the array area plus 2 km buffer as a result of displacement

Season	Regional baseline population	Annual Regional Baseline Mortality	Increase in baseline mortality (%) (adults)
Breeding (Mar-Sep) (adults only)	238,718	19,336	0.02
Autumn migration (Oct-Nov)	585,183	105,918	0
Spring migration (Dec-Feb)	643,917	116,549	0
Total	-	-	0.02

6.17.11 For the autumn and spring migration periods, estimated seasonal gannet mortality was zero birds (Table 30). Therefore, predicted annual gannet mortality due to displacement effects was the same as for the breeding season (four adult gannets, which corresponds to an increase in the annual baseline mortality rate of 0.02% (Table 30).

6.17.12 A comparison of estimated gannet mortality against a regional population consisting of adult and immature birds is shown in Table 31. Applying a mortality rate of 1%, the additional mortality due to displacement effects was five gannets (four adults and one immature bird) in the breeding season. The total gannet regional breeding population (all ages) is estimated to be 420,382 birds (Table 14). The average mortality for all age classes is 0.181 (Table 16). Applying this mortality rate, the estimated regional baseline mortality of gannets is 76,089 birds per breeding season (all ages) (420,382 x 0.181). The additional predicted mortality of five gannets in the breeding season would increase the baseline mortality rate by 0.007% (Table 31).

Table 31 Increase in estimated baseline mortality for gannet (all ages) in the array area plus 2 km buffer as a result of displacement

Season	Regional baseline population	Annual Regional Baseline Mortality	Increase in baseline mortality (%) (all ages)
Breeding (Mar-Sep) (all ages)	420,382	76,089	0.007
Autumn migration (Oct-Nov)	585,183	105,918	0
Spring migration (Dec-Feb)	643,917	116,549	0
Total	-	-	0.007

6.17.13 For the autumn and spring migration periods, estimated seasonal gannet mortality was zero birds (Table 31). Therefore, predicted annual gannet mortality (all ages) due to displacement effects was the same as for the breeding season (five gannets; all ages), which corresponds to an increase in the annual baseline mortality rate of 0.007% (Table 31).

6.17.14 As highlighted by Natural England guidance, where predicted impacts equate to 1% or below of baseline mortality for a population (e.g. colony population) then this level of impact could be considered non-significant (Parker *et al.,* 2022c). As the predicted increases in annual baseline mortality for gannet were below 1%, PVA was not carried out on the regional gannet population, as agreed in the East Coast Phase 1 Method Statement (GoBe, 2022).

6.17.15 Based on the results of the displacement assessment, the magnitude of impact from displacement on the regional gannet population was considered to be **Negligible** (Table 32).

Table 32 Determination of magnitude for gannet displacement

	MDO	Alternative Design Option
Extent	Very small proportion of the population is predicted to be affected	Very small proportion of the population is predicted to be affected
Duration	The impact is likely to occur throughout the operation phase of the project and will therefore be long-term, as defined by EPA (2022).	The impact is likely to occur throughout the operation phase of the project and will therefore be long-term, as defined by EPA (2022).
Frequency	The effect is anticipated to occur for gannet throughout the year.	The effect is anticipated to occur for gannet throughout the year.
Probability	Displacement effects are considered likely in the vicinity of the array area and surrounding 2 km buffer.	Displacement effects are considered likely in the vicinity of the array area and surrounding 2 km buffer.
Consequence	Although displacement of gannets from the array area is likely throughout the year, at the population level, associated mortality is predicted to be very low, which would equate to Negligible magnitude.	Although displacement of gannets from the array area is likely throughout the year, at the population level, associated mortality is predicted to be very low, which would equate to Negligible magnitude.
Overall magnitude	The potential magnitude is rated as Negligible.	The potential magnitude is rated as Negligible.

6.17.16 For this assessment, receptor sensitivity has been based on three reviews of evidence from post-construction studies at offshore wind farms. A review of post-construction studies of seabirds at offshore wind farms in European waters concluded that gannet was one of the species which strongly or nearly completely avoided offshore wind farms (Dierschke *et al.,* 2016). However, other factors such as flexibility of habitat use and extensive foraging range also should be considered. A review of vulnerability of Scottish seabirds to offshore wind turbines in the context of disturbance and displacement ranked gannet as the 28th most sensitive out of 38 species (Furness *et al.,* 2013). Bradbury *et al.,* (2014), classified the gannet population vulnerability to displacement from offshore wind farms as very low.

6.17.17 However, it should be noted that the inclusion of gannets 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 increasing distance from the site, as demonstrated in a study of gannet distribution in relation to the Greater Gabbard wind farm (APEM, 2014).

6.17.18 Evidence from reviews presented above and from post-construction studies summarised in the Displacement Matrices Technical Report, indicates that gannet sensitivity to displacement from operational offshore wind farms is likely to be **Medium**.

6.17.19 Estimated numbers of gannets recorded within the array area would qualify as internationally important in the breeding season (Offshore and Intertidal Ornithology Technical Baseline), with individuals potentially originating from a number of SPAs in the region, as well as non-SPA colonies. On this basis the conservation importance for gannet was considered to be medium.

6.17.20 Overall, based on available evidence from published studies, and the origin of birds from SPA and non-SPA colonies in the region, it is considered that gannet sensitivity to displacement associated with Dublin Array is likely to be **Medium** (Table 4).

6.17.21 For gannet, the magnitude of the impact is deemed to be **Negligible,** and the overall sensitivity of this species is considered to be **Medium**, with individuals potentially originating from a number of SPAs in the region, as well as non-SPA colonies. The significance of any effect on gannets from displacement and barrier effects associated with Dublin Array is a **Not Significant** effect, which is **Not significant** in EIA terms.

Shag Displacement

6.17.22 For shag, a displacement rate of 60% and a mortality rate of 1% was applied to each season based on an evaluation of the published literature. Further information is presented in the Seabird Displacement Matrices Technical Report.

6.17.23 There were sufficient sightings of shags on the water to run a Distance analysis on both the 2016-2017 and 2019-2021 datasets, therefore the shag displacement assessment is based on the Distance analysis of the 2016-2017 and 2019-2021 data for birds on the water and flying birds.

6.17.24 During baseline surveys, shags were most abundant in the array area plus 2 km buffer in the non-breeding season. In the breeding season (February to August), the peak mean estimated number of shags in the array area plus the 2 km buffer was 295 birds in July. In the non-breeding season (September to January), mean estimated numbers were higher, with a peak mean estimated number of 373 birds in the array area and 2 km buffer in November (Table 33). The complete range of displacement matrices for the array area and the array area and 2 km buffer as well as for the different seasons are presented in the Seabird Displacement Matrices Technical Report.

6.17.25 Annual estimated shag mortality from displacement in the array area and 2 km buffer based on a 60% displacement rate and a 1% mortality rate is presented in Table 33.

Table 33 Displacement and mortality estimates for shag (all ages) in the array area plus 2 km buffer

Season	Mean peak number	Estimated seasonal displacement	Estimated seasonal mortality
Breeding (Feb-Aug)	295	177	2 (1 adult)
Non-breeding (Sep-Jan)	373	224	2
Total	668	401	4

6.17.26 During the breeding season, the mean peak number of shags was 295 individuals within the array area and 2 km buffer. Based on a displacement rate of 60% in the array area and 2 km buffer, this would affect an estimated 177 birds. However, this estimate includes non-breeding adults and immature birds, as well as breeding adults.

6.17.27 In the breeding season (February to August) age was recorded for 228 shags on baseline surveys, with 66 immature (non-breeding) birds (28.9%) and 162 adults (71.1%) recorded. Further details are presented in the Offshore and Intertidal Ornithology Technical Baseline.

6.17.28 Based on the proportion of immature shags recorded on baseline surveys in the breeding season, it was assumed that 28.9% of the population present are immature birds. This would mean that an estimated 51 shags displaced from the array area and 2 km buffer during the breeding season would be immature, with 126 adult birds also displaced.

6.17.29 Applying a mortality rate of 1%, it was calculated that the additional mortality due to displacement effects was two shags. Rounding to the nearest whole bird, this gave an age breakdown of one adult and one immature bird in the breeding season.

6.17.30 However, a proportion of adult birds present at colonies in the breeding season will opt not to breed in a particular breeding season. It has been estimated that between 10% and 60% of adult shags may be “sabbatical” birds in any particular breeding season (Aebischer and Wanless, 1991), and this has been applied for this assessment. On this basis, 0.1 displaced adult shags were considered not to be breeding, however, for this assessment numbers have been rounded to the nearest whole bird for clarity, therefore shag mortality was considered to be one adult and one immature bird.

6.17.31 The total shag regional breeding population is estimated to be 274 adult birds (Table 14). For the breeding season assessment based on adult birds only, the increase in baseline mortality was calculated based on an estimated adult shag baseline survival rate of 0.858, therefore the corresponding rate for adult mortality is 0.142 (Table 16). Applying this mortality rate, the estimated regional baseline mortality of shags is 39 adult birds per breeding season (274 x 0.142). The additional predicted mortality of one breeding adult shag in the breeding season would increase the baseline mortality rate by 2.6% (Table 34).

Table 34 Increase in estimated baseline mortality for adult shag in the array area plus 2 km buffer as a result of displacement

Season	Regional baseline population	Annual Regional Baseline Mortality	Increase in baseline mortality (%) (adults)
Breeding (Feb-Aug) (adults only)	274	39	2.6
Non-breeding (Sep-Jan)	17,111	4,483	0.04
Total	-	-	2.64

6.17.32 For the non-breeding season, estimated seasonal shag mortality was also two birds (all ages) (Table 33). The total shag regional population in the non-breeding season is estimated to be 17,111 birds (Table 15). The increase in baseline mortality was calculated based on an estimated average mortality rate of 0.262 (Table 16). Applying this mortality rate, the estimated regional baseline mortality of shags is 4,483 birds in the non-breeding season (17,111 x 0.262). The additional predicted mortality of two shags in the non-breeding season would increase the baseline mortality rate by 0.04% (Table 34).

6.17.33 Predicted annual shag mortality due to displacement effects for adults in the breeding season and all ages in the non-breeding season was four birds, which corresponds to an increase in the annual baseline mortality rate of 2.64% (Table 34). However, this does not take account of any non-breeding, adult "sabbatical" birds that might be present at colonies but not breeding, therefore this is considered to be a precautionary estimate.

6.17.34 A comparison of estimated shag mortality against a regional population consisting of adult and immature birds is shown in Table 35. Applying a mortality rate of 1%, the additional mortality due to displacement effects was two shags (one adult and one immature bird) in the breeding season. The total shag regional breeding population (all ages) is estimated to be 491 birds (Table 14). The average mortality for all age classes is 0.262 (Table 16). Applying this mortality rate, the estimated regional baseline mortality of shags is 129 birds per breeding season (all ages) (491 x 0.262). The additional predicted mortality of two shags in the breeding season would increase the baseline mortality rate by 1.55% (Table 35).

Table 35 Increase in estimated baseline mortality for shag (all ages) in the array area plus 2 km buffer as a result of displacement

Season	Regional baseline population	Annual Regional Baseline Mortality	Increase in baseline mortality (%) (all ages)
Breeding (Feb-Aug) (all ages)	491	129	1.55
Non-breeding (Sep-Jan)	17,111	4,483	0.04
Total	-	-	1.59

6.17.35 For the non-breeding season, estimated seasonal shag mortality was also two birds (all ages) (Table 33). The total shag regional population in the non-breeding season is estimated to be 17,111 birds (Table 15). Applying the average mortality rate of 0.262 (Table 16), the estimated regional baseline mortality of shags is 4,483 birds in the non-breeding season (17,111 x 0.262). The additional predicted mortality of two shags in the non-breeding season would increase the baseline mortality rate by 0.04% (Table 35).

6.17.36 Predicted annual shag mortality due to displacement effects for all ages of shags in the breeding and non-breeding season was four birds, which corresponds to an increase in the annual baseline mortality rate of 1.59% (Table 35).

6.17.37 As the predicted percentage increase in the baseline mortality rate exceeded 1%, PVA was carried out on the regional shag population considering potential displacement. The results of the regional PVA for predicted displacement impacts during the 35-year operational phase is summarised in Table 36. Further details of the PVA methodology, input parameters and an explanation of how to interpret the PVA results can be found in the PVA Technical Report.

Table 36 Summary of PVA displacement outputs for the regional shag population for the array area and 2 km buffer after 35 years

Scenario	Counterfactual of Population Growth Rate		Counterfactual of Population Size		50% Quantiles	
	Median	Mean	Median	Mean	U=50%I	I=50%U
Project alone	0.9884	0.9883	0.6566	0.6597	39.92	61.32

6.17.38 For the regional shag population over 35 years, the PVA model predicted a reduction in growth rate by 1.16% (median CGR = 0.9884) and a reduction in population size by 34.34% (median CPS = 0.6566; Table 36).

6.17.39 These values indicate that the PVA predicted a slight negative effect from the project alone effects of displacement mortality on the regional shag population after 35 years, however, the predicted effects were not considered to be significant, as the population with Dublin Array was still predicted to increase over the lifetime of the project (PVA Technical Report).

6.17.40 Based on the results of the displacement assessment and the PVA assessment, the magnitude of impact from displacement on the regional shag population was considered to be Low to Medium, as the estimated increases in the annual baseline mortality rate were between 2% and 5% for the adult only breeding season assessment and between 1% and 2% when adults and immature birds were assessed in the breeding season (Table 6).

6.17.41 In addition, it should be noted that this assessment was based on an assumed level of 60% displacement and 1% mortality, with little direct evidence that displacement is likely to occur. Although studies on the effects of offshore wind farms on shags are limited, available evidence from published studies at operational offshore wind farms indicates that displacement levels for shags are likely to be low and therefore the estimated displacement and mortality rates used in this assessment are considered precautionary. There is evidence that, like cormorants, shags are attracted to offshore wind farms to take advantage of opportunities for resting on turbines, met masts and transformer platforms, and that this has allowed them to explore new foraging areas further offshore than they normally forage (Dierschke *et al.,* 2016). For example, in the Belgian North Sea, shags were only very rarely observed before the construction of the first offshore wind turbines (four observations of five individuals in the course of 20 years of seabird monitoring) (Vanerman *et al.,* 2013). At Thortonbank OWF, post-construction studies have recorded 14 shags within the OWF, with 11 of these recorded roosting on the turbine jacket foundations (Vanerman *et al.,* 2017). Shags are not considered at risk of collision with OWFs as the majority of birds typically fly close to the sea surface, below the minimum height of turbine blades (Cook *et al.*, 2012).

6.17.42 A cumulative wind farm modelling study at Egmond aan Zee OWF in the Netherlands recorded low numbers of shags occasionally in or near the wind farm and concluded that, similar to cormorant, potentially only positive cumulative effects are expected, as the development of more offshore wind farms will imply habitat expansion for this species due to the increased availability of resting and foraging opportunities (Poot *et al.,* 2011).

6.17.43 Results from post-construction surveys at North Hoyle OWF between April 2006 and March 2007 showed that shags were recorded close to three of the outer turbines, but not between rows of turbines, indicating that displacement was not 100%. The report concluded that based on density estimates, shags may have made more use of the wind farm site since it became operational (N Power Renewables, 2007).

6.17.44 Since the PVA outputs based on these rates did not predict a significant negative effect, and taking the limited evidence of likely attraction to OWFs from post-construction studies into account, it is considered that the magnitude of impact for shag is therefore **Low** (Table 37)**.**

Table 37 Determination of magnitude for shag displacement

	MDO	Alternative Design Option
Extent	Small proportion of the population is predicted to be affected	Small proportion of the population is predicted to be affected
Duration	The impact is likely to occur throughout the operation phase of the project and will therefore be long-term, as defined by EPA (2022).	The impact is likely to occur throughout the operation phase of the project and will therefore be long-term, as defined by EPA (2022).
Frequency	The effect is anticipated to occur throughout the year.	The effect is anticipated to occur throughout the year.
Probability	Displacement effects are considered possible in the vicinity of the array area and surrounding 2 km buffer.	Displacement effects are considered possible in the vicinity of the array area and surrounding 2 km buffer.
Consequence	Although displacement of shags from the array area is possible throughout the year, at the population level, associated mortality is predicted to be low, which would equate to Low magnitude.	Although displacement of shags from the array area is possible throughout the year, at the population level, associated mortality is predicted to be low, which would equate to Low magnitude.
Overall magnitude	The potential magnitude is rated as Low.	The potential magnitude is rated as Low.

6.17.45 For this assessment, receptor sensitivity has been based on three reviews of evidence from post-construction studies at offshore wind farms. A review of post-construction studies of seabirds at offshore wind farms in European waters concluded that shag was one of the species which was strongly attracted to offshore wind farms (Dierschke *et al.,* 2016). A review of vulnerability of Scottish seabirds to offshore wind turbines in the context of disturbance and displacement ranked shag as the 13th most sensitive out of 38 species (Furness *et al.,* 2013). Bradbury *et al.,* (2014), classified the shag population vulnerability to displacement from offshore wind farms as moderate.

6.17.46 Estimated numbers of shags recorded within the array area would qualify as nationally important in the breeding season (Offshore and Intertidal Ornithology Technical Baseline), with individuals potentially originating from a number of non-SPA colonies within mean maximum foraging range. On this basis the conservation importance for shag was considered to be low.

6.17.47 Overall, based on the conservation importance, with no SPAs for breeding shag within mean maximum foraging range of the array area, together with evidence from reviews and post-construction studies presented above indicates that shag sensitivity to displacement associated with Dublin Array is likely to be **Low** (Table 4).

6.17.48 For shag, the magnitude of the impact is deemed to be **Low** and the overall sensitivity of this species is considered to be Low, with no SPAs for breeding shag within mean maximum foraging range of the array area and evidence of potential attraction to wind farms from post-construction studies. The significance of any effect on shags from displacement and barrier effects associated with Dublin Array is a **Slight Adverse** effect, which is **Not significant** in EIA terms.

Kittiwake Displacement

6.17.49 For kittiwake, a displacement rate of 30% and a mortality rate of 1% was applied to each season based on recent NatureScot guidance (NatureScot, 2023) and an evaluation of the published literature and expert judgement. Further information is presented in the Seabird Displacement Matrices Technical Report.

6.17.50 There were sufficient sightings of kittiwakes on the water to run a Distance analysis on both the 2016-2017 and 2019-2021 datasets, therefore the kittiwake displacement assessment is based on the Distance analysis of the 2016-2017 and 2019-2021 data for birds on the water and flying birds. A more detailed breakdown of monthly numbers of birds on the water and in flight is presented in the Offshore and Intertidal Ornithology Technical Baseline.

6.17.51 Annual estimated kittiwake mortality from displacement in the array area and 2 km buffer based on a 30% displacement rate and a 1% mortality rate is presented in Table 38.

Table 38 Displacement and mortality estimates for kittiwake (all ages) in the array area plus 2 km buffer

Season	Mean peak number	Estimated seasonal displacement	Estimated seasonal mortality
Migration-free Breeding (May-Jul)	622	187	2 adults
Autumn migration (Aug-Dec)	749	225	2
Spring migration (Jan-Apr)	850	255	3
Total	2,221	667	7

6.17.52 In the migration-free breeding season (May to July), the peak mean estimated number of kittiwakes in the array area plus 2 km buffer was 622 birds (Table 38). Based on a displacement rate of 30% in the array area and 2 km buffer, this would affect an estimated 187 birds. However, this estimate includes non-breeding adults and immature birds, as well as breeding adults.

6.17.53 In the migration-free breeding season (May to July) age was recorded for 1,399 kittiwakes on baseline surveys, with 35 immature (non-breeding) birds (2.5%) and 1,364 adults (97.5%) recorded. Further details are presented in the Offshore and Intertidal Ornithology Technical Baseline.

6.17.54 Based on the proportion of immature kittiwakes recorded on baseline surveys in the breeding season, it was assumed that 2.5% of the population present are immature birds. This would mean that an estimated five kittiwakes displaced from the array area and 2 km buffer during the breeding season would be immature, with 182 adult birds also displaced.

6.17.55 Applying a mortality rate of 1%, it was calculated that the additional mortality due to displacement effects was two kittiwakes. Rounding to the nearest whole bird, this gave an age breakdown of two adults and zero immature bird in the breeding season. However, a proportion of adult birds present at colonies in the breeding season will opt not to breed in a particular breeding season. It has been estimated that 10% of adult kittiwakes may be "sabbatical" birds in any particular breeding season (Xodus, 2023), and this has been applied for this assessment. On this basis, 0.2 displaced adult kittiwakes were considered not to be breeding, however, for this assessment numbers have been rounded to the nearest whole bird for clarity, therefore kittiwake mortality was considered to be two adults.

6.17.56 The total kittiwake regional breeding population is estimated to be 70,260 adult birds (Table 14). For the breeding season assessment based on adult birds only, the increase in baseline mortality was calculated based on an estimated adult kittiwake baseline survival rate of 0.854, therefore the corresponding rate for adult mortality is 0.146 (Table 16). Applying this mortality rate, the estimated regional baseline mortality of kittiwakes is 10,258 adult birds per breeding season (70,260 x 0.146). The additional predicted mortality of two breeding adult kittiwakes in the breeding season would increase the baseline mortality rate by 0.019% (Table 39).

Table 39 Increase in estimated baseline mortality for adult kittiwakes in the array area plus 2 km buffer as a result of displacement

Season	Regional baseline population	Annual Regional Baseline Mortality	Increase in baseline mortality (%) (adults)
Migration-free Breeding (May-Jul)	70,260	10,258	0.019
Autumn migration (Aug-Dec)	933,197	145,579	0.001
Spring migration (Jan-Apr)	713,137	111,249	0.003
Total	-	-	0.023

6.17.57 In the autumn migration period of the non-breeding season (August to December), the peak mean estimated number of kittiwakes in the array area and 2 km buffer, was 749 birds (all ages) (Table 38). Based on a displacement rate of 30% in the array area and 2 km buffer, this would affect an estimated 187 birds. Applying a mortality rate of 1% would result in an estimated displacement mortality of two kittiwakes in the autumn migration period.

6.17.58 The total kittiwake regional population in the autumn migration period of the non-breeding season is estimated to be 933,197 birds (Table 15). The increase in baseline mortality was calculated based on an estimated average mortality rate of 0.156 (Table 16). Applying this mortality rate, the estimated regional baseline mortality of kittiwakes is 145,579 birds in the autumn migration period (933,197 x 0.156). The additional predicted mortality of two kittiwakes in the autumn migration period would increase the baseline mortality rate by 0.001% (Table 39).

6.17.59 In the spring migration period (January to April), the peak mean estimated number of kittiwakes was 850 birds (all ages) (Table 38). Based on a displacement rate of 30% in the array area and 2 km buffer, this would affect an estimated 255 birds. Applying a mortality rate of 1% would result in an estimated displacement mortality of three kittiwakes in the spring migration period.

6.17.60 The total kittiwake regional population in the spring migration period of the non-breeding season is estimated to be 713,137 birds (Table 15). The increase in baseline mortality was calculated based on an estimated average mortality rate of 0.156. Applying this mortality rate, the estimated regional baseline mortality of kittiwakes is 111,249 birds in the spring migration period (713,137 x 0.156). The additional predicted mortality of three kittiwakes in the spring migration period would increase the baseline mortality rate by 0.003% (Table 39).

6.17.61 Predicted annual kittiwake mortality due to displacement effects for adults in the breeding season and all ages in the non-breeding season was seven birds, which corresponds to an increase in the annual baseline mortality rate of 0.023% (Table 39).

6.17.62 A comparison of estimated kittiwake mortality against a regional population consisting of adult and immature birds throughout the year gives the same predicted result, as numbers of immature birds and sabbatical birds were considerably less than one whole bird, so did not reduce the overall predicted mortality.

6.17.63 As highlighted by Natural England guidance, where predicted impacts equate to 1% or below of baseline mortality for a population (e.g. colony population) then this level of impact could be considered non-significant (Parker *et al.,* 2022c). As the predicted increase in annual baseline mortality for kittiwake was below 1%, PVA was not carried out on the regional kittiwake population, as agreed in the East Coast Phase 1 Method Statement (GoBe, 2022).

6.17.64 Based on the results of the displacement assessment, the magnitude of impact from displacement on the regional kittiwake population was considered to be **Negligible**, as the estimated increases in the annual baseline mortality rate were less than 1% (Table 40).

Table 40 Determination of magnitude for kittiwake displacement

	MDO	Alternative Design Option
Extent	Very small proportion of the population is predicted to be affected	Very small proportion of the population is predicted to be affected
Duration	The impact is likely to occur throughout the operation phase of the project and will therefore be long-term, as defined by EPA (2022).	The impact is likely to occur throughout the operation phase of the project and will therefore be long-term, as defined by EPA (2022).

	MDO	Alternative Design Option
Frequency	The effect is anticipated to occur throughout the year.	The effect is anticipated to occur throughout the year.
Probability	Displacement effects are considered possible in the vicinity of the array area and surrounding 2 km buffer.	Displacement effects are considered possible in the vicinity of the array area and surrounding 2 km buffer.
Consequence	Although displacement of kittiwakes from the array area is possible throughout the year, at the population level, associated mortality is predicted to be very low, which would equate to Negligible magnitude.	Although displacement of kittiwakes from the array area is possible throughout the year, at the population level, associated mortality is predicted to be very low, which would equate to Negligible magnitude.
Overall magnitude	The potential magnitude is rated as Negligible.	The potential magnitude is rated as Negligible.

6.17.65 For this assessment, receptor sensitivity has been based on three reviews of evidence from post-construction studies at offshore wind farms. A review of post-construction studies of seabirds at offshore wind farms in European waters concluded that kittiwake was one of the species which were hardly affected by OWFs or with attraction and avoidance approximately equal over all studies (Dierschke *et al.,* 2016). A review of vulnerability of Scottish seabirds to offshore wind turbines in the context of disturbance and displacement ranked kittiwake as the 24th most sensitive out of 38 species (Furness *et al.,* 2013). Bradbury *et al.,* (2014), classified the kittiwake population vulnerability to displacement from offshore wind farms as very low.

6.17.66 Estimated numbers of kittiwakes recorded within the array area would qualify as internationally important in the breeding season (Offshore and Intertidal Ornithology Technical Baseline), with individuals potentially originating from a number of SPA and non-SPA colonies within mean maximum foraging range. On this basis the conservation importance for kittiwake was considered to be medium.

6.17.67 Overall, based on the conservation importance, with SPAs for breeding kittiwake within mean maximum foraging range of the array area, together with evidence from reviews and post-construction studies presented above indicates that kittiwake sensitivity to displacement associated with Dublin Array is likely to be **Low** (Table 4).

6.17.68 For kittiwake, the magnitude of the impact is deemed to be **Negligible** and the overall sensitivity of this species to displacement is considered to be **Low**, with evidence from post-construction studies indicating low displacement effects from OWFs. The significance of any effect on kittiwakes from displacement and barrier effects associated with Dublin Array is a **Not Significant** effect, which is **Not significant** in EIA terms.

Guillemot Displacement

6.17.69 For guillemot, displacement rates of 50%-60% and mortality rates of 1%, 3% and 5% were applied for the breeding season, with displacement rates of 50%-60% and mortality rates of 1% and 3% applied for the non-breeding season. Rates were based on recent guidance from NatureScot (NatureScot, 2024), and an evaluation of the published literature. The rates are in line with values discussed and agreed between the east coast Phase 1 developers, and circulated to NPWS in December 2022 (GoBe, 2022). Further information is presented in the Seabird Displacement Matrices Technical Report.

6.17.70 There were sufficient sightings of guillemots on the water to run a Distance analysis on both the 2016-2017 and 2019-2021 datasets, therefore the guillemot displacement assessment is based on the Distance analysis of the 2016-2017 and 2019-2021 data for birds on the water and flying birds. In addition, there were sightings of guillemots/razorbills on baseline surveys that could not be determined to species. These have been divided up between guillemot and razorbill based on the monthly ratios of identified birds recorded on baseline surveys. A more detailed breakdown of monthly numbers of birds on the water and in flight, along with the treatment of unidentified birds is presented in the Seabird Displacement Matrices Technical Report.

6.17.71 During baseline surveys, guillemots were most abundant in the array area plus 2 km buffer in the breeding season (March to July). The peak mean estimated number of guillemots in the array area plus 2 km buffer was 18,687 birds in April (Table 41). In the non-breeding season (August to February), mean estimated numbers were lower, with a peak mean estimated number of 2,063 birds in the array area and 2 km buffer in August (Table 43). The complete range of displacement matrices for the array area and the array area and 2 km buffer as well as for the different seasons are presented in the Seabird Displacement Matrices Technical Report.

6.17.72 Estimated guillemot mortality in the breeding season from displacement in the array area and 2 km buffer is presented in Table 41.

Table 41 Displacement and mortality estimates for guillemot in the array area plus 2 km buffer in the breeding season (March to July)

Rates	Estimated seasonal displacement	Estimated seasonal mortality (all ages)	Estimated seasonal mortality (breeding adults only)
Mean peak number in breeding season = 18,687 birds			
50%; 1%	9,344	93	46
60%; 3%	11,212	336	151
60%; 5%	11,212	561	254

6.17.73 During the breeding season, the mean peak number of guillemots was 18,687 individuals within the array area and 2 km buffer (Seabird Displacement Matrices Technical Report). Based on a displacement rate of 50% in the array area and 2 km buffer, this would affect an estimated 9,344 birds. Applying a displacement rate of 60% in the array area and 2 km buffer would affect an estimated 11,212 birds (Table 41).

6.17.1 Applying a displacement rate of 50% and a mortality rate of 1%, it was calculated that the additional mortality due to displacement effects was 93 guillemots. Applying a displacement rate of 60% and a mortality rate of 3%, it was calculated that the additional mortality due to displacement effects was 336 guillemots. Applying a displacement rate of 60% and a mortality rate of 5%, it was calculated that the additional mortality due to displacement effects was 561 guillemots (Table 41).

6.17.2 However, these estimates include non-breeding adults and immature birds, as well as breeding adults. Studies have shown that for several seabird species, in addition to breeding birds, colonies are also attended by many immature individuals and a smaller number of non-breeding adults (e.g. Wanless *et al.,* 1998). There is little information on the breakdown of immature and non-breeding adults present at a colony, however, this has been estimated using proportions from Horswill and Robinson (2015) (Offshore and Intertidal Ornithology Technical Baseline). Based on the proportion of immature guillemots from the population age ratio (0.479), 47.9% of the population present are immature birds, with a corresponding 52.2% of the population being adult birds.

6.17.3 Rounding to the nearest whole bird, this gave an age breakdown of 49 adults and 44 immature birds in the breeding season for a displacement rate of 50% and mortality rate of 1%. Based on a displacement rate of 60% and a mortality rate of 3%, the additional mortality due to displacement effects was 336 guillemots. Rounding to the nearest whole bird gave an age breakdown of 175 adults and 161 immature birds in the breeding season.

6.17.4 Based on a displacement rate of 60% and a mortality rate of 5%, the additional mortality due to displacement effects was 561 guillemots. Rounding to the nearest whole bird, this gave an age breakdown of 293 adults and 268 immature birds in the breeding season.

6.17.5 However, a proportion of adult birds present at colonies in the breeding season will opt not to breed in a particular breeding season. It has been estimated that 7% of adult guillemots may be "sabbatical" birds in any particular breeding season (Xodus, 2023), and this has been applied for this assessment. On this basis, for 50% displacement rate and 1% mortality rate, three displaced adult guillemots were considered not to be breeding, therefore guillemot mortality was considered to be 46 breeding adults, three non-breeding "sabbatical" adults and 44 immature birds.

6.17.6 Similarly, for a 60% displacement rate and 3% mortality rate, 24 adult guillemots were considered not to be breeding, therefore guillemot mortality was considered to involve 151 breeding adults, 24 non-breeding "sabbatical" adults and 161 immature birds.

6.17.7 For a 60% displacement rate and 5% mortality rate, 39 adult guillemots were considered not to be breeding, therefore guillemot mortality was considered to be 254 breeding adults, 39 non-breeding "sabbatical" adults and 268 immature birds.

6.17.8 The total guillemot regional breeding population is estimated to be 119,058 adult birds (Table 14). For the breeding season assessment based on adult birds only, the increase in baseline mortality was calculated based on an estimated adult guillemot baseline survival rate of 0.939, therefore the corresponding rate for adult mortality is 0.061 (Table 16). Applying this mortality rate, the estimated regional baseline mortality of guillemots is 7,263 adult birds per breeding season (119,058 x 0.061). Based on 50% displacement rate and 1% mortality rate, the additional predicted mortality of 46 breeding adult guillemots in the breeding season would increase the baseline mortality rate by 0.633% (Table 42).

6.17.9 Based on 60% displacement rate and 3% mortality rate, the additional predicted mortality of 151 breeding adult guillemots in the breeding season would increase the baseline mortality rate by 2.08% (Table 42).

6.17.10 Based on 60% displacement rate and 5% mortality rate, the additional predicted mortality of 254 breeding adult guillemots in the breeding season would increase the baseline mortality rate by 3.50% (Table 42).

Table 42 Increase in estimated baseline mortality for guillemots in the array area plus 2 km buffer as a result of displacement in the breeding season

Rates	Estimated seasonal mortality (breeding adults only)	Increase in baseline mortality (%) (adults)	Estimated seasonal mortality (all ages)	Increase in baseline mortality (%) (all ages)
50%; 1%	46	0.633	93	0.30
60%; 3%	151	2.08	336	1.08
60%; 5%	254	3.50	561	1.81

6.17.11 A comparison of estimated guillemot mortality against a regional population consisting of adult and immature birds is shown in Table 42. The total guillemot regional breeding population (all ages) is estimated to be 228,115 birds (Table 14). The average mortality for all age classes is 0.136 (Table 16). Applying this mortality rate, the estimated regional baseline mortality of guillemots is 31,024 birds per breeding season (all ages) (228,115 x 0.136).

6.17.12 Based on a 50% displacement rate and a 1% mortality rate, the predicted additional mortality due to displacement effects was 93 guillemots in the breeding season (Table 41). The additional predicted mortality of 93 guillemots in the breeding season would increase the baseline mortality rate by 0.3% (Table 42).

6.17.13 Based on a 60% displacement rate and a 3% mortality rate, the predicted additional mortality due to displacement effects was 336 guillemots in the breeding season (Table 41). The additional predicted mortality of 336 guillemots in the breeding season would increase the baseline mortality rate by 1.08% (Table 42).

6.17.14 Based on a 60% displacement rate and a 5% mortality rate, the predicted additional mortality due to displacement effects was 561 guillemots in the breeding season (Table 41). The additional predicted mortality of 561 guillemots in the breeding season would increase the baseline mortality rate by 1.81% (Table 42).

6.17.15 Estimated guillemot mortality in the non-breeding season from displacement in the array area and 2 km buffer is presented in Table 43.

Table 43 Displacement and mortality estimates for guillemot in the array area plus 2 km buffer in the non-breeding season (August to February)

Rates	Estimated seasonal displacement	Estimated seasonal mortality (all ages)
Mean peak number in non-breeding season = 2,063 birds		
50%; 1%	1,032	10
60%; 1%	1,238	12
60%; 3%	1,238	37

6.17.16 In the non-breeding season, the mean peak number of guillemots was 2,063 individuals within the array area and 2 km buffer (Seabird Displacement Matrices Technical Report). Based on a displacement rate of 50% in the array area and 2 km buffer, this would affect an estimated 1,032 birds. Applying a displacement rate of 60% in the array area and 2 km buffer would affect an estimated 1,238 birds (Table 43).

6.17.17 Applying a displacement rate of 50% and a mortality rate of 1%, it was calculated that the additional mortality due to displacement effects was 10 guillemots. Applying a displacement rate of 60% and a mortality rate of 1%, it was calculated that the additional mortality due to displacement effects was 12 guillemots. Applying a displacement rate of 60% and a mortality rate of 3%, it was calculated that the additional mortality due to displacement effects was 37 guillemots (Table 43).

6.17.18 The total guillemot regional non-breeding population is estimated to be 1,332,623 birds (Table 15). The increase in baseline mortality was calculated based on an estimated average mortality rate of 0.136 (Table 16). Applying this mortality rate, the estimated regional baseline mortality of guillemots is 181,237 birds in the non-breeding season (1,332,623 x 0.136).

6.17.1 Based on a 50% displacement rate and a 1% mortality rate, the predicted additional mortality of 10 guillemots in the non-breeding season would increase the baseline mortality rate by 0.006% (Table 43).

6.17.2 Based on a 60% displacement rate and a 3% mortality rate, the predicted additional mortality of 12 guillemots in the non-breeding season would increase the baseline mortality rate by 0.007% (Table 43).

6.17.3 Based on a 60% displacement rate and a 5% mortality rate, the predicted additional mortality of 37 guillemots in the non-breeding season would increase the baseline mortality rate by 0.02% (Table 43.

6.17.4 Predicted annual guillemot mortality due to displacement effects for adults in the breeding season and all ages in the non-breeding season based on a 50% displacement rate and a 1% mortality rate was 56 birds, which corresponds to an increase in the annual baseline mortality rate of 0.639% (Table 44).

6.17.5 Predicted annual guillemot mortality due to displacement effects for all ages in the breeding and non-breeding seasons based on a 50% displacement rate and a 1% mortality rate was 103 birds, which corresponds to an increase in the annual baseline mortality rate of 0.306% (Table 44).

6.17.6 Predicted annual guillemot mortality due to displacement effects for adults in the breeding season and all ages in the non-breeding season based on a 60% displacement rate and a 3% mortality rate in the breeding season and a 1% mortality rate in the non-breeding season was 163 birds, which corresponds to an increase in the annual baseline mortality rate of 2.087% (Table 44).

6.17.7 Predicted annual guillemot mortality due to displacement effects for all ages in the breeding and non-breeding seasons based on a 60% displacement rate and a 3% mortality rate in the breeding season and a 1% mortality rate in the non-breeding season was 348 birds, which corresponds to an increase in the annual baseline mortality rate of 1.087% (Table 44).

6.17.1 Predicted annual guillemot mortality due to displacement effects for adults in the breeding season and all ages in the non-breeding season based on a 60% displacement rate and a 5% mortality rate in the breeding season and a 3% mortality rate in the non-breeding season was 291 birds, which corresponds to an increase in the annual baseline mortality rate of 3.52% (Table 44).

6.17.2 Predicted annual guillemot mortality due to displacement effects for all ages in the breeding and non-breeding seasons based on a 60% displacement rate and a 5% mortality rate in the breeding season and a 3% mortality rate in the non-breeding season was 598 birds, which corresponds to an increase in the annual baseline mortality rate of 1.83% (Table 44).

Table 44 Annual Increase in estimated baseline mortality for guillemots in the array area plus 2 km buffer as a result of displacement

Rates	Estimated seasonal mortality	Increase in baseline mortality (%)	Estimated seasonal mortality	Increase in baseline mortality (%)
Breeding season (adults only)			Breeding season (all ages)	
50%; 1%	46	0.633	93	0.30
60%; 3%	151	2.08	336	1.08
60%; 5%	254	3.50	561	1.81
Non-breeding season (all ages)			Non-breeding season (all ages)	
50%; 1%	10	0.006	10	0.006
60%; 1%	12	0.007	12	0.007
60%; 3%	37	0.02	37	0.02
Annual (breeding adults & all ages in non-breeding)			Annual (all ages))	
50%; 1%	56	0.639	103	0.306
60%; 1&3%	163	2.087	348	1.087
60%; 3&5%	291	3.52	598	1.83

6.17.3 As the predicted percentage increase in the baseline mortality rate exceeded 1%, PVA was carried out on the regional guillemot population considering potential displacement. The results of the regional PVAs for predicted displacement impacts during the 35-year operational phase is summarised in Table 45. Further details of the PVA methodology, input parameters and an explanation of how to interpret the PVA results can be found in PVA Technical Report.

Table 45 Summary of PVA displacement outputs for the regional guillemot population for the array area and 2 km buffer after 35 years

Scenario	Counterfactual of Population Growth Rate		Counterfactual of Population Size		50% Quantiles	
	Median	Mean	Median	Mean	U=50%I	I=50%U
50% displacement & 1% mortality	0.9995	0.9995	0.9872	0.9871	48.00	51.80
60% displacement & 1%/3% mortality	0.9983	0.9983	0.9402	0.9402	41.84	58.46
60% displacement & 3%/5% mortality	0.9971	0.9971	0.8997	0.8997	35.96	65.12

6.17.4 For the regional guillemot population over 35 years, based on a displacement rate of 50% and a mortality rate of 1%, the PVA model predicted a very slight reduction in the population growth rate of 0.05% (median CGR = 0.9995; Table 45) and a slight reduction in population size by 1.28% (median CPS = 0.9872; Table 45).

6.17.5 Based on a displacement rate of 60% and a mortality rate of 3% in the breeding season and 1% in the non-breeding season, the PVA model predicted a very slight reduction in the population growth rate of 0.17% (median CGR = 0.9983; Table 45) and a slight reduction in population size by 5.98% (median CPS =0.9402; Table 45).

6.17.6 Based on a displacement rate of 60% and a mortality rate of 5% in the breeding season and 3% in the non-breeding season, the PVA model predicted a slight reduction in the population growth rate of 0.29% (median CGR = 0.9971; Table 45) and a reduction in population size by 10.03% (median CPS =0.8997; Table 45).

6.17.7 These values indicate that the PVA did not predict a significant negative effect from the project alone effects of displacement mortality on the regional guillemot population after 35 years. The populations with no OWF present were predicted to increase over the lifetime of the project, and the populations with Dublin Array were also predicted to increase over the lifetime of the project, at a slightly lower rate (PVA Technical Report.

6.17.8 Based on the results of the displacement assessment and the PVA assessment, the magnitude of impact from displacement on the regional guillemot population based on a 50% displacement rate and a 1% mortality rate was considered to be **Negligible**, as the estimated increases in the annual baseline mortality rate were less than 1% for both the adult only breeding season assessment and when adults and immature birds were assessed in the breeding season (Table 6), while the PVA outputs did not predict a significant negative effect.

6.17.9 Based on the results of the displacement assessment and the PVA assessment, the magnitude of impact from displacement on the regional guillemot population based on a 60% displacement rate and mortality rates of 3-5% in the breeding season and 1-3% in the non-breeding season could be considered to be Low to Medium, as the estimated increases in the annual baseline mortality rate were between 1% and 5% for both the adult only breeding season assessment and when adults and immature birds were assessed in the breeding season (Table 6). However, since the PVA outputs based on these rates did not predict a significant negative effect, it is considered that the magnitude of impact based on these rates is therefore **Low.**

Table 46 Determination of magnitude for guillemot displacement

	MDO	Alternative Design Option
Extent	Small proportion of the population is predicted to be affected	Small proportion of the population is predicted to be affected
Duration	The impact is likely to occur throughout the operation phase of the project and will therefore be long-term, as defined by EPA (2022).	The impact is likely to occur throughout the operation phase of the project and will therefore be long-term, as defined by EPA (2022).
Frequency	The effect is anticipated to occur throughout the year.	The effect is anticipated to occur throughout the year.
Probability	Displacement effects are considered possible in the vicinity of the array area and surrounding 2 km buffer.	Displacement effects are considered possible in the vicinity of the array area and surrounding 2 km buffer.
Consequence	Although displacement of guillemots from the array area is possible throughout the year, at the population level, associated mortality is predicted by PVA to be at worse low, which would equate to Low magnitude.	Although displacement of guillemots from the array area is possible throughout the year, at the population level, associated mortality is predicted by PVA to be at worse low, which would equate to Low magnitude.
Overall magnitude	The potential magnitude is rated as Low.	The potential magnitude is rated as Low.

6.17.10 For this assessment, receptor sensitivity has been based on three reviews of evidence from post-construction studies at offshore wind farms. A review of post-construction studies of seabirds at offshore wind farms in European waters concluded that guillemot was one of the species that weakly avoided offshore wind farms (Dierschke *et al.,* 2016). A review of vulnerability of Scottish seabirds to offshore wind turbines in the context of disturbance and displacement ranked guillemot as the 11th most sensitive out of 38 species (Furness *et al.,* 2013). Bradbury *et al.,* (2014), classified the guillemot population vulnerability to displacement from offshore wind farms as moderate.

6.17.11 Estimated numbers of guillemots recorded within the array area would qualify as internationally important in the breeding season (Offshore and Intertidal Ornithology Technical Baseline), with individuals potentially originating from a number of SPA colonies within mean maximum foraging range, and also some non-SPA colonies. On this basis the conservation importance for guillemot was considered to be medium.

6.17.12 Overall, based on the conservation importance, with SPAs for breeding guillemots within mean maximum foraging range of the array area, together with evidence from reviews and post-construction studies presented above indicates that guillemot sensitivity to displacement associated with Dublin Array is likely to be **Medium** (Table 4).

6.17.13 For guillemot, based on a 50% displacement rate and a 1% mortality rate, the magnitude of the impact is deemed to be **Negligible** and the overall sensitivity of this species is considered to be **Medium**, with SPAs for breeding guillemots within mean maximum foraging range of the array area and evidence of a degree of potential avoidance of wind farms from post-construction studies. The significance of any effect on guillemots from displacement and barrier effects associated with Dublin Array is a **Not Significant** effect, which is **Not significant** in EIA terms.

6.17.14 Based on a 60% displacement rate and mortality rates of 3-5% in the breeding season and 1-3% in the non-breeding season, the magnitude of the impact is deemed to be **Low** and the overall sensitivity of this species is considered to be **Medium**, with SPAs for breeding guillemots within mean maximum foraging range of the array area and evidence of a degree of potential avoidance of wind farms from post-construction studies. The significance of any effect on guillemots from displacement and barrier effects associated with Dublin Array would be a **Slight Negative** effect, which is **Not significant** in EIA terms. However, it should be noted that a displacement rate of 60% and mortality rates of 3-5% are considered overly precautionary, based on post-construction evidence from OWFs.

Razorbill Displacement

6.17.15 For razorbill, displacement rates of 50%-60% and mortality rates of 1%, 3% and 5% were applied for the breeding season, with displacement rates of 50%-60% and mortality rates of 1% and 3% applied for the non-breeding season. Rates were based on recent guidance from NatureScot (NatureScot, 2024), and an evaluation of the published literature. The rates are in line with values discussed and agreed between the east coast Phase 1 developers, and circulated to NPWS in December 2022 (GoBe, 2022). Further information is presented in the Seabird Displacement Matrices Technical Report.

6.17.16 There were sufficient sightings of razorbills on the water to run a Distance analysis on both the 2016-2017 and 2019-2021 datasets, therefore the razorbill displacement assessment is based on the Distance analysis of the 2016-2017 and 2019-2021 data for birds on the water and flying birds. In addition, there were sightings of guillemots/razorbills on baseline surveys that could not be determined to species. These have been divided up between guillemot and razorbill based on the monthly ratios of identified birds recorded on baseline surveys. A more detailed breakdown of monthly numbers of birds on the water and in flight, along with the treatment of unidentified birds is presented in the Seabird Displacement Matrices Technical Report.

6.17.17 During baseline surveys in the breeding season (April to July), the peak mean estimated number of razorbills in the array area plus 2 km buffer was 1,068 birds in July (Table 47). In the autumn migration period of the non-breeding season (August to October), mean estimated numbers were higher, with a peak mean estimated number of 2,070 birds in the array area and 2 km buffer in September. In the winter period of the non-breeding season (November to December) the peak mean estimated number of razorbills was 281 birds in November, while in the spring migration period (January to March) the peak mean estimated number of razorbills was 478 birds in March (Table 49).

6.17.18 The complete range of displacement matrices for the array area and the array area and 2 km buffer as well as for the different seasons are presented in the Seabird Displacement Matrices Technical Report.

6.17.1 Estimated razorbill mortality in the breeding season from displacement in the array area and 2 km buffer is presented in Table 47.

Table 47 Displacement and mortality estimates for razorbill in the array area plus 2 km buffer in the breeding season (April to July)

Rates	Estimated seasonal displacement	Estimated seasonal mortality (all ages)	Estimated seasonal mortality (breeding adults only)
Mean peak number in breeding season = 1,068 birds			
50%; 1%	534	5	3
60%; 3%	641	19	9
60%; 5%	641	32	15

6.17.2 During the breeding season, the mean peak number of razorbills was 1,068 individuals within the array area and 2 km buffer (Seabird Displacement Matrices Technical Report). Based on a displacement rate of 50% in the array area and 2 km buffer, this would affect an estimated 534 birds. Applying a displacement rate of 60% in the array area and 2 km buffer would affect an estimated 641 birds (Table 47).

6.17.3 Applying a displacement rate of 50% and a mortality rate of 1%, it was calculated that the additional mortality due to displacement effects was five razorbills. Applying a displacement rate of 60% and a mortality rate of 3%, it was calculated that the additional mortality due to displacement effects was 19 razorbills. Applying a displacement rate of 60% and a mortality rate of 5%, it was calculated that the additional mortality due to displacement effects was 32 razorbills (Table 47).

6.17.4 Studies have shown that for several seabird species, in addition to breeding birds, colonies are also attended by many immature individuals and a smaller number of non-breeding adults (e.g. Wanless *et al.,* 1998). There is little information on the breakdown of immature and non-breeding adults present at a colony, however, this has been estimated using proportions from Horswill and Robinson (2015) (Offshore and Intertidal Ornithology Technical Baseline). Based on the proportion of immature razorbills from the population age ratio (0.467), 46.7% of the population present are immature birds, with a corresponding 53.3% of the population being adult birds.

6.17.5 Rounding to the nearest whole bird, this gave an age breakdown of three adults and two immature birds in the breeding season for a displacement rate of 50% and mortality rate of 1%. Based on a displacement rate of 60% and a mortality rate of 3%, the additional mortality due to displacement effects was 19 razorbills. Rounding to the nearest whole bird gave an age breakdown of 10 adults and nine immature birds in the breeding season.

6.17.6 Based on a displacement rate of 60% and a mortality rate of 5%, the additional mortality due to displacement effects was 32 razorbills. Rounding to the nearest whole bird, this gave an age breakdown of 17 adults and 15 immature birds in the breeding season.

6.17.1 However, a proportion of adult birds present at colonies in the breeding season will opt not to breed in a particular breeding season. It has been estimated that 7% of adult razorbills may be "sabbatical" birds in any particular breeding season (Xodus, 2023), and this has been applied for this assessment. On this basis, for 50% displacement rate and 1% mortality rate, zero displaced adult razorbills were considered not to be breeding, therefore razorbill mortality was considered to be three breeding adults, zero non-breeding "sabbatical" adults and two immature birds (Table 47).

6.17.2 Similarly, for a 60% displacement rate and 3% mortality rate, one adult razorbill was considered not to be breeding, therefore razorbill mortality was considered to involve nine breeding adults, one non-breeding "sabbatical" adult and nine immature birds (Table 47).

6.17.3 For a 60% displacement rate and 5% mortality rate, two adult razorbills were considered not to be breeding, therefore razorbill mortality was considered to be 15 breeding adults, two non-breeding "sabbatical" adults and 15 immature birds (Table 47).

6.17.4 The total razorbill regional breeding population is estimated to be 26,338 adult birds (Table 14). For the breeding season assessment based on adult birds only, the increase in baseline mortality was calculated based on an estimated adult razorbill baseline survival rate of 0.895, therefore the corresponding rate for adult mortality is 0.105 (Table 16). Applying this mortality rate, the estimated regional baseline mortality of razorbills is 2,765 adult birds per breeding season (26,338 x 0.105). Based on a 50% displacement rate and 1% mortality rate, the additional predicted mortality of three breeding adult razorbills in the breeding season would increase the baseline mortality rate by 0.108% (Table 48).

6.17.1 Based on 60% displacement rate and 3% mortality rate, the additional predicted mortality of nine breeding adult razorbills in the breeding season would increase the baseline mortality rate by 0.325% (Table 48).

6.17.2 Based on 60% displacement rate and 5% mortality rate, the additional predicted mortality of 15 breeding adult razorbills in the breeding season would increase the baseline mortality rate by 0.542% (Table 48).

Table 48 Increase in estimated baseline mortality for razorbills in the array area plus 2 km buffer as a result of displacement in the breeding season

Rates	Estimated seasonal mortality (breeding adults only)	Increase in baseline mortality (%) (adults)	Estimated seasonal mortality (all ages)	Increase in baseline mortality (%) (all ages)
50%; 1%	3	0.108	5	0.078
60%; 3%	9	0.325	19	0.298
60%; 5%	15	0.542	32	0.502

6.17.3 A comparison of estimated razorbill mortality against a regional population consisting of adult and immature birds is shown in Table 48. The total razorbill regional breeding population (all ages) is estimated to be 49,410 birds (Table 14). The average mortality for all age classes is 0.129 (Table 16). Applying this mortality rate, the estimated regional baseline mortality of razorbills is 6,374 birds per breeding season (all ages) (49,410 x 0.129).

6.17.4 Based on a 50% displacement rate and a 1% mortality rate, the predicted additional mortality due to displacement effects was five razorbills in the breeding season. The additional predicted mortality of five razorbills in the breeding season would increase the baseline mortality rate by 0.078% (Table 48).

6.17.5 Based on a 60% displacement rate and a 3% mortality rate, the predicted additional mortality due to displacement effects was 19 razorbills in the breeding season. The additional predicted mortality of 19 razorbills in the breeding season would increase the baseline mortality rate by 0.298% (Table 48).

6.17.6 Based on a 60% displacement rate and a 5% mortality rate, the predicted additional mortality due to displacement effects was 32 razorbills in the breeding season. The additional predicted mortality of 32 razorbills in the breeding season would increase the baseline mortality rate by 0.502% (Table 48).

6.17.7 Estimated razorbill mortality in the autumn migration, winter and spring migration periods of the non-breeding season from displacement in the array area and 2 km buffer is presented in Table 49.

Table 49 Displacement and mortality estimates for razorbill in the array area plus 2 km buffer in the non-breeding season

Rates	Estimated seasonal displacement	Estimated seasonal mortality (all ages)	Increase in baseline mortality (%)
Mean peak number in Autumn migration period (Aug-Oct) = 2,070 birds			
50%; 1%	1,035	10	0.012
60%; 1%	1,242	12	0.015
60%; 3%	1,242	37	0.045
Mean peak number in Winter period (Nov-Dec) = 281 birds			
50%; 1%	141	1	0.002
60%; 1%	169	2	0.005
60%; 3%	169	5	0.012
Mean peak number in Spring migration period (Jan-Mar) = 478 birds			
50%; 1%	239	2	0.002
60%; 1%	287	3	0.004
60%; 3%	287	9	0.011
Total for non-breeding season			
50%; 1%	1,415	13	0.016
60%; 1%	1,698	17	0.024
60%; 3%	1,698	51	0.068

6.17.8 In the autumn migration period of the non-breeding season, the mean peak number of razorbills was 2,070 individuals within the array area and 2 km buffer (Seabird Displacement Matrices Technical Report).

6.17.9 Based on a displacement rate of 50% in the array area and 2 km buffer, this would affect an estimated 1,035 birds. Applying a displacement rate of 60% in the array area and 2 km buffer would affect an estimated 1,242 birds (Table 49).

6.17.10 Applying a displacement rate of 50% and a mortality rate of 1%, it was calculated that the additional mortality due to displacement effects was 10 razorbills. Applying a displacement rate of 60% and a mortality rate of 1%, it was calculated that the additional mortality due to displacement effects was 12 razorbills. Applying a displacement rate of 60% and a mortality rate of 3%, it was calculated that the additional mortality due to displacement effects was 37 razorbills (Table 49).

6.17.11 The total razorbill regional population for the autumn migration period is estimated to be 632,453 birds (Table 15). The increase in baseline mortality was calculated based on an estimated average mortality rate of 0.129 (Table 16). Applying this mortality rate, the estimated regional baseline mortality of razorbills is 81,586 birds in the autumn migration period of the non-breeding season (632,453 x 0.129).

6.17.12 Based on a displacement rate of 50% and a mortality rate of 1%, the additional predicted mortality of 10 razorbills in the autumn migration period would increase the baseline mortality rate by 0.012% (Table 49).

6.17.13 Based on a displacement rate of 60% and a mortality rate of 1%, the additional predicted mortality of 12 razorbills in the autumn migration period would increase the baseline mortality rate by 0.015% (Table 49).

6.17.14 Based on a displacement rate of 60% and a mortality rate of 3%, the additional predicted mortality of 37 razorbills in the autumn migration period would increase the baseline mortality rate by 0.045% (Table 49).

6.17.15 The total razorbill regional population in the winter period of the non-breeding season is estimated to be 366,961 birds (Table 15). Applying the mortality rate of 0.129 (Table 16), the estimated regional baseline mortality of razorbills is 43,468 birds in the winter period of the non-breeding season (366,961 x 0.129).

6.17.16 The additional predicted mortality of one razorbill in the winter period would increase the baseline mortality rate by 0.002% (Table 49).

6.17.17 Based on a displacement rate of 60% and a mortality rate of 1%, the additional predicted mortality of two razorbills in the winter period would increase the baseline mortality rate by 0.005% (Table 49).

6.17.18 Based on a displacement rate of 60% and a mortality rate of 3%, the additional predicted mortality of five razorbills in the winter period would increase the baseline mortality rate by 0.012% (Table 49).

6.17.19 The total razorbill regional population in the spring migration period of the non-breeding season is estimated to be 632,453 birds (Table 15). Applying the mortality rate of 0.129 (Table 16), the estimated regional baseline mortality of razorbills is 81,586 birds in the spring migration period of the non-breeding season (632,453 x 0.129).

6.17.20 The additional predicted mortality of two razorbills in the spring migration period would increase the baseline mortality rate by 0.002% (Table 49).

6.17.21 Based on a displacement rate of 60% and a mortality rate of 1%, the additional predicted mortality of three razorbills in the spring migration period would increase the baseline mortality rate by 0.004% (Table 49).

6.17.22 Based on a displacement rate of 60% and a mortality rate of 3%, the additional predicted mortality of nine razorbills in the spring migration period would increase the baseline mortality rate by 0.011% (Table 49).

6.17.23 Predicted annual razorbill mortality due to displacement effects for adults in the breeding season and all ages in the non-breeding season based on a 50% displacement rate and a 1% mortality rate was 16 birds, which corresponds to an increase in the annual baseline mortality rate of 0.0.124% (Table 50).

6.17.24 Predicted annual razorbill mortality due to displacement effects for all ages in the breeding and non-breeding seasons based on a 50% displacement rate and a 1% mortality rate was 18 birds, which corresponds to an increase in the annual baseline mortality rate of 0.094% (Table 50).

6.17.25 Predicted annual razorbill mortality due to displacement effects for adults in the breeding season and all ages in the non-breeding season based on a 60% displacement rate and a 3% mortality rate in the breeding season and a 1% mortality rate in the non-breeding season was 26 birds, which corresponds to an increase in the annual baseline mortality rate of 0.349% (Table 50).

6.17.26 Predicted annual razorbill mortality due to displacement effects for all ages in the breeding and non-breeding seasons based on a 60% displacement rate and a 3% mortality rate in the breeding season and a 1% mortality rate in the non-breeding season was 36 birds, which corresponds to an increase in the annual baseline mortality rate of 0.322% (Table 50).

6.17.27 Predicted annual razorbill mortality due to displacement effects for adults in the breeding season and all ages in the non-breeding season based on a 60% displacement rate and a 5% mortality rate in the breeding season and a 3% mortality rate in the non-breeding season was 66 birds, which corresponds to an increase in the annual baseline mortality rate of 0.61% (Table 50).

6.17.28 Predicted annual razorbill mortality due to displacement effects for all ages in the breeding and non-breeding seasons based on a 60% displacement rate and a 5% mortality rate in the breeding season and a 3% mortality rate in the non-breeding season was 83 birds, which corresponds to an increase in the annual baseline mortality rate of 0.57% (Table 50).

Table 50 Annual Increase in estimated baseline mortality for razorbills in the array area plus 2 km buffer as a result of displacement

Rates	Estimated seasonal mortality	Increase in baseline mortality (%)	Estimated seasonal mortality	Increase in baseline mortality (%)
Breeding season (adults only)			Breeding season (all ages)	
50%; 1%	3	0.108	5	0.078
60%; 3%	9	0.325	19	0.298
60%; 5%	15	0.542	32	0.502
Non-breeding season (all ages)			Non-breeding season (all ages)	
50%; 1%	13	0.016	13	0.016
60%; 1%	17	0.024	17	0.024
60%; 3%	51	0.068	51	0.068
Annual (breeding adults & all ages in non-breeding)			Annual (all ages))	
50%; 1%	16	0.124	18	0.094
60%; 1&3%	26	0.349	36	0.322
60%; 3&5%	66	0.61	83	0.57

6.17.29 As highlighted by Natural England guidance, where predicted impacts equate to 1% or below of baseline mortality for a population (e.g. colony population) then this level of impact could be considered non-significant (Parker *et al.,* 2022c). As the predicted increases in annual baseline mortality for razorbill were below 1%, PVA was not carried out on the regional razorbill population, as agreed in the East Coast Phase 1 Method Statement (GoBe, 2022).

6.17.30 Based on the results of the displacement assessment using displacements rates of 50%-60% and mortality rates of 1% 3% and 5%, the magnitude of impact from displacement on the regional razorbill population was considered to be **Negligible**, as the estimated increases in the annual baseline mortality rate were less than 1% for both the adult only breeding season assessment and when adults and immature birds were assessed in the breeding season (Table 51).

Table 51 Determination of magnitude for razorbill displacement

	MDO	Alternative Design Option
Extent	Very small proportion of the population is predicted to be affected	Very small proportion of the population is predicted to be affected
Duration	The impact is likely to occur throughout the operation phase of the project and will therefore be long-term, as defined by EPA (2022).	The impact is likely to occur throughout the operation phase of the project and will therefore be long-term, as defined by EPA (2022).
Frequency	The effect is anticipated to occur throughout the year.	The effect is anticipated to occur throughout the year.
Probability	Displacement effects are considered possible in the vicinity of the array area and surrounding 2 km buffer.	Displacement effects are considered possible in the vicinity of the array area and surrounding 2 km buffer.
Consequence	Although displacement of razorbills from the array area is possible throughout the year, at the population level, associated mortality is predicted by PVA to be very low, which would equate to Negligible magnitude.	Although displacement of razorbills from the array area is possible throughout the year, at the population level, associated mortality is predicted by PVA to be very low, which would equate to Negligible magnitude.
Overall magnitude	The potential magnitude is rated as Negligible.	The potential magnitude is rated as Negligible.

6.17.31 For this assessment, receptor sensitivity has been based on three reviews of evidence from post-construction studies at offshore wind farms. A review of post-construction studies of seabirds at offshore wind farms in European waters concluded that razorbill was one of the species that weakly avoided offshore wind farms (Dierschke *et al.,* 2016). A review of vulnerability of Scottish seabirds to offshore wind turbines in the context of disturbance and displacement ranked razorbill as the 12th most sensitive out of 38 species (Furness *et al.,* 2013). Bradbury *et al.,* (2014), classified the razorbill population vulnerability to displacement from offshore wind farms as moderate.

6.17.32 Estimated numbers of razorbills recorded within the array area would qualify as internationally important in the breeding season (Offshore and Intertidal Ornithology Technical Baseline), with individuals potentially originating from a number of SPA colonies within mean maximum foraging range, and also some non-SPA colonies. On this basis the conservation importance for razorbill was considered to be medium.

6.17.33 Overall, based on the conservation importance, with SPAs for breeding razorbills within mean maximum foraging range of the array area, together with evidence from reviews and post-construction studies presented above indicates that razorbill sensitivity to displacement associated with Dublin Array is likely to be **Medium** (Table 4).

6.17.34 For razorbill, the magnitude of the impact is deemed to be **Negligible,** and the overall sensitivity of this species is considered to be **Medium**, with SPAs for breeding razorbills within mean maximum foraging range of the array area and evidence of a degree of potential avoidance of wind farms from post-construction studies. The significance of any effect on razorbills from displacement and barrier effects associated with Dublin Array is a **Not Significant** effect, which is **Not significant** in EIA terms.

Other species

6.17.35 For the remaining 11 species (red-throated diver, great northern diver, cormorant, common scoter, Sandwich tern, roseate tern, common tern, Arctic tern, little tern, black guillemot and puffin), it was not possible to estimate monthly populations for the array area and buffer area due to the low numbers of individuals of these species recorded on baseline surveys. Displacement and barrier effects for these species were instead assessed qualitatively, using evidence from existing operational offshore wind projects where available.

6.17.36 For each species, a review of the baseline survey results was undertaken, along with evidence of sensitivity from published reviews. This was then followed by a screening exercise considering the likelihood of significant displacement effects (Table 52). Further details of baseline survey results are presented in the Offshore and Intertidal Ornithology Technical Baseline.

Table 52 Summary of baseline surveys and species sensitivity

Species	Summary of baseline surveys	Sensitivity/Evidence from other OWFs	Screened IN/OUT
Red-throated Diver	Recorded in low numbers between September and May. Total of 63 birds recorded, with a peak of nine birds in January and eight birds in April and December. No sightings between June and August.	Ranked as “strongly or completely avoiding offshore wind farms by Dierschke *et al.,* (2016). Sensitivity to displacement ranked “5” out of “5” by Furness *et al.,* (2013) and as “High” by Bradbury *et al.,* (2014).	Screened IN based on sensitivity to displacement, conservation importance and numbers of birds recorded. Birds in the vicinity are not breeding birds.
Great Northern Diver	Recorded in very low numbers between November and May. Total of 20 birds recorded, with a peak of three birds in December. No sightings between June and October.	Sensitivity to displacement ranked “5” out of “5” by Furness *et al.,* (2013) and as “High” by Bradbury *et al.,* (2014).	Although highly sensitive to displacement, screened OUT based on the very low numbers recorded within the array area, and no sightings between June and October. Birds in the vicinity are not breeding birds.
Cormorant	Recorded in all months. Total of 619 birds recorded. Highest numbers recorded in the breeding season, with a peak of 135 birds in July.	Evidence of strong attraction reported at Robin Rigg, North Hoyle, Prinses Amalia and Egmond aan Zee, and ranked as “strongly attracted” overall by Dierschke *et al.,* (2016)	Screened OUT as evidence of strong attraction to OWFs.
Common Scoter	Recorded in low numbers in all months except January. Mostly recorded inshore of the array area in low numbers, with just two sightings in the array area. Total of 133 birds recorded, with peak numbers of 55 birds in April and 23 birds in October. Majority of birds recorded in flight (95%).	Ranked as “weakly avoiding offshore wind farms by Dierschke *et al.,* (2016). Sensitivity to displacement ranked “5” out of “5” by Furness *et al.,* (2013) and as “High” by Bradbury *et al.,* (2014).	Although highly sensitive to displacement, screened OUT based on the very low numbers recorded within the array area, and all birds flying through study area, with no evidence of regularly feeding within the array area. Birds in the vicinity are not breeding birds.
Sandwich Tern	Total of 13 birds recorded, with three birds in May and 10 birds in August. No breeding colonies within mean maximum foraging range (+1SD) of Dublin Array.	Ranked as “weakly avoiding offshore wind farms by Dierschke *et al.,* (2016). Sensitivity to displacement ranked “2” out of “5” by Furness *et al.,* (2013) and	Screened OUT based on very low numbers recorded in offshore study area during breeding season, and no breeding colonies within foraging range. All birds recorded are considered to be on passage through the

Species	Summary of baseline surveys	Sensitivity/Evidence from other OWFs	Screened IN/OUT
		as “Moderate” by Bradbury *et al.,* (2014).	study area, therefore significant displacement effects considered very unlikely, as birds are not using the array area regularly in the breeding season.
Roseate Tern	Total of 119 birds recorded between May and September, with peaks of 27 birds in May, 18 in August and 41 in September. No breeding colonies within mean maximum foraging range (+1SD) of Dublin Array.	Sensitivity to displacement ranked “2” out of “5” by Furness *et al.,* (2013) and as “Moderate” by Bradbury *et al.,* (2014).	Screened OUT based on very low numbers recorded in offshore study area during breeding season, and no breeding colonies within foraging range. All birds recorded are considered to be on passage through the study area, therefore significant displacement effects considered very unlikely, as birds are not using the array area regularly in the breeding season.
Common Tern	Regularly recorded between April and September, with peaks of 123 birds in July, 385 birds in August and 376 birds in September. Two colonies within mean maximum foraging range (+1SD) of Dublin Array.	Ranked as “hardly affected by offshore wind farms by Dierschke *et al.,* (2016). Sensitivity to displacement ranked “2” out of “5” by Furness *et al.,* (2013) and as “Low” by Bradbury *et al.,* (2014).	Screened OUT based on low numbers recorded in offshore study area during breeding season. Peak numbers were recorded from July to September, indicating that most birds recorded are likely to be on autumn passage through the study area, therefore significant displacement effects considered very unlikely, as birds are not regularly using the array area in large numbers in the earlier part of the breeding season.
Arctic Tern	Regularly recorded in low numbers between May and September, with peaks of 39 birds in July, 49 birds in August and 13 birds in September. Three colonies within mean maximum foraging range (+1SD) of Dublin Array.	Ranked as “hardly affected by offshore wind farms by Dierschke *et al.,* (2016). Sensitivity to displacement ranked “2” out of “5” by Furness *et al.,* (2013) and as “Low” by Bradbury *et al.,* (2014).	
Unidentified Common/Arctic terns	A further 360 unidentified common/Arctic terns also recorded, with peaks of 93 birds in July, 94 birds in August and 98 birds in September.	See above.	
Little Tern	A total of 14 little terns recorded between June and August, with a peak of	Sensitivity to displacement ranked “2” out of “5” by Furness *et al.*, (2013) and	Screened OUT based on very low numbers recorded in offshore study area during

Species	Summary of baseline surveys	Sensitivity/Evidence from other OWFs	Screened IN/OUT
	nine birds in July. No breeding colonies within mean maximum foraging range (+1SD) of Dublin Array.	as "Moderate" by Bradbury *et al.*, (2014).	breeding season, and no breeding colonies within foraging range. All birds recorded are considered to be on passage through the study area, therefore significant displacement effects considered very unlikely, as birds are not using the array area regularly throughout the breeding season.
Black Guillemot	Total of 130 birds recorded, with peaks of 17 birds in September, 37 birds in October and 22 birds in December. Only seven birds were recorded between April and August, with no sightings in the array area. No breeding colonies within mean maximum foraging range (+1SD) of Dublin Array.	Sensitivity to displacement ranked "3" out of "5" by Furness *et al.*, (2013) and as "Moderate" by Bradbury *et al.*, (2014).	Screened OUT based on very low numbers recorded in offshore study area during breeding season, with no records within the array area. Majority of sightings in non-breeding season at south end of study area, outside array area.
Puffin	Total of 58 birds recorded between April and November, with peaks of 12 birds in June and 16 birds in July. Only seven birds recorded between November and March. Several colonies within mean maximum foraging range (+1SD) of Dublin Array.	Sensitivity to displacement ranked "2" out of "5" by Furness *et al.*, (2013) and as "Low" by Bradbury *et al.*, (2014).	Screened OUT based on low numbers recorded in offshore study area during breeding season, and low sensitivity to displacement based on published reviews.

6.17.37 Based on the information summarised in Table 52, it is considered that red-throated diver sensitivity to displacement arising from Dublin Array will be **High.**

6.17.38 Based on evidence from other OWFs, it is likely that any red-throated divers in the vicinity of the array area will be displaced by wind turbines. However, as highlighted in the SNCBs displacement guidance for red-throated divers, displacement will not be 100% across the distance over which the effect occurs but there will likely be a gradation, with decreasing effects at increased distance from an OWF (SNCBs, 2022b).

6.17.39 Studies in the German North Sea have shown that red-throated diver abundance declined within a wind farm and surrounding 1 km buffer by 94%, and within 10 km of the wind farm by 52% (Garthe *et al.,* 2023). In the UK North Sea, Webb *et al.,* (2017) estimated a decrease in density of 83% within the Lincs, Lynn & Inner Dowsing OWF based on visual and digital aerial surveys, with the displacement effect decreasing to 55% at 4 km and 34% at 8 km from the OWF. Post-construction monitoring at Kentish Flats in the UK southern North Sea using boat-based surveys indicated a 95% displacement rate within the OWF site, decreasing to 63% at 3 km from the OWF site (Percival *et al.,* 2010).

6.17.40 However, only low numbers of red-throated divers were recorded between September and May (non-breeding season) in the Offshore Ornithology study area on baseline surveys, which includes the array area and a 4 km buffer. There was no evidence from baseline surveys that the study area was used regularly by significant numbers of red-throated divers, as the peak count across the survey period (2016-2017 and 2019-2020) was nine birds in January 2020.

6.17.41 Behaviour-based computer simulation models of waders, geese and sea ducks have demonstrated that displacement can, through changes to the energy budgets of individuals, lead to changes to mortality levels (SNCBs, 2022). However, no such effects were predicted when similar models were applied to wintering divers (Topping and Petersen 2011). This modelling predicted that even in a scenario where there were many OWFs in an area, the increase in population level mortality would be less than 2%. In addition, red-throated divers are generalist, opportunistic feeders that mainly prey on clupeids, mackerel, flatfish, gadoids, and sandeels. They are generally able to switch their target prey species to account for seasonal variations in availability (Garthe *et al.,* 2023).

6.17.42 The magnitude of impact is considered in Table 53.

Table 53 Determination of magnitude for red-throated diver displacement

	MDO	Alternative Design Option
Extent	Small proportion of the population is predicted to be affected	Small proportion of the population is predicted to be affected
Duration	The impact is likely to occur throughout the operation phase of the project and will therefore be long-term, as defined by EPA (2022).	The impact is likely to occur throughout the operation phase of the project and will therefore be long-term, as defined by EPA (2022).
Frequency	The effect is anticipated to occur in the non-breeding season, between September and May.	The effect is anticipated to occur in the non-breeding season, between September and May.
Probability	Displacement effects are considered very likely in the vicinity of the array area and surrounding area potentially out to approximately 10 km.	Displacement effects are considered very likely in the vicinity of the array area and surrounding area potentially out to approximately 10 km.
Consequence	Although displacement of red-throated divers in the non-breeding season is very likely, at the population level, associated mortality is predicted to be less than 2% (Topping and Petersen 2011), which would equate to Low magnitude.	Although displacement of red-throated divers in the non-breeding season is very likely, at the population level, associated mortality is predicted to be less than 2% (Topping and Petersen 2011), which would equate to Low magnitude.
Overall magnitude	The potential magnitude is rated as Low.	The potential magnitude is rated as Low.

6.17.43 On this basis, it is considered that the magnitude of any displacement effect on red-throated diver will be **Low**.

6.17.44 For red-throated diver, the magnitude of the impact is deemed to be **Low,** and the overall sensitivity of this species is considered to be **High**. The significance of any displacement effect associated with Dublin Array on red-throated divers is a **Moderate Adverse** effect, which is not significant in EIA terms.

6.17.45 The alternative design options (any other option within the range of parameters set out in the project description) will not give rise to an effect which is more significant than the maximum design option.

Residual Effect

The effect on key bird species from displacement effects associated with Dublin Array have been assessed as 'not significant' in EIA terms. Therefore, no further mitigation (in addition to that already identified in Table 19 is considered necessary. No ecologically significant adverse residual effects on offshore ornithology have therefore been predicted.

Impact 9: Mortality of key bird species as a result of collision with offshore wind turbines

6.17.46 There is potential risk to birds from offshore wind farms arising from collision with operating turbines resulting in injury or fatality. This may occur when birds fly through an offshore wind farm whilst foraging for food, commuting between breeding colonies and foraging areas, or during migration. For this assessment, CRM for both seabird species and migratory non-seabird species has been undertaken. CRM for seabirds is presented below, while CRM for migratory non-seabirds is presented from paragraph 6.17.208 onwards.

6.17.47 CRM has been undertaken for Dublin Array, with detailed methods and results presented in the Seabird CRM Technical Report. Formerly, the CRM tool which was most commonly used for offshore collision predictions was the Band (2012) model. To incorporate uncertainty in input parameters the Band (2012) model has been updated to the stochastic CRM (sCRM) simulation-based tool, (McGregor *et al.,* 2018, Caneco *et al.,* 2022) which has been used for this assessment. The sCRM tool allows multiple iterations of the model to be straightforwardly undertaken with the input parameter values for each run drawn at random from appropriate probability distributions. Outputs are provided as mean estimates with measures of uncertainty (e.g. standard deviation, confidence intervals) also presented.

6.17.48 The MDO, outlined in Table 18, describes the turbine scenarios considered within this assessment. In all cases, the Option A: 50 WTGs represented the MDO, based on CRM outputs. For all species considered the MDO presents the largest theoretical collision impact risk. Further details are presented in the Seabird CRM Technical Report.

6.17.49 CRM has been undertaken on 11 species:

- Gannet;
- Black-headed gull;
- Common gull;
- Lesser black-backed gull;
- Herring gull;
- Great black-backed gull;
- Kittiwake;
- Sandwich tern;
- Roseate tern;
- Common tern; and
- Arctic tern.

6.17.50 These 11 species were selected based on their abundance within the array area on baseline surveys (see Offshore and Intertidal Ornithology Technical Baseline), and on evidence about their sensitivity to collision effects (Furness *et al.,* 2013).

6.17.51 Collision Risk Modelling (CRM) was conducted using the stochastic implementation of the Band (2012) model provided as scripts in the R programming environment (package: stochLAB v.1.1.2; Caneco *et al.* 2022). This model uses seabird data (both site-specific and generic) and turbine data to estimate the predicted number of collisions for each species per month, with uncertainty incorporated through the use of mean and standard deviation parameter values and appropriate probability distributions. This approach is currently recommended for assessing collisions at offshore wind farm projects by both NatureScot in their Guidance Note 7 (NatureScot, 2023) and Natural England (Parker *et al.,* 2022c).

6.17.52 Details of all turbine parameters used in the CRM are presented in the Seabird CRM Technical Report.

6.17.53 The estimate of the proportion of birds at rotor height (PRH) was calculated from the generic flight height dataset in Johnston *et al.* (2014) and was used with Option 2 of the basic model. This approach is currently considered as best practice in the UK. As the generic flight height data (Johnston *et al.* 2014) do not include roseate tern, Sandwich tern flight height data were used as a proxy for this species.

6.17.54 In addition to flight height data, average density of seabirds in flight in each calendar month within the wind farm boundary was used in the CRM assessment. Average density data was obtained from analysis of the baseline seabird survey data (Offshore and Intertidal Ornithology Technical Baseline).

6.17.55 Seabird parameters such as body length, wingspan and flight speed were taken from published sources (e.g. Robinson, (2005), Pennycuick, (1987), Alerstam, (2007) and Skov, *et al.,* (2018) that are acknowledged in current NatureScot and Natural England CRM guidance (NatureScot, 2023 and Parker *et al.,* 2022c). Further details on biological parameters such as Nocturnal Activity Factors (NAF) are presented in the Seabird CRM Technical Report. Current guidance from Natural England has been followed on NAF rates for use in the stochastic CRM (Parker *et al.,* 2022c). The use of these parameters was agreed with the east coast Phase 1 developers and circulated to NPWS in December 2022 (GoBe, 2022).

6.17.56 A key parameter in the CRM is the species-specific avoidance rate, which accounts for the fact that birds will take action to avoid colliding with the rotors (at a range of scales, from the whole wind farm to individual turbine blades). This adjustment is required in the model since baseline survey data are collected before turbines are present and hence do not contain any avoidance behaviour. The avoidance rates used in this assessment for each species have been derived from reviews of evidence from onshore studies and theoretical modelling (e.g. Cook *et al.* 2014 and JNCC *et al.*, 2014; Ozsanlav-Harris *et al.* 2022). Further details on the avoidance rates used for CRM are presented in the Seabird CRM Technical Report.

6.17.57 Revised guidance from the SNCBs was published in August 2024 (JNCC *et al.,* 2024). However, as the four other Phase 1 assessments were based on the agreed Phase 1 method statement (GoBe, 2022), it was considered that in order to maintain comparability between the Phase 1 assessments, the previously agreed Phase 1 approach would be used for this assessment.

6.17.58 Annual collision estimates for the MDO (50 turbines, Option A) for the key species considered in the CRM assessment are summarised in Table 54. Estimated numbers of collisions for the breeding and non-breeding seasons are presented in the individual species assessments below. Estimates are rounded to the nearest whole bird.

Table 54 Estimated annual numbers of collisions in the array area

Species	Annual collisions
Gannet	3
Black-headed gull	1
Common gull	4
Lesser black-backed gull	4
Herring gull	36
Great black-backed gull	9
Kittiwake	42
Sandwich tern	0
Roseate tern	0
Common tern	3
Arctic tern	0

6.17.59 The CRM assessments are presented for each species below.

Gannet

6.17.60 Annual estimated gannet mortality from collision impacts in the array area was based on mean densities of flying birds recorded on baseline surveys. A complete range of collision numbers for the array area, and the different design scenarios are presented in the Seabird CRM Technical Report.

6.17.61 The annual estimated number of collisions for gannet are presented in Table 55. Figures are presented for the breeding season and the autumn and spring migration periods of the non-breeding season, based on the MDO (50 turbines, Option A). Highest numbers of collisions were predicted for the breeding season, with zero collisions predicted for the autumn and spring migration periods of the non-breeding season.

Table 55 Estimated numbers of collisions by season for gannet in the array area

Season	Lower 95% confidence limit	Mean number of collisions	Upper 95% confidence limit
Breeding (Mar-Sep)	0.79	3.23	6.28
Autumn migration (Oct-Nov)	0.02	0.11	0.23
Spring migration (Dec-Feb)	0.01	0.11	0.25
Total	0.82	3.45	6.76

Season	Lower 95% confidence limit	Mean number of collisions	Upper 95% confidence limit
Total (to nearest whole bird)	1	3	7

6.17.62 In the breeding season (March to September), the total mean estimated number of gannet collisions was three birds (Table 55). However, this includes non-breeding adults and immature birds, as well as breeding adults. Based on the proportion of immature gannets recorded on baseline surveys in the breeding season (see Offshore and Intertidal Ornithology Technical Baseline), it was assumed that 16.1% of the population present are immature birds. This would mean that an estimated 0.48 gannets predicted to collide during the breeding season would be immature birds. However, for this assessment numbers have been rounded to the nearest whole bird for clarity, therefore breeding season gannet mortality was considered to involve three adult birds.

6.17.63 Similarly, a proportion of adult birds present at colonies in the breeding season will opt not to breed in a particular breeding season. It has been estimated that 10% of adult gannets may be “sabbatical” birds in any particular breeding season (Xodus, 2023), and this has been applied for this assessment. On this basis, 0.3 adult gannets predicted to collide were considered not to be breeding, however, for this assessment numbers have been rounded to the nearest whole bird for clarity, therefore gannet mortality was considered to be three adult breeding birds.

6.17.64 The total gannet regional breeding population is estimated to be 238,718 adult birds (Table 14). For the breeding season assessment based on adult birds only, the increase in baseline mortality was calculated based on an estimated adult gannet baseline survival rate of 0.919, therefore the corresponding rate for adult gannet mortality is 0.081 (Table 16). Applying this mortality rate, the estimated regional baseline mortality of gannets is 19,336 adult birds per breeding season (238,718 x 0.081). The additional predicted mortality of three breeding adult gannets in the breeding season would increase the baseline mortality rate by 0.015% (Table 56).

Table 56 Increase in estimated baseline mortality for adult gannets in the array area as a result of collisions

Season	Regional baseline popn.	Annual Regional Baseline Mortality	Increase in baseline mortality (%) (adults)
Breeding (Mar-Sep) (adults only)	238,718	19,336	0.015
Autumn migration (Oct-Nov)	583,315	105,580	0
Spring migration (Dec-Feb)	643,917	116,549	0
Total	-	-	0.015

6.17.65 For the autumn and spring migration periods, estimated seasonal gannet mortality from collision was zero birds (Table 56). Therefore, predicted annual gannet mortality due to collision effects was the same as for the breeding season (three adult gannets), which corresponds to an increase in the annual baseline mortality rate of 0.015% (Table 56).

6.17.66 A comparison of estimated gannet mortality from collisions against a regional population consisting of adult and immature birds is shown in Table 57. The predicted additional mortality due to collision effects was three gannets (all ages) in the breeding season. The total gannet regional breeding population (all ages) is estimated to be 420,382 birds (Table 14). The average mortality for all age classes is 0.181 (Table 16). Applying this mortality rate, the estimated regional baseline mortality of gannets is 76,089 birds per breeding season (all ages) (420,382 x 0.181). The additional predicted mortality of three gannets in the breeding season would increase the baseline mortality rate by 0.004% (Table 57).

6.17.67 For the autumn and spring migration periods, estimated seasonal gannet mortality due to collisions was zero birds (Table 57). Therefore, predicted annual gannet mortality (all ages) due to collision effects was the same as for the breeding season (three gannets; all ages), which corresponds to an increase in the annual baseline mortality rate of 0.004% (Table 57).

Table 57 Increase in estimated baseline mortality for gannets (all ages) in the array area as a result of collisions

Season	Regional baseline popn.	Annual Regional Baseline Mortality	Increase in baseline mortality (%) (all ages)
Breeding (Mar-Sep) (all ages)	420,382	76,089	0.004
Autumn migration (Oct-Nov)	583,315	105,580	0
Spring migration (Dec-Feb)	643,917	116,549	0
Total	-	-	0.004

6.17.68 As highlighted by Natural England guidance, where predicted impacts equate to 1% or below of baseline mortality for a population (e.g. colony population) then this level of impact could be considered non-significant (Parker *et al.,* 2022c). As the predicted increases in annual baseline mortality for gannet were below 1%, PVA was not carried out on the regional gannet population, as agreed in the East Coast Phase 1 Method Statement (GoBe, 2022).

6.17.69 Based on the results of the collision assessment, the magnitude of impact from collision effects on the regional gannet population was considered to be Negligible (Table 58).

Table 58 Determination of magnitude for gannet collision mortality

	MDO	Alternative Design Option
Extent	Very small proportion of the population is predicted to be affected	Very small proportion of the population is predicted to be affected
Duration	The impact is likely to occur throughout the operation phase of the project and will therefore be long-term, as defined by EPA (2022).	The impact is likely to occur throughout the operation phase of the project and will therefore be long-term, as defined by EPA (2022).
Frequency	The effect is anticipated to occur throughout the year.	The effect is anticipated to occur throughout the year.
Probability	Collision mortality is considered possible in the array area, although evidence suggests the majority of gannets will avoid the array area.	Collision mortality is considered possible in the array area, although evidence suggests the majority of gannets will avoid the array area.
Consequence	Although gannet collision mortality in the array area is possible throughout the year, at the population level, associated mortality is predicted by PVA to be very low, which would equate to Negligible magnitude.	Although gannet collision mortality in the array area is possible throughout the year, at the population level, associated mortality is predicted by PVA to be very low, which would equate to Negligible magnitude.
Overall magnitude	The potential magnitude is rated as Negligible.	The potential magnitude is rated as Negligible.

6.17.70 For gannet, there is evidence that gannets show a high degree of avoidance of offshore wind farms. A detailed study (Krijgsveld *et al.,* 2011) using radar and visual observations to monitor the post-construction effects of the Windpark Egmond aan Zee OWEZ established that 64% of gannets avoided entering the wind farm (macro-avoidance) and a similar result (80% macro avoidance) was also observed during a study at the Thanet wind farm (Skov *et al.*, 2018). Leopold *et al.*, (2013) reported that most gannets avoided Dutch offshore wind farms and did not forage within these.

6.17.71 In addition, the Year 1 post-construction study report for Beatrice offshore wind farm reported that gannet showed a marked difference in distribution within the wind farm on post-construction surveys than on pre-construction surveys, with only two birds recorded within the wind farm boundary across all post-construction six surveys undertaken in Year 1. Spatial modelling indicated a significant decrease centred on the wind farm and extending towards the coast with no areas of significant increase. Beyond the region of decrease, the density in the remainder of the survey area was almost identical when comparing pre- and post-construction data (MacArthur Green, 2021).

6.17.72 Estimated numbers of gannets recorded within the array area would qualify as nationally important in the breeding season (Offshore and Intertidal Ornithology Technical Baseline), with individuals potentially originating from a number of SPAs in the region, as well as non-SPA colonies. On this basis the conservation importance for gannet was considered to be medium.

6.17.73 Overall, based on available evidence from published studies indicating high levels of wind farm avoidance, and the origin of birds from SPA and non-SPA colonies in the region, it is considered that gannet sensitivity to collision effects associated with Dublin Array is likely to be **Medium** (Table 4).

6.17.74 For gannet, the magnitude of the impact is deemed to be **Negligible,** and the overall sensitivity of this species is considered to be **Medium**, with individuals potentially originating from a number of SPAs in the region, as well as non-SPA colonies. The significance of any effect on gannets from collision effects associated with Dublin Array is a **Not Significant** effect, which is not significant in EIA terms.

Gannet Collision and Displacement effects combined

6.17.75 The SNCBs guidance on displacement assessments (SNCBs, 2022) states that collision and displacement impacts should be combined for species that are considered likely to be affected by both displacement and collision effects. The guidance does acknowledge that this approach includes a degree of precaution, as there is the potential for double-counting. As highlighted by NatureScot in the NnG Scoping Opinion (Marine Scotland, 2017), collision risk and displacement are considered to be mutually exclusive impacts, and therefore combining mortality estimates for displacement and collision should be considered extremely precautionary.

6.17.76 Results from the collision and displacement assessments for gannet were combined, using the annual predicted mortality totals (Table 59).

Table 59 Combined annual estimated mortality for gannet (all ages) as a result of collisions and displacement

	Combined estimated mortality	Increase in baseline mortality (%) (breeding adults)	Increase in baseline mortality (%) (all ages)
Annual collisions	6	0.015	0.004
Annual displacement mortality	5	0.02	0.007
Combined total	11	0.035	0.011

6.17.77 Combined estimated annual gannet mortality due to collision and displacement effects showed a maximum increase in the annual baseline mortality rate of 0.035% (Table 59).

6.17.78 As highlighted by Natural England guidance, where predicted impacts equate to 1% or below of baseline mortality for a population (e.g. colony population) then this level of impact could be considered non-significant (Parker *et al.,* 2022c). As the predicted increases in annual baseline mortality for gannet were below 1%, PVA was not carried out on the regional gannet population, as agreed in the East Coast Phase 1 Method Statement (GoBe, 2022).

6.17.79 Based on the results of this combined collision and displacement assessment and the PVA assessment, the magnitude of impact from collision and displacement effects on the regional gannet population was considered to be **Negligible** (Table 60).

Table 60 Determination of magnitude for combined gannet collision and displacement mortality

	MDO	Alternative Design Option
Extent	Very small proportion of the population is predicted to be affected	Very small proportion of the population is predicted to be affected
Duration	The impact is likely to occur throughout the operation phase of the project and will therefore be long-term, as defined by EPA (2022).	The impact is likely to occur throughout the operation phase of the project and will therefore be long-term, as defined by EPA (2022).
Frequency	The effect is anticipated to occur throughout the year.	The effect is anticipated to occur throughout the year.
Probability	Combined collision and displacement mortality is considered possible in the array area, although evidence suggests the majority of gannets will avoid the array area.	Combined collision and displacement mortality is considered possible in the array area, although evidence suggests the majority of gannets will avoid the array area.
Consequence	Although combined gannet collision and displacement mortality in the array area is possible throughout the year, at the population level, associated mortality is predicted by PVA to be very low, which would equate to Negligible magnitude.	Although combined gannet collision and displacement mortality in the array area is possible throughout the year, at the population level, associated mortality is predicted by PVA to be very low, which would equate to Negligible magnitude.
Overall magnitude	The potential magnitude is rated as Negligible.	The potential magnitude is rated as Negligible.

6.17.80 Overall, based on available evidence from published studies, and the origin of birds from SPA and non-SPA colonies in the region, it is considered that gannet sensitivity to collision and displacement effects associated with Dublin Array is likely to be **Medium**.

6.17.81 For gannet, the magnitude of the impact is deemed to be **Negligible,** and the overall sensitivity of this species is considered to be **Medium**, with individuals potentially originating from a number of SPAs in the region, as well as non-SPA colonies. The significance of any effect on gannets from collision and displacement effects associated with Dublin Array is a **Not Significant** effect, which is not significant in EIA terms.

Black-headed gull

6.17.82 Annual estimated black-headed gull mortality from collision impacts in the array area was based on mean densities of flying birds recorded on baseline surveys. A complete range of collision numbers for the array area, and the different design scenarios are presented in the Seabird CRM Technical Report.

6.17.83 The annual estimated number of collisions for black-headed gull are presented in Table 61. Figures are presented for the breeding season and the non-breeding season, based on the MDO (50 turbines, Option A). Overall, very low numbers of collisions were predicted for the non-breeding season, with zero collisions predicted for the breeding season.

Table 61 Estimated numbers of collisions by season for black-headed gull in the array area

Season	Lower 95% confidence limit	Mean number of collisions	Upper 95% confidence limit
Breeding (Mar-Aug)	0	0	0
Non-breeding (Sep-Feb)	0.11	0.78	1.55
Total	0.11	0.78	1.55
Total (to nearest whole bird)	0	1	2

6.17.84 In the breeding season (March to August), there were zero black-headed gull collisions predicted (Table 61). In the non-breeding season, one black-headed gull collision was predicted, therefore the annual predicted collision mortality for black-headed gull was one bird.

6.17.85 The total black-headed gull regional population in the non-breeding season is estimated to be 28,049 birds, although this is considered likely to be an under-estimate (Table 15). The increase in baseline mortality was calculated based on an average mortality rate of 0.175 (Table 16). Applying this mortality rate, the estimated regional baseline mortality of black-headed gulls is 4,909 birds in the non-breeding season (28,049 x 0.175). The additional predicted mortality of one black-headed gull in the non-breeding season would increase the baseline mortality rate by 0.02% (Table 62).

Table 62 Increase in estimated baseline mortality for black-headed gulls in the array area as a result of collisions

Season	Regional baseline popn	Annual Regional Baseline Mortality	Increase in baseline mortality (%) (adults)
Breeding (Mar-Aug) (adults only)	-	-	0
Non-breeding season (Sep-Feb)	48,119	8,421	0.02
Total	-	-	0.02

6.17.86 Predicted annual black-headed gull mortality due to collision effects based on all ages in the breeding and non-breeding seasons, involved one bird, which corresponds to an increase in the annual baseline mortality rate of 0.02% (Table 62).

6.17.87 As highlighted by Natural England guidance, where predicted impacts equate to 1% or below of baseline mortality for a population (e.g. colony population) then this level of impact could be considered non-significant (Parker *et al.,* 2022c). As the predicted increase in annual baseline mortality for black-headed gull was below 1%, PVA was not carried out on the regional black-headed gull population, as agreed in the East Coast Phase 1 Method Statement (GoBe, 2022).

6.17.88 Based on the results of the collision assessment, the magnitude of impact from collision effects on the regional non-breeding season black-headed gull population was considered to be **Negligible** (Table 63).

Table 63 Determination of magnitude for black-headed gull collision mortality

	MDO	Alternative Design Option
Extent	Very small proportion of the population is predicted to be affected	Very small proportion of the population is predicted to be affected
Duration	The impact is likely to occur throughout the operation phase of the project and will therefore be long-term, as defined by EPA (2022).	The impact is likely to occur throughout the operation phase of the project and will therefore be long-term, as defined by EPA (2022).
Frequency	The effect is anticipated to occur in the non-breeding season.	The effect is anticipated to occur in the non-breeding season.
Probability	Collision mortality is considered possible in the array area in the non-breeding season.	Collision mortality is considered possible in the array area in the non-breeding season.
Consequence	Although black-headed gull collision mortality in the array area is possible in the non-breeding season, at the population level, associated mortality is predicted to be very low, which would equate to Negligible magnitude.	Although black-headed gull collision mortality in the array area is possible in the non-breeding season, at the population level, associated mortality is predicted to be very low, which would equate to Negligible magnitude.
Overall magnitude	The potential magnitude is rated as Negligible.	The potential magnitude is rated as Negligible.

6.17.89 For this assessment, receptor sensitivity has been based on three reviews of evidence from post-construction studies at offshore wind farms. A review of post-construction studies of seabirds at offshore wind farms in European waters concluded that black-headed gull was one of the species that was weakly attracted to offshore wind farms (Dierschke *et al.,* 2016). A review of vulnerability of Scottish seabirds to offshore wind turbines in the context of collision ranked black-headed gull as the 10^{th} most sensitive out of 38 species (Furness *et al.,* 2013). Bradbury *et al.,* (2014), classified the black-headed gull population vulnerability to collision mortality from offshore wind farms as moderate.

6.17.90 Estimated numbers of black-headed gulls recorded within the array area would qualify as nationally important in the non-breeding season (Offshore and Intertidal Ornithology Technical Baseline), as the available evidence does not indicate any connectivity i to any SPA with any certainty. On this basis the conservation importance for black-headed gulls was considered to be low (Table 4).

6.17.91 Overall, based on available evidence from published studies indicating a moderate to high sensitivity to collision, and the low conservation importance in the non-breeding season, it is considered that black-headed gull sensitivity to collision effects associated with Dublin Array is likely to be **Medium** (Table 4).

6.17.92 For black-headed gull, the magnitude of the impact is deemed to be **Negligible,** and the overall sensitivity of this species is considered to be **Medium**, with a number of non-breeding season SPAs designated for the species in the region. The significance of any effect on black-headed gulls from collision effects associated with Dublin Array is a **Not Significant** effect, which is **Not significant** in EIA terms.

Common gull

6.17.93 Annual estimated common gull mortality from collision impacts in the array area was based on mean densities of flying birds recorded on baseline surveys. A complete range of collision numbers for the array area, and the different design scenarios are presented in the Seabird CRM Technical Report.

6.17.94 The annual estimated number of collisions for common gull are presented in Table 64. Figures are presented for the breeding season and the non-breeding season, based on the MDO (50 turbines, Option A). Overall, very low numbers of collisions were predicted for the non-breeding season, with zero collisions predicted for the breeding season.

Table 64 Estimated numbers of collisions by season for common gull in the array area

Season	Lower 95% confidence limit	Mean number of collisions	Upper 95% confidence limit
Breeding (Mar-Aug)	0.07	0.46	0.92
Non-breeding (Sep-Feb)	0.57	3.05	5.83
Total	0.64	3.51	6.75
Total (to nearest whole bird)	1	4	7

6.17.95 In the breeding season (March to August), there were zero common gull collisions predicted (Table 64). In the non-breeding season, three common gull collisions were predicted. Due to rounding to two decimal places, the annual predicted collision mortality for common gull was four birds.

6.17.96 The total common gull regional population in the non-breeding season is estimated to be 10,242 birds, although this is considered likely to be an under-estimate (Table 15). The increase in baseline mortality was calculated based on an average mortality rate of 0.175 (Table 16). Applying this mortality rate, the estimated regional baseline mortality of common gulls is 1,792 birds in the non-breeding season (10,242 x 0.175). The additional predicted mortality of three common gulls in the non-breeding season would increase the baseline mortality rate by 0.167% (Table 65).

Table 65 Increase in estimated baseline mortality for common gulls in the array area as a result of collisions

Season	Regional baseline popn	Annual Regional Baseline Mortality	Increase in baseline mortality (%) (adults)
Breeding (Mar-Aug) (adults only)	-	-	0
Non-breeding season (Sep-Feb)	11,502	2,910	0.167
Total	-	-	0.167

6.17.97 Predicted annual common gull mortality due to collision effects based on all ages in the breeding and non-breeding seasons, involved four birds, which corresponds to an increase in the annual baseline mortality rate of 0.167% (Table 65).

6.17.98 As highlighted by Natural England guidance, where predicted impacts equate to 1% or below of baseline mortality for a population (e.g. colony population) then this level of impact could be considered non-significant (Parker *et al.,* 2022c). As the predicted increases in annual baseline mortality for common gull was below 1%, PVA was not carried out on the regional common gull population, as agreed in the East Coast Phase 1 Method Statement (GoBe, 2022).

6.17.99 Based on the results of the collision assessment, the magnitude of impact from collision effects on the regional non-breeding season common gull population was considered to be **Negligible** (Table 66).

Table 66 Determination of magnitude for common gull collision mortality

	MDO	Alternative Design Option
Extent	Very small proportion of the population is predicted to be affected	Very small proportion of the population is predicted to be affected
Duration	The impact is likely to occur throughout the operation phase of the project and will therefore be long-term, as defined by EPA (2022).	The impact is likely to occur throughout the operation phase of the project and will therefore be long-term, as defined by EPA (2022).
Frequency	The effect is anticipated to occur in the non-breeding season.	The effect is anticipated to occur in the non-breeding season.
Probability	Collision mortality is considered possible in the array area in the non-breeding season.	Collision mortality is considered possible in the array area in the non-breeding season.
Consequence	Although common gull collision mortality in the array area is possible in the non-breeding season, at the population level, associated mortality is predicted to be very low, which would equate to Negligible magnitude.	Although common gull collision mortality in the array area is possible in the non-breeding season, at the population level, associated mortality is predicted to be very low, which would equate to Negligible magnitude.
Overall magnitude	The potential magnitude is rated as Negligible.	The potential magnitude is rated as Negligible.

6.17.100 For this assessment, receptor sensitivity has been based on three reviews of evidence from post-construction studies at offshore wind farms. A review of post-construction studies of seabirds at offshore wind farms in European waters concluded that common gull was one of the species that was weakly attracted to offshore wind farms (Dierschke *et al.,* 2016). A review of vulnerability of Scottish seabirds to offshore wind turbines in the context of collision ranked common gull as the sixth most sensitive out of 38 species (Furness *et al.,* 2013). Bradbury *et al.,* (2014), classified the common gull population vulnerability to collision mortality from offshore wind farms as high.

6.17.101 Estimated numbers of common gulls recorded within the array area would qualify as nationally important in the non-breeding season (Offshore and Intertidal Ornithology Technical Baseline as the available evidence does not indicate any connectivity to any SPA with any certainty. On this basis the conservation importance for common gull was considered to be low.

6.17.102 Overall, based on available evidence from published studies indicating a high sensitivity to collision, and the low conservation importance in the non-breeding season, it is considered that common gull sensitivity to collision effects associated with Dublin Array is likely to be **High** (Table 4).

6.17.103 For common gull, the magnitude of the impact is deemed to be **Negligible** and the overall sensitivity of this species is considered to be **High**, with a number of non-breeding season SPAs designated for the species in the region. The significance of any effect on common gulls from collision effects associated with Dublin Array is a **Not Significant** effect, which is **Not significant** in EIA terms.

Lesser black-backed gull

6.17.104 Annual estimated lesser black-backed gull mortality from collision impacts in the array area was based on mean densities of flying birds recorded on baseline surveys. A complete range of collision numbers for the array area, and the different design scenarios are presented in the Seabird CRM Technical Report.

6.17.105 The annual estimated number of collisions for lesser black-backed gull are presented in Table 67. Figures are presented for the breeding season and the autumn migration, winter and spring migration periods of the non-breeding season, based on the MDO (50 turbines, Option A). Highest numbers of collisions were predicted for the breeding season, with fewer collisions predicted for the autumn migration, winter and spring migration periods of the non-breeding season.

Table 67 Estimated numbers of collisions by season for lesser black-backed gull in the array area

Season	Lower 95% confidence limit	Mean number of collisions	Upper 95% confidence limit
Breeding (Apr-Aug)	0.70	3.28	6.58
Autumn migration (Sept-Oct)	0.02	0.27	0.62
Winter period (Nov-Feb)	0.03	0.37	0.84
Spring migration (Mar)	0.01	0.15	0.36
Total	0.76	4.07	8.4
Total (to nearest whole bird)	1	4	8

6.17.106 In the breeding season (April to August), the total estimated number of lesser black-backed gull collisions was three birds (Table 67). However, this includes non-breeding adults and immature birds, as well as breeding adults. Based on the proportion of immature lesser black-backed gulls recorded on baseline surveys in the breeding season (see Offshore and Intertidal Ornithology Technical Baseline), it was assumed that 65.5% of the population present are immature birds. This would mean that an estimated two lesser black-backed gulls predicted to collide during the breeding season would be immature birds. Therefore, breeding season lesser black-backed gull mortality was considered to involve one adult bird and two immature birds.

6.17.107 Similarly, a proportion of adult birds present at colonies in the breeding season will opt not to breed in a particular breeding season. It has been estimated that 35% of adult lesser black-backed gulls may be "sabbatical" birds in any particular breeding season (RPS, 2022), and this has been applied for this assessment. On this basis, 0.35 adult lesser black-backed gulls predicted to collide were considered not to be breeding, however, for this assessment numbers have been rounded to the nearest whole bird for clarity, therefore lesser black-backed gull mortality was considered to be one adult breeding bird.

6.17.108 The total lesser black-backed gull regional breeding population is estimated to be 39,684 adult birds (Table 14). For the breeding season assessment based on adult birds only, the increase in baseline mortality was calculated based on an estimated adult lesser black-backed gull baseline survival rate of 0.885, therefore the corresponding rate for adult lesser black-backed gull mortality is 0.115 (Table 16). Applying this mortality rate, the estimated regional baseline mortality of lesser black-backed gulls is 4,564 adult birds per breeding season (39,684 x 0.115). The additional predicted mortality of one breeding adult lesser black-backed gull in the breeding season would increase the baseline mortality rate by 0.02% (Table 68).

Table 68 Increase in estimated baseline mortality for adult lesser black-backed gull in the array area as a result of collisions

Season	Regional baseline popn	Annual Regional Baseline Mortality	Increase in baseline mortality (%) (adults)
Breeding (Apr-Aug)	39,684	4,564	0.02
Non-breeding season (Sep-Mar)	52,385	6,443	0.016
Total	-	-	0.036

6.17.109 For the autumn migration, winter and spring migration periods of the non-breeding season, the combined estimated lesser black-backed gull mortality from collision was one bird, when rounded to the nearest whole bird (Table 68). These periods have therefore been considered as non-breeding season in Table 58 and assessed against the estimated regional population for the winter period. The lesser black-backed gull regional population for the winter period of the non-breeding season is estimated to be 52,385 birds (Table 15). The increase in baseline mortality was calculated based on an average lesser black-backed gull baseline mortality rate of 0.123 (Table 16). Applying this mortality rate, the estimated regional baseline mortality of lesser black-backed gulls is 6,443 birds for the winter period of the non-breeding season (52,385 x 0.123). The additional predicted mortality of one lesser black-backed gull in the non-breeding season would increase the baseline mortality rate by 0.016% (Table 68).

6.17.110 Predicted annual lesser black-backed gull mortality due to collision effects based on adult birds in the breeding season and all ages in the non-breeding season, involved four birds, which corresponds to an increase in the annual baseline mortality rate of 0.036% (Table 68).

6.17.111 A comparison of estimated lesser black-backed gull mortality from collisions against a regional population consisting of adult and immature birds is shown in (Table 69). The predicted additional mortality due to collision effects was three lesser black-backed gulls (all ages) in the breeding season. The total lesser black-backed gull regional breeding population (all ages) is estimated to be 74,447 birds (Table 14). The average mortality for all age classes is 0.123 (Table 16). Applying this mortality rate, the estimated regional baseline mortality of lesser black-backed gulls is 9,157 birds per breeding season (all ages) (74,447 x 0.123). The additional predicted mortality of three lesser black-backed gulls in the breeding season would increase the baseline mortality rate by 0.033% (Table 69).

6.17.112 For the autumn migration, winter and spring migration periods of the non-breeding season, the combined estimated lesser black-backed gull mortality from collision was one bird, when rounded to the nearest whole bird. As above, the additional predicted mortality of one lesser black-backed gull in the non-breeding season would increase the baseline mortality rate by 0.016% (Table 69).

Table 69 Increase in estimated baseline mortality for lesser black-backed gull (all ages) in the array area as a result of collisions

Season	Regional baseline popn	Annual Regional Baseline Mortality	Increase in baseline mortality (%) (all ages)
Breeding (Apr-Aug)	74,447	9,157	0.033
Non-breeding season (Sep-Mar	52,385	6,443	0.016
Total	-	-	0.049

6.17.113 Predicted annual lesser black-backed gull mortality due to collision effects based on all ages in the breeding and non-breeding seasons, involved four birds, which corresponds to an increase in the annual baseline mortality rate of 0.049% (Table 69).

6.17.114 As highlighted by Natural England guidance, where predicted impacts equate to 1% or below of baseline mortality for a population (e.g. colony population) then this level of impact could be considered non-significant (Parker *et al.,* 2022c). As the predicted increases in annual baseline mortality for lesser black-backed gull were below 1%, PVA was not carried out on the regional lesser black-backed gull population, as agreed in the East Coast Phase 1 Method Statement (GoBe, 2022).

6.17.115 Based on the results of the collision assessment, the magnitude of impact from collision effects on the regional lesser black-backed gull populations was considered to be **Negligible** (Table 70).

Table 70 Determination of magnitude for lesser black-backed gull collision mortality

	MDO	Alternative Design Option
Extent	Very small proportion of the population is predicted to be affected	Very small proportion of the population is predicted to be affected
Duration	The impact is likely to occur throughout the operation phase of the project and will therefore be long-term, as defined by EPA (2022).	The impact is likely to occur throughout the operation phase of the project and will therefore be long-term, as defined by EPA (2022).

	MDO	Alternative Design Option
Frequency	The effect is anticipated to occur throughout the year.	The effect is anticipated to occur in the non-breeding season.
Probability	Collision mortality is considered possible in the array area throughout the year.	Collision mortality is considered possible in the array area in the non-breeding season.
Consequence	Although lesser black-backed gull collision mortality in the array area is possible throughout the year, at the population level, associated mortality is predicted to be very low, which would equate to Negligible magnitude.	Although lesser black-backed gull collision mortality in the array area is possible throughout the year, at the population level, associated mortality is predicted to be very low, which would equate to Negligible magnitude.
Overall magnitude	The potential magnitude is rated as Negligible.	The potential magnitude is rated as Negligible.

6.17.116 For this assessment, receptor sensitivity has been based on three reviews of evidence from post-construction studies at offshore wind farms. A review of post-construction studies of seabirds at offshore wind farms in European waters concluded that lesser black-backed gull was one of the species that was weakly attracted to offshore wind farms (Dierschke *et al.,* 2016). A review of vulnerability of Scottish seabirds to offshore wind turbines in the context of collision ranked lesser black-backed gull as the third most sensitive out of 38 species (Furness *et al.,* 2013). Bradbury *et al.,* (2014), classified the lesser black-backed gull population vulnerability to collision mortality from offshore wind farms as very high.

6.17.117 Estimated numbers of lesser black-backed gulls recorded within the array area would qualify as internationally important in the breeding season (Offshore and Intertidal Ornithology Technical Baseline), with individuals potentially originating from a number of SPAs in the region, as well as non-SPA colonies. On this basis the conservation importance for lesser black-backed gull was considered to be medium (Table 4).

6.17.118 Overall, based on available evidence from published studies indicating a high sensitivity to collision, and the origin of birds from SPA and non-SPA colonies in the region, it is considered that lesser black-backed gull sensitivity to collision effects associated with Dublin Array is likely to be **High** (Table 4).

6.17.119 For lesser black-backed gull, the magnitude of the impact is deemed to be **Negligible,** and the overall sensitivity of this species is considered to be **High**, with individuals potentially originating from a number of SPAs in the region, as well as non-SPA colonies. The significance of any effect on lesser black-backed gulls from collision effects associated with Dublin Array is a **Not Significant** effect, which is not significant in EIA terms.

Herring gull

6.17.120 Annual estimated herring gull mortality from collision impacts in the array area was based on mean densities of flying birds recorded on baseline surveys. A complete range of collision numbers for the array area, and the different design scenarios are presented in the Seabird CRM Technical Report.

6.17.121 The annual estimated number of collisions for herring gull are presented in Table 71. Figures are presented for the breeding and non-breeding seasons, based on the MDO (50 turbines, Option A). Predicted numbers of collisions were slightly lower for the breeding season compared to the non-breeding season.

Table 71 Estimated numbers of collisions by season for herring gull in the array area

Season	Lower 95% confidence limit	Mean number of collisions	Upper 95% confidence limit
Breeding (Mar-Aug)	3.24	16.14	32.48
Non-breeding (Sept-Feb)	5.50	19.87	36.65
Total	8.74	36.01	69.13
Total (to nearest whole bird)	9	36	69

6.17.122 In the breeding season (March to August), the total estimated number of herring gull collisions was 16 birds (Table 71). However, this includes non-breeding adults and immature birds, as well as breeding adults. Based on the proportion of immature herring gulls recorded on baseline surveys in the breeding season (see Offshore and Intertidal Ornithology Technical Baseline), it was assumed that 58.8% of the population present are immature birds. This would mean that an estimated nine herring gulls predicted to collide during the breeding season would be immature birds. Therefore, breeding season herring gull mortality was considered to involve seven adult bird and nine immature birds.

6.17.123 Similarly, a proportion of adult birds present at colonies in the breeding season will opt not to breed in a particular breeding season. It has been estimated that 35% of adult herring gulls may be “sabbatical” birds in any particular breeding season (RPS, 2022), and this has been applied for this assessment. On this basis, two adult herring gulls predicted to collide were considered not to be breeding, therefore herring gull mortality was considered to involve five adult breeding birds, two adult non-breeding birds and nine immature birds.

6.17.124 The total herring gull regional breeding population is estimated to be 8,264 adult birds (Table 72). For the breeding season assessment based on adult birds only, the increase in baseline mortality was calculated based on an estimated adult herring gull baseline survival rate of 0.834, therefore the corresponding rate for adult herring gull mortality is 0.166 (Table 16). Applying this mortality rate, the estimated regional baseline mortality of herring gulls is 1,372 adult birds per breeding season (8,264 x 0.166). The additional predicted mortality of five breeding adult herring gulls in the breeding season would increase the baseline mortality rate by 0.364% (Table 72).

Table 72 Increase in estimated baseline mortality for adult herring gull in the array area as a result of collisions

Season	Regional baseline popn	Annual Regional Baseline Mortality	Increase in baseline mortality (%) (adults)
Breeding (Mar-Aug)	8,264	1,372	0.364
Non-breeding (Sept-Feb)	187,094	32,180	0.062

Season	Regional baseline popn	Annual Regional Baseline Mortality	Increase in baseline mortality (%) (adults)
Total	-	-	0.426

6.17.125 For the non-breeding season, the estimated herring gull mortality from collision was 20 birds, when rounded to the nearest whole bird (Table 72). The herring gull regional population for the non-breeding season is estimated to be 187,094 birds (Table 15). The increase in baseline mortality was calculated based on an average herring gull baseline mortality rate of 0.172 (Table 16). Applying this mortality rate, the estimated regional baseline mortality of herring gulls is 32,180 birds for non-breeding season (187,094 x 0.172). The additional predicted mortality of 20 herring gulls in the non-breeding season would increase the baseline mortality rate by 0.062% (Table 72).

6.17.126 Predicted annual herring gull mortality due to collision effects based on adult birds in the breeding season and all ages in the non-breeding season, involved 36 birds, which corresponds to an increase in the annual baseline mortality rate of 0.426% (Table 72).

6.17.127 A comparison of estimated herring gull mortality from collisions against a regional population consisting of adult and immature birds is shown in Table 73. The predicted additional mortality due to collision effects was 16 herring gulls (all ages) in the breeding season (Table 72). The total herring gull regional breeding population (all ages) is estimated to be 16,529 birds (Table 14). The average mortality for all age classes is 0.172 (Table 16). Applying this mortality rate, the estimated regional baseline mortality of herring gulls is 2,843 birds per breeding season (all ages) (16,529 x 0.172). The additional predicted mortality of 20 herring gulls in the breeding season would increase the baseline mortality rate by 0.703% (Table 73).

Table 73 Increase in estimated baseline mortality for herring gull (all ages) in the array area as a result of collisions

Season	Regional baseline popn	Annual Regional Baseline Mortality	Increase in baseline mortality (%) (all ages)
Breeding (Mar-Aug)	16,529	2,843	0.703
Non-breeding (Sept-Feb)	187,094	32,180	0.062
Total	-	-	0.765

6.17.128 For the non-breeding season, the estimated herring gull mortality from collision was 20 birds, when rounded to the nearest whole bird (Table 72). The herring gull regional population for the non-breeding season is estimated to be 187,094 birds (Table 15). Applying the mortality rate of 0.172 (Table 16), the estimated regional baseline mortality of herring gulls is 32,180 birds for non-breeding season (187,094 x 0.172). The additional predicted mortality of 20 herring gulls in the non-breeding season would increase the baseline mortality rate by 0.062% (Table 73).

6.17.129 Predicted annual herring gull mortality due to collision effects based on all ages in the breeding and non-breeding seasons, involved 36 birds, which corresponds to an increase in the annual baseline mortality rate of 0.765% (Table 73).

6.17.130 As highlighted by Natural England guidance, where predicted impacts equate to 1% or below of baseline mortality for a population (e.g. colony population) then this level of impact could be considered non-significant (Parker *et al.,* 2022c). As the predicted increases in annual baseline mortality for herring gull were below 1%, PVA was not carried out on the regional herring gull population, as agreed in the East Coast Phase 1 Method Statement (GoBe, 2022).

6.17.131 Based on the results of the collision assessment, the magnitude of impact from collision effects on the regional herring gull populations was considered to be **Negligible** (Table 74).

Table 74 Determination of magnitude for herring gull collision mortality

	MDO	Alternative Design Option
Extent	Very small proportion of the population is predicted to be affected	Very small proportion of the population is predicted to be affected
Duration	The impact is likely to occur throughout the operation phase of the project and will therefore be long-term, as defined by EPA (2022).	The impact is likely to occur throughout the operation phase of the project and will therefore be long-term, as defined by EPA (2022).
Frequency	The effect is anticipated to occur throughout the year.	The effect is anticipated to occur in the non-breeding season.
Probability	Collision mortality is considered possible in the array area throughout the year.	Collision mortality is considered possible in the array area in the non-breeding season.
Consequence	Although herring gull collision mortality in the array area is possible throughout the year, at the population level, associated mortality is predicted to be very low, which would equate to Negligible magnitude.	Although herring gull collision mortality in the array area is possible throughout the year, at the population level, associated mortality is predicted to be very low, which would equate to Negligible magnitude.
Overall magnitude	The potential magnitude is rated as Negligible.	The potential magnitude is rated as Negligible.

6.17.132 For this assessment, receptor sensitivity has been based on three reviews of evidence from post-construction studies at offshore wind farms. A review of post-construction studies of seabirds at offshore wind farms in European waters concluded that herring gull was one of the species that was weakly attracted to offshore wind farms (Dierschke *et al.,* 2016). A review of vulnerability of Scottish seabirds to offshore wind turbines in the context of collision ranked herring gull as the most sensitive out of 38 species (Furness *et al.,* 2013). Bradbury *et al.,* (2014), classified the herring gull population vulnerability to collision mortality from offshore wind farms as very high.

6.17.133 Estimated numbers of herring gulls recorded within the array area would qualify as internationally important in the breeding season (Offshore and Intertidal Ornithology Technical Baseline), with individuals potentially originating from a number of SPAs in the region, as well as non-SPA colonies. On this basis the conservation importance for herring gull was considered to be medium.

6.17.134 Overall, based on available evidence from published studies indicating a high sensitivity to collision, and the origin of birds from SPA and non-SPA colonies in the region, it is considered that herring gull sensitivity to collision effects associated with Dublin Array is likely to be **High** (Table 4).

6.17.135 For herring gull, the magnitude of the impact is deemed to be **Negligible** and the overall sensitivity of this species is considered to be **High**, with individuals potentially originating from a number of SPAs in the region, as well as non-SPA colonies. The significance of any effect on herring gulls from collision effects associated with Dublin Array is a **Not Significant** effect, which is **Not significant** in EIA terms.

Great black-backed gull

6.17.136 Annual estimated great black-backed gull mortality from collision impacts in the array area was based on mean densities of flying birds recorded on baseline surveys. A complete range of collision numbers for the array area, and the different design scenarios are presented in the Seabird CRM Technical Report.

6.17.137 The annual estimated number of collisions for great black-backed gull are presented in Table 75. Figures are presented for the breeding season and the non-breeding season, based on the MDO (50 turbines, Option A). Predicted numbers of collisions were lower for the breeding season compared to the non-breeding season.

Table 75 Estimated numbers of collisions by season for great black-backed gull in the array area

Season	Lower 95% confidence limit	Mean number of collisions	Upper 95% confidence limit
Breeding (late Mar-Aug)	0.42	3.72	8.01
Non-breeding (Sep-Feb)	0.55	5.29	11.77
Total	0.97	9.01	19.78
Total (to nearest whole bird)	1	9	20

6.17.138 In the breeding season (late March to August), the total estimated number of great black-backed gull collisions was four birds (Table 75). However, this includes non-breeding adults and immature birds, as well as breeding adults. Based on the proportion of immature great black-backed gulls recorded on baseline surveys in the breeding season (see Offshore and Intertidal Ornithology Technical Baseline), it was assumed that 34.9% of the population present are immature birds. This would mean that an estimated one great black-backed gull predicted to collide during the breeding season would be an immature bird. Therefore, breeding season great black-backed gull mortality was considered to involve three adult birds and one immature bird.

6.17.139 Similarly, a proportion of adult birds present at colonies in the breeding season will opt not to breed in a particular breeding season. It has been estimated that 35% of adult great black-backed gulls may be "sabbatical" birds in any particular breeding season (Xodus, 2023), and this has been applied for this assessment. On this basis, one adult great black-backed gull predicted to collide was considered not to be breeding. Therefore, great black-backed gull mortality was considered to involve two adult breeding birds, one adult non-breeding bird and one immature bird.

6.17.140 The total great black-backed gull regional breeding population is estimated to be 940 adult birds (Table 76). For the breeding season assessment based on adult birds only, the increase in baseline mortality was calculated based on an estimated adult great black-backed gull baseline survival rate of 0.930, therefore the corresponding rate for adult great black-backed gull mortality is 0.07 (Table 76). Applying this mortality rate, the estimated regional baseline mortality of great black-backed gulls is 66 adult birds per breeding season (940 x 0.07). The additional predicted mortality of two breeding adult great black-backed gulls in the breeding season would increase the baseline mortality rate by 3.03% (Table 76).

Table 76 Increase in estimated baseline mortality for adult great black-backed gull in the array area as a result of collisions

Season	Regional baseline popn	Annual Regional Baseline Mortality	Increase in baseline mortality (%) (adults)
Breeding (late Mar-Aug)	940	66	3.03
Non-breeding (Sep-Feb)	53,406	5,074	0.099
Total	-	-	3.129

6.17.141 For the non-breeding season, the estimated great black-backed gull mortality from collision was five birds, when rounded to the nearest whole bird (Table 75). The great black-backed gull regional population for the non-breeding season is estimated to be 53,406 birds (Table 15). The increase in baseline mortality was calculated based on an average great black-backed gull baseline mortality rate of 0.095 (Table 16). Applying this mortality rate, the estimated regional baseline mortality of great black-backed gulls is 5,074 birds for the non-breeding season (53,406 x 0.095). The additional predicted mortality of five great black-backed gulls in the non-breeding season would increase the baseline mortality rate by 0.099% (Table 76).

6.17.142 Predicted annual great black-backed gull mortality due to collision effects based on adult birds in the breeding season and all ages in the non-breeding season, involved seven birds, which corresponds to an increase in the annual baseline mortality rate of 3.129% (Table 76).

6.17.143 A comparison of estimated great black-backed gull mortality from collisions against a regional population consisting of adult and immature birds is shown in Table 77. The predicted additional mortality due to collision effects was four great black-backed gulls (all ages) in the breeding season (Table 76). The total great black-backed gull regional breeding population (all ages) is estimated to be 2,386 birds (Table 14). The average mortality for all age classes is 0.095 (Table 16). Applying this mortality rate, the estimated regional baseline mortality of great black-backed gulls is 227 birds per breeding season (all ages) (2,386 x 0.095). The additional predicted mortality of four great black-backed gulls in the breeding season would increase the baseline mortality rate by 1.762% (Table 77).

Table 77 Increase in estimated baseline mortality for great black-backed gull (all ages) in the array area as a result of collisions

Season	Regional baseline popn	Annual Regional Baseline Mortality	Increase in baseline mortality (%) (all ages)
Breeding (late Mar-Aug)	2,386	227	1.762
Non-breeding (Sep-Feb)	53,406	5,074	0.099
Total	-	-	1.861

6.17.144 For the non-breeding season, the estimated great black-backed gull mortality from collision was five birds, when rounded to the nearest whole bird (Table 75). The great black-backed gull regional population for the non-breeding season is estimated to be 53,406 birds (Table 15). Applying the mortality rate of 0.095, the estimated regional baseline mortality of great black-backed gulls is 5,074 birds for the non-breeding season (53,406 x 0.095). The additional predicted mortality of five great black-backed gulls in the non-breeding season would increase the baseline mortality rate by 0.099% (Table 77).

6.17.145 Predicted annual great black-backed gull mortality due to collision effects based on all ages in the breeding and non-breeding seasons, involved nine birds, which corresponds to an increase in the annual baseline mortality rate of 1.861% (Table 77).

6.17.146 As the predicted percentage increase in the baseline mortality rate exceeded 1%, PVA was carried out on the regional great black-backed gull population considering a wide range of collision scenarios. The results of the regional PVAs for predicted collision impacts during the 35-year operational phase is summarised in Table 78. Further details of the PVA methodology, input parameters and an explanation of how to interpret the PVA results can be found in PVA Technical Report.

Table 78 Summary of PVA collision outputs for the regional great black-backed gull population for the array area after 35 years

Scenario	Counterfactual of Population Growth Rate		Counterfactual of Population Size		50% Quantiles	
	Median	Mean	Median	Mean	U=50%I	I=50%U
Project alone	0.9959	0.9959	0.8634	0.8641	34.6	66.14

6.17.147 For the regional great black-backed gull population over 35 years, the PVA model predicted a small reduction in growth rate by 0.41% (median CGR = 0.99.59) and a reduction in population size by 13.66% (median CPS = 0.8634; Table 78).

6.17.148 These values indicate that the PVA predicted a slight negative effect from the project alone effects of displacement mortality on the great black-backed gull regional population after 35 years, however, the predicted effects were not considered to be significant, as the population with Dublin Array was still predicted to increase over the lifetime of the project (PVA Technical Report).

6.17.149 Based on the results of the collision assessment and the PVA assessment, the magnitude of impact from collision effects on the regional great black-backed gull populations was considered to be Low to Medium, as the estimated increases in the annual baseline mortality rate were between 1.8% and 3.1% (Table 6), However, since the PVA outputs based on these rates did not predict a significant negative effect, it is considered that the magnitude of impact based on these rates is therefore **Low** (Table 79)**.**

Table 79 Determination of magnitude for great black-backed gull collision mortality

	MDO	Alternative Design Option
Extent	Small proportion of the population is predicted to be affected	Small proportion of the population is predicted to be affected
Duration	The impact is likely to occur throughout the operation phase of the project and will therefore be long-term, as defined by EPA (2022).	The impact is likely to occur throughout the operation phase of the project and will therefore be long-term, as defined by EPA (2022).
Frequency	The effect is anticipated to occur throughout the year.	The effect is anticipated to occur in the non-breeding season.
Probability	Collision mortality is considered possible in the array area throughout the year.	Collision mortality is considered possible in the array area in the non-breeding season.
Consequence	Although great black-backed gull collision mortality in the array area is possible throughout the year, at the population level, associated mortality is predicted by PVA to be low, which would equate to Low magnitude.	Although great black-backed gull collision mortality in the array area is possible throughout the year, at the population level, associated mortality is predicted by PVA to be low, which would equate to Low magnitude.
Overall magnitude	The potential magnitude is rated as Low.	The potential magnitude is rated as Low.

6.17.150 For this assessment, receptor sensitivity has been based on three reviews of evidence from post-construction studies at offshore wind farms. A review of post-construction studies of seabirds at offshore wind farms in European waters concluded that great black-backed gull was one of the species that was weakly attracted to offshore wind farms (Dierschke *et al.,* 2016). A review of vulnerability of Scottish seabirds to offshore wind turbines in the context of collision ranked great black-backed gull as the second most sensitive out of 38 species (Furness *et al.,* 2013). Bradbury *et al.,* (2014), classified the great black-backed gull population vulnerability to collision mortality from offshore wind farms as very high.

6.17.151 Great black-backed gull is not listed as a qualifying interest in the breeding season for any SPA within mean maximum foraging distance. The species is listed as a qualifying interest for the North West Irish Sea SPA in the non-breeding season (NPWS, 2023a). Great black-backed gull is Green-listed in Ireland in terms of its conservation status (Gilbert *et al.,* 2021), indicating that it is not a species of conservation concern. On this basis, it is considered that great black-backed gull is of "local" importance in terms of its conservation value. Although the species has a high behavioural sensitivity to collision impacts, it is only of local conservation importance, leading to an overall **Medium** sensitivity to collision risk (Table 4).

6.17.152 For great black-backed gull, the magnitude of the impact is deemed to be **Low** and the overall sensitivity of this species is considered to be **Medium**, with low conservation importance in the breeding and non-breeding seasons. The significance of any effect on great black-backed gulls from collision effects associated with Dublin Array is a **Slight Adverse** effect, which is **Not significant** in EIA terms.

Kittiwake

6.17.153 Annual estimated kittiwake mortality from collision impacts in the array area was based on mean densities of flying birds recorded on baseline surveys. A complete range of collision numbers for the array area, and the different design scenarios are presented in the Seabird CRM Technical Report.

6.17.154 The annual estimated number of collisions for kittiwake are presented in Table 80. Figures are presented for the breeding season and the autumn and spring migration periods of the non-breeding season, based on the MDO (50 turbines, Option A). Highest numbers of collisions were predicted for the breeding season, with lower numbers of collisions predicted for the autumn and spring migration periods of the non-breeding season.

Table 80 Estimated numbers of collisions by season for kittiwake in the array area

Season	Lower 95% confidence limit	Mean number of collisions	Upper 95% confidence limit
Migration-free Breeding season (May-Jul)	6.60	13.57	21.69
Autumn migration (Aug-Dec)	2.97	10.47	18.52
Spring migration (Jan-Apr)	2.30	5.45	9.09
Total	11.87	29.49	49.3
Total (to nearest whole bird)	12	29	49

6.17.155 In the migration-free breeding season (May to July), the total mean estimated number of kittiwake collisions was 14 birds (Table 80). However, this includes non-breeding adults and immature birds, as well as breeding adults. Based on the proportion of immature kittiwakes recorded on baseline surveys in the breeding season (see Offshore and Intertidal Ornithology Technical Baseline), it was assumed that 2.5% of the population present are immature birds. This would mean that an estimated 0.35 kittiwakes predicted to collide during the breeding season would be immature birds. However, for this assessment numbers have been rounded to the nearest whole bird for clarity, therefore breeding season kittiwake mortality was considered to involve 14 adult birds.

6.17.156 Similarly, a proportion of adult birds present at colonies in the breeding season will opt not to breed in a particular breeding season. It has been estimated that 10% of adult kittiwakes may be “sabbatical” birds in any particular breeding season (Xodus, 2023), and this has been applied for this assessment. On this basis, one adult kittiwake predicted to collide was considered not to be breeding. Therefore, kittiwake mortality in the breeding season was considered to involve 13 adult breeding birds and one non-breeding adult.

6.17.157 The total kittiwake regional breeding population is estimated to be 70,260 adult birds (Table 14). For the breeding season assessment based on adult birds only, the increase in baseline mortality was calculated based on an estimated adult kittiwake baseline survival rate of 0.854, therefore the corresponding rate for adult kittiwake mortality is 0.146 (Table 16). Applying this mortality rate, the estimated regional baseline mortality of kittiwakes is 10,258 adult birds per breeding season (70,260 x 0.146). The additional predicted mortality of 13 breeding adult kittiwakes in the breeding season would increase the baseline mortality rate by 0.127% (Table 81).

Table 81 Increase in estimated baseline mortality for adult kittiwake in the array area as a result of collisions

Season	Regional baseline popn	Annual Regional Baseline Mortality	Increase in baseline mortality (%) (adults)
Migration-free Breeding season (May-Jul)	70,260	10,258	0.127
Autumn migration (Aug-Dec)	933,197	145,579	0.007
Spring migration (Jan-Apr)	713,137	111,249	0.004
Total	-	-	0.138

6.17.158 For the autumn migration period of the non-breeding season, estimated kittiwake mortality from collision was 10 birds, when rounded to the nearest whole bird (Table 80). The kittiwake regional population for the autumn migration period is estimated to be 933,197 birds (Table 15). The increase in baseline mortality was calculated based on an average kittiwake baseline mortality rate of 0.156 (Table 16). Applying this mortality rate, the estimated regional baseline mortality of kittiwakes is 145,579 birds for the autumn migration period (933,197 x 0.156). The additional predicted mortality of 10 kittiwakes in the autumn migration period of the non-breeding season would increase the baseline mortality rate by 0.007% (Table 81).

6.17.159 For the spring migration period of the non-breeding season, estimated kittiwake mortality from collision was five birds, when rounded to the nearest whole bird (Table 80). The kittiwake regional population for the spring migration period is estimated to be 713,137 birds (Table 15). Applying the baseline mortality rate of 0.156 (Table 16), the estimated regional baseline mortality of kittiwakes is 111,249 birds for the spring migration period (713,137 x 0.156). The additional predicted mortality of five kittiwakes in the spring migration period of the non-breeding season would increase the baseline mortality rate by 0.004% (Table 81).

6.17.160 Predicted annual kittiwake mortality due to collision effects based on adult birds in the breeding season and all ages in the autumn and spring migration periods of the non-breeding season, involved 28 birds, which corresponds to an increase in the annual baseline mortality rate of 0.138% (Table 81).

6.17.161 A comparison of estimated kittiwake mortality from collisions against a regional population consisting of adult and immature birds is shown in Table 82. The predicted additional mortality due to collision effects was 14 kittiwakes (all ages) in the migration-free breeding season (May to July) (Table 81). The total kittiwake regional breeding population (all ages) is estimated to be 133,353 birds (Table 14). The average mortality for all age classes is 0.156 (Table 16). Applying this mortality rate, the estimated regional baseline mortality of kittiwakes is 20,803 birds per breeding season (all ages) (133,353 x 0.156). The additional predicted mortality of 14 kittiwakes in the breeding season would increase the baseline mortality rate by 0.067% (Table 82).

Table 82 Increase in estimated baseline mortality for kittiwake (all ages) in the array area as a result of collisions

Season	Regional baseline popn	Annual Regional Baseline Mortality	Increase in baseline mortality (%) (adults)
Migration-free Breeding season (May-Jul)	133,353	20,803	0.067
Autumn migration (Aug-Dec)	933,197	145,579	0.007
Spring migration (Jan-Apr)	713,137	111,249	0.004
Total	-	-	0.078

6.17.162 As above, the additional predicted mortality of 10 kittiwakes in the autumn migration period of the non-breeding season would increase the baseline mortality rate by 0.007%. The additional predicted mortality of five kittiwakes in the spring migration period of the non-breeding season would increase the baseline mortality rate by 0.004% (Table 82).

6.17.163 Predicted annual kittiwake mortality due to collision effects based on all ages in the breeding season and the autumn and spring migration periods of the non-breeding season, involved 29 birds, which corresponds to an increase in the annual baseline mortality rate of 0.078% (Table 82).

6.17.164 As highlighted by Natural England guidance, where predicted impacts equate to 1% or below of baseline mortality for a population (e.g. colony population) then this level of impact could be considered non-significant (Parker *et al.,* 2022c). As the predicted increases in annual baseline mortality for kittiwake were below 1%, PVA was not carried out on the regional kittiwake population, as agreed in the East Coast Phase 1 Method Statement (GoBe, 2022).

6.17.165 Based on the results of the collision assessment, the magnitude of impact from collision effects on the regional kittiwake population was considered to be **Negligible** (Table 83).

Table 83 Determination of magnitude for kittiwake collision mortality

	MDO	Alternative Design Option
Extent	Very small proportion of the population is predicted to be affected	Very small proportion of the population is predicted to be affected
Duration	The impact is likely to occur throughout the operation phase of the project and will therefore be long-term, as defined by EPA (2022).	The impact is likely to occur throughout the operation phase of the project and will therefore be long-term, as defined by EPA (2022).
Frequency	The effect is anticipated to occur throughout the year.	The effect is anticipated to occur in the non-breeding season.
Probability	Collision mortality is considered possible in the array area throughout the year.	Collision mortality is considered possible in the array area in the non-breeding season.
Consequence	Although kittiwake collision mortality in the array area is possible throughout the year, at the population level, associated mortality is predicted to be very low, which would equate to Negligible magnitude.	Although kittiwake collision mortality in the array area is possible throughout the year, at the population level, associated mortality is predicted to be very low, which would equate to Negligible magnitude.
Overall magnitude	The potential magnitude is rated as Negligible.	The potential magnitude is rated as Negligible.

6.17.166 For this assessment, receptor sensitivity has been based on three reviews of evidence from post-construction studies at offshore wind farms. A review of post-construction studies of seabirds at offshore wind farms in European waters concluded that kittiwake was one of the species that was hardly affected by offshore wind farms (Dierschke *et al.,* 2016). A review of vulnerability of Scottish seabirds to offshore wind turbines in the context of collision ranked kittiwake as the seventh most sensitive out of 38 species (Furness *et al.,* 2013). Bradbury *et al.,* (2014), classified the kittiwake population vulnerability to collision mortality from offshore wind farms as high.

6.17.167 Estimated numbers of kittiwakes recorded within the array area would qualify as internationally important in the breeding season (Offshore and Intertidal Ornithology Technical Baseline), with individuals potentially originating from a number of SPAs in the region, as well as non-SPA colonies. On this basis the conservation importance for kittiwake was considered to be medium.

6.17.168 Overall, based on available evidence from published studies indicating a high sensitivity to collision, and the origin of birds from SPA and non-SPA colonies in the region, it is considered that kittiwake sensitivity to collision effects associated with Dublin Array is likely to be **High** (Table 4).

6.17.169 For kittiwake, the magnitude of the impact is deemed to be **Negligible** and the overall sensitivity of this species is considered to be **High**, with individuals potentially originating from a number of SPAs in the region, as well as non-SPA colonies. The significance of any effect on kittiwakes from collision effects associated with Dublin Array is a **Not Significant** effect, which is **Not significant** in EIA terms.

Sandwich tern

6.17.170 Annual estimated Sandwich tern mortality from collision impacts in the array area was based on mean densities of flying birds recorded on baseline surveys. A complete range of collision numbers for the array area, and the different design scenarios are presented in the Seabird CRM Technical Report.

6.17.171 The annual estimated number of collisions for Sandwich tern are presented in Table 84. Figures are presented for the breeding season and the autumn and spring migration periods of the non-breeding season, based on the MDO (50 turbines, Option A). Collisions were only predicted for August and were very low (0.07 birds). Given that there are no Sandwich tern breeding colonies within mean maximum foraging range (+1S.D.), and there were no sightings of Sandwich terns in the array area in June or July, it is considered that birds in August were likely to be migrating south after the breeding season. The predicted collisions for August were therefore considered to be birds on autumn migration, rather than breeding birds.

Table 84 Estimated numbers of collisions by season for Sandwich tern in the array area

Season	Lower 95% confidence limit	Mean number of collisions	Upper 95% confidence limit
Breeding season (Apr-Aug)	0	0	0
Autumn migration (Jul-Sep)	0	0.07	0.16
Spring migration (Mar-May)	0	0	0
Total	0	0.07	0.16
Total (to nearest whole bird)	0	0	0

6.17.172 When rounded to the nearest whole bird, predicted annual Sandwich tern mortality due to collision effects was zero, which would not result in an increase in the annual baseline mortality rate.

6.17.173 Based on the results of the collision assessment, the magnitude of impact from collision effects on the regional Sandwich tern population was considered to be **Negligible**, as the estimated increases in the annual baseline mortality rate were below 1%, based on zero predicted collisions (Table 85).

Table 85 Determination of magnitude for Sandwich tern collision mortality

	MDO	Alternative Design Option
Extent	Zero predicted collisions therefore none of the population is predicted to be affected	Zero predicted collisions therefore none of the population is predicted to be affected
Duration	The impact could potentially occur throughout the operation phase of the project which would be long-term, as defined by EPA (2022).	The impact could potentially occur throughout the operation phase of the project which would be long-term, as defined by EPA (2022).
Frequency	No collisions were anticipated to occur.	No collisions were anticipated to occur.
Probability	Collision mortality is considered unlikely in the array area in the autumn migration period.	Collision mortality is considered unlikely in the array area in the autumn migration period.
Consequence	Zero predicted collisions, which would equate to Negligible magnitude.	Zero predicted collisions, which would equate to Negligible magnitude.
Overall magnitude	The potential magnitude is rated as Negligible.	The potential magnitude is rated as Negligible.

6.17.174 For this assessment, receptor sensitivity has been based on three reviews of evidence from post-construction studies at offshore wind farms. A review of post-construction studies of seabirds at offshore wind farms in European waters concluded that Sandwich tern was one of the species that weakly avoided offshore wind farms (Dierschke *et al.,* 2016). A review of vulnerability of Scottish seabirds to offshore wind turbines in the context of collision ranked Sandwich tern as the 11th most sensitive out of 38 species (Furness *et al.,* 2013). Bradbury *et al.,* (2014), classified the Sandwich tern population vulnerability to collision mortality from offshore wind farms as moderate.

6.17.175 Estimated numbers of Sandwich terns recorded within the array area would qualify as nationally important in the breeding season (Offshore and Intertidal Ornithology Technical Baseline), as the species is listed on Annex I of the EU Birds Directive, however there are no SPAs within mean maximum foraging range (+1S.D.) in the region. On this basis the conservation importance for Sandwich tern was considered to be low.

6.17.176 Overall, based on available evidence from published studies indicating a high sensitivity to collision, and a low conservation importance, it is considered that Sandwich tern sensitivity to collision effects associated with Dublin Array is likely to be **Medium** (Table 4).

6.17.177 For Sandwich tern, the magnitude of the impact is deemed to be **Negligible** and the overall sensitivity of this species is considered to be **Medium**, as the species is listed on Annex I of the EU Birds Directive. The significance of any effect on Sandwich tern from collision effects associated with Dublin Array is a **Not Significant** effect, which is **Not significant** in EIA terms.

Roseate tern

6.17.178 Annual estimated roseate tern mortality from collision impacts in the array area was based on mean densities of flying birds recorded on baseline surveys. A complete range of collision numbers for the array area, and the different design scenarios are presented in the Seabird CRM Technical Report.

6.17.179 The annual estimated number of collisions for roseate tern are presented in Table 86. Figures are presented for the breeding season and the autumn and spring migration periods of the non-breeding season, based on the MDO (50 turbines, Option A). Collisions were predicted for the breeding season and autumn migration period of the non-breeding season and were very low. Although there are no roseate tern colonies within mean maximum foraging range (+1S.D.) of the array area, it is considered likely that the majority of sightings of roseate tern on baseline surveys were birds from the colony at Rockabill, which is 41.3 km from the array area.

Table 86 Estimated numbers of collisions by season for roseate tern in the array area

Season	Lower 95% confidence limit	Mean number of collisions	Upper 95% confidence limit
Breeding season (May-Aug)	0.02	0.16	0.34
Autumn migration (Aug-Sep)	0.01	0.11	0.24
Spring migration (late Apr-May)	0	0	0
Total	0.03	0.27	0.58
Total (to nearest whole bird)	0	0	1

6.17.180 The total annual number of roseate tern collisions was 0.27 birds per year, which is considerably less than one whole bird. When rounded to the nearest whole bird, predicted annual roseate tern mortality due to collision effects was zero, which would not result in an increase in the annual baseline mortality rate.

6.17.181 Based on the results of the collision assessment, the magnitude of impact from collision effects on the regional roseate tern population was considered to be **Negligible**, as the estimated increases in the annual baseline mortality rate were below 1%, based on zero predicted collisions (Table 87).

Table 87 Determination of magnitude for roseate tern collision mortality

	MDO	Alternative Design Option
Extent	Zero predicted collisions therefore none of the population is predicted to be affected	Zero predicted collisions therefore none of the population is predicted to be affected
Duration	The impact could potentially occur throughout the operation phase of the project which would be long-term, as defined by EPA (2022).	The impact could potentially occur throughout the operation phase of the project which would be long-term, as defined by EPA (2022).
Frequency	No collisions were anticipated to occur.	No collisions were anticipated to occur.
Probability	Collision mortality is considered unlikely in the array area in the breeding season and autumn migration period.	Collision mortality is considered unlikely in the array area in the breeding season and autumn migration period.
Consequence	Zero predicted collisions, which would equate to Negligible magnitude.	Zero predicted collisions, which would equate to Negligible magnitude.

	MDO	Alternative Design Option
Overall magnitude	The potential magnitude is rated as Negligible.	The potential magnitude is rated as Negligible.

6.17.182 For this assessment, receptor sensitivity has been based on reviews of evidence from post-construction studies at offshore wind farms. A review of vulnerability of Scottish seabirds to offshore wind turbines in the context of collision ranked roseate tern as the 18th most sensitive out of 38 species (Furness *et al.,* 2013). Bradbury *et al.,* (2014), classified the roseate tern population vulnerability to collision mortality from offshore wind farms as moderate.

6.17.183 Estimated numbers of roseate terns recorded within the array area would qualify as internationally important in the breeding season (Offshore and Intertidal Ornithology Technical Baseline), as the species is listed on Annex I of the EU Birds Directive, and although there are no SPAs within mean maximum foraging range (+1S.D.), it is very likely that all birds recorded in the breeding season were from the Rockabill colony. On this basis the conservation importance for roseate tern was considered to be medium.

6.17.184 Overall, based on available evidence from published studies indicating a moderate sensitivity to collision, and a medium conservation importance, it is considered that roseate tern sensitivity to collision effects associated with Dublin Array is likely to be **Medium** (Table 4).

6.17.185 For roseate tern, the magnitude of the impact is deemed to be **Negligible** and the overall sensitivity of this species is considered to be **Medium**, as the species is listed on Annex I of the EU Birds Directive. The significance of any effect on Sandwich tern from collision effects associated with Dublin Array is a **Not Significant** effect, which is **Not significant** in EIA terms.

Common tern

6.17.186 Annual estimated common tern mortality from collision impacts in the array area was based on mean densities of flying birds recorded on baseline surveys. A complete range of collision numbers for the array area, and the different design scenarios are presented in the Seabird CRM Technical Report.

6.17.187 The annual estimated number of collisions for common tern are presented in Table 88. As the predicted number of collisions was low for common tern, the assessment has been undertaken using collision numbers to two decimal places, rather than rounded to the nearest whole bird. Figures are presented for the migration-free breeding season and the autumn and spring migration periods of the non-breeding season, based on the MDO (50 turbines, Option A). Furness (2015) defined the migration-free breeding season as June to mid-July, however for this assessment, the whole of July was considered as breeding season, as this was considered more precautionary. Similarly, Furness (2015) defined the autumn period of the non-breeding season as late July to early September, however for this assessment August and September were considered the autumn migration period.

6.17.188 Highest numbers of collisions were predicted for the autumn migration period of the non-breeding season, with lower numbers of collisions predicted for the breeding season and spring migration period of the non-breeding season.

Table 88 Estimated numbers of collisions by season for common tern in the array area

Season	Lower 95% confidence limit	Mean number of collisions	Upper 95% confidence limit
Migration-free Breeding season (June-July)[1]	0.19	0.78	1.39
Autumn migration (Aug-early Sep)[1]	0.28	1.73	3.13
Spring migration (Apr-May)	0.07	0.49	1.03
Total	0.54	3.0	5.55
Total (to nearest whole bird)	1	3	6

1 Breeding season was taken as June & July and Autumn migration period was taken as August and September, as this was considered more precautionary than June to mid-July and late July to early September as defined in Furness (2015).

6.17.189 In the migration-free breeding season (June to July), the total mean estimated number of common tern collisions was 0.78 birds (Table 88). For this assessment, it was assumed that only breeding adults were involved.

6.17.190 The total common tern regional breeding population is estimated to be 1,034 adult birds (Table 14). For the breeding season assessment based on adult birds only, the increase in baseline mortality was calculated based on an estimated adult common tern baseline survival rate of 0.883, therefore the corresponding rate for adult common tern mortality is 0.117 (Table 16). Applying this mortality rate, the estimated regional baseline mortality of common terns is 121 adult birds per breeding season (1,034 x 0.117). The additional predicted mortality of 0.78 breeding adult common terns in the breeding season would increase the baseline mortality rate by 0.64% (Table 89).

Table 89 Increase in estimated baseline mortality for adult common terns in the array area as a result of collisions

Season	Regional baseline population	Annual Regional Baseline Mortality	Increase in baseline mortality (%) (adults)
Breeding season (Jun-Jul)	1,034	121	0.64
Autumn migration (Aug-early Sep)	74,000	14,134	0.012
Spring migration (Apr-May)	74,000	14,134	0.003
Total	-	-	0.655

6.17.191 For the autumn migration period of the non-breeding season, estimated common tern mortality from collisions was 1.73 birds, (Table 88). The common tern regional population for the autumn migration period is estimated to be 74,000 birds (Table 15). The increase in baseline mortality was calculated based on an average common tern baseline mortality rate of 0.191 (Table 16). Applying this mortality rate, the estimated regional baseline mortality of common terns is 14,134 birds for the autumn migration period (74,000 x 0.191). The additional predicted mortality of 1.73 common terns in the autumn migration period of the non-breeding season would increase the baseline mortality rate by 0.012% (Table 89).

6.17.192 For the spring migration period of the non-breeding season, estimated common tern mortality from collision was 0.49 birds(Table 88). The common tern regional population for the spring migration period is estimated to be 74,000 birds (Table 15). The increase in baseline mortality was calculated based on an average common tern baseline mortality rate of 0.191 (Table 16). Applying this mortality rate, the estimated regional baseline mortality of common terns is 14,134 birds for the autumn migration period (74,000 x 0.191). The additional predicted mortality of 0.49 common terns in the spring migration period of the non-breeding season would increase the baseline mortality rate by 0.003% (Table 89).

6.17.193 Predicted annual common tern mortality due to collision effects based on all birds in the migration-free breeding season and the autumn and spring migration periods of the non-breeding season, involved three birds, which corresponds to an increase in the annual baseline mortality rate of 0.655% (Table 89).

6.17.194 As highlighted by Natural England guidance, where predicted impacts equate to 1% or below of baseline mortality for a population (e.g. colony population) then this level of impact could be considered non-significant (Parker *et al.,* 2022c). As the predicted increases in annual baseline mortality for common tern were below 1%, PVA was not carried out on the regional common tern population, as agreed in the East Coast Phase 1 Method Statement (GoBe, 2022).

6.17.195 Based on the results of the collision assessment, the magnitude of impact from collision effects on the regional common tern population was considered to be **Negligible** (Table 90).

Table 90 Determination of magnitude for common tern collision mortality

	MDO	Alternative Design Option
Extent	Very small proportion of the population is predicted to be affected	Very small proportion of the population is predicted to be affected
Duration	The impact is likely to occur throughout the operation phase of the project and will therefore be long-term, as defined by EPA (2022).	The impact is likely to occur throughout the operation phase of the project and will therefore be long-term, as defined by EPA (2022).
Frequency	The effect is anticipated to occur between April and September.	The effect is anticipated to occur between April and September.
Probability	Collision mortality is considered possible in the array area between April and September.	Collision mortality is considered possible in the array area between April and September.
Consequence	Although common tern collision mortality in the array area is possible between April and September, at the population level, associated mortality is predicted to be very low, which would equate to Negligible magnitude.	Although common tern collision mortality in the array area is possible between April and September, at the population level, associated mortality is predicted to be very low, which would equate to Negligible magnitude.
Overall magnitude	The potential magnitude is rated as Negligible.	The potential magnitude is rated as Negligible.

6.17.196 For this assessment, receptor sensitivity has been based on reviews of evidence from post-construction studies at offshore wind farms. A review of post-construction studies of seabirds at offshore wind farms in European waters concluded that common tern was one of the species that was hardly affected by offshore wind farms (Dierschke *et al.,* 2016). A review of vulnerability of Scottish seabirds to offshore wind turbines in the context of collision ranked common tern as the 14th most sensitive out of 38 species (Furness *et al.,* 2013). Bradbury *et al.,* (2014), classified the common tern population vulnerability to collision mortality from offshore wind farms as moderate.

6.17.197 Estimated numbers of common terns recorded within the array area would qualify as internationally important in the breeding season (Offshore and Intertidal Ornithology Technical Baseline), as the species is listed on Annex I of the EU Birds Directive, and there are SPAs within mean maximum foraging range (+1S.D.). On this basis the conservation importance for common tern was considered to be medium.

6.17.198 Overall, based on available evidence from published studies indicating a moderate sensitivity to collision, and a medium conservation importance, it is considered that common tern sensitivity to collision effects associated with Dublin Array is likely to be **Medium** (Table 4).

6.17.199 For common tern, the magnitude of the impact is deemed to be **Negligible,** and the overall sensitivity of this species is considered to be **Medium**, as the species is listed on Annex I of the EU Birds Directive and there are SPAs within mean maximum foraging range. The significance of any effect on common tern from collision effects associated with Dublin Array is **Not significant** effect, which is **Not significant** in EIA terms (Table 7).

Arctic tern

6.17.200 Annual estimated Arctic tern mortality from collision impacts in the array area was based on mean densities of flying birds recorded on baseline surveys. A complete range of collision numbers for the array area, and the different design scenarios are presented in the Seabird CRM Technical Report.

6.17.201 The annual estimated number of collisions for Arctic tern are presented in Table 91. Figures are presented for the breeding season and the autumn and spring migration periods of the non-breeding season, based on the MDO (50 turbines, Option A). Collisions were only predicted for May to September and were very low.

6.17.202 The total annual number of Arctic tern collisions was 0.27 birds per year, which is considerably less than one whole bird (Table 91). When rounded to the nearest whole bird, predicted annual Arctic tern mortality due to collision effects was zero, which would not result in an increase in the annual baseline mortality rate.

Table 91 Estimated numbers of collisions by season for Arctic tern in the array area

Season	Lower 95% confidence limit	Mean number of collisions	Upper 95% confidence limit
Breeding season (May-early Aug)	0.03	0.24	0.51
Autumn migration (Jul-early Sep)	0	0.03	0.06
Spring migration (late Apr-May)	0	0	0
Total	0.03	0.27	0.57
Total (to nearest whole bird)	0	0	1

6.17.203 Based on the results of the collision assessment, the magnitude of impact from collision effects on the regional Arctic tern population was considered to be **Negligible**, as the estimated increases in the annual baseline mortality rate were below 1%, based on zero predicted collisions (Table 92).

Table 92 Determination of magnitude for Arctic tern collision mortality

	MDO	Alternative Design Option
Extent	Zero predicted collisions therefore none of the population is predicted to be affected	Zero predicted collisions therefore none of the population is predicted to be affected
Duration	The impact could potentially occur throughout the operation phase of the project which would be long-term, as defined by EPA (2022).	The impact could potentially occur throughout the operation phase of the project which would be long-term, as defined by EPA (2022).
Frequency	No collisions were anticipated to occur.	No collisions were anticipated to occur.
Probability	Collision mortality is considered unlikely in the array area in the breeding season and autumn migration period.	Collision mortality is considered unlikely in the array area in the breeding season and autumn migration period.
Consequence	Zero predicted collisions, which would equate to Negligible magnitude.	Zero predicted collisions, which would equate to Negligible magnitude.
Overall magnitude	The potential magnitude is rated as Negligible.	The potential magnitude is rated as Negligible.

6.17.204 For this assessment, receptor sensitivity has been based on reviews of evidence from post-construction studies at offshore wind farms. A review of post-construction studies of seabirds at offshore wind farms in European waters concluded that Arctic tern was one of the species that was hardly affected by offshore wind farms (Dierschke *et al.,* 2016). A review of vulnerability of Scottish seabirds to offshore wind turbines in the context of collision ranked Arctic tern as the 17th most sensitive out of 38 species (Furness *et al.,* 2013). Bradbury *et al.,* (2014), classified the Arctic tern population vulnerability to collision mortality from offshore wind farms as low.

6.17.205 Estimated numbers of Arctic terns recorded within the array area would qualify as internationally important in the breeding season (Offshore and Intertidal Ornithology Technical Baseline), as the species is listed on Annex I of the EU Birds Directive, and there are SPAs within mean maximum foraging range (+1S.D.). On this basis the conservation importance for Arctic tern was considered to be medium.

6.17.206 Overall, based on available evidence from published studies indicating a low to moderate sensitivity to collision, and a medium conservation importance, it is considered that Arctic tern sensitivity to collision effects associated with Dublin Array is likely to be **Medium** (Table 4).

6.17.207 For Arctic tern, the magnitude of the impact is deemed to be **Negligible,** and the overall sensitivity of this species is considered to be **Medium**, as the species is listed on Annex I of the EU Birds Directive and there are SPAs within mean maximum foraging range. The significance of any effect on Arctic tern from collision effects associated with Dublin Array is a **Not Significant** effect, which is **Not significant** in EIA terms.

Migratory non-seabird species

6.17.208 There is the potential risk to migratory birds flying through the array area to collide with the wind turbines and associated infrastructure. Migratory species are at risk when passing through the area on seasonal migration on spring and autumn passage. The potential collision risk to each species can be estimated throughout the year by CRM.

6.17.209 The Marine Scotland Avian Migration Collision Risk Model Shiny Application ("mCRM App"; HiDef Aerial Surveying Ltd., 2024) was used to model the movements of migratory non-seabird species passing through Dublin Array. Full details of the approach and the methods used are presented in the Migratory CRM (mCRM) Technical Report.

6.17.210 The mCRM tool uses species-specific biometric input parameters, together with turbine parameters, as well as flight speeds and avoidance rates from published sources. The decision on which species were screened into the mCRM assessment was carried out by utilising a quantitative screening methodology. Further details are presented in the mCRM Technical Report.

6.17.211 For all assessed species, the predicted number of annual collisions was found to be negligible (less than one bird per year). This was the case for all three turbine design options presented in Table 18, with 50 turbines (Option A) being considered the MDO due to having the highest annual collision values for all species (Table 93).

Table 93 Summary of annual collision estimates following the Dublin Array approach for Option A; 50 turbines

Species	Predicted Annual Total of Collisions
Bewick's swan	0 ± 0
Black-tailed godwit	0.028 ± 0.004
Black-throated diver	0 ± 0
Canadian Light-Bellied Brent Goose	0.008 ± 0.001
Common scoter	0.128 ± 0.021
Corncrake	0.016 ± 0.003
Curlew	0.016 ± 0.003

Species	Predicted Annual Total of Collisions
Dunlin	0.136 ± 0.017
Eider	0.04 ± 0.006
Goldeneye	0.052 ± 0.007
Great crested grebe	0.009 ± 0.002
Great northern diver	0.002 ± 0
Greenland white-fronted goose	0.004 ± 0.001
Greenshank	0 ± 0
Grey plover	0 ± 0
Hen harrier	0.002 ± 0
Knot	0.024 ± 0.003
Lapwing	0.02 ± 0.003
Long-tailed duck	0.056 ± 0.007
Mallard	0.147 ± 0.017
Marsh harrier	0. 002 ± 0
Merlin	0.012 ± 0.008
Oystercatcher	0.034 ± 0.006
Pintail	0.02 ± 0.003
Pochard	0.042 ± 0.006
Purple Sandpiper	0.002 ± 0
Red-breasted merganser	0.024 ± 0.004
Redshank	0.028 ± 0.004
Ringed plover	0.02 ± 0.003
Ruff	0.006 ± 0.001
Sanderling	0.01 ± 0.001
Scaup	0.012 ± 0.001
Shelduck	0.03 ± 0.003
Short-eared owl	0.016 ± 0.003
Shoveler	0.015 ± 0.002
Snipe	0.873 ± 0.113
Teal	0.45 ± 0.075
Tufted duck	0.192 ± 0.028
Turnstone	0.022 ± 0.003
Whimbrell	0.002 ± 0
Wigeon	0.526 ± 0.088
Wood sandpiper	0 ± 0

6.17.212 Based on the above results, the magnitude of impact was considered to be **Negligible** (Table 94).

Table 94 Determination of magnitude for migratory non-seabird species collision mortality

	MDO	Alternative Design Option
Extent	Very small proportion of the populations is predicted to be affected	Very small proportion of the populations is predicted to be affected
Duration	The impact is likely to occur throughout the operation phase of the project and will therefore be long-term, as defined by EPA (2022).	The impact is likely to occur throughout the operation phase of the project and will therefore be long-term, as defined by EPA (2022).

	MDO	Alternative Design Option
Frequency	The effect is anticipated to occur during spring and autumn migration periods.	The effect is anticipated to occur during spring and autumn migration periods.
Probability	Collision mortality is considered possible in the array area during spring and autumn migration.	Collision mortality is considered possible in the array area during spring and autumn migration.
Consequence	Although collision mortality in the array area is possible during spring and autumn migration, at the population level, associated mortality for these populations is predicted to be very low, which would equate to Negligible magnitude.	Although collision mortality in the array area is possible during spring and autumn migration, at the population level, associated mortality for these populations is predicted to be very low, which would equate to Negligible magnitude.
Overall magnitude	The potential magnitude is rated as Negligible.	The potential magnitude is rated as Negligible.

6.17.213 Assuming the sensitivity of migratory species was a maximum of **High**, then the significance of any effect on migratory species from collisions associated with Dublin Array is a **Not Significant** effect, which is **Not significant** in EIA terms.

6.17.214 The alternative design options (any other option within the range of parameters set out in the project description) will not give rise to an effect which is more significant than the maximum design option…

Residual Effect

The effect on key bird species from collision effects associated with Dublin Array have been assessed as 'not significant' in EIA terms. Therefore, no further mitigation (in addition to that already identified in Table 19) is considered necessary. No ecologically significant adverse residual effects on offshore ornithology have therefore been predicted.

6.18 Environmental Assessment: Decommissioning phase

6.18.1 As referenced in the Project Description, the Decommissioning and Restoration Plan (Volume 7, Appendix 2), including the three rehabilitation schedules attached thereto, describes how the Applicant proposes to rehabilitate that part of the maritime area, and any other part of the maritime area, adversely affected by the permitted maritime usages that are the subject of the MACs (Reference Nos. 2022-MAC-003 and 004 / 20230012 and 240020).

6.18.2 It is based on the best scientific and technical knowledge available at the time of submission of this planning application. However, the lengthy passage of time between submission of the application and the carrying out of decommissioning works (expected to be in the region of 35 years as defined in the MDO) gives rise to knowledge limitations and technical difficulties. Accordingly, the Decommissioning and Restoration Plan will be kept under review by the Applicant as the project progresses, and an alteration application will be submitted if necessary. In particular, it will be reviewed having regard to the following:

- The baseline environment at the time rehabilitation works are proposed to be carried out,
- What, if any, adverse effects have occurred that require rehabilitation,
- Technological developments relating to the rehabilitation of marine environments,
- Changes in what is accepted as best practice relating to the rehabilitation of marine environments,
- Submissions or recommendations made to the Applicant by interested parties, organisations and other bodies concerned with the rehabilitation of marine environments, and/or
- Any new relevant regulatory requirements.

6.18.3 The Decommissioning and Restoration Plan outlines the process for decommissioning of the WTG, foundations, scour protection, OSP, inter array cables and Offshore ECC. The plan outlines the assumption that the most practicable environmental option is to leave certain infrastructure in situ (e.g. cables, scour protection), however the general principle for decommissioning and of particular relevance to offshore ornithology is for all structures which penetrate the sea surface to be removed and it is assumed that the wind turbine generators (WTG's) will be dismantled and completely removed to shore. Piled foundations will be cut at a level below the seabed, buried cables and scour and cable protection left in situ.

Impact 10: Disturbance and displacement on key bird species as a result of increased vessel activity and other decommissioning activity within the array area

6.18.4 Direct temporary disturbance or displacement of birds within the array area during the decommissioning phase may occur as a result of a range of activities including use of jack-up vessels during structure removal, and anchor placements associated with these activities. Disturbance arising from these activities has the potential to affect identified key species directly (e.g. disturbance of individuals) and indirectly (e.g. disturbance to prey distribution or availability, which subsequently affects foraging seabirds). The MDO outlined in Table 18 describes the elements of Dublin Array considered within this assessment. Turbines will be removed in reverse to the construction methodology although, there is no requirement for seabed preparation prior to decommissioning with the potential for some buried assets including the inter array cables to be left in situ.

6.18.5 Some species are more susceptible to disturbance than others. There is evidence from studies that demonstrate that species such as divers and scoters may avoid shipping by several kilometres (e.g. Garthe and Hüppop, 2004; Schwemmer *et al.,* 2011), while gulls are not considered susceptible to disturbance, as they are often associated with fishing boats (e.g. Camphuysen, 1995; Hüppop and Wurm, 2000).

6.18.6 As for Impact 1 in this assessment, species with very low or low sensitivity to disturbance or displacement or species that were only recorded occasionally in very small numbers within the offshore study area were screened out of further assessment for Impact 12.

6.18.7 Based on Table 20, five species (red-throated diver, cormorant, shag, guillemot and razorbill) were identified as being potentially sensitive to disturbance and displacement from increased vessel activity within the array area during the decommissioning phase. For each of these species, the magnitude of impact and overall sensitivity to Impact 12 were considered.

6.18.8 For red-throated diver, published evidence from reviews indicates that this species has a very high sensitivity to disturbance from vessels (Table 20). In addition, the species is listed on Annex I of the Birds Directive, and so would be considered to be of international importance. As the Murrough SPA is within 10 km of the array area, there is the potential for birds from this SPA to occur within the array area, although it is considered that not all birds in the array area may spend time within the SPA. The degree of connectivity between the Murrough SPA and birds recorded in the array area is not known.

6.18.9 Baseline surveys show that red-throated divers occur in the vicinity of the array area between September and April, i.e. in the non-breeding season, with no birds recorded between May and August (Offshore and Intertidal Ornithology Technical Baseline). Any disturbance from vessels will therefore be limited to the non-breeding season, when birds are in the vicinity of the array area, and there will be no disturbance to red-throated divers in the breeding season, therefore reproductive rates will not be directly affected. The overall sensitivity of red-throated diver to Impact 12 is therefore considered to be **Medium**.

6.18.10 For cormorant, published evidence from reviews indicates that this species has a high sensitivity to disturbance from vessels (Table 20). The species is not listed on Annex I of the Birds Directive, however there are designated SPAs for breeding cormorant within mean maximum foraging range of the array area, which would be considered to be of international importance (Table 5). Available evidence does not indicate any connectivity between these SPAs and birds recorded in the array area, and other non-SPA colonies may also contribute to the population at risk. The overall sensitivity of cormorant to Impact 11 is therefore considered to be **Medium**.

6.18.11 For shag, guillemot and razorbill, published evidence from reviews indicates that these species have a medium sensitivity to disturbance from vessels (Table 20). These species are not listed on Annex I of the Birds Directive, however there are designated SPAs for breeding shags, guillemots and razorbills within mean maximum foraging range of the array area, which would be considered to be of international importance (Table 4). However, the available evidence does not indicate any connectivity between these SPAs and birds recorded in the array area, and birds from other non-SPA colonies may also contribute to the population potentially at risk of disturbance. The overall sensitivity of these species to Impact 11 is therefore considered to be **Medium** (Table 4).

6.18.12 Activities resulting in the disturbance or displacement of birds within the array area from increased vessel activity and decommissioning activities will occur intermittently throughout the decommissioning phase. The offshore decommissioning works which includes activities resulting in temporary disturbance or displacement of birds from increased vessel activity are assumed to be undertaken over a period of 36 months which represents a reasonable MDO for the purposes of this assessment.

6.18.13 The impact is predicted to affect a small proportion of the regional populations and will be, intermittent, and of temporary to short-term duration. The EPA (2022) guidance defines temporary duration as lasting less than one year, while "short-term" duration is defined as between one and seven years duration. However, it is considered that only a small proportion of the total array area will be affected by decommissioning activities at any one time, and that individual decommissioning activities will typically be completed within a few months. Consequently, only birds in the vicinity of these individual activities will be affected directly (Table 95).

Table 95 Determination of magnitude for Impact 10

	MDO	Alternative design option
Extent	Small proportion of the populations is predicted to be affected.	Small proportion of the populations is predicted to be affected.
Duration	The impact will be restricted to the decommissioning phase of the project and will therefore be short-term (one - seven years), although works in any given discrete location within the project boundary will be temporary (less than one year).as defined by EPA (2022)	The impact will be restricted to the decommissioning phase of the project and will therefore be short-term (one - seven years), although works in any given discrete location within the project boundary will be temporary (less than one year).as defined by EPA (2022)
Frequency	The effect is anticipated to occur intermittently within the decommissioning area during the proposed decommissioning activities, with only a small proportion of the total decommissioning area being affected at any one time.	The effect is anticipated to occur intermittently within the decommissioning area during the proposed decommissioning activities, with only a small proportion of the total decommissioning area being affected at any one time.
Probability	Temporary disturbance effects are considered likely in the immediate vicinity of the decommissioning activities	Temporary disturbance effects are considered likely in the immediate vicinity of the decommissioning activities
Consequence	As disturbance will be temporary, the degree of change relative to the baseline level is considered to be low and reversible.	As disturbance will be temporary, the degree of change relative to the baseline level is considered to be low and reversible.
Overall magnitude	The potential magnitude is rated as Low.	The potential magnitude is rated as Low.

6.18.14 On this basis, it is considered that any disturbance to red-throated diver will be temporary (non-breeding season only), and that the magnitude of any effect will therefore be **Low**. Similarly for cormorant, shag, guillemot and razorbill, the duration of any disturbance will be temporary, and the magnitude of any effect will therefore be **Low**.

6.18.15 For red-throated diver, cormorant, shag, guillemot and razorbill, the magnitude of the impact is deemed to be **Low**, and the overall sensitivity of these species is considered to be **Medium**. The effect will therefore be of **Slight Adverse** significance, which is **Not significant** in EIA terms.

6.18.16 The alternative design options (any other option within the range of parameters set out in the project description) will not give rise to an effect which is more significant than the maximum design option.

Residual Effect

The impacts associated with disturbance and displacement from increased vessel activity and other decommissioning activity within the array area as a result of the Dublin Array development have been assessed as 'not significant' in EIA terms. Therefore, no further mitigation (in addition to that already identified in Table 19) is considered necessary. No ecologically significant adverse residual effects on offshore ornithology have therefore been predicted.

Impact 11: Disturbance and displacement on key bird species as a result of increased vessel activity and other decommissioning activity within the Offshore ECC

6.18.17 Direct temporary disturbance or displacement of birds within the Offshore ECC may occur during decommissioning as a result of increased vessel activity associated with decommissioning activities. The MDO outlined in Table 18 describes the elements of the proposed project considered within this assessment.

6.18.18 Activities resulting in the disturbance or displacement of birds within the Offshore ECC as a result of increased vessel activity associated with decommissioning activities may occur intermittently throughout the decommissioning phase.

6.18.19 The Offshore ECC does not pass through any areas designated as SPAs (Figure 3).

6.18.20 Direct disturbance impacts on seabirds are predicted to affect a small proportion of the regional populations and will be, intermittent, and of temporary duration, as the decommissioning activities are predicted to last 36 months, (although only a small proportion of the total area will be affected at any one time, with individual activities having much shorter durations) and will only affect any birds in the vicinity of these activities directly.

6.18.21 The species scoped in as being sensitive to disturbance and displacement in Table 20 will also potentially be affected for Impact 11. Thus, five species (red-throated diver, cormorant, shag, guillemot and razorbill) were identified as being potentially sensitive to disturbance and displacement from increased vessel activity within the Offshore ECC during the decommissioning phase. For each of these species, the magnitude of impact for Impact 11 was considered to be the same as for Impact 1 (Table 21).

6.18.22 On this basis, it is considered that any disturbance to red-throated diver will be temporary (non-breeding season only), and that the magnitude of any effect will therefore be **Low**. Similarly for cormorant, shag, guillemot and razorbill, the duration of any disturbance will be temporary, and the magnitude of any effect will therefore be **Low**.

6.18.23 For red-throated diver, cormorant, shag, guillemot and razorbill, the magnitude of the impact is deemed to be **Low** and the overall sensitivity of these species to Impact 12 is considered to be **Medium**. The effect will therefore be of **Slight Adverse** significance, which is **Not significant** in EIA terms.

6.18.24 The alternative design options (any other option within the range of parameters set out in the project description) will not give rise to an effect which is more significant than the maximum design option.

Residual Effect

The impacts associated with disturbance and displacement from increased vessel activity and other decommissioning activity within the Offshore ECC as a result of the Dublin Array development have been assessed as 'not significant' in EIA terms. Therefore, no further mitigation (in addition to that already identified in Table 19) is considered necessary. No ecologically significant adverse residual effects on offshore ornithology have therefore been predicted.

Impact 12: Disturbance and displacement on key bird species as a result of decommissioning activity at the export cable landfall within the Intertidal study area

6.18.25 Temporary disturbance or displacement of inter-tidal bird species within the vicinity of the decommissioning of the transition joint bay (which lies well above MHWS) may occur as a result of works associated with these activities. Disturbance arising from these activities has the potential to affect identified species directly, for example as disturbance of individual intertidal birds by the presence of plant, and also by indirect effects caused by localised disturbance or reduction in availability of prey species. The MDO outlined in Table 18 describes the elements of the proposed project considered within this assessment.

6.18.26 Overall, baseline surveys recorded low numbers of birds in the Intertidal study area at the location of the proposed export cable landfall. Details on the numbers and species recorded are summarised in the Offshore and Intertidal Technical Baseline. Species that are known to be susceptible to disturbance such as divers and common scoter were only recorded in the Inter-tidal study area in very low numbers over the study period. Between November 2019 and October 2020, a peak of four red-throated divers were recorded on intertidal surveys at the export cable landfall in January 2020, with two birds seen in December 2019, February 2020, March 2020 and October 2020. Single great northern divers were recorded in December 2019 and March 2020, with two recorded in October 2020. Common scoter were only recorded in December 2019 when 14 birds were seen (SLR, 2021c). Between September 2023 and March 2024, the peak count of red-throated divers was three birds in December 2023. Great northern diver and common scoter were not recorded during the latter survey period (SLR, 2024). Overall, the low numbers recorded on intertidal surveys indicates that the Intertidal study area does not support significant numbers of these species.

6.18.27 Based on the survey results, these three species (red-throated diver, great northern diver and common scoter) were considered to be potentially affected by Impact 12. For each of these species, the magnitude of impact and overall sensitivity to Impact 12 were considered to be the same as for Impact 1 and 2 during construction activities (Table 21).

6.18.28 It is considered that any disturbance to red-throated diver, great northern diver and common scoter will be temporary (non-breeding season only), and that the magnitude of any effect will therefore be **Low**.

6.18.29 For red-throated diver, great northern diver and common scoter, the magnitude of the impact is deemed to be **Low**, and the overall sensitivity of these species is considered to be **Medium**. The effect will therefore be of **Slight Adverse** significance, which is **Not significant** in EIA terms.

6.18.30 The alternative design options (any other option within the range of parameters set out in the project description) will not give rise to an effect which is more significant than the maximum design option.

Residual Effect

The impacts associated with disturbance and displacement from decommissioning activity associated with the Export cable landfall within the Inter-tidal study area as a result of the Dublin Array development have been assessed as 'not significant' in EIA terms. Therefore, no further mitigation (in addition to that already identified in Table 19) is considered necessary. No ecologically significant adverse residual effects on offshore ornithology have therefore been predicted.

Impact 13: Indirect effects on foraging seabirds as a result of habitat loss/displacement of prey species due to increased noise and disturbance to seabed during decommissioning in array area and Offshore ECC

6.18.31 Indirect effects on foraging seabirds caused by disturbance or displacement to prey species may occur during decommissioning. Indirect effects may arise from the generation of suspended sediments or underwater noise associated with certain decommissioning activities. Such activities may change the behaviour or distribution of prey species for foraging seabirds in the vicinity, resulting in lower prey availability for these individuals. An increase in suspended sediment concentration (SSC) may cause fish and mobile invertebrates to avoid the area and may smother and hide immobile benthic prey. Suspended sediments may also make it harder for foraging seabirds to see their prey. These outcomes may lead to a reduction in prey being available within the decommissioning area for foraging seabirds. Such potential effects on benthic invertebrates and fish have been assessed in the Benthic Ecology chapter and the Fish and Shellfish Ecology chapter. The conclusions of those assessments inform this assessment of indirect effects on foraging seabirds in the array area and the Offshore ECC.

6.18.32 Decommissioning activities may change the behaviour or availability of prey species for seabirds, resulting in the availability of such prey species being temporarily reduced. However, the majority of seabird species have a variety of target prey species and have large foraging ranges, meaning that they can forage for alternative prey species or move to other foraging areas if prey becomes temporarily unavailable due to decommissioning activities. Overall, the magnitude of impact for Impact 13 is predicted to be the same as for Impact 1 (Table 21), and is therefore considered to be **Low.**

6.18.33 The sensitivity of seabirds to indirect effects as a result of habitat loss or displacement of prey species due to increased noise and disturbance during decommissioning is therefore considered to be **Low**.

6.18.34 Within the array area, the area of seabed predicted to be disturbed during decommissioning is predicted to be less than for the construction phase. Therefore, both habitat disturbance to prey species and increases in suspended sediment will be temporary, short-term and small in extent.

6.18.35 It is concluded that disturbance to seabed habitat within the Offshore ECC as a result of removal of any cable protection will not cause a significant reduction in the extent, distribution or quality of habitats that support the prey of foraging seabirds.

6.18.36 For benthic ecology, the nature and extent of temporary habitat loss/disturbance during decommissioning was assumed to be similar to the equivalent activities during the construction phase. Based on the assessment undertaken for construction, it is predicted that the maximum sensitivity of the receptors is **High**, and the magnitude is **Low Adverse**. Therefore, the significance of effect from temporary habitat disturbance as a result of Dublin Array is **Moderate Adverse**, which is **Not significant** in EIA terms.

6.18.37 For benthic ecology, increases in SSC and sediment deposition from the decommissioning works are expected to be less than that for construction and are therefore of a reduced magnitude. Based on the assessment undertaken for construction, it is predicted that the maximum sensitivity of the receptors in the subtidal and intertidal zones is **Medium**. The magnitude for the subtidal is **Low**, and **Negligible** for the intertidal on account of the HDD and limited impact from open cut works. Therefore, the significance of effects from temporary habitat disturbance as a result of Dublin Array is **Slight Adverse** within the subtidal region which is **Not significant** in EIA terms and **Imperceptible** (**Not significant**) across the intertidal.

6.18.38 The magnitude of the impact from on fish and shellfish receptors from increases in SSC and deposition occurring as a result of decommissioning activities has been assessed as **Low**, with the maximum sensitivity of these receptors being **Medium**. Therefore, the significance of effect of temporary increases in SSC and deposition on fish and shellfish receptors is **Slight Adverse**, which is **Not significant** in EIA terms.

6.18.39 There is likely to be underwater noise generated during the decommissioning of Dublin Array, however, percussive piling or clearance of UXO would not be necessary. Therefore, the magnitude of effect will be reduced, and any impacts will be no greater in magnitude than for the construction phase.

6.18.40 The maximum level of significance of increases in underwater noise as a result of decommissioning activities associated with Dublin Array is therefore **Slight Adverse**, which is **Not significant** in EIA terms.

6.18.41 As no significant effects on potential prey species (benthic organisms, fish or shellfish) or on the habitats that support them were identified in the Benthic Ecology chapter and the Fish and Shellfish Ecology chapter from decommissioning activities, then there is no potential for any indirect effects of an adverse significance to occur on foraging seabirds in the vicinity.

6.18.42 The maximum magnitude of any indirect impact on foraging seabirds has therefore been assessed as **Low**, with the maximum sensitivity of these receptors being **Low**. Therefore, the significance of any indirect effect on foraging seabirds as a result of habitat loss/displacement of prey species due to increased noise and disturbance to seabed during decommissioning activities in the array area and Offshore ECC is a **Slight Adverse** effect, which is **Not significant** in EIA terms.

6.18.43 The alternative design options (any other option within the range of parameters set out in the project description) will not give rise to an effect which is more significant than the maximum design option.

Residual Effect

The indirect impacts associated with habitat loss/displacement of prey species due to increased noise and disturbance to seabed during decommissioning on key bird species have been assessed as 'not significant' in EIA terms. Therefore, no further mitigation (in addition to that already identified in Table 19) is considered necessary. No ecologically significant adverse residual effects on offshore ornithology have therefore been predicted.

6.19 Environmental assessment: cumulative effects

Methodology

6.19.1 This section outlines the cumulative impact assessment on Offshore Ornithology and takes in account the impacts of the proposed development, together with other plans and projects. As outlined in Volume 2, Chapter 2: Cumulative Effect Assessment Methodology (hereafter referred to as the Cumulative Effect Assessment Methodology Chapter), the screening process involved determination of appropriate search areas for projects, plans and activities and Zones of Influence (ZoIs) for potential cumulative impacts. These were then screened according to the level of detail publicly available and the potential for interactions with regard to the presence of an impact pathway as well as spatial and temporal overlap.

6.19.2 The Cumulative Effects Assessment (CEA) long list of projects and plans with which Dublin Array's offshore infrastructure has the potential to interact with to produce a cumulative impact, is presented within the Cumulative Effect Assessment Methodology chapter (Volume 2, Chapter 4, Annex A: Offshore Long-list).

6.19.3 The cumulative long list has been derived by considering each plan and project within a search area that is coincident with the ICES Area Celtic Seas. Although this search area is defined for ecological purposes at a project level it has been defined to capture to all projects, plans and activities that could potentially act cumulatively with the proposed development. Three study areas were used for the offshore and intertidal ornithology assessment alone, as outlined in Section 6.4 above. For the cumulative assessment, any projects beyond the Offshore Ornithology Regional Study Area (509.4 km) were not considered to have the potential to add any direct or indirect cumulative impact to offshore ornithology receptors in the breeding season. In the non-breeding season, all consented or submitted projects within the ICES Area Celtic Seas were considered in the CEA.

Projects for cumulative assessment

6.19.4 Plans and projects screened in, together with their allocated tier as defined in the Cumulative Effect Assessment Methodology Chapter that reflects their current stage within the planning and development process are presented in Table 96 below.

6.19.5 The specific projects scoped into this CEA, and the tiers into which they have been allocated are presented in Table 96 below. Projects other than OWF projects e.g. dredging activities or port extensions have been screened out of the cumulative effects assessment on the basis that there is low potential for cumulative effects on offshore and intertidal ornithology with Dublin Array because the contribution from Dublin Array in terms of temporary habitat loss/disturbance and increased suspended sediment concentrations (SSCs) is predicted to be small (and even if these occurred at the same time this would not constitute a significant effect).

6.19.6 The full list of plans and projects considered, including those screened out, are presented in Volume 1, Annex 3.1.

6.19.7 For the purposes of the cumulative impact assessment, a precautionary construction period has been assumed between the years 2029 to 2032, with offshore construction (excluding preparation works) lasting up 30 months as a continuous phase within this period (refer to the Project Description Chapter)..

Table 96 List of other projects and plans considered within the CEA for Offshore and Intertidal Ornithology

Project/Plan	Status (In planning, Consented, Construction, Operational)	No. of turbines	Overlap with Dublin Array
Tier 1			
Burbo Bank Extension	Operational	32	Operational
Walney 1 + 2	Operational	102	Operational
Walney Extension 3 + 4	Operational	87	Operational
West of Duddon Sands	Operational	108	Operational
Ormonde	Operational	30	Operational
Robin Rigg	Operational	60	Operational
Tier 2			
Awel-y-Mor	Consented	Maximum 50	Operational
Erebus	Consented	Seven	Operational
Twinhub	Consented	Four	Operational
Morgan	Submitted	Maximum 68	Operational
Morecambe	Submitted	40	Operational
Mona	Submitted	Maximum 68	Operational
White Cross	Consented	Seven	Operational
Morlais Tidal Energy	Consented	N/A	Operational
Tier 3			
Oriel	Submitted	Maximum 25	Potential overlap in Construction; Operation
NISA	Submitted	Maximum 49	Potential overlap in Construction; Operation
Codling	Submitted	Maximum 75	Potential overlap in Construction; Operation
Arklow Bank	Submitted	Maximum 56	Potential overlap in Construction; Operation

Screening of potential cumulative effects

6.19.8 The range of potential cumulative effects is a subset of those considered for Dublin Array alone. This is because some of the potential effects identified and assessed for Dublin Array alone are localised and temporary in nature and therefore it is considered, that these potential effects have limited or no potential to interact with similar changes associated with other plans or projects. These have therefore been scoped out of the CEA.

6.19.9 Similarly, some of the potential effects considered within the Dublin Array alone assessment are specific to a particular phase of development (e.g. construction, operation and maintenance or decommissioning). Where there is no realistic potential for cumulative effects because spatial or temporal overlap with Dublin Array is considered unlikely, then such effects may be omitted from further consideration.

6.19.10 Potential effects arising from Dublin Array alone have been screened for their potential to create a cumulative impact for offshore and intertidal ornithological receptors (Table 97).

Table 97 Potential cumulative effects for offshore and intertidal ornithological receptors

Impact	Potential for cumulative impact	Data confidence	Rationale
Construction phase			
Disturbance and displacement in array area, offshore ECC and Export Cable landfall	No	Medium	There is a possibility that some construction activities could overlap temporally with construction of other east coast Phase 1 projects. However, the impact assessment for Dublin Array was assessed as being Slight Adverse at worst, and impacts for other east coast projects are considered likely to be similar. This, together with the distances between projects indicates that even if construction occurred at the same time this would not constitute a significant cumulative effect.
Indirect impacts through effects on prey species and their habitats	No	Medium	The significance of indirect impacts on foraging seabirds through effects on prey species and their habitats for Dublin Array alone was assessed as being Slight Adverse at worst. The CEA for fish and shellfish concluded a Slight Adverse significance of effect from both cumulative increases in SSC and material deposition, and cumulative effects of underwater noise, therefore cumulative indirect effects on foraging seabirds are considered not significant.
Operation and maintenance phase			
Indirect impacts through effects on	No	High	No potential for cumulative effect because the predicted contribution from Dublin Array is smaller during the Operation phase

Impact	Potential for cumulative impact	Data confidence	Rationale
habitats and prey species			compared to the Construction phase. This, together with the distances between projects indicates that this will not constitute a significant cumulative effect.
Disturbance from aviation and navigation lighting	No	Medium	No potential for cumulative effect because the predicted contribution from Dublin Array is small, and due to distances between projects.
Displacement and barrier effects on key bird species[1]	Yes	Medium	There is potential for a cumulative effect, so a cumulative effect assessment is required. Note that data confidence is lower for older projects due to variations in the level of detail reported. There is greater confidence in assessments for more recent projects which have typically followed a standard approach to assessment and reporting.
Mortality of key bird species as a result of collision	Yes	Medium	There is potential for a cumulative effect, so a cumulative effect assessment is required.
Decommissioning phase			
Disturbance and displacement in array area, offshore ECC and Export Cable landfall	No	Medium	There is a possibility that decommissioning activities could overlap temporally with other east coast Phase 1 projects. However, the impact assessment for Dublin Array was assessed as being Slight Adverse at worst, and impacts for other east coast projects are considered likely to be similar. This, together with the distances between projects mean that even if decommissioning occurred at the same time this would not constitute a significant cumulative effect.
Indirect impacts through effects on habitats and prey species	No	Medium	There is a possibility that decommissioning activities could overlap temporally with other east coast Phase 1 projects. However, the impact assessment for Dublin Array was assessed as being Slight Adverse at worst, and impacts for other east coast projects are considered likely to be similar. This, together with the distances between projects mean that even if decommissioning occurred at the same time this would not constitute a significant cumulative effect.

1 Barrier effect is also included as CEA is based on SNCB Matrix approach (SNCBs, 2022).

Impact 14: Cumulative displacement and barrier effects on key bird species

6.19.11 Cumulative effects in the construction and decommissioning phases were scoped out as listed in (Table 97) and so are not considered further here.

6.19.12 For the operation and maintenance phase, the cumulative effects assessment was conducted at the individual species level, considering predicted impacts from Dublin Array, the other east coast Phase 1 projects and existing, operational OWF projects in the wider region.

6.19.13 An annual cumulative displacement assessment was conducted for four species: gannet, kittiwake, guillemot and razorbill. No cumulative displacement assessment was conducted for shag, as numbers recorded on baseline surveys at other east coast Phase 1 projects were very low. Based on this, it was concluded that no cumulative displacement mortality effect would occur for shag. For Manx shearwater, no cumulative displacement assessment was undertaken as the predicted effects for Dublin Array alone were very low. A combined cumulative collision and displacement assessment was not undertaken for gannet as the predicted combined effects for Dublin Array alone were very low.

Gannet

6.19.14 There is potential for cumulative displacement effects on gannets. The estimated annual cumulative abundance of gannets from Tier 1, Tier 2 and Tier 3 projects are presented in Table 98. An annual cumulative displacement matrix for gannet is presented in the Seabird Displacement Matrices Technical Report.

Table 98 Cumulative annual abundance for gannets for Tier 1, Tier 2 and Tier 3 projects (Site +2 km)

Project	Annual abundance
Dublin Array	748
Oriel[1]	625
Arklow[2]	160
NISA[3]	582
Codling[4]	265
Awel-y-Mor[5]	528
Burbo Bank Extension[2,3,4]	429
Walney Extension[2,3,4]	1,348
Erebus[6]	658
Morgan[7]	254
Morecambe[8]	673
Mona[9]	337
White Cross[10]	456

Project	Annual abundance
Ormonde[7,8]	199
West of Duddon Sands[7,8]	431
Robin Rigg[11]	17
Cumulative Total	**7,710**

1 Oriel EIAR Chapter 11 (RPS, 2024a)
2 Arklow EIAR Chapter 12 (SSE Renewables, 2024)
3 NISA EIAR Chapter 15 (Ove Arup & Partners, 2024)
4 Codling EIAR Appendix 10.1 (Natural Power, 2024)
5 Awel-y-Mor EIAR Vol 4, Annex 4.3 (APEM, 2022)
6 Supplementary Environmental Information Addendum Report (Blue Gem Wind, 2023)
7 Morgan OWF EIAR (RPS, 2024b)
8 Morecambe OWF EIAR (Royal Haskoning DHV, 2024a)
9 Mona OWF EIAR (RPS, 2024c)
10 White Cross EIAR (APEM, 2023)
11 Robin Rigg EIA (Natural Power, 2005)

6.19.15 It should be noted that for the Burbo Bank Extension and Walney Extension projects, data was only provided within the array and 4 km buffer. The total mean peak abundance is therefore an overestimate of actual mean peak abundance across the projects and is considered a precautionary approach.

6.19.16 Annual cumulative estimated gannet mortality from displacement by Tier 1, 2 and 3 projects was based on 70% displacement and 1% mortality, based on recent NatureScot guidance (NatureScot, 2023). The overall baseline mortality rates were based on age-specific demographic rates and age class proportions (Table 16). The potential magnitude of impact was estimated by calculating the increase in cumulative baseline mortality within each season with respect to the relevant regional population.

6.19.17 The annual cumulative abundance for gannet was estimated to be 7,710 individuals (all ages) (Table 99). Based on a displacement rate of 70%, this would affect an estimated 5,397 birds. Applying a mortality rate of 1%, the annual cumulative additional mortality due to displacement effects would be 54 gannets (all ages), of which the proposed development contributes five individuals (all ages) (Table 29).

Table 99 Annual cumulative displacement mortality estimates for gannets for Tier 1, 2 and 3 projects

Peak abundance	Annual displacement	Annual displacement mortality	Regional baseline pop	Annual regional baseline mortality	Increase in annual baseline mortality (%)
7,710	5,397	54	643,917	116,549	0.046

6.19.18 The largest gannet regional population is estimated to be 643,917 individuals (Table 15). For the annual cumulative displacement assessment based on all ages, the increase in baseline mortality was calculated based on an estimated average gannet mortality rate of 0.181 (Table 16). Applying this mortality rate, the estimated regional annual baseline mortality of gannets is 116,549 birds per year (643,917 x 0.181). The additional predicted mortality of 54 gannets (all ages) per year would increase the baseline mortality rate by 0.046% (Table 99).

6.19.19 As highlighted by Natural England guidance, where predicted impacts equate to 1% or below of baseline mortality for a population (e.g. colony population) then this level of impact could be considered non-significant (Parker *et al.,* 2022c). As the predicted increase in annual cumulative baseline mortality for gannet was below 1%, PVA was not carried out on the regional gannet population, as agreed in the East Coast Phase 1 Method Statement (GoBe, 2022).

6.19.20 Based on the results of the cumulative displacement assessment, the magnitude of impact from annual cumulative displacement on the regional gannet population was considered to be **Negligible** (Table 100).

Table 100 Determination of magnitude for cumulative gannet displacement

	MDO	Alternative Design Option
Extent	Very small proportion of the population is predicted to be affected	Very small proportion of the population is predicted to be affected
Duration	The cumulative impact is likely to occur throughout the operation phase of the projects and will therefore be long-term, as defined by EPA (2022).	The impact is likely to occur throughout the operation phase of the project and will therefore be long-term, as defined by EPA (2022).
Frequency	The effect is anticipated to occur throughout the year.	The effect is anticipated to occur throughout the year.
Probability	Displacement effects are considered likely, based on post-construction evidence from operational OWFs.	Displacement effects are considered likely, based on post-construction evidence from operational OWFs.
Consequence	Although cumulative displacement of gannets from the OWFs considered in this assessment is likely throughout the year, at the population level, associated mortality is predicted to be very low, which would equate to Negligible magnitude.	Although cumulative displacement of gannets from the OWFs considered in this assessment is likely throughout the year, at the population level, associated mortality is predicted to be very low, which would equate to Negligible magnitude.
Overall magnitude	The potential magnitude is rated as Negligible.	The potential magnitude is rated as Negligible.

6.19.21 For this assessment, receptor sensitivity has been based on three reviews of evidence from post-construction studies at offshore wind farms. A review of post-construction studies of seabirds at offshore wind farms in European waters concluded that gannet was one of the species which strongly or nearly completely avoided offshore wind farms (Dierschke *et al.,* 2016). However, other factors such as flexibility of habitat use and extensive foraging range also should be considered. A review of vulnerability of Scottish seabirds to offshore wind turbines in the context of disturbance and displacement ranked gannet as the 28th most sensitive out of 38 species (Furness *et al.,* 2013). Bradbury *et al.,* (2014), classified the gannet population vulnerability to displacement from offshore wind farms as very low.

6.19.22 Evidence from reviews presented above and from post-construction studies summarised in the Displacement Matrices Technical Report, indicates that gannet sensitivity to displacement from operational offshore wind farms is likely to be **Medium**.

6.19.23 For gannet, the magnitude of the cumulative impact is deemed to be **Negligible**, and the overall sensitivity of this species is considered to be **Medium**, with individuals potentially originating from a number of SPAs in the region, as well as non-SPA colonies. The significance of any cumulative effect on gannets from displacement and barrier effects associated with the Tier 1, 2 and 3 projects is a **Not Significant** effect, which is **Not significant** in EIA terms.

Kittiwake

6.19.24 There is potential for cumulative displacement effects on kittiwakes. The estimated annual cumulative abundance of kittiwakes from Tier 1, 2 and 3 projects are presented in Table 101. An annual cumulative displacement matrix for kittiwake is presented in the Seabird Displacement Matrices Technical Report.

Table 101 Annual cumulative abundance for kittiwakes for Tier 1, 2 and 3 projects (Site +2 km)

Project	Annual abundance
Dublin Array	2,221
Oriel[1]	382
Arklow[2]	12,210
NISA[3]	3,430
Codling[4]	2,492
Awel-y-Mor[5]	467
Burbo Bank Extension[6]	707
Walney Extension[7]	2,900
Erebus[8]	2,532
Morgan[9]	2,345
Mona[10]	592
Morecambe[11]	1,479
Cumulative Total	31,757

1 Oriel EIAR Appendix 11.1 (RPS, 2024a)
2 Arklow EIAR Appendix 12.03 (SSE Renewables, 2024)
3 NISA EIAR Appendix 15.1 (Ove Arup & Partners, 2024)
4 Codling EIAR Appendix 10.5 (Natural Power, 2024)
5 based on array area only; Awel-y-Mor EIAR Vol 4, Annex 4.3 (APEM, 2022)
6 Annex 15: Ornithology (Dong Energy, 2013a)
7 Annex B.7.A: Ornithology Technical Report (Dong Energy, 2013b)
8 Erebus Offshore Ornithology Technical Appendix (Hi-Def, 2021)
9 Morgan OWF EIAR Annex 5.1 (RPS, 2024b)
10 Mona OWF EIAR Annex 5.1 (RPS, 2024c)
11 Morecambe OWF EIAR Appendix 12.1 (Royal Haskoning DHV, 2024b)

6.19.25 Annual cumulative estimated kittiwake mortality from displacement by Tier 1, 2 and 3 projects was based on 30% displacement and 1% mortality, based on recent NatureScot guidance (NatureScot, 2023) and an evaluation of the published literature and expert judgement. For more detail on the displacement and mortality rates used for kittiwake in this assessment, see the Displacement Matrices Appendix (Volume 4, Appendix 4.3.6-6). The overall baseline mortality rates were based on age-specific demographic rates and age class proportions (Table 16).

6.19.26 The potential magnitude of impact was estimated by calculating the increase in annual cumulative baseline mortality with respect to the largest regional population (Table 14 and Table 15).

6.19.27 The annual cumulative abundance for kittiwake was estimated to be 31,757 individuals (all ages) (Table 102). Based on a displacement rate of 30%, this would affect an estimated 9,527 birds. Applying a mortality rate of 1%, the annual cumulative additional mortality due to displacement effects would be 95 kittiwakes (all ages), of which the proposed development contributes seven individuals (all ages) (Table 38).

Table 102 Annual cumulative displacement mortality estimates for kittiwakes for Tier 1, 2 and 3 projects

Peak abundance	Annual displaceme nt	Annual displaceme nt mortality	Regional baseline pop	Annual regional baseline mortality	Increase in annual baseline mortality (%)
31,757	9,527	95	933,197	145,579	0.065

6.19.28 The largest kittiwake regional population is estimated to be 933,197 individuals (Table 15). For the annual cumulative displacement assessment based on all ages, the increase in baseline mortality was calculated based on an estimated average kittiwake mortality rate of 0.156 (Table 16). Applying this mortality rate, the estimated regional annual baseline mortality of kittiwakes is 145,579 birds per year (933,197 x 0.156). The additional predicted mortality of 95 kittiwakes (all ages) per year would increase the baseline mortality rate by 0.065% (Table 102).

6.19.29 As highlighted by Natural England guidance and agreed in the East Coast Phase 1 methodology, where predicted impacts equate to 1% or below of baseline mortality for a population (e.g. colony population) then this level of impact could be considered non-significant, and no further assessment of impacts is required (Parker *et al.,* 2022c). As the predicted increase in annual cumulative baseline mortality for kittiwake was below 1%, , the predicted level of change is represents no discernible change to baseline mortality and therefore the magnitude of impact from annual cumulative displacement on the regional kittiwake population was considered to be **Negligible** (Table 103).

Table 103 Determination of magnitude for cumulative kittiwake displacement

	MDO	Alternative Design Option
Extent	Very small proportion of the population is predicted to be affected	Very small proportion of the population is predicted to be affected
Duration	The cumulative impact is likely to occur throughout the operation phase of the projects and will therefore be long-term, as defined by EPA (2022).	The impact is likely to occur throughout the operation phase of the project and will therefore be long-term, as defined by EPA (2022).
Frequency	The effect is anticipated to occur throughout the year.	The effect is anticipated to occur throughout the year.
Probability	Displacement effects are considered possible, based on post-construction evidence from operational OWFs.	Displacement effects are considered possible, based on post-construction evidence from operational OWFs.
Consequence	Although cumulative displacement of kittiwakes from the OWFs considered in this assessment is possible throughout the year, at the population level, associated mortality is predicted to be very low, which would equate to Negligible magnitude.	Although cumulative displacement of kittiwakes from the OWFs considered in this assessment is possible throughout the year, at the population level, associated mortality is predicted to be very low, which would equate to Negligible magnitude.
Overall magnitude	The potential magnitude is rated as Negligible.	The potential magnitude is rated as Negligible.

6.19.30 For this assessment, receptor sensitivity has been based on three reviews of evidence from post-construction studies at offshore wind farms. A review of post-construction studies of seabirds at offshore wind farms in European waters concluded that kittiwake was one of the species which were hardly affected by OWFs or with attraction and avoidance approximately equal over all studies (Dierschke *et al.,* 2016). A review of vulnerability of Scottish seabirds to offshore wind turbines in the context of disturbance and displacement ranked kittiwake as the 24th most sensitive out of 38 species (Furness *et al.,* 2013). Bradbury *et al.,* (2014), classified the kittiwake population vulnerability to displacement from offshore wind farms as very low.

6.19.31 Evidence from reviews presented above and from post-construction studies summarised in the Displacement Matrices Technical Report, indicates that kittiwake sensitivity to displacement from operational offshore wind farms is likely to be **Low**.

6.19.32 For kittiwake, the magnitude of the annual cumulative impact is deemed to be **Negligible**, and the overall sensitivity of this species is considered to be **Low**. The significance of any annual cumulative effect on kittiwakes from displacement and barrier effects associated with the Tier 1 and Tier 2 projects is a **Not Significant** effect, which is **Not significant** in EIA terms.

Guillemot

6.19.33 There is potential for cumulative displacement effects on guillemots. The estimated annual cumulative abundance of guillemots from Tier 1, 2 and 3 projects are presented in Table 104. An annual cumulative displacement matrix for guillemot is presented in the Seabird Displacement Matrices Technical Report.

Table 104 Annual cumulative abundance for guillemots for Tier 1, 2 and 3 projects (Site +2 km)

Project	Annual abundance
Dublin Array	18,675
Oriel[1]	3,490
Arklow[2]	8,112
NISA[3]	43,468
Codling[4]	16,964
Awel-y-Mor[5]	4,488
Burbo Bank Extension[2,3]	3,448
Walney Extension[2,3]	6,093
West of Duddon Sands[2,3]	833
Ormonde[2,3]	238
Erebus[6]	35,339
Morgan[7]	7,834
Morecambe[8]	14,689
Mona[9]	7,976
White Cross[10]	4,363
Robin Rigg[11]	39
Twin Hub[8]	256
Cumulative Total	**176,305**

1 Oriel EIAR Chapter 11 (RPS, 2024a)
2 Arklow EIAR Chapter 12 (SSE Renewables, 2024)
3 NISA EIAR Chapter 15 (Ove Arup & Partners, 2024)
4 Codling EIAR Appendix 10.1 (Natural Power, 2024)
5 Awel-y-Mor EIAR Vol 4, Annex 4.3 (APEM, 2022)
6 Supplementary Environmental Information Addendum Report (Blue Gem Wind, 2023)
7 Morgan OWF EIAR (RPS, 2024b)
8 Morecambe OWF EIAR (Royal Haskoning DHV, 2024a)
9 Mona OWF EIAR (RPS, 2024c)
10 White Cross EIAR (APEM, 2023)
11 Robin Rigg EIA (Natural Power, 2005)

6.19.34 For guillemot, annual displacement rates of 50%-60% and mortality rates of 1%, 3% and 5% were applied, based on recent guidance from NatureScot (NatureScot, 2023), and an evaluation of the published literature and evidence from post-construction studies at operational OWFs. For further details, see the Seabird Displacement Matrices Technical Report.

6.19.35 The overall baseline mortality rates were based on age-specific demographic rates and age class proportions as presented in Table 16. The potential magnitude of impact was estimated by calculating the increase in annual cumulative baseline mortality with respect to the largest regional population.

6.19.36 The annual cumulative abundance for guillemot was estimated to be 176,305 individuals (all ages) (Table 105). Based on a displacement rate of 50%, this would affect an estimated 88,153 birds. Applying a mortality rate of 1%, the annual cumulative additional mortality due to displacement effects would be 882 guillemots (all ages), of which the proposed development contributes 103 individuals (all ages) (Table 44).

6.19.37 Based on a displacement rate of 60%, this would affect an estimated 105,783 birds. Applying a mortality rate of 1% and 3%, the annual cumulative additional mortality due to displacement effects would be 2,116 guillemots (all ages) (Table 105). Applying a mortality rate of 3% and 5%, the annual cumulative additional mortality due to displacement effects would be 4,231 guillemots (all ages) (Table 105).

Table 105 Annual cumulative displacement mortality estimates for guillemots for Tier 1, 2 and 3 projects

Scenario	Peak abundance	Annual displacement	Annual mortality	Regional baseline pop	Annual regional baseline mortality	Increase in baseline mortality (%)
50% and 1%	176,305	88,153	882	1,332,623	181,237	0.487%
60% and 1%/3%	176,305	105,783	2,116	1,332,623	181,237	1.168%
60% and 3%/5%	176,305	105,783	4,231	1,332,623	181,237	2.335%

6.19.38 The largest guillemot regional population is estimated to be 1,332,623 individuals (Table 15). For the annual cumulative displacement assessment based on all ages, the increase in baseline mortality was calculated based on an estimated average guillemot mortality rate of 0.136 (Table 16). Applying this mortality rate, the estimated regional annual baseline mortality of guillemots is 181,237 birds per year (1,332,623 x 0.136). Based on 50% displacement and 1% mortality, the additional predicted mortality of 882 guillemots (all ages) per year would increase the baseline mortality rate by 0.487% (Table 105).

6.19.39 Based on 60% displacement and 1% and 3% mortality, the additional predicted mortality of 2,116 guillemots (all ages) per year would increase the baseline mortality rate by 1.168% (Table 105).

6.19.40 Based on 60% displacement and 3% and 5% mortality, the additional predicted mortality of 4,231 guillemots (all ages) per year would increase the baseline mortality rate by 2.335% (Table 105).

6.19.41 The predicted percentage increase in the baseline mortality rate was less than 1% when applying a displacement rate of 50% and a mortality rate of 1%, indicating that any impact arising from cumulative displacement impacts would be non-significant, as stated in the Natural England guidance (Parker *et al.,* 2022c).

6.19.42 However, as the predicted percentage increase in the baseline mortality rate exceeded 1% when applying a 60% displacement and 1% to 5% mortality rates, PVA was carried out on the regional guillemot population considering cumulative displacement effects. The results of the regional PVAs for predicted cumulative displacement during the 35-year operational phase is summarised in Table 106. Further details of the PVA methodology, input parameters and an explanation of how to interpret the PVA results can be found in the PVA Technical Report.

Table 106 Summary of PVA cumulative displacement outputs for the regional guillemot population after 35 years

Scenario	Counterfactual of Population Growth Rate		Counterfactual of Population Size		50% Quantiles	
	Median	Mean	Median	Mean	U=50%I	I=50%U
50% and 1%	0.9957	0.9957	0.8555	0.8555	29.56	71.44
60% and 1%/3%	0.9896	0.9896	0.6867	0.6868	10.0	90.56
60% and 3%/5%	0.9792	0.9792	0.4699	0.4699	0.70	99.66

6.19.43 For the regional guillemot population over 35 years, based on a displacement rate of 50% and a mortality rate of 1%, the PVA model predicted a very slight reduction in the population growth rate of 0.43% (median CGR = 0.9957) and a reduction in population size by 14.45% (median CPS = 0.8555; Table 106).

6.19.44 Based on a displacement rate of 60% and a mortality rate of 3% in the breeding season and 1% in the non-breeding season, the PVA model predicted a slight reduction in the population growth rate of 1.04% (median CGR = 0.9896) and a reduction in population size by 31.33% (median CPS = 0.6867; Table 106).

6.19.45 Based on a displacement rate of 60% and a mortality rate of 5% in the breeding season and 3% in the non-breeding season, the PVA model predicted a reduction in the population growth rate of 2.08% (median CGR = 0.9792) and a reduction in population size by 53.01% (median CPS = 0.4699; Table 106).

6.19.46 These values indicate that, based on a displacement rate of 50% and a mortality rate of 1%, the PVA did not predict a significant negative effect from the cumulative effects of displacement mortality on the regional guillemot population after 35 years. The PVA model predicted that with no OWFs, the regional guillemot population would increase over the 35-year lifetime of the project. When considering cumulative impacts from Dublin Array and the other OWFs, the regional guillemot population was still predicted to increase, but at a slightly lower rate (PVA Technical Report).

6.19.47 Based on a displacement rate of 60% and mortality rates of 1%, 3% and 5%, the PVA again did not predict a significant negative effect from the cumulative effects of displacement mortality on the regional guillemot population after 35 years. The PVA model predicted that considering cumulative impacts from Dublin Array and the other OWFs, the regional guillemot population was still predicted to increase slightly, but at a lower rate than when using a displacement rate of 50% and a mortality rate of 1% (PVA Technical Report).

6.19.48 Based on the results of the cumulative displacement assessment and the PVA assessment, the magnitude of impact from cumulative displacement on the regional guillemot population was considered to be **Low** (Table 107), while the PVA outputs did not predict a significant negative effect.

Table 107 Determination of magnitude for cumulative guillemot displacement

	MDO	Alternative Design Option
Extent	Small proportion of the population is predicted to be affected	Small proportion of the population is predicted to be affected
Duration	The cumulative impact is likely to occur throughout the operation phase of the projects and will therefore be long-term, as defined by EPA (2022).	The impact is likely to occur throughout the operation phase of the project and will therefore be long-term, as defined by EPA (2022).
Frequency	The effect is anticipated to occur throughout the year.	The effect is anticipated to occur throughout the year.
Probability	Displacement effects are considered likely, based on post-construction evidence from operational OWFs.	Displacement effects are considered likely, based on post-construction evidence from operational OWFs.
Consequence	Although cumulative displacement of guillemots from the OWFs considered in this assessment is likely throughout the year, at the population level, associated mortality is predicted by PVA to be low, which would equate to Low magnitude.	Although cumulative displacement of guillemots from the OWFs considered in this assessment is likely throughout the year, at the population level, associated mortality is predicted by PVA to be low, which would equate to Low magnitude.
Overall magnitude	The potential magnitude is rated as Low.	The potential magnitude is rated as Low.

6.19.49 For this assessment, receptor sensitivity has been based on three reviews of evidence from post-construction studies at offshore wind farms. A review of post-construction studies of seabirds at offshore wind farms in European waters concluded that guillemot was one of the species that weakly avoided offshore wind farms (Dierschke *et al.,* 2016). A review of vulnerability of Scottish seabirds to offshore wind turbines in the context of disturbance and displacement ranked guillemot as the 11th most sensitive out of 38 species (Furness *et al.,* 2013). Bradbury *et al.,* (2014), classified the guillemot population vulnerability to displacement from offshore wind farms as moderate.

6.19.50 Overall, based on the conservation importance, together with evidence from reviews and post-construction studies presented above indicates that guillemot sensitivity to displacement associated with Dublin Array is likely to be **Medium** (Table 3).

6.19.51 For guillemot, the magnitude of the cumulative impact is deemed to be **Low**, and the overall sensitivity of this species is considered to be **Medium**, with individuals potentially originating from a number of SPAs in the region, as well as non-SPA colonies. The significance of any cumulative effect on guillemots from displacement and barrier effects associated with the Tier 1 and Tier 2 projects is a **Slight Adverse** effect, which is **Not significant** in EIA terms.

Razorbill

6.19.52 There is potential for cumulative displacement effects on razorbills. The estimated annual cumulative abundance of razorbills from Tier 1, 2 and 3 projects are presented in Table 108. A cumulative annual displacement matrix for razorbill is presented in the Seabird Displacement Matrices Technical Report.

Table 108 Annual cumulative abundance for razorbills for Tier 1, 2 and 3 projects (Site +2 km)

Project	Annual abundance
Dublin Array	3,897
Oriel[1]	2,345
Arklow[2]	8,313
NISA[3]	6,101
Codling[4]	6,084
Awel-y-Mor[5]	692
Burbo Bank Extension[2]	360
Walney Extension[7,8]	9,933
Erebus[6]	3,867
Morgan[7]	1,787
Morecambe[8]	1,979
Mona[9]	2,519
White Cross[10]	786
Robin Rigg[11]	7
Cumulative Total	48,670

1 Oriel EIAR Chapter 11 (RPS, 2024a)
2 Arklow EIAR Chapter 12 (SSE Renewables, 2024)
3 NISA EIAR Chapter 15 (Ove Arup & Partners, 2024)
4 Codling EIAR Appendix 10.1 (Natural Power, 2024)
5 Awel-y-Mor EIAR Vol 4, Annex 4.3 (APEM, 2022)
6 Supplementary Environmental Information Addendum Report (Blue Gem Wind, 2023)
7 Morgan OWF EIAR (RPS, 2024b)
8 Morecambe OWF EIAR (Royal Haskoning DHV, 2024a)
9 Mona OWF EIAR (RPS, 2024c)
10 White Cross EIAR (APEM, 2023)
11 Robin Rigg EIA (Natural Power, 2005)

6.19.53 For razorbill, annual displacement rates of 50%-60% and mortality rates of 1%, 3% and 5% were applied, based on recent guidance from NatureScot (NatureScot, 2023), and an evaluation of the published literature and evidence from post-construction studies at operational OWFs. For further details, see the Seabird Displacement Matrices Technical Report.

6.19.54 The overall baseline mortality rates were based on age-specific demographic rates and age class proportions as presented in Table 16. The potential magnitude of impact was estimated by calculating the increase in annual cumulative baseline mortality with respect to the largest regional population.

6.19.55 The annual cumulative abundance for razorbill was estimated to be 48,670 individuals (all ages) (Table 109). Based on a displacement rate of 50%, this would affect an estimated 24,335 birds. Applying a mortality rate of 1%, the annual cumulative additional mortality due to displacement effects would be 243 razorbills (all ages), of which the proposed development contributes 16 individuals (all ages) (Table 50).

6.19.56 Based on a displacement rate of 60%, this would affect an estimated 29,202 birds. Applying a mortality rate of 1% and 3%, the annual cumulative additional mortality due to displacement effects would be 584 razorbills (all ages) (Table 109). Applying a mortality rate of 3% and 5%, the annual cumulative additional mortality due to displacement effects would be 1,168 razorbills (all ages) (Table 109).

Table 109 Cumulative displacement mortality estimates for razorbills (adults in breeding season) for Tier 1, 2 and 3 projects

Scenario	Peak abundance	Annual displacement	Annual mortality	Regional baseline pop	Annual regional baseline mortality	Increase in baseline mortality (%)
50% and 1%	48,670	24,335	243	632,453	81,586	0.30
60% and 1%/3%	48,670	29,202	584	632,453	81,586	0.72
60% and 3%/5%	48,670	29,202	1,168	632,453	81,586	1.43

6.19.57 The largest razorbill regional population is estimated to be 632,453 individuals (Table 15). For the annual cumulative displacement assessment based on all ages, the increase in baseline mortality was calculated based on an estimated average razorbill mortality rate of 0.129 (Table 16). Applying this mortality rate, the estimated regional annual baseline mortality of razorbills is 81,586 birds per year (632,453 x 0.129). Based on 50% displacement and 1% mortality, the additional predicted mortality of 243 razorbills (all ages) per year would increase the baseline mortality rate by 0.30% (Table 109).

6.19.58 Based on 60% displacement and 1% and 3% mortality, the additional predicted mortality of 584 razorbills (all ages) per year would increase the baseline mortality rate by 0.72% (Table 109).

6.19.59 Based on 60% displacement and 3% and 5% mortality, the additional predicted mortality of 1,168 razorbills (all ages) per year would increase the baseline mortality rate by 1.43% (Table 109).

6.19.60 The predicted percentage increase in the baseline mortality rate was less than 1% when applying a displacement rate of 50% and a mortality rate of 1%, indicating that any impact arising from cumulative displacement impacts would be non-significant, as stated in the Natural England guidance (Parker *et al.,* 2022c).

6.19.61 However, as the predicted percentage increase in the baseline mortality rate exceeded 1% when applying a 60% displacement and 3% and 5% mortality rates, PVA was carried out on the regional razorbill population considering cumulative displacement effects. The results of the regional PVAs for predicted cumulative displacement during the 35-year operational phase is summarised in Table 110. Further details of the PVA methodology, input parameters and an explanation of how to interpret the PVA results can be found in the PVA Technical Report.

Table 110 Summary of PVA cumulative displacement outputs for the regional razorbill population after 35 years

Scenario	Counterfactual of Population Growth Rate		Counterfactual of Population Size		50% Quantiles	
	Median	Mean	Median	Mean	U=50%I	I=50%U
50% and 1%	0.9942	0.9942	0.8112	0.8113	31.20	69.62
60% and 1%/3%	0.9861	0.9861	0.6032	0.6033	12.38	88.48
60% and 3%/5%	0.9721	0.9721	0.3616	0.3613	1.18	99.36

6.19.62 For the regional razorbill population over 35 years, based on a displacement rate of 50% and a mortality rate of 1%, the PVA model predicted a very slight reduction in the population growth rate of 0.58% (median CGR = 0.9942) and a reduction in population size by 18.88% (median CPS = 0.8112; Table 110).

6.19.63 Based on a displacement rate of 60% and a mortality rate of 3% in the breeding season and 1% in the non-breeding season, the PVA model predicted a slight reduction in the population growth rate of 1.39% (median CGR = 0.9861) and a reduction in population size by 39.68% (median CPS = 0.6032; Table 110).

6.19.64 Based on a displacement rate of 60% and a mortality rate of 5% in the breeding season and 3% in the non-breeding season, the PVA model predicted a reduction in the population growth rate of 2.79% (median CGR = 0.9721) and a reduction in population size by 63.84% (median CPS = 0.3616; Table 110).

6.19.65 These values indicate that, based on a displacement rate of 50% and a mortality rate of 1%, the PVA did not predict a significant negative effect from the cumulative effects of displacement mortality on the regional razorbill population after 35 years. The PVA model predicted that with no OWFs, the regional razorbill population would decrease over the 35-year lifetime of the project. When considering cumulative impacts from Dublin Array and the other OWFs, the regional razorbill population was also predicted to decrease, but at a slightly higher rate (PVA Technical Report).

6.19.66 Based on a displacement rate of 60% and mortality rates of 1%, 3% and 5%, the PVA again did not predict a significant negative effect from the cumulative effects of displacement mortality on the regional razorbill population after 35 years. The PVA model predicted that considering cumulative impacts from Dublin Array and the other OWFs, the regional razorbill population was still predicted to decrease, but at higher rates than when using a displacement rate of 50% and a mortality rate of 1% (PVA Technical Report).

6.19.67 Based on the results of the cumulative displacement assessment and the PVA assessment, the magnitude of impact from cumulative displacement on the regional razorbill population was considered to be **Negligible**, as the estimated increases in the annual baseline mortality rate were below 1%, when using a 50% displacement rate and a 1% mortality rate (Table 7), while the PVA outputs did not predict a significant negative effect.

Table 111 Determination of magnitude for cumulative razorbill displacement

	MDO	Alternative Design Option
Extent	Very small proportion of the population is predicted to be affected	Very small proportion of the population is predicted to be affected
Duration	The cumulative impact is likely to occur throughout the operation phase of the projects and will therefore be long-term, as defined by EPA (2022).	The impact is likely to occur throughout the operation phase of the project and will therefore be long-term, as defined by EPA (2022).
Frequency	The effect is anticipated to occur throughout the year.	The effect is anticipated to occur throughout the year.
Probability	Some degree of displacement effects are considered likely, based on post-construction evidence from operational OWFs.	Some degree of displacement effects are considered likely, based on post-construction evidence from operational OWFs.
Consequence	Although some degree of cumulative displacement of razorbills from the OWFs considered in this assessment is likely throughout the year, at the population level, associated mortality is predicted by PVA to be low, which would equate to Negligible magnitude.	Although some degree of cumulative displacement of razorbills from the OWFs considered in this assessment is likely throughout the year, at the population level, associated mortality is predicted by PVA to be low, which would equate to Negligible magnitude.
Overall magnitude	The potential magnitude is rated as Negligible.	The potential magnitude is rated as Negligible.

6.19.68 For this assessment, receptor sensitivity has been based on three reviews of evidence from post-construction studies at offshore wind farms. A review of post-construction studies of seabirds at offshore wind farms in European waters concluded that razorbill was one of the species that weakly avoided offshore wind farms (Dierschke *et al.,* 2016). A review of vulnerability of Scottish seabirds to offshore wind turbines in the context of disturbance and displacement ranked razorbill as the 12th most sensitive out of 38 species (Furness *et al.,* 2013). Bradbury *et al.,* (2014), classified the razorbill population vulnerability to displacement from offshore wind farms as moderate.

6.19.69 Overall, based on the conservation importance, together with evidence from reviews and post-construction studies presented above indicates that razorbill sensitivity to displacement associated with Dublin Array is likely to be **Medium**.

6.19.70 For razorbill, the magnitude of the cumulative impact is deemed to be **Negligible**, and the overall sensitivity of this species is considered to be **Medium**, with individuals potentially originating from a number of SPAs in the region, as well as non-SPA colonies. The significance of any cumulative effect on razorbills from displacement and barrier effects associated with the Tier 1 and Tier 2 projects is a **Not Significant** effect, which is **Not significant** in EIA terms.

6.19.71 The alternative design options (any other option within the range of parameters set out in the project description) will not give rise to an effect which is more significant than the maximum design option.

Residual Effect

The effect on key bird species from cumulative displacement effects associated with Dublin Array and other Tier 1 and 2 projects have been assessed as 'not significant' in EIA terms. Therefore, no further mitigation (in addition to that already identified in Table 19) is considered necessary. No ecologically significant adverse residual effects on offshore ornithology have therefore been predicted.

Impact 15: Cumulative collision effects on key bird species

6.19.72 Cumulative effects in the construction and decommissioning phases were scoped out in Table 97 and so are not considered further here.

6.19.73 For the operation and maintenance phase, the cumulative effects assessment was conducted at the individual species level, considering predicted impacts from Dublin Array, the other east coast Phase 1 projects and existing, operational OWF projects in the wider region.

6.19.74 A cumulative collision assessment was conducted for five species: gannet, herring gull, great black-backed gull, kittiwake and common tern.

6.19.75 For black-headed gull, common gull and lesser black-backed gull, no cumulative collision assessment was undertaken on the basis that the overall predicted collision mortality for these species from Dublin Array alone was very low, with a resulting negligible predicted increase in the baseline mortality rate for these species. For black-headed gull and common gull, the very low numbers of predicted collisions were limited to the non-breeding season, when any such impacts would be undetectable at a population level. It was considered that Dublin Array would not contribute to cumulative collision mortality for these species due to the very low number of collisions predicted from Dublin Array alone. Similarly, a combined cumulative collision and displacement assessment was not undertaken for gannet as the predicted combined effects for Dublin Array alone were very low.

6.19.76 No cumulative collision assessment was conducted for Sandwich tern, roseate tern or Arctic tern on the basis that predicted collisions for these species from Dublin Array alone were zero. Therefore, it was considered that Dublin Array would not contribute to cumulative collision mortality for these species.

Gannet

6.19.77 The cumulative estimated number of collisions per season for gannet are presented in Table 112. The overall baseline mortality rates were based on age-specific demographic rates and age class proportions (Table 16). The potential magnitude of impact was estimated by calculating the increase in cumulative baseline mortality with respect to the largest regional population.

Table 112 Annual cumulative estimated collision mortality for gannets for Tier 1, 2 and 3 projects

Project	Annual collisions
Dublin Array	3.45
Oriel[1]	10.18
Arklow[2]	0.9
NISA[3]	1.4
Codling[4]	2.56
Awel-y-Mor[7,9]	13.41
Burbo Bank Extension[8]	11.9
Walney Extension[2,3]	37.40
Ormonde[2,3]	2.00
Erebus[6]	7.01
Twinhub[2,3]	12.0
Morgan[7]	1.5
Morecambe[8]	1.26
Mona[9]	5.6
White Cross[10]	6.55
Morlais (tidal)[3]	1.00
Total	**118.12**
Cumulative Total (to nearest whole bird)	**118**

1 Oriel EIAR Chapter 11 (RPS, 2024a)
2 Arklow EIAR Chapter 12 (SSE Renewables, 2024)
3 NISA EIAR Chapter 15 (Ove Arup & Partners, 2024)
4 Codling EIAR Appendix 10.1 (Natural Power, 2024)
5 Awel-y-Mor EIAR Vol 4, Annex 4.3 (APEM, 2022)
6 Supplementary Environmental Information Addendum Report (Blue Gem Wind, 2023)
7 Morgan OWF EIAR (RPS, 2024b)
8 Morecambe OWF EIAR (Royal Haskoning DHV, 2024a)
9 Mona OWF EIAR (RPS, 2024c)
10 White Cross EIAR (APEM, 2023)

6.19.78 Annual cumulative collision mortality for gannet was estimated to be 118 individuals (Table 112). The largest gannet regional population is estimated to be 643,917 individuals (Table 15). For the annual cumulative collision assessment based on all ages, the increase in baseline mortality was calculated based on an estimated average gannet mortality rate of 0.181 (Table 16). Applying this mortality rate, the estimated regional annual baseline mortality of gannets is 116,549 birds per year (643,917 x 0.181). The additional predicted mortality of 118 gannets (all ages) per year would increase the baseline mortality rate by 0.10% (Table 113).

Table 113 Cumulative collision mortality estimates for gannets for Tier 1, 2 and 3 projects

Annual cumulative mortality	Regional baseline pop	Annual regional baseline mortality	Increase in baseline mortality (%)
118 birds	643,917	116,549	0.10%

6.19.79 As highlighted by Natural England guidance, where predicted impacts equate to 1% or below of baseline mortality for a population (e.g. colony population) then this level of impact could be considered non-significant (Parker *et al.,* 2022c). As the predicted increase in annual cumulative baseline mortality for gannet was below 1%, PVA was not carried out on the regional gannet population, as agreed in the East Coast Phase 1 Method Statement (GoBe, 2022).

6.19.80 Based on the results of the cumulative collision assessment, the magnitude of impact from cumulative collision effects on the regional gannet population was considered to be **Negligible** (Table 114).

Table 114 Determination of magnitude for cumulative gannet collision mortality

	MDO	Alternative Design Option
Extent	Very small proportion of the population is predicted to be affected	Very small proportion of the population is predicted to be affected
Duration	The cumulative impact is likely to occur throughout the operation phase of the projects and will therefore be long-term, as defined by EPA (2022).	The impact is likely to occur throughout the operation phase of the project and will therefore be long-term, as defined by EPA (2022).
Frequency	The effect is anticipated to occur throughout the year.	The effect is anticipated to occur throughout the year.
Probability	Cumulative collision mortality is considered possible, although evidence suggests the majority of gannets will avoid OWFs.	Cumulative collision mortality is considered possible, although evidence suggests the majority of gannets will avoid OWFs.
Consequence	Although cumulative gannet collision mortality is possible throughout the year, at the population level, associated mortality is predicted to be very low, which would equate to Negligible magnitude.	Although cumulative gannet collision mortality is possible throughout the year, at the population level, associated mortality is predicted to be very low, which would equate to Negligible magnitude.
Overall magnitude	The potential magnitude is rated as Negligible.	The potential magnitude is rated as Negligible.

6.19.81 For gannet, there is evidence that gannets show a high degree of avoidance of offshore wind farms. A detailed study (Krijgsveld *et al.,* 2011) using radar and visual observations to monitor the post-construction effects of the Windpark Egmond aan Zee OWEZ established that 64% of gannets avoided entering the wind farm (macro-avoidance) and a similar result (80% macro avoidance) was also observed during a study at the Thanet wind farm (Skov *et al.,* 2018). Leopold *et al.,* (2013) reported that most gannets avoided Dutch offshore wind farms and did not forage within these.

6.19.82 In addition, the Year 1 post-construction study report for Beatrice offshore wind farm reported that gannet showed a marked difference in distribution within the wind farm on post-construction surveys than on pre-construction surveys, with only two birds recorded within the wind farm boundary across all post-construction six surveys undertaken in Year 1. Spatial modelling indicated a significant decrease centred on the wind farm and extending towards the coast with no areas of significant increase. Beyond the region of decrease, the density in the remainder of the survey area was almost identical when comparing pre- and post-construction data (MacArthur Green, 2021).

6.19.83 Overall, based on available evidence from published studies indicating high levels of wind farm avoidance, and the origin of birds from SPA and non-SPA colonies in the region, it is considered that gannet sensitivity to cumulative collision effects is likely to be **Medium**.

6.19.84 For gannet, the magnitude of the impact is deemed to be **Negligible**, and the overall sensitivity of this species is considered to be **Medium**, with individuals potentially originating from a number of SPAs in the region, as well as non-SPA colonies. The significance of any effect on gannets from cumulative collision effects associated with the Tier 1, 2 and 3 projects is a **Not Significant** effect, which is **Not significant** in EIA terms.

Herring Gull

6.19.85 The cumulative estimated number of collisions per season for herring gull are presented in Table 115. The overall baseline mortality rates were based on age-specific demographic rates and age class proportions (Table 16). The potential magnitude of impact was estimated by calculating the increase in annual cumulative baseline mortality with respect to the largest regional population.

Table 115 Annual cumulative estimated collision mortality for herring gulls for Tier 1, 2 and 3 projects

Project	Annual collisions
Dublin Array	36.01
Oriel[1]	91.8
Arklow[2]	1.3
NISA[3]	57.2
Codling[4]	20.64
Awel-y-Mor[8]	2.96
Burbo Bank Extension[4]	28.32
Walney Extension[4]	32.70
Ormonde[3]	0.4
Erebus[6]	3
Twinhub[3,4]	22.90
Morgan[7]	10.1
Morecambe[8]	4.15

Project	Annual collisions
Mona[9]	1.51
White Cross[10]	0.28
Total (in foraging range in breeding season)	313.27
Cumulative Total (to nearest whole bird)	313

1 Oriel EIAR Chapter 11 (RPS, 2024a)
2 Arklow EIAR Chapter 12 (SSE Renewables, 2024)
3 NISA EIAR Chapter 15 (Ove Arup & Partners, 2024)
4 Codling EIAR Appendix 10.1 (Natural Power, 2024)
5 Awel-y-Mor EIAR Vol 4, Annex 4.3 (APEM, 2022)
6 Supplementary Environmental Information Addendum Report (Blue Gem Wind, 2023)
7 Morgan OWF EIAR (RPS, 2024b)
8 Morecambe OWF EIAR (Royal Haskoning DHV, 2024a)
9 Mona OWF EIAR (RPS, 2024c)
10 White Cross EIAR (APEM, 2023)

6.19.86 Annual cumulative collision mortality for herring gull was estimated to be 313 individuals (Table 115). The largest herring gull regional population is estimated to be 187,094 individuals (Table 15). For the annual cumulative collision assessment based on all ages, the increase in baseline mortality was calculated based on an estimated average herring gull mortality rate of 0.172 (Table 16). Applying this mortality rate, the estimated regional annual baseline mortality of herring gulls is 32,180 birds per year (187,094 x 0.172). The additional predicted mortality of 313 herring gulls (all ages) per year would increase the baseline mortality rate by 0.97% (Table 116).

Table 116 Cumulative collision mortality estimates for herring gulls for Tier 1, 2 and 3 projects

Annual cumulative mortality	Regional baseline pop	Annual regional baseline mortality	Increase in baseline mortality (%)
313 birds	187,094 birds	32,180 birds	0.97%

6.19.87 As highlighted by Natural England guidance, where predicted impacts equate to 1% or below of baseline mortality for a population (e.g. colony population) then this level of impact could be considered non-significant (Parker *et al.,* 2022c). As the predicted increase in annual cumulative baseline mortality for herring gull was below 1%, PVA was not carried out on the regional herring gull population, as agreed in the East Coast Phase 1 Method Statement (GoBe, 2022).

6.19.88 Based on the results of the cumulative collision assessment, the magnitude of impact from cumulative collision effects on the regional herring gull population was considered to be **Negligible** (Table 117)

Table 117 Determination of magnitude for cumulative herring gull collision mortality

	MDO	Alternative Design Option
Extent	Very small proportion of the population is predicted to be affected	Very small proportion of the population is predicted to be affected
Duration	The cumulative impact is likely to occur throughout the operation phase of the	The impact is likely to occur throughout the operation phase of the project and

	MDO	Alternative Design Option
	projects and will therefore be long-term, as defined by EPA (2022).	will therefore be long-term, as defined by EPA (2022).
Frequency	The effect is anticipated to occur throughout the year.	The effect is anticipated to occur throughout the year.
Probability	Cumulative collision mortality is considered possible throughout the year.	Cumulative collision mortality is considered possible throughout the year.
Consequence	Although cumulative herring gull collision mortality is possible throughout the year, at the population level, associated mortality is predicted to be very low, which would equate to Negligible magnitude.	Although cumulative herring gull collision mortality is possible throughout the year, at the population level, associated mortality is predicted to be very low, which would equate to Negligible magnitude.
Overall magnitude	The potential magnitude is rated as Negligible.	The potential magnitude is rated as Negligible.

6.19.89 For this assessment, receptor sensitivity has been based on three reviews of evidence from post-construction studies at offshore wind farms. A review of post-construction studies of seabirds at offshore wind farms in European waters concluded that herring gull was one of the species that was weakly attracted to offshore wind farms (Dierschke *et al.,* 2016). A review of vulnerability of Scottish seabirds to offshore wind turbines in the context of collision ranked herring gull as the most sensitive out of 38 species (Furness *et al.,* 2013). Bradbury *et al.,* (2014), classified the herring gull population vulnerability to collision mortality from offshore wind farms as very high.

6.19.90 Overall, based on available evidence from published studies indicating a high sensitivity to collision, and the origin of birds from SPA and non-SPA colonies in the region, it is considered that herring gull sensitivity to cumulative collision effects is likely to be **High**.

6.19.91 For herring gull, the magnitude of the impact is deemed to be **Negligible**, and the overall sensitivity of this species is considered to be **High**. The significance of any effect on herring gulls from cumulative collision effects associated with the Tier 1, 2 and 3 projects is a **Not Significant** effect, which is N**ot significant** in EIA terms (Table 7).

Great black-backed Gull

6.19.92 The annual cumulative estimated number of collisions for great black-backed gull are presented in Table 118. The overall baseline mortality rates were based on age-specific demographic rates and age class proportions (Table 16). The potential magnitude of impact was estimated by calculating the increase in annual cumulative baseline mortality with respect to the largest regional population.

Table 118 Annual cumulative estimated collision mortality for great black-backed gulls for Tier 1, 2 and 3 projects

Project	Annual collisions
Dublin Array	9.01
Oriel[1]	65.91
Arklow[2]	1.6
NISA[3]	26.3
Codling[4]	4.15
Awel-y-Mor[3,4]	4.87
Walney Extension[4]	16.20
Walney 1 & 2[3,4]	12.30
Ormonde[3,4]	0.3
Erebus[5]	1
Morgan[6]	5.7
Morecambe[7]	1.75
Mona[8]	4.83
White Cross[9]	0.70
Total (in foraging range in breeding season)	154.62
Cumulative Total (to nearest whole bird)	155

1 Oriel EIAR Chapter 11 (RPS, 2024a)
2 Arklow EIAR Chapter 12 (SSE Renewables, 2024)
3 NISA EIAR Chapter 15 (Ove Arup & Partners, 2024)
4 Codling EIAR Appendix 10.1 (Natural Power, 2024)
5 Supplementary Environmental Information Addendum Report (Blue Gem Wind, 2023)
6 Morgan OWF EIAR (RPS, 2024b)
7 Morecambe OWF EIAR (Royal Haskoning DHV, 2024a)
8 Mona OWF EIAR (RPS, 2024c)
9 White Cross EIAR (APEM, 2023)

6.19.93 Annual cumulative collision mortality for great black-backed gull was estimated to be 155 individuals (Table 118). The largest great black-backed gull regional population is estimated to be 53,406 individuals (Table 15). For the annual cumulative collision assessment based on all ages, the increase in baseline mortality was calculated based on an estimated average great black-backed gull mortality rate of 0.095 (Table 16). Applying this mortality rate, the estimated regional annual baseline mortality of great black-backed gulls is 5,076 birds per year (53,406 x 0.095). The additional predicted mortality of 155 great black-backed gulls (all ages) per year would increase the baseline mortality rate by 3.05% (Table 119).

Table 119 Cumulative collision mortality estimates for great black-backed gulls for Tier 1, 2 and 3 projects

Annual cumulative mortality	Regional baseline pop	Annual regional baseline mortality	Increase in baseline mortality (%)
155 birds	53,406 birds	5,076 birds	3.05%

6.19.94 As the predicted increase in annual cumulative baseline mortality for great black-backed gull was above 1%, PVA was carried out on the regional great black-backed gull population considering cumulative collision impacts. The results of the regional PVAs for predicted annual cumulative collision impacts during the 35-year operational phase is summarised in Table 120. Further details of the PVA methodology, input parameters and an explanation of how to interpret the PVA results can be found in the PVA Technical Report.

Table 120 Summary of PVA annual cumulative collision outputs for great black-backed gull for Tier 1, 2 and 3 projects after 35 years

Scenario	Counterfactual of Population Growth Rate		Counterfactual of Population Size		50% Quantiles	
	Median	Mean	Median	Mean	U=50%I	I=50%U
Annual	0.9301	0.9301	0.0738	0.0738	0	100

6.19.95 For the regional great black-backed gull population over 35 years, the PVA model predicted a reduction in the population growth rate of 6.99% (median CGR = 0.9301) and a reduction in population size by 92.62% (median CPS = 0.0738; Table 120).

6.19.96 The predicted PVA effects were not considered to be significant, as although the predicted counterfactual for the population growth rate for the population with the cumulative impacts from Dublin Array and other OWF projects was lower than the rate for the population with no OWF developments over the lifetime of the project, there was still an overall predicted increase in the regional population over the period.

6.19.97 Based on the results of the cumulative collision assessment and the PVA assessment, the magnitude of impact from cumulative collision effects on the regional great black-backed gull population was considered to be **Medium** (Table 121), and the PVA outputs did not indicate a significant negative effect.

Table 121 Determination of magnitude for cumulative great black-backed gull collision mortality

	MDO	Alternative Design Option
Extent	Medium proportion of the population is predicted to be affected	Medium proportion of the population is predicted to be affected
Duration	The cumulative impact is likely to occur throughout the operation phase of the projects and will therefore be long-term, as defined by EPA (2022).	The impact is likely to occur throughout the operation phase of the project and will therefore be long-term, as defined by EPA (2022).
Frequency	The effect is anticipated to occur throughout the year.	The effect is anticipated to occur throughout the year.
Probability	Cumulative collision mortality is considered possible throughout the year.	Cumulative collision mortality is considered possible throughout the year.

	MDO	Alternative Design Option
Consequence	Although cumulative great black-backed gull collision mortality is possible throughout the year, at the population level, associated mortality is predicted to result in potential reductions to lifetime reproductive success for some individuals although not at the population level, which would equate to Medium magnitude.	Although cumulative great black-backed gull collision mortality is possible throughout the year, at the population level, associated mortality is predicted to result in potential reductions to lifetime reproductive success for some individuals although not at the population level, which would equate to Medium magnitude.
Overall magnitude	The potential magnitude is rated as Medium.	The potential magnitude is rated as Medium.

6.19.98 For this assessment, receptor sensitivity has been based on three reviews of evidence from post-construction studies at offshore wind farms. A review of post-construction studies of seabirds at offshore wind farms in European waters concluded that great black-backed gull was one of the species that was weakly attracted to offshore wind farms (Dierschke *et al.,* 2016). A review of vulnerability of Scottish seabirds to offshore wind turbines in the context of collision ranked great black-backed gull as the second most sensitive out of 38 species (Furness *et al.,* 2013). Bradbury *et al.,* (2014), classified the great black-backed gull population vulnerability to collision mortality from offshore wind farms as very high.

6.19.99 However, in an Irish context, great black-backed gull is not listed as a qualifying interest in the breeding season for any SPA within mean maximum foraging distance of the east coast Phase 1 projects. Similarly, within the UK, there are no SPAs for great black-backed gulls within mean maximum foraging distance in the breeding season for UK Irish Sea OWF projects (Stroud *et al.,* 2016). In Ireland, the species is listed as a qualifying interest for the North West Irish Sea SPA in the non-breeding season (NPWS, 2023a), but there are no designated SPAs for the species in the non-breeding season in the UK (Stroud *et al.,* 2016).

6.19.100 Great black-backed gull is Green-listed in Ireland in terms of its conservation status (Gilbert *et al.,* 2021), indicating that it is not a species of conservation concern, while in the UK, the species is Amber-listed, due to moderate declines in breeding and non-breeding populations (Stanbury *et al.,* 2021). On this basis, it is considered that great black-backed gull is of "local" importance in terms of its conservation value. Although the species has a high behavioural sensitivity to collision impacts, it is only of local conservation importance, leading to an overall **Medium** sensitivity to collision risk.

6.19.101 For great black-backed gull, the magnitude of the impact is deemed to be **Medium**, and the overall sensitivity of this species is considered to be **Medium**. The significance of any effect on great black-backed gulls from cumulative collision effects associated with the Tier 1, 2 and 3 projects is a **Moderate Adverse** effect, which is **Not significant** in EIA terms.

Kittiwake

6.19.102 The cumulative estimated number of collisions per season for kittiwake are presented in Table 122. The overall baseline mortality rates were based on age-specific demographic rates and age class proportions (Table 16). The potential magnitude of impact was estimated by calculating the increase in annual cumulative baseline mortality with respect to the largest regional population.

Table 122 Annual cumulative estimated collision mortality for kittiwakes for Tier 1, 2 and 3 projects

Project	Annual collisions
Dublin Array	29.49
Oriel[1]	56.28
Arklow[2]	186.8
NISA[3]	19.3
Codling[4]	18.28
Awel-y-Mor[2,3,4]	53.87
Burbo Bank Extension[2,3,4]	22.26
Walney Extension[2,3,4]	187.6
Ormonde[2,3,4]	2.2
Erebus[5]	58
Twinhub[2,3,4]	10.80
Morgan[6]	40.0
Morecambe[7]	25.45
Mona[8]	32.67
White Cross[9]	21.47
Total (in foraging range in breeding season)	764.47
Cumulative Total (to nearest whole bird)	764

1 Oriel EIAR Chapter 11 (RPS, 2024a)
2 Arklow EIAR Chapter 12 (SSE Renewables, 2024)
3 NISA EIAR Chapter 15 (Ove Arup & Partners, 2024)
4 Codling EIAR Appendix 10.1 (Natural Power, 2024)
5 Supplementary Environmental Information Addendum Report (Blue Gem Wind, 2023)
6 Morgan OWF EIAR (RPS, 2024b)
7 Morecambe OWF EIAR (Royal Haskoning DHV, 2024a)
8 Mona OWF EIAR (RPS, 2024c)
9 White Cross EIAR (APEM, 2023)

6.19.103 Annual cumulative collision mortality for kittiwake was estimated to be 764 individuals (Table 122). The largest kittiwake regional population is estimated to be 933,197 individuals (Table 15). For the annual cumulative collision assessment based on all ages, the increase in baseline mortality was calculated based on an estimated average kittiwake mortality rate of 0.156 (Table 16). Applying this mortality rate, the estimated regional annual baseline mortality of kittiwakes is 145,579 birds per year (933,197 x 0.156). The additional predicted mortality of 764 kittiwakes (all ages) per year would increase the baseline mortality rate by 0.52% (Table 123).

Table 123 Cumulative collision mortality estimates for kittiwakes for Tier 1, 2 and 3 projects

Annual cumulative mortality	Regional baseline pop	Annual regional baseline mortality	Increase in baseline mortality (%)
764 birds	933,197	145,579	0.52%

6.19.104 As highlighted by Natural England guidance, where predicted impacts equate to 1% or below of baseline mortality for a population (e.g. colony population) then this level of impact could be considered non-significant (Parker *et al.,* 2022c). As the predicted increase in annual cumulative baseline mortality for kittiwake was below 1%, PVA was not carried out on the regional kittiwake population, as agreed in the East Coast Phase 1 Method Statement (GoBe, 2022).

6.19.105 Based on the results of the cumulative collision assessment, the magnitude of impact from annual cumulative collision effects on the regional kittiwake population was considered to be **Negligible** (Table 124).

Table 124 Determination of magnitude for cumulative kittiwake collision mortality

	MDO	Alternative Design Option
Extent	Very small proportion of the population is predicted to be affected	Very small proportion of the population is predicted to be affected
Duration	The cumulative impact is likely to occur throughout the operation phase of the projects and will therefore be long-term, as defined by EPA (2022).	The impact is likely to occur throughout the operation phase of the project and will therefore be long-term, as defined by EPA (2022).
Frequency	The effect is anticipated to occur throughout the year.	The effect is anticipated to occur throughout the year.
Probability	Cumulative collision mortality is considered possible throughout the year.	Cumulative collision mortality is considered possible throughout the year.
Consequence	Although cumulative kittiwake collision mortality is possible throughout the year, at the population level, associated mortality is predicted to be very low, which would equate to Negligible magnitude.	Although cumulative kittiwake collision mortality is possible throughout the year, at the population level, associated mortality is predicted to be very low, which would equate to Negligible magnitude.
Overall magnitude	The potential magnitude is rated as Negligible.	The potential magnitude is rated as Negligible.

6.19.106 For this assessment, receptor sensitivity has been based on three reviews of evidence from post-construction studies at offshore wind farms. A review of post-construction studies of seabirds at offshore wind farms in European waters concluded that kittiwake was one of the species that was hardly affected by offshore wind farms (Dierschke *et al.,* 2016). A review of vulnerability of Scottish seabirds to offshore wind turbines in the context of collision ranked kittiwake as the seventh most sensitive out of 38 species (Furness *et al.,* 2013). Bradbury *et al.,* (2014), classified the kittiwake population vulnerability to collision mortality from offshore wind farms as high.

6.19.107 Overall, based on available evidence from published studies indicating a high sensitivity to collision, and the origin of birds from SPA and non-SPA colonies in the region, it is considered that kittiwake sensitivity to cumulative collision effects is likely to be **High**.

6.19.108 For kittiwake, the magnitude of the impact is deemed to be **Negligible,** and the overall sensitivity of this species is considered to be **High**, with individuals potentially originating from a number of SPAs in the region, as well as non-SPA colonies. The significance of any effect on kittiwakes from cumulative collision effects associated with the Tier 1, 2 and 3 projects is a **Not Significant** effect, which is **Not significant** in EIA terms.

Common Tern

6.19.109 The cumulative estimated annual number of collisions for common tern are presented in Table 125, although it should be noted that common terns are not present in Irish waters in the winter months. The overall baseline mortality rates were based on age-specific demographic rates and age class proportions (Table 16). The potential magnitude of impact was estimated by calculating the increase in annual cumulative baseline mortality with respect to the largest regional population.

Table 125 Annual cumulative estimated collision mortality for common terns for Tier 1, 2 and 3 projects

Project	Annual collisions
Dublin Array	3.0
Oriel[1]	0
Arklow[2]	8.6
NISA[3]	0.7
Codling[4]	2.27
Awel-y-Mor[2,3,4]	0.2
Burbo Bank Extension[2,3]	9
Walney Extension[2,3]	0
Erebus[5]	0
Morgan[6]	0
Morecambe[2,3,4]	0.17
Mona[7]	0

Project	Annual collisions
Total (in foraging range in breeding season)	23.94
Cumulative Total (to nearest whole bird)	24

1 Oriel EIAR Chapter 11 (RPS, 2024a)
2 Arklow EIAR Chapter 12 (SSE Renewables, 2024)
3 NISA EIAR Chapter 15 (Ove Arup & Partners, 2024)
4 Codling EIAR Appendix 10.1 (Natural Power, 2024)
5 Supplementary Environmental Information Addendum Report (Blue Gem Wind, 2023)
6 Morgan OWF EIAR (RPS, 2024b)
7 Morecambe OWF EIAR (Royal Haskoning DHV, 2024a)
8 Mona OWF EIAR (RPS, 2024c)

6.19.110 Annual cumulative collision mortality for common tern was estimated to be 24 individuals (Table 125). The largest common tern regional population is estimated to be 74,000 individuals (Table 15). For the annual cumulative collision assessment based on all ages, the increase in baseline mortality was calculated based on an estimated average common tern mortality rate of 0.191 (Table 16). Applying this mortality rate, the estimated regional annual baseline mortality of common terns is 14,134 birds per year (74,000 x 0.191). The additional predicted mortality of 24 common terns (all ages) per year would increase the baseline mortality rate by 0.17% (Table 126).

Table 126 Cumulative collision mortality estimates for common terns for Tier 1, 2 and 3 projects

Annual cumulative mortality	Regional baseline pop	Annual regional baseline mortality	Increase in baseline mortality (%)
24 birds	74,000 birds	14,134 birds	0.17

6.19.111 As highlighted by Natural England guidance, where predicted impacts equate to 1% or below of baseline mortality for a population (e.g. colony population) then this level of impact could be considered non-significant (Parker *et al.,* 2022c). As the predicted increase in annual cumulative baseline mortality for common tern was below 1%, PVA was not carried out on the regional common tern population, as agreed in the East Coast Phase 1 Method Statement (GoBe, 2022).

6.19.112 Based on the results of the cumulative collision assessment, the magnitude of impact from annual cumulative collision effects on the regional common tern population was considered to be **Negligible** (Table 127)

Table 127 Determination of magnitude for cumulative common tern collision mortality

	MDO	Alternative Design Option
Extent	Very small proportion of the population is predicted to be affected	Very small proportion of the population is predicted to be affected
Duration	The cumulative impact is likely to occur throughout the operation phase of the projects and will therefore be long-term, as defined by EPA (2022).	The impact is likely to occur throughout the operation phase of the project and will therefore be long-term, as defined by EPA (2022).
Frequency	The effect is anticipated to occur between April and September.	The effect is anticipated to occur between April and September.

	MDO	Alternative Design Option
Probability	Cumulative collision mortality is considered possible between April and September.	Cumulative collision mortality is considered possible between April and September.
Consequence	Although cumulative common tern collision mortality is possible between April and September, at the population level, associated mortality is predicted to be very low, which would equate to Negligible magnitude.	Although cumulative common tern collision mortality is possible between April and September, at the population level, associated mortality is predicted to be very low, which would equate to Negligible magnitude.
Overall magnitude	The potential magnitude is rated as Negligible.	The potential magnitude is rated as Negligible.

6.19.113 For this assessment, receptor sensitivity has been based on reviews of evidence from post-construction studies at offshore wind farms. A review of post-construction studies of seabirds at offshore wind farms in European waters concluded that common tern was one of the species that was hardly affected by offshore wind farms (Dierschke *et al.,* 2016). A review of vulnerability of Scottish seabirds to offshore wind turbines in the context of collision ranked common tern as the 14th most sensitive out of 38 species (Furness *et al.,* 2013). Bradbury *et al.,* (2014), classified the common tern population vulnerability to collision mortality from offshore wind farms as moderate.

6.19.114 Overall, based on available evidence from published studies indicating a moderate sensitivity to collision, and a medium conservation importance, it is considered that common tern sensitivity to cumulative collision effects associated with the Tier 1, 2 and 3 projects is likely to be **Medium**.

6.19.115 For common tern, the magnitude of the impact is deemed to be **Negligible**, and the overall sensitivity of this species is considered to be **Medium**, as the species is listed on Annex I of the EU Birds Directive, there are SPAs within mean maximum foraging range and sensitivity to collision has been ranked as moderate. The significance of any effect on common terns from cumulative collision effects associated with the Tier 1, 2 and 3 projects is a **Not Significant** effect, which is **Not significant** in EIA terms.

Cumulative CRM for migratory non-seabird species

6.19.116 The cumulative predicted numbers of collisions for migratory wildfowl and waders across the east coast Phase 1 projects are very low as presented in Table 128. Predicted totals for Arklow Bank, Codling Wind Park, NISA and Oriel have been combined. Note that Arklow Bank and Oriel used the BTO SOSS tool to estimate CRM for migratory species, while Codling Wind Park, Dublin Array and NISA used the mCRM tool.

Table 128 Summary of annual collision estimates following the Dublin Array approach for 50 turbines, Option A

Species	Predicted Annual Total of Collisions		
	Dublin Array	Other east coast Phase 1 projects	Combined Total
Bewick's swan	0 ± 0	0.01	0
Black-tailed godwit	0.028 ± 0.003	0.514	0.542
Common scoter	0.128 ± 0.021	0.02	0.148
Corncrake	0.016 ± 0.003	0	0.016
Curlew	0.016 ± 0.003	3.868	3.884
Dunlin	0.134 ± 0.018	2.462	2.596
Eider	0.04 ± 0.004	0	0.04
Goldeneye	0.056 ± 0.008	0.242	0.298
Great crested grebe	0.009 ± 0.002	0.025	0.034
Greenland white-fronted goose	0.004 ± 0.001	0.009	0.013
Greenshank	0 ± 0	0.031	0.031
Grey plover	0 ± 0	0.103	0.103
Hen harrier	0.002 ± 0	0	0.002
Knot	0.022 ± 0.003	0.459	0.481
Lapwing	0.02 ± 0.003	4.486	4.506
Light-bellied brent goose	0.006 ± 0.001	0.043	0.049
Mallard	0.144 ± 0.019	0.944	1.088
Merlin	0.012 ± 0.008	0.01	0.022
Oystercatcher	0.036 ± 0.006	4.141	4.177
Pintail	0.02 ± 0.004	0.066	0.086
Pochard	0.04 ± 0.007	0.503	0.543
Purple Sandpiper	0.002 ± 0	0.004	0.006
Red-breasted merganser	0.024 ± 0.004	0.067	0.091
Redshank	0.028 ± 0.004	3.29	3.318
Ringed plover	0.014 ± 0.001	0.328	0.342
Scaup	0.012 ± 0.001	0.061	0.073
Shelduck	0.027 ± 0.003	0.277	0.304
Shoveler	0.015 ± 0.002	0.066	0.081
Snipe	0.873 ± 0.1	19.153	20.026
Teal	0.124 ± 0.017	1.61	1.734
Tufted duck	0.2 ± 0.031	0.406	0.606
Turnstone	0.024 ± 0.003	0.278	0.302
Whooper swan	0.04 ± 0.007	0.028	0.068
Wigeon	0.526 ± 0.088	2.578	3.104

6.19.117 Cumulative predicted annual collisions exceeded one bird per year for six species of wader (curlew, dunlin, lapwing, oystercatcher, redshank and snipe), and three species of wildfowl (mallard, teal and wigeon). These annual collisions are presented as an estimated percentage increase in regional adult baseline mortality for a regional population based on I-Webs mean 5-year counts between 2011/12 and 2015/16 for coastal sites on the east and south coast of Ireland (Lewis *et al.,* 2019) (Table 129). Baseline adult mortality was derived from adult survival figures published on the BTO Birdfacts website (BTO, 2023). The population used for snipe was based on the majority of the mainly Icelandic-breeding faeroeensis race, which are thought to overwinter in Ireland (Wernham *et al.,* 2002, Delany *et al.,* 2009) meaning Ireland provides vital wintering grounds for this population estimated at 5,700 individuals (Wetlands International, 2018). This is considered likely to be an under-estimate but there is no population estimate for the non-breeding season for Ireland, and the species is usually under-recorded on I-WeBS counts (Lewis *et al.,* 2019).

Table 129 Summary of annual collision estimates following the Dublin Array approach for 50 turbines, Option A

Species	Cumulative mortality	East & South coast pop[1]	Baseline Adult mortality[2]	Estimated baseline mortality	Increase in baseline mortality %
Curlew	3.884	9,030	0.101	912	0.43
Dunlin	2.596	21,178	0.26	5,506	0.05
Lapwing	4.506	23,445	0.295	6,916	0.07
Oystercatcher	4.177	18,865	0.12	2,264	0.18
Redshank	3.318	10,241	0.26	2,663	0.12
Snipe	20.026	5,000[3]	0.519	2,595	0.77
Mallard	1.088	2,390	0.373	891	0.12
Teal	1.734	8,582	0.47	4,034	0.04
Wigeon	3.104	13,457	0.47	6,325	0.05

1 Figures from 5-yr mean I-WeBS counts for east and south coast sites (Lewis, *et al.,* 2019)
2 Figures based on adult survival rates (BTO, 2023)
3 Estimated ROI population of 5,000 birds based on Icelandic breeding population (Wetlands International, 2018)

6.19.118 Based on the above results, the magnitude of cumulative collision impact was considered to be **Negligible** (Table 130).

Table 130 Determination of magnitude for cumulative collision mortality for migratory non-seabird species

	MDO	Alternative Design Option
Extent	Very small proportion of the populations are predicted to be affected	Very small proportion of the population is predicted to be affected
Duration	The cumulative impact is likely to occur throughout the operation phase of the projects and will therefore be long-term, as defined by EPA (2022).	The impact is likely to occur throughout the operation phase of the project and will therefore be long-term, as defined by EPA (2022).
Frequency	The effect is anticipated to occur during spring and autumn migration periods.	The effect is anticipated to occur during spring and autumn migration periods.
Probability	Cumulative collision mortality is considered possible during spring and autumn migration.	Cumulative collision mortality is considered possible during spring and autumn migration.

	MDO	Alternative Design Option
Consequence	Although cumulative collision mortality is possible during spring and autumn migration, at the species population levels, associated mortality is predicted to be very low, which would equate to Negligible magnitude.	Although cumulative collision mortality is possible during spring and autumn migration, at the species population levels, associated mortality is predicted to be very low, which would equate to Negligible magnitude.
Overall magnitude	The potential magnitude is rated as Negligible.	The potential magnitude is rated as Negligible.

6.19.119 Based on a **Negligible** magnitude of impact and assuming the sensitivity of migratory species was a maximum of **High**, then the significance of any effect on migratory species from cumulative collisions associated with Dublin Array and the other east coast Phase 1 projects is a **Not Significant** effect, which is **Not significant** in EIA terms.

6.19.120 The alternative design options (any other option within the range of parameters set out in the project description) will not give rise to an effect which is more significant than the maximum design option.

Residual Effect

*The effect on key bird species and migratory species from cumulative collision effects associated with Dublin Array and other Tier 1 and 2 projects have been assessed as '**Not significant**' in EIA terms. Therefore, no further mitigation (in addition to that already identified in Table 19) is considered necessary. No ecologically significant adverse residual effects on offshore ornithology have therefore been predicted.*

6.20 Interactions of environmental factors

6.20.1 A matrix illustrating where interactions between effects on different factors have been addressed is provided in Volume 8, Chapter 1: Interactions of the Environmental Factors.

6.20.2 Interactions of the foregoing are considered to be the effects and associated effects of different aspects of the proposal on the same receptor. These are considered to be:

- Project lifetime effects: Assessment of the scope for effects that occur throughout more than one phase of the project (construction, O&M and decommissioning) to interact and potentially create a more significant effect on a receptor than if just assessed in isolation in these three key project phases; and
- Receptor led effects: Assessment of the scope for all effects to interact, spatially and temporally, to create inter-related effects on a receptor. As an example, all effects on benthic ecology such as direct habitat loss or disturbance, sediment plumes, scour, jack up vessel use etc., may interact to produce a different, or greater effect on this receptor than when the effects are considered in isolation. Receptor-led effects might be short-term, temporary or transient effects.

6.20.3 As indicated in the interactions matrix (Volume 8, Chapter 1) there are linkages between the topic-specific chapters presented within this EIAR, whereby the effects assessed in one chapter have either the potential to result in secondary effects on another receptor (e.g. effects on fish and shellfish ecology have the potential to result in secondary effects on ornithology resources).

6.20.4 The potential effects on offshore ornithology during construction, operational and maintenance and decommissioning phases of the Project have been assessed in sections 1.15 – 1.17 above.

6.20.5 Effects on Offshore Ornithology (i.e. effects to prey species) are fully assessed in the topic-specific chapters. These receptors are:

- Chapter 5: Fish and Shellfish Ecology.

6.20.6 For Offshore Ornithology receptors, the following potential impacts have been considered within the interactions assessment:

- Disturbance and displacement from increased vessel activity; and
- Effects on seabirds as a result of habitat loss/displacement of prey species due to increased noise and disturbance to seabed (including SSC and sediment deposition).

Fish and Shellfish

6.20.7 Effects to Fish and Shellfish, both direct (e.g. removal or injury of individuals) and indirect (e.g. loss of important fish and shellfish habitats, such as spawning grounds) have the potential to indirectly effect Offshore Ornithology through effects on prey resources (i.e. availability and distribution of fish and shellfish).

6.20.8 The potential effects of the project on fish and shellfish communities and resulting direct and indirect effects on Offshore Ornithology have been assessed in Section 5.1.17 - 5.1.19.

6.20.9 Changes in the fish and shellfish community affecting offshore ornithology prey resources resulting in indirect effects on ornithology receptors at all phases are no greater than Slight adverse Negligible, which is Not Significant in EIA terms, as outlined in Chapter 6: Offshore Ornithology, Section 6.1.15 - 6.1.17. Therefore, no significant interactions exist between offshore ornithology and fish and shellfish.

Project lifetime effects

6.20.10 Project lifetime effects consider impacts from the construction, operation or decommissioning of Dublin Array on the same receptor (or group). The potential inter-related effects that could arise in relation to offshore and intertidal ornithology are presented in Table 131.

Table 131 Project lifetime effects assessment for offshore and intertidal ornithology

Impact Type	Effects (Assessment Alone)			Interaction Assessment
	C	O&M	D	Project lifetime effects
Disturbance and displacement from increased vessel activity	Slight Adverse	Not significant	Slight Adverse	Disturbance arising from increased vessel activity has the potential to affect identified key species directly (e.g. disturbance of individuals) and indirectly (e.g. disturbance to prey distribution or availability). Such disturbance is predicted to occur intermittently throughout the construction and decommissioning periods, with less disturbance from vessel activity predicted in the O&M period. As this disturbance will be temporary and intermittent in nature, effects on seabirds are not anticipated to interact in such a way as to result in combined effects of greater significance than the assessments presented for each individual period.
Indirect effects on seabirds as a result of habitat loss/displacement of prey species due to increased noise and disturbance to seabed (including SSC and sediment deposition.	Slight Adverse	Slight Adverse	Slight Adverse	When subtidal habitat loss (temporary and long term) is considered additively across all phases of the project, although the total area of habitat affected is larger than for the individual project stages, similar habitats are widespread across the Irish Sea. During the O&M phase, the majority of the disturbance will be highly localised and the habitats affected are predicted to recover quickly following completion of maintenance activities with prey species for seabirds recovering into the affected areas. In addition, many O&M activities will be affecting the same areas affected during construction (e.g., jack up operations adjacent to turbines, reburial of exposed cables). The majority of the seabed disturbance (resulting in highest SSC will occur during the construction and decommissioning phases. Fish prey species and associated spawning/nursery habitats potentially affected by increased SSC and deposition will recover quickly following impact exposure such that there will be no inter-related effects across the construction and decommissioning phases. Therefore, across the project lifetime, the effects on seabirds are not anticipated to interact in such a way as to result in combined effects of greater significance

Impact Type	Effects (Assessment Alone)			Interaction Assessment
	C	O&M	D	Project lifetime effects
				than the assessments presented for each individual phase.

Receptor-led Effects

6.20.11 The potential exists for spatial and temporal interactions between habitat loss/disturbance, increased SSC/deposition and colonisation of foundations, scour protection and cable protection, during the lifetime of the Project. Based on current understanding and expert knowledge, there is scope for potential interaction impacts to arise through the interaction of habitat loss (temporary and long term) and increased SSC.

6.20.12 There is the potential for these identified impacts to interact to cause an additive/synergistic/antagonistic effect on offshore and intertidal ornithology receptors. One possible pathway that has been identified is changes in distribution and availability of prey communities. Various activities described from the impacts considered above could interact to contribute to a different, or greater effect on changes in prey communities than when the effects are considered in isolation, which in turn could affect foraging seabirds.

6.20.13 The assessment considers the overall effects on foraging seabirds from potential changes in prey communities that could be caused by disturbance, habitat loss and SSC. In the assessment of effects, it is considered that due to the high mobility of foraging seabirds and their ability to exploit different prey species, and the small scale of potential changes in the context of the wider available habitats, any resulting changes to fish prey communities are unlikely to have a significant effect on foraging seabirds.

6.21 Transboundary Effects

6.21.1 Transboundary effects may arise if impacts from a development within one country affects the environment of another country or state. Transboundary impacts upon offshore ornithological receptors are possible due to the large foraging ranges and migrations undertaken by several seabird species in the Irish Sea.

6.21.2 There is potential for transboundary collision and displacement effects between Dublin Array and existing and planned OWF projects in UK waters. There will be temporal overlap within the operational phases with these UK OWF projects, and relevant UK projects were included in the cumulative effects assessment.

6.21.3 During the breeding season, it is highly unlikely that key seabird species with relatively large mean-maximum foraging ranges such as gannet will travel further than the Irish and Celtic Seas (Wakefield *et al.,* 2013; Woodward *et al.,* 2019). Therefore, developments outside of UK and Irish waters will not contribute significantly to any transboundary effects.

6.21.4 During the non-breeding season, seabird species may travel more widely and as such, may come into contact with developments elsewhere in European waters such as those OWF projects that are operational, under construction or in planning in the English Channel and North Sea, off the Netherlands, Belgium and Germany, and potentially further afield. Given this larger spatial scale, any potential transboundary effects would be in relation to much larger bio-geographic populations than those considered at the Irish-UK-scale. Therefore, it is considered that the scale of development within such a wide context would be relatively much smaller with respect to any potential impacts considered at the Irish or UK BDMPS scale.

6.21.5 Therefore, the inclusion of OWFs beyond the UK is considered very unlikely to alter the conclusions of the existing cumulative assessment, and highly likely to reduce estimated effects at population levels due to the larger spatial scales and larger biogeographic populations involved.

6.22 Potential Monitoring Requirements

6.22.1 Monitoring requirements for the Dublin Array OWF will be described in the Project Environmental Monitoring Plan (PEMP) submitted alongside the EIAR and further developed and agreed with stakeholders prior to construction.

6.22.2 Assessed project only and cumulative impacts on ornithological receptors as a result of the construction, operation and maintenance and decommissioning phases of the Dublin Array OWF are predicted to be not significant in EIA terms. Based on the assessed impacts it is concluded that no specific monitoring is required.

6.22.3 There are however several monitoring options that could be considered by the project to address some of the key assumptions in this impact assessment. 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 of the EIAR process, in consultation with statutory and technical stakeholders, and with a focus on validation and evidence gathering.

6.23 Summary of Effects

6.23.1 This section provides a summary of effects in relation to the assessment presented within this chapter. In reference to this summary and of particular note are the following concluding statements:

6.23.2 The windfarm has been designed in such a way as to avoid, prevent and reduce as much as possible the risk of (a) incidental bird collision and (b) significant bird disturbance particularly during the period of breeding and rearing and to ensure the maintenance of the populations of the identified species at a favourable conservation status. Further, it has been concluded that the populations of the identified species will be maintained at a level, or adapted to a level, which corresponds to the ecological, scientific and cultural requirements for the species in question. In this respect, the necessary and appropriate mitigation measures are already provided for within the proposed development.

6.23.3 2.

6.23.4 4. This conclusion has been reached on the basis of assessment specific modelling (i.e. CRM and displacement matrices), PVA (if required)and expert qualitative judgment.

6.23.5 A summary of the effects presented within this EIAR chapter are presented in Table 132.

Table 132: Summary of effects assessed for offshore and intertidal ornithology

Description of Effect	Effect	Additional mitigation measures	Residual impact
Construction			
Impact 1	Disturbance and displacement on key bird species as a result of increased vessel activity (including helicopters) and other construction activity within the array area	Not Applicable – no additional mitigation identified	No ecologically significant adverse residual effects
Impact 2	Disturbance and displacement on key bird species as a result of increased vessel activity and other construction activity within the Offshore ECC	Not Applicable – no additional mitigation identified	No ecologically significant adverse residual effects
Impact 3	Disturbance and displacement on key bird species as a result of construction activity for the export cable landfall within the Intertidal study area	Not Applicable – no additional mitigation identified	No ecologically significant adverse residual effects
Impact 4	Indirect effects as a result of habitat loss/displacement of prey species due to increased noise and disturbance to seabed during construction in array area and Offshore ECC	Not Applicable – no additional mitigation identified	No ecologically significant adverse residual effects
Operation and maintenance			
Impact 5	Disturbance and displacement on key bird species as a result of O&M vessel activity within the array area	Not Applicable – no additional mitigation identified	No ecologically significant adverse residual effects
Impact 6	Indirect effects as a result of habitat loss/displacement of prey species due to increased noise and disturbance to seabed	Not Applicable – no additional mitigation identified	No ecologically significant adverse residual effects
Impact 7	Disturbance from aviation and navigation lighting	Not Applicable – no additional mitigation identified	No ecologically significant adverse residual effects
Impact 8	Displacement and barrier effects on key bird species within the array area and appropriate buffer as a result of offshore infrastructure	Not Applicable – no additional mitigation identified	No ecologically significant adverse residual effects

Description of Effect	Effect	Additional mitigation measures	Residual impact
Impact 9	Mortality of key bird species as a result of collision with offshore wind turbines	Not Applicable – no additional mitigation identified	No ecologically significant adverse residual effects
Decommissioning			
Impact 10	Disturbance and displacement on key bird species as a result of increased vessel activity and other decommissioning activity within the array area	Not Applicable – no additional mitigation identified	No ecologically significant adverse residual effects
Impact 11	Disturbance and displacement on key bird species as a result of increased vessel activity and other decommissioning activity within the Offshore ECC	Not Applicable – no additional mitigation identified	No ecologically significant adverse residual effects
Impact 12	Disturbance and displacement on key bird species as a result of decommissioning activity for the export cable landfall within the Intertidal study area	Not Applicable – no additional mitigation identified	No ecologically significant adverse residual effects
Impact 13	Indirect effects as a result of habitat loss/displacement of prey species due to increased noise and disturbance to seabed during decommissioning	Not Applicable – no additional mitigation identified	No ecologically significant adverse residual effects
Cumulative effects			
Impact 14	Displacement and barrier effects on key bird species	Not Applicable – no additional mitigation identified	No ecologically significant adverse residual effects
Impact 15	Mortality of key bird species as a result of collision	Not Applicable – no additional mitigation identified	No ecologically significant adverse residual effects
Impact 16	Disturbance to qualifying interest species within marine SPAs	Not Applicable – no additional mitigation identified	No ecologically significant adverse residual effects
Transboundary			
No transboundary effects have been identified.			

7 References

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Dublin Array Offshore Wind Farm

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Annex A: Offshore Ornithology Policy

Legislation, Policy and Guidance

Policy/ Legislation	Key provisions	Section where provision is addressed
Legislation		
Wildlife Acts 1976 to 2021[13]	All birds are protected under the Wildlife Act (1976) and subsequent amendments. Under the act and its amendments, it is an offence to hunt, injure or wilfully interfere with, disturb or destroy the resting or breeding place of a protected species (except under license or permit). The act applies out to the 12 nm limit of Irish territorial waters.	Assessment of the potential to injure and disturb birds is provided in the impact assessment sections of this document from section 6.16 to 6.19 (e.g. Impact 9: Mortality of key bird species as a result of collision with offshore wind turbines and Impact 5: Disturbance and displacement on key bird species as a result of vessel activity associated with O&M).
EU Directive 2009/147/EC on the conservation of wild birds (the Birds Directive)	All birds, their eggs, nests and habitats are protected under the Birds Directive. This includes deliberate destruction of wild birds, deliberate damage to nests and eggs and deliberate disturbance which puts conservation at risk.	Assessment of the potential to injure and disturb birds is provided in the impact assessment section (e.g. Impact 9: Mortality of key bird species as a result of collision with offshore wind turbines and Impact 5: Disturbance and displacement on key bird species as a result of vessel activity associated with O&M).
	Species listed on Annex I, as well as regularly occurring migratory species, are subject to special measures concerning their habitat to ensure survival and reproduction in their area of distribution through the establishment of SPAs	Assessment of the potential to disturb SPAs or qualifying interest species of SPAs is provided in the NIS (Part 4: Habitats Directive Assessments, Volume 4 NIS).
European Communities (Birds and Natural Habitats) Regulations 2011	For the purpose of giving effect to Directive 2009/147/EC of the European Parliament. S.I. No. 477 of 2011 - The 2011 Regulations require the designation of SPAs for the protection of listed rare and vulnerable species, regularly occurring migratory species and wetlands, especially those of international importance.	An assessment of the qualifying interests of SPAs and SACs is undertaken within the NIS (Part 4: Habitats Directive Assessments, Volume 4 NIS).

[13] Wildlife Acts 1976 to 2021 is a collective citation for the Wildlife Act 1976 and subsequent amendment acts (2000, 2010, 2012), the Heritage Act 2018, and Planning, Heritage and Broadcasting (Amendment) Act 2021.

Policy/ Legislation	Key provisions	Section where provision is addressed
	S.I. No. 477 of 2011 - The 2011 Regulations, require the designation of SACs for the protection of certain habitats and species of plants and animals (other than birds).	
Guidelines and technical standards		
DCCAE (2017) Guidance on EIS and NIS Preparation for Offshore Renewable Energy Projects	A description of the receiving environment is required to allow for a prediction of significant likely effects of a development.	The offshore and intertidal ornithology receiving environment is provided in Volume 4, Appendix 4.3.6-1: Offshore and Intertidal Ornithology Technical Baseline, and is summarised herein Section 6.6.
	Mitigation measures are usually required where likely significant effects on the environment are identified. Mitigation measures may be proposed in order to avoid, prevent, reduce, rectify, or sometimes compensate any major adverse effects. The impact of residual effects should then be assessed.	Project Design Features and Avoidance and Preventative Measures related to offshore and intertidal ornithology are outlined in Volume 4, Appendix 4.3.6-1: Offshore and Intertidal Ornithology Technical Baseline Residual effects are presented in the Impact assessment section.
	In undertaking assessments, there will be recognised areas of scientific uncertainty in relation to offshore marine renewable energy projects. Areas of uncertainty should be specified in the assessment.	This is covered primarily within Section 6.11.
DCCAE (2018a&b) Guidance on Marine Baseline Ecological Assessments & Monitoring Activities: Offshore Renewable Energy Projects Parts 1 and 2	Relevant baseline datasets are identified by considering the species, habitats and receiving environment that may be impacted by the proposed project. Any data and information on receptors that could be impacted which are available from previously published studies should be collated.	The offshore and intertidal ornithology receiving environment is provided in Volume 4, Appendix 4.3.6-1: Offshore and Intertidal Ornithology Technical Baseline, and is summarised here in Section 6.4 Baseline Data.
	When relevant data on the receiving environment is unavailable, the developer should commission surveys to be conducted by specialists (e.g. marine ecologists, ornithologists and archaeologists).This information will provide the basis for predicting and assessing impacts that may be attributable to the development.	Site-specific surveys were conducted to collate data on offshore and intertidal ornithology. This is detailed Volume 4, Appendix 4.3.6-1: Offshore and Intertidal Ornithology Technical Baseline, and is summarised here in Section 6.4 Baseline Data.

Policy/ Legislation	Key provisions	Section where provision is addressed
EPA (2022) Guidelines on the information to be contained in Environmental Impact Assessment Reports	The EIAR should contain details of a 'do-nothing' alternative describing consequences that are reasonably likely to occur were the project to not go ahead.	Currently presented in Section 3.6 of Volume 4, Appendix 4.3.6-1: Offshore and Intertidal Ornithology Technical Baseline.
	The EIAR should include a description of the project comprising information on the site, design, size and other relevant features of the project.	See Volume 2, Chapter 6: Project Description.
	The EIAR should include a description of the relevant aspects of the current state of the environment (baseline scenario).	The offshore and intertidal ornithology receiving environment is provided in Volume 4, Appendix 4.3.6-1: Offshore and Intertidal Ornithology Technical Baseline, and is summarised here in Baseline Data.
	The EIAR should include a description of the likely significant effects of the project on the environment covering the direct effects and any indirect, secondary, cumulative, transboundary, short-term, medium-term and long-term, permanent and temporary, positive and negative effects of the project.	Assessments of the likely significant effects of the project are provided in the impact assessment section and the cumulative impact assessment section
	The EIAR should include a description of the measures envisaged to avoid, prevent, reduce or, if possible, offset any identified significant adverse effects on the environment and, where appropriate, of any proposed monitoring arrangements.	Project Design Features and Avoidance and Preventative Measures related to offshore and intertidal ornithology are outlined in Section 6.15. Residual effects are presented in the Impact assessment section. Proposed offshore and intertidal ornithology post-construction monitoring is detailed in Section 6.22
	The EIAR should clearly describe any residual effects and include a summary of effects.	Residual effects are presented in the Impact assessment section. A summary of effects is presented in Section 6.23

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